# *Chemically-Enhanced Primary Treatment Facility*

# *Pilot Study Report*

# *City of Portsmouth, NH*

## December 22, 2017

**UE #2120**


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## Table of Contents

## List of Tables

## List of Figures

## List of Appendices

# 1. Introduction

The City of Portsmouth, New Hampshire owns and operates a 22 MGD chemically-enhanced primary treatment facility located on Peirce Island. The Peirce Island WWTF is currently undergoing major construction to upgrade the plant to achieve secondary treatment. In the interim during construction, the facility is operating under a Consent Decree (Decree) modification issued by the EPA dated April 2016 (see ***Appendix A***). The Decree requires the City to comply with several items but the focus of this report is to address Part IV, Paragraph 8.a. on Page 6 of the Decree which requires the City to conduct a full-scale pilot study to confirm that the combination of coagulant and polymer chemicals being added ahead of primary clarification is being optimized during this interim construction period.

Underwood Engineers was retained by the City in late 2016 to assist with performance of the study and interpretation of the data generated. The first task of the engineering scope was to develop a pilot testing protocol for review and approval by the EPA. During the period of November 2016 – January 2017, Underwood compiled and submitted draft pilot protocols to the City and the EPA on November 28, 2016, December 30, 2016, and January 30, 2017. The final version was submitted on February 28, 2017 and approved by the EPA on March 20, 2017. A copy of the approved pilot testing protocol can be found in ***Appendix B***.

The pilot testing protocol required a series of jar tests to be performed upfront with various coagulants and polymers to identify several combinations of chemicals that perform best on the Peirce Island WWTF influent. Once those combinations were identified, Underwood assisted the City with purchase of the chemicals to be tested and short-term modifications to the chemical storage and feed equipment including permanent modifications to the chemical feed PLC and SCADA programming to allow any coagulant or polymer to be dosed at the plant on a volumetric basis. In total, three chemical combinations were tested full-scale and data was gathered five days per week (Monday-Friday) for both influent and effluent total suspended solids (TSS) during five individual pilot tests.

This report presents the data obtained during the pilot study as well as statistical analyses that have been performed on the various data sets to ascertain which, if any, of the three chemical combinations performed best in terms of final effluent TSS concentrations achieved. The ultimate goal of the test was to determine if it might be possible to achieve a 10% improvement in final effluent TSS concentrations discharged from the facility with a new chemical combination versus the historic chemical combination used at the facility.

# 2. Jar Testing

### *2.1 Coagulant Jar Testing*

Jar testing of coagulants was performed on two separate occasions. The Round 1 jar testing was performed in August 2016. This involved testing eight different coagulants that represent the typical range of characteristics for coagulants utilized for chemically-enhanced primary treatment (CEPT). Based on visual observations of the settled jar contents (liquid clarity and floc characteristics), each coagulant was ranked in order of performance. Underwood and Aries Chemical identified four of the Round 1 coagulants as worthy of further testing.

In January/February 2017, Round 2 jar testing was performed. The intent was to further evaluate the top three performing coagulants from the Round 1 jar testing. The top performing coagulants from the Round 1 jar testing are as follows in order from best performance to worst performance:

1. Aries 2076
2. Aries 245
3. Aries 252
4. Aries 291

Inadvertently, the first Round 2 jar testing evaluated the Nos. 1, 2, and 4 performers from Round 1; the No. 3 coagulant from Round 1 was not tested. This was realized part way through the Round 2 testing so all four Round 1 chemicals were re-evaluated.

The Round 2 jar testing of all four coagulants was run utilizing the historic polymer that had proved to work well at Peirce Island at a historic dose that had worked well. The variable instead was the dose of coagulant utilized and, in all cases, it required a dose of <20 ppm volumetric in the jar to see good results. This is important to note since the doses which result in noticeable visible improvement within the jars has proven in all cases to be higher than is necessary to achieve good results at full-scale at Peirce Island. A summary of the coagulant jar testing performed can be found in ***Appendix C***.

### *2.2 Polymer Jar Testing*

Polymer testing was performed during the Round 2 jar testing in January/February 2017. Once an acceptable dose of coagulant was identified in the jar tests, multiple tests were done with the three best coagulants utilizing various polymers. A minimum polymer dose in the range of 2 ppm proved necessary to affect a noticeable improvement in the jars. Each of the three coagulants was run in a jar test paired with four different polymers which Aries Chemical felt covered the typical range of anionic polymers from low molecular weight to high molecular weight. In all cases, the polymer that appeared to work best based on visual observations of clarity and floc characteristic was Aries 3644, which happens to be the historic polymer that has been used at the Peirce Island WWTF for some time. This is of no surprise given that Peirce Island has conducted multiple rounds of jar testing in recent years in an attempt to optimize

performance of the system. For a complete description of the polymer jar testing, refer to ***Appendix C***.

# 3. Pilot Data

### *3.1 Pilot No. 1 Data*

The first chemical combination pair piloted consisted of the Aries 291 coagulant paired with the Aries 3644 polymer. Aries 291 is a high basicity polyaluminum chloride (PAC) coagulant. Aries 3644 is a high molecular weight anionic polymer. This chemical combination was pilot tested from February 27, 2017 – April 23, 2017. Refer to the Pilot Meeting Notes contained in ***Appendix D*** for this timeframe which summarize discussions that occurred during Pilot No. 1 which led to the decisions made for when and how to vary chemical dosing.

During the first few days of pilot testing with this chemical combination, the effluent TSS results were typical of what had been seen in the past; however, within only a few days of use of this chemical combination, the operators noticed visual changes at the primary clarifiers and the gravity thickener. The most noticeable change was that the floc being generated in the clarifiers appeared to be lighter and fluffier and carried further across the clarifier surface towards the effluent weirs. The operators also noticed that the overflow from the gravity thickener became milky white and full of solids. Further, it was noticed that the underflow from the gravity thickener thinned out significantly such that dewatering became more difficult.

On March 7, 2017 a failure of equipment within the sludge handling system resulted in a decision by the City to temporarily suspend piloting of the first chemical combination and the facility reverted back to the historic chemical combination in order to allow solids to be better managed at the facility and to allow the facility to catch up on the solids inventory.

On March 21, 2017 the facility recommenced pilot testing of the first chemical combination. The first two weeks of the Pilot No. 1 restart was run at a higher coagulant dose of approximately 27 ppm volumetric. While this chemical dose provided good effluent TSS results, the operators again noticed a change in the appearance of the floc at the full-scale level with lighter floc being generated that was carrying out of the clarifiers and not settling well in the gravity thickener. During this time period, it was noted by operators that the thinner underflow from the gravity thickener to the Fournier rotary press resulted in a much wetter cake solids such that the wet tonnage of solids hauled away from the facility increased significantly. Further, operators noticed when they did their routine cleaning of the chlorine contact tank that solids that had made their way over the primary clarifier weir appeared to have settled out within the chlorine contact tank, resulting in a thicker sludge mat at the tank bottom which needed to be removed. During the initial week of testing and again during the initial restart of the testing at high coagulant doses, the operators noted that it appeared as if the system might fail with too many solids being recycled without being settled in the gravity thickener. A high flow event occurred on the weekend which flushed solids out of the system. However, as 24-hour composite sampling was not being performed on the weekend days, no definitive laboratory results captured the degree of solids washout that occurred.

During the next three weeks of testing from March 26 – April 15, 2017, the coagulant dose was lowered considerably to approximately 6-8 ppm. During this timeframe, operators noticed good TSS results and also felt that the appearance of the clarifier and the gravity thickener were more representative of normal historic operations. They did again note a thinner underflow from the gravity thickeners and decreased cake solids from the Fournier rotary press but solids within the gravity thickener did appear to settle acceptably.

In order to try and capture the potential washout of solids that is believed to have occurred during the higher coagulant dose period at the beginning of Pilot No. 1, the dose of coagulant was put back to 27 ppm for the final week of testing. Underwood requested that the City take grab samples for thickener overflow TSS and thickener underflow total solids (TS) in order to assess whether the floc was truly settling poorly and being recycled back to the primary clarifiers in the gravity thickener overflow. The City only began taking samples on May 3; therefore, there is no thickener overflow and underflow data for Pilot No. 1. The results of the Pilot No. 1 testing for influent and effluent TSS are presented in ***Table 3-1*** below.

**Table 3-1 Pilot No. 1 Summary Results**

| Pilot 1 (February 27 - April 23, 2017) | |
|---|---|
| Coagulant | Aries 291 |
| Polymer | Aries 3644 |
| No. of TSS Data Points | 29 |
| Average Influent TSS (mg/L) | 233.0 |
| Average Effluent TSS (mg/L) | 39.9 |
| Average Percent Removal | 81.2% |
| No. of Overflow/Underflow Data Points | 0/0 |
| Average Thickener Overflow (mg/L) | - |
| Average Thickener Underflow (% Solids) | - |

Based on the data collected for Pilot No. 1, it can be seen that the average influent TSS was 233 mg/L and the average effluent TSS was 39.9 mg/L, representing an 81.2% removal rate on average.

### *3.2 Pilot No. 2 Data*

The second chemical combination piloted consisted of the Aries 252 low basicity polyaluminum chloride (PAC) coagulant and the Aries 3644 polymer. The pilot was operated for six weeks from April 24 – June 4, 2017. During the six-week period, the coagulant was dosed for four weeks at a low dose of 8.6 ppm volumetric while the polymer was held at 0.19 ppm volumetric. For the last two weeks of the test, the coagulant dose was increased to 27 ppm volumetric and the polymer was held at 0.19 ppm volumetric. ***Table 3-2*** below contains summary data for Pilot No. 2.

Table 3-2 Pilot No. 2 Summary Results

| Pilot 2 (April 24 – June 4, 2017) | |
|---|---|
| Coagulant | Aries 252 |
| Polymer | Aries 3644 |
| No. of TSS Data Points | 29 |
| Average Influent TSS (mg/L) | 318.1 |
| Average Effluent TSS (mg/L) | 55.7 |
| Average Percent Removal | 80% |
| No. of Overflow/Underflow Data Points | 20/15 |
| Average Thickener Overflow (mg/L) | 229.9 |
| Average Thickener Underflow (% Solids) | 3.9% |

As can be seen from the above table, the average influent TSS for Pilot No. 2 was 318 mg/L, the average effluent was 56 mg/L, and the average percent removal was 80%.

Operator observations during the Pilot No. 2 testing were that this chemical performed more similar to the historic chemical combination than did the first chemical combination. Operators felt that the appearance of the primary clarifier surfaces, the appearance of the gravity thickener and the characteristics of the gravity thickener underflow were more similar to historic observations, but not as good.

Midway through the Pilot No. 2 the clarifier surface began to get cloudy and gray. Operators noted that the underflow solids from the gravity thickener during Pilot No. 2 were thicker than typical at times but attributed the thickness of the sludge to the typical thickening of sludge that the plant sees when rains flush the system of fats, oils, and greases (FOG).

During the last two weeks of the Pilot No. 2 period at the higher coagulant dose, the operators felt that underflow solids had definitely thinned out with the Aries 252 coagulant. It should be noted that during the typical cleaning of the chlorine contact tank which occurs approximately every two weeks, the operators found that the accumulation of an inch or so of solids in the chlorine contact tank during Pilot No. 2 was similar to that which had been seen historically.

### *3.3 Pilot No. 3 Data*

The third chemical combination piloted consisted of the historic chemical combination which is Aries 2032 ferric chloride coagulant and Aries 3644 polymer. The rationale for running six weeks of pilot testing with the historical chemicals was that the historic data was only collected on specific days of the week rather than five days a week and the historic data was collected while the solids dewatering method utilized was a belt filter press rather than the Fournier rotary press that was put into operation in February 2017. It was felt by all that to get an apples-to-apples comparison between data that a six-week pilot test with the historic chemicals should be performed similar to Pilot No. 1 and No. 2.

Similar to Pilot No. 2, the first four weeks of Pilot No. 3 were performed with the coagulant at a low dose of 8.6 ppm volumetric and the polymer at 0.19 ppm volumetric. The last two weeks of the testing was operated at a high coagulant dose of 27 ppm volumetric and a polymer dose of 0.19 ppm volumetric. The six-week period for Pilot No. 3 lasted from June 5 – July 16, 2017. ***Table 3-3*** below presents the results from Pilot No. 3.

**Table 3-3 Pilot No. 3 Summary Results**

| Pilot 3 (June 5 – July 16, 2017) | |
|---|---|
| Coagulant | Aries 2076 |
| Polymer | Aries 3644 |
| No. of TSS Data Points | 28 |
| Average Influent TSS (mg/L) | 358.6 |
| Average Effluent TSS (mg/L) | 70.3 |
| Average Percent Removal | 79% |
| No. of Overflow/Underflow Data Points | 27/0 |
| Average Thickener Overflow (mg/L) | 213.6 |
| Average Thickener Underflow (% Solids) | - |

From ***Table 3-3***, it can be seen that the average influent TSS for Pilot No. 3 was 359 mg/L, the average effluent was 70 mg/L, and the average percent removal was 79%.

During Pilot No. 3, operator observations were that plant characteristics mimicked what they had seen historically over the past three years as would be expected given that Pilot No. 3 utilized the historic chemical combination. Visual observations of the primary clarifier surface were acceptable, as was the performance of the gravity thickener. Gravity thickener underflow was of an acceptable solids content and dewatering of the sludge was also acceptable. In comparison to Pilot No. 1 and Pilot No. 2, the operators felt the Pilot No. 3 chemical combination yielded the highest thickener underflow solids and the highest cake solids. However, no thickener underflow samples were taken during Pilot No. 3. It should be noted that due to failure of some of the sludge pumping equipment, the City was unable to utilize the Fournier rotary press for dewatering from the time period from May 9 – June 6, 2017. During that time, the belt filter press was utilized. Operators also noted during the routine cleaning of the chlorine contact tank that the typical one inch of accumulated solids existed at the time of cleaning.

**FIGURE 3-1.**

Portsmouth, NH

Peirce Island WWTF CEPT Pilot 1-3A, Influent and Effluent TSS

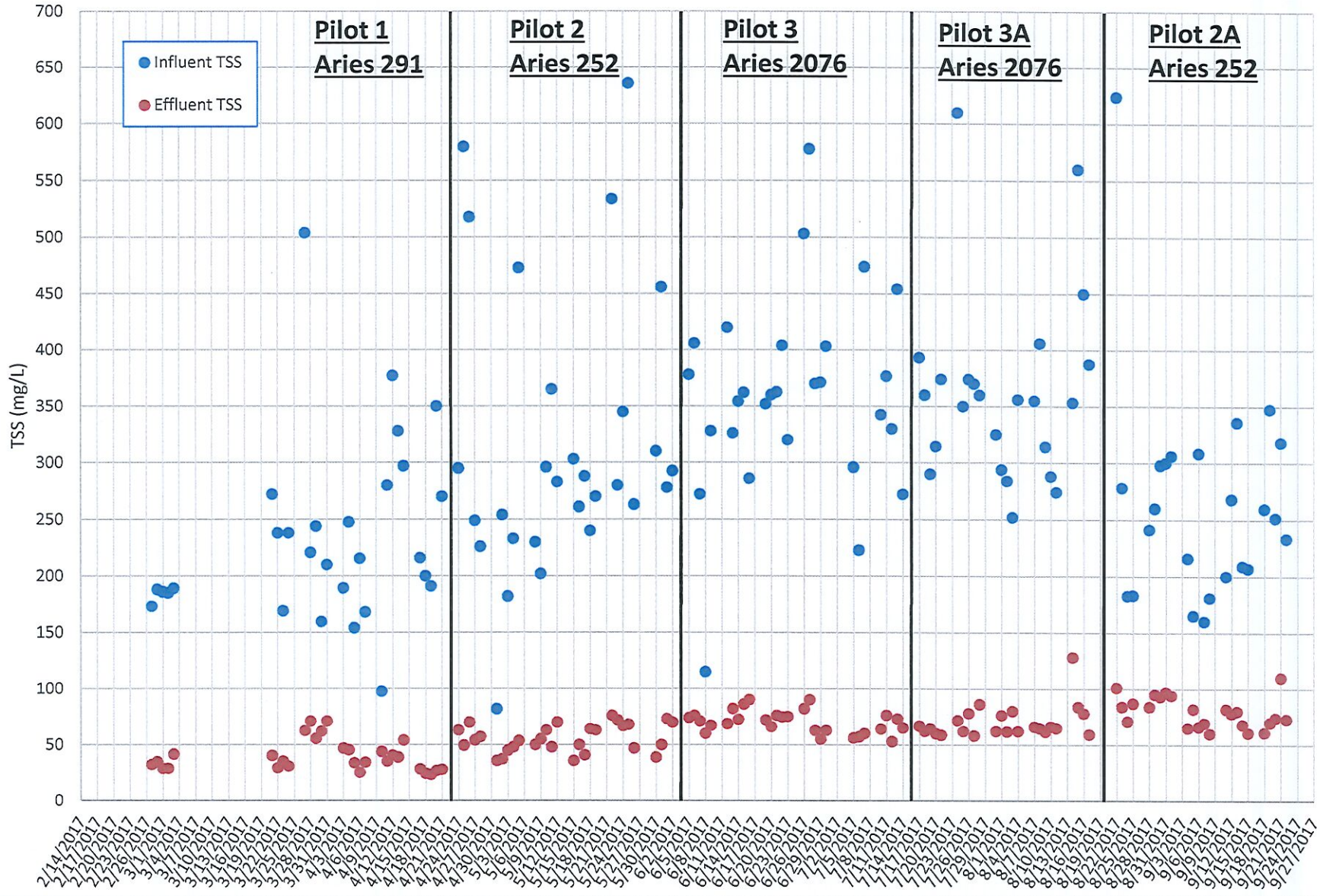


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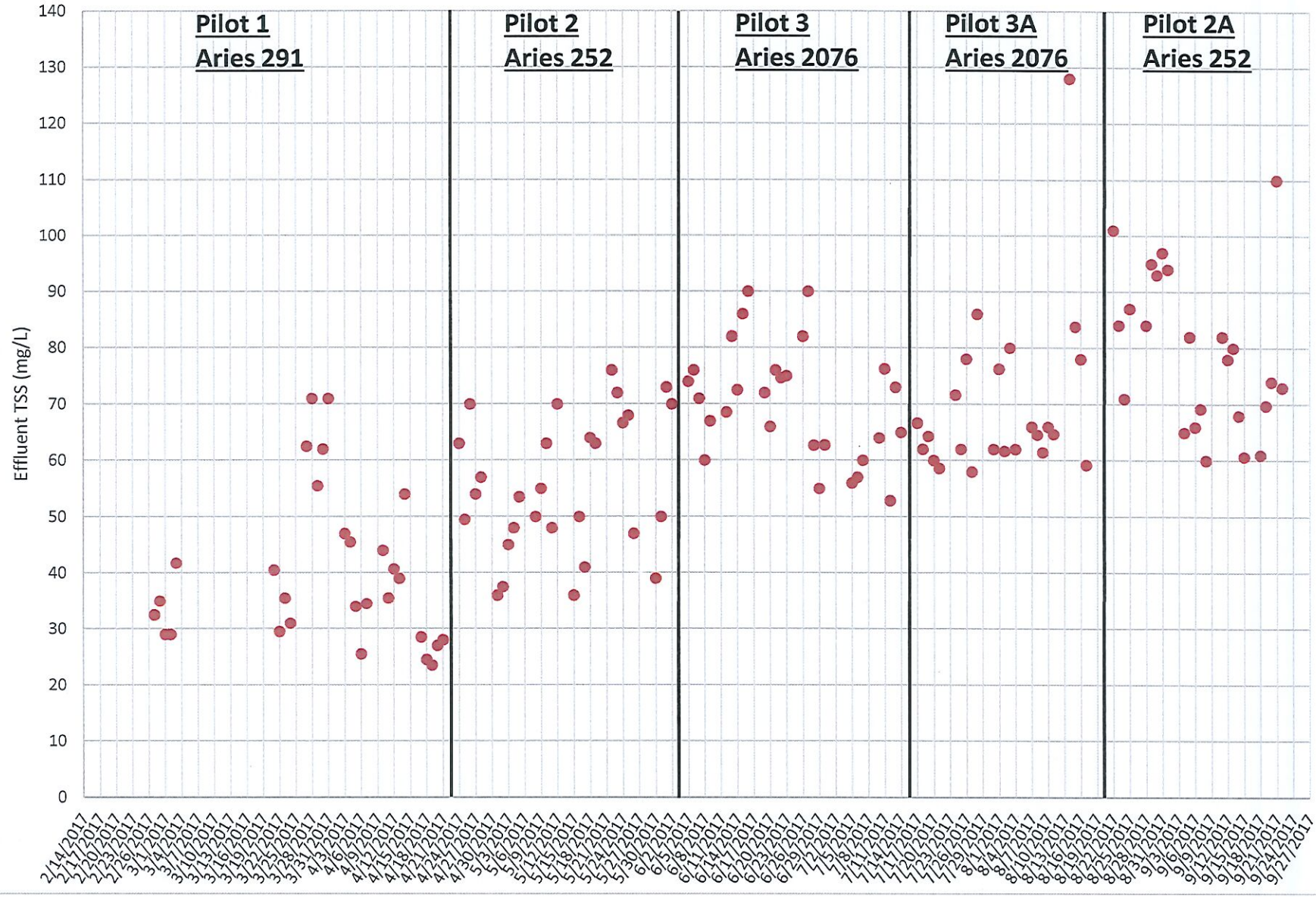
**FIGURE 3-2.**

Portsmouth, NH

Peirce Island WWTF CEPT Pilot 1-3A, Effluent TSS

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### *3.4 Discussion of Pilots 1-3 Results*

In looking at trends over the course of the first three pilots, the effluent TSS was consistent for each pilot even though the influent TSS varied significantly (***Figure 3-1***). It was also very apparent that the effluent TSS got increasingly higher as the piloting went on (see ***Figure 3-2***). In fact, the historic chemical combination, Pilot No. 3, produced the poorest results of the first three pilots and a much higher effluent TSS value than historic (70 mg/L vs. 51 mg/L). This prompted discussion on why Pilot No. 3 performed poorer than typical.

The City and the Underwood team collectively decided to extend Pilot No. 3 under normal conditions which involved the operator varying the coagulant and polymer doses on a daily basis in an attempt to optimize performance (Pilot No. 3A).

At the same time, Underwood began performing additional data analysis and noted that historically the Peirce Island WWTF produces higher effluent TSS values during the warmer months of the year than during the colder months of the year (see ***Section 4*** for more information).

At that time EPA requested that the second chemical combination be retested in the warmer weather to see if the trend would be the same for a PAC coagulant. This became Pilot No. 2A.

### *3.5 Pilot No. 3A Data*

The fourth chemical combination, denoted as Pilot No. 3A, consisted again of the historic chemical combination, but with operator optimized chemical dosing varying day-to-day. This pilot was conducted because of the higher than average effluent TSS values achieved during Pilot No. 3. The dose adjustments by the operator were done in order to see if an effluent TSS closer to average historic values could be achieved. The pilot was operated from July 17 – August 22, 2017. The pilot began at a chemical dose of 32 PPMV of coagulant and 0.29 PPMV of polymer and was slowly increased to 45 PPMV of coagulant and 0.58 PPMV of polymer within the first two weeks. During the last three weeks of the pilot the polymer dose was kept at 0.58 PPMV and the coagulant dose varied between 43 PPMV and 52 PPMV. ***Table 3-4*** below contains summary data for Pilot No. 3A.

Table 3-4 Pilot No. 3A Summary Results

| Pilot 3A (July 17 – August 22, 2017) | |
|---|---|
| Coagulant | Aries 2076 |
| Polymer | Aries 3644 |
| No. of TSS Data Points | 24 |
| Average Influent TSS (mg/L) | 362.3 |
| Average Effluent TSS (mg/L) | 70.0 |
| Average Percent Removal | 80% |
| No. of Overflow/Underflow Data Points | 23/0 |
| Average Thickener Overflow (mg/L) | 186.2 |
| Average Thickener Underflow (% Solids) | - |

As can be seen from above, the average influent TSS for Pilot No. 3A was 362 mg/L, the average effluent TSS was 70 mg/L, and the average percent removal was 80%.

During Pilot No. 3A, operator observations of the chemical combination continued to mimic what had been seen historically and throughout Pilot No. 3. The performance of the primary clarifiers and gravity thickener continued to be acceptable. Operators noted that the sludge characteristics were good, producing thick sludge that pressed well. No thickener underflow samples were taken during Pilot No. 3A.

### *3.6 Pilot No. 2A Data*

The fifth chemical combination consisted of re-piloting the second chemical combination which was the Aries 252 coagulant and the Aries 3644 polymer. This test was requested by the EPA in order to test the performance of Aries 252 in warmer conditions. Pilot No. 2A was operated for four weeks from August 23 – September 23, 2017. The coagulant was dosed at a low dose of 8.6 PPMV and polymer dosed at 0.19 PPMV for the first two weeks. For the last two weeks, the coagulant dose was increased to 27 PPMV and the polymer dose remained at 0.19 PPMV. ***Table 3-5*** below contains summary data for Pilot No. 2A.

**Table 3-5 Pilot No. 2A Summary Results**

| Pilot 2A (August 23 – September 23, 2017) | |
|---|---|
| Coagulant | Aries 252 |
| Polymer | Aries 3644 |
| No. of TSS Data Points | 24 |
| Average Influent TSS (mg/L) | 263.9 |
| Average Effluent TSS (mg/L) | 79.4 |
| Average Percent Removal | 68% |
| No. of Overflow/Underflow Data Points | 16/0 |
| Average Thickener Overflow (mg/L) | 195.4 |
| Average Thickener Underflow (% Solids) | - |

As can be seen from above, the average influent TSS for Pilot No. 2A was 264 mg/L, the average effluent TSS was 79 mg/L, and the average percent removal was 68%.

Operator observations for the first two weeks of Pilot No. 2A were that this pilot did not perform as well as the other four pilots. Higher effluent TSS values were produced despite the average influent TSS being lower when compared to the previous pilots. Operational issues were observed during the first two weeks of Pilot No. 2A, including a scum mat on the gravity thickener and a thinner, watery sludge at a lower inventory than usual. No thickener underflow samples were taken during Pilot No. 2A. The coagulant dose was increased to 27 PPMV on September 7, 2017. The chlorine contact tanks were cleaned on September 8, 2017 and the operators observed that there was a lot more settled material than normal with Aries 252. The bottom of the chlorine contact tank had about nine to ten inches of settled material, where there is typically only one to two inches of settled material at the bottom of the tank. The pilot continued to produce higher effluent TSS values after the coagulant dose was increased, and the sludge produced was still very thin and watery. NOTE: Due to construction, the plant was only running on one primary clarifier between the dates of September 11 to September 14, 2017.

# 4. Statistical Analysis of Pilot Data

### *4.1 Introduction*

As stated in the EPA Decree, the goal of this pilot study was to determine if an alternate chemical combination to the historical chemical combination could yield better results in terms of final TSS values. Better performance is defined within the Decree as a "10 percent improvement in final effluent TSS values". Given the high degree of variability that exists in the day-to-day effluent quality produced by the WWTF, as a result of changes in flows, changes in water temperature, and changes in wastewater chemistry, it is necessary to utilize statistical analysis in order to determine if the results obtained from the pilot tests are truly different from each other or historic results. In the event that they are proven to be truly different from one another, then one can assess which results are best and if those results are 10 percent better than the historic chemical combination has produced.

### *4.2 Statistical Analysis*

In order to consolidate the various data sets, Underwood created ***Table 4-1*** below which presents the historic data and the data gathered during each of the five pilots conducted as part of this study. The total number of data points, the influent TSS values, the effluent TSS values, and the standard deviations are presented in ***Table 4-1***.



**Table 4-1 Pilot Testing and Historical Data Summary**

| Pilot 1 (Aries 291) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pilot Data, 2017 | | | 2016 Historical Data | | 2015 Historical Data | | 2014 Historical Data | |
| Date | Influent TSS (mg/L) | Effluent TSS (mg/L) | % Removal | Influent TSS (mg/L) | Effluent TSS (mg/L) | Influent TSS (mg/L) | Effluent TSS (mg/L) | Influent TSS (mg/L) | Effluent TSS (mg/L) |
| 28-Feb | 173 | 32.5 | 81% | | | | | | |
| 1-Mar | 188 | 35 | 81% | | | | | | |
| 2-Mar | 186 | 29 | 84% | | | | | | |
| 3-Mar | 185 | 29 | 84% | | | | | | |
| 4-Mar | 189 | 41.76 | 78% | | | | | | |
| 22-Mar | 272 | 40.5 | 85% | | | | | | |
| 23-Mar | 238 | 29.5 | 88% | 181 | 40 | | | | |
| 24-Mar | 169 | 35.5 | 79% | 190 | 39 | 182.5 | 41 | | |
| 25-Mar | 238 | 31 | 87% | | | 197.5 | 52.5 | 221 | 26.5 |
| 28-Mar | 504 | 62.5 | 88% | | | | | 196.5 | 42 |
| 29-Mar | 220.8 | 71 | 68% | 157 | 47 | | | | |
| 30-Mar | 244 | 55.5 | 77% | 181 | 30 | | | | |
| 31-Mar | 159.5 | 62 | 61% | | | | | | |
| 1-Apr | 210 | 71 | 66% | | | 163.5 | 45 | 117.5 | 30.5 |
| 4-Apr | 189.3 | 47 | 75% | | | 151.5 | 50 | 121.5 | 20 |
| 5-Apr | 247.7 | 45.5 | 82% | 235 | 37 | | | | |
| 6-Apr | 154 | 34 | 78% | 132 | 62 | | | | |
| 7-Apr | 215.5 | 25.5 | 88% | | | 162.5 | 38.5 | | |
| 8-Apr | 168 | 34.5 | 79% | | | 147.5 | 53 | 159 | 29.5 |
| 11-Apr | 97.6 | 44 | 55% | | | | | 153 | 25.5 |
| 12-Apr | 280 | 35.5 | 87% | 198 | 43 | | | | |
| 13-Apr | 377 | 40.7 | 89% | 263 | 58 | | | | |
| 14-Apr | 328 | 39 | 88% | | | 151.5 | 53 | | |
| 15-Apr | 297 | 54 | 82% | | | 174.5 | 44 | 281 | 33 |
| 18-Apr | 216 | 28.5 | 87% | | | | | 231 | 29 |
| 19-Apr | 200 | 24.5 | 88% | 198 | 37 | | | | |
| 20-Apr | 191 | 23.5 | 88% | 185 | 41 | | | | |
| 21-Apr | 350 | 27 | 92% | | | 122 | 77.5 | 285.5 | 52.5 |
| 22-Apr | 270 | 28 | 90% | | | 139.5 | 57 | 180.5 | 35.5 |
| **Average** | **233.0** | **39.9** | **81.2%** | **192** | **43.4** | **159.3** | **51.15** | **194.7** | **32.4** |
| **Standard Deviation** | **80.8** | **13.7** | **8.94%** | **36.6** | **9.8** | **21.9** | **11.0** | **59.8** | **9.2** |
| **No. of Data Points** | **29** | | | **10** | | **10** | | **10** | |

| Pilot 2 (Aries 252) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pilot Data, 2017 | | | 2016 Historical Data | | 2015 Historical Data | | 2014 Historical Data | |
| Date | Influent TSS (mg/L) | Effluent TSS (mg/L) | % Removal | Influent TSS (mg/L) | Effluent TSS (mg/L) | Influent TSS (mg/L) | Effluent TSS (mg/L) | Influent TSS (mg/L) | Effluent TSS (mg/L) |
| 25-Apr | 295 | 63 | 79% | | | | | | |
| 26-Apr | 580 | 49.5 | 91% | | | | | | |
| 27-Apr | 518 | 70 | 86% | | | | | | |
| 28-Apr | 249 | 54 | 78% | | | 189.5 | 42 | | |
| 29-Apr | 226 | 57 | 75% | | | 254.5 | 31 | 427 | 45 |
| 2-May | 82 | 36 | 56% | | | | | 220 | 36.5 |
| 3-May | 254 | 37.5 | 85% | 215 | 32 | | | | |
| 4-May | 182 | 45 | 75% | 135 | 27 | | | | |
| 5-May | 233 | 48 | 79% | | | 356.3 | 32 | | |
| 6-May | 473 | 53.5 | 89% | | | 326.5 | 26 | 250 | 27 |
| 9-May | 230 | 50 | 78% | | | | | 161 | 29 |
| 10-May | 202 | 55 | 73% | 214 | 52 | | | | |
| 11-May | 296 | 63 | 79% | 210 | 78 | | | | |
| 12-May | 365 | 48 | 87% | | | | | | |
| 13-May | 283 | 70 | 75% | | | 378.5 | 42 | 382.5 | 38 |
| 16-May | 303 | 36 | 88% | | | | | 319.5 | 44 |
| 17-May | 261 | 50 | 81% | 210 | 39 | 840 | 51.5 | | |
| 18-May | 288 | 41 | 86% | 218 | 20 | | | | |
| 19-May | 240 | 64 | 73% | | | | | | |
| 20-May | 270 | 63 | 77% | | | 487.5 | 66 | 332.5 | 42.5 |
| 23-May | 534 | 76 | 86% | | | 426 | 54.5 | 283.5 | 48.5 |
| 24-May | 280 | 72 | 74% | 332 | 36 | | | | |
| 25-May | 345 | 66.67 | 81% | 215 | 33 | | | | |
| 26-May | 636 | 68 | 89% | | | | | | |
| 27-May | 263 | 47 | 82% | | | 513 | 55.5 | 388 | 49 |
| 31-May | 310 | 39 | 87% | 271 | 31 | 729 | 110 | 285.5 | 44 |
| 1-Jun | 456 | 50 | 89% | 261 | 33 | | | | |
| 2-Jun | 278 | 73 | 74% | | | | | | |
| 3-Jun | 292.7 | 70 | 76% | | | | | | |
| **Average** | **318.1** | **55.7** | **80.3%** | **228.1** | **38.1** | **450.1** | **51.1** | **305.0** | **40.4** |
| **Standard Deviation** | **125.9** | **12.2** | **7.4%** | **51.3** | **16.3** | **203.1** | **24.2** | **82.0** | **7.6** |
| **No. of Data Points** | **29** | | | **10** | | **10** | | **10** | |

| Pilot 3 (Aries 2076) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pilot Data, 2017 | | | 2016 Historical Data | | 2015 Historical Data | | 2014 Historical Data | |
| Date | Influent TSS (mg/L) | Effluent TSS (mg/L) | % Removal | Influent TSS (mg/L) | Effluent TSS (mg/L) | Influent TSS (mg/L) | Effluent TSS (mg/L) | Influent TSS (mg/L) | Effluent TSS (mg/L) |
| 6-Jun | 378 | 74 | 80% | | | | | | |
| 7-Jun | 406 | 76 | 81% | 227 | 37 | | | | |
| 8-Jun | 272 | 71 | 74% | 237 | 34 | | | | |
| 9-Jun | 115 | 60 | 48% | | | 531 | 33 | | |
| 10-Jun | 328 | 67 | 80% | | | 367 | 55 | 429 | 59.5 |
| 13-Jun | 420 | 68.57 | 84% | | | | | 308.5 | 54 |
| 14-Jun | 326 | 82 | 75% | 270 | 46 | | | | |
| 15-Jun | 354.28 | 72.5 | 80% | 266 | 53 | | | | |
| 16-Jun | 362 | 86 | 76% | | | 517 | 45 | | |
| 17-Jun | 286 | 90 | 69% | | | 423.5 | 56 | 302 | 54 |
| 20-Jun | 352 | 72 | 80% | | | | | 396.5 | 50 |
| 21-Jun | 360 | 66 | 82% | | | | | | |
| 22-Jun | 362.5 | 76 | 79% | 294 | 45 | | | | |
| 23-Jun | 404 | 74.67 | 82% | 413 | 34 | 358.5 | 59 | | |
| 24-Jun | 320 | 75 | 77% | | | 392 | 46 | 470.5 | 58 |
| 27-Jun | 503.3 | 82 | 84% | | | | | 537 | 63 |
| 28-Jun | 578 | 90 | 84% | 346 | 36 | | | | |
| 29-Jun | 370 | 62.67 | 83% | 620 | 91 | | | | |
| 30-Jun | 371.1 | 55 | 85% | | | 439 | 54 | | |
| 1-Jul | 403.3 | 62.73 | 84% | | | 956 | 55.5 | 576.5 | 65.5 |
| 6-Jul | 296 | 56 | 81% | | | | | 528.5 | 38.5 |
| 7-Jul | 222.86 | 57 | 74% | 291 | 43 | 320.5 | 71 | | |
| 8-Jul | 474 | 60 | 87% | 379 | 38 | 227.5 | 76 | 236.5 | 39 |
| 11-Jul | 342.5 | 64 | 81% | | | | | 353 | 42 |
| 12-Jul | 376.67 | 76.25 | 80% | | | | | | |
| 13-Jul | 330 | 52.86 | 84% | | | | | | |
| 14-Jul | 454.29 | 73 | 84% | | | | | | |
| 15-Jul | 272 | 65 | 76% | | | | | | |
| **Average** | **358.6** | **70.3** | **79%** | **334.3** | **45.7** | **453.2** | **55.1** | **413.8** | **52.4** |
| **Standard Deviation** | **88.0** | **10.2** | **7.4%** | **117.0** | **17.0** | **198.0** | **12.4** | **114.1** | **9.8** |
| **No. of Data Points** | **28** | | | **10** | | **10** | | **10** | |

| Pilot 3A (Aries 2076) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pilot Data, 2017 | | | 2016 Historical Data | | 2015 Historical Data | | 2014 Historical Data | |
| Date | Influent TSS (mg/L) | Effluent TSS (mg/L) | % Removal | Influent TSS (mg/L) | Effluent TSS (mg/L) | Influent TSS (mg/L) | Effluent TSS (mg/L) | Influent TSS (mg/L) | Effluent TSS (mg/L) |
| 18-Jul | 393.33 | 66.67 | 83% | | | | | | |
| 19-Jul | 360 | 62 | 83% | 240 | 49 | | | | |
| 20-Jul | 290 | 64.29 | 78% | 281 | 47 | | | | |
| 21-Jul | 314.3 | 60 | 81% | | | 251 | 64.5 | 384 | 39.5 |
| 22-Jul | 374 | 58.6 | 84% | | | 271 | 67.5 | 240 | 50.5 |
| 25-Jul | 610 | 71.67 | 88% | | | | | | |
| 26-Jul | 350 | 62 | 82% | 244 | 70 | | | | |
| 27-Jul | 374 | 78 | 79% | 234 | 50 | | | | |
| 28-Jul | 370 | 58 | 84% | | | 376.5 | 69.5 | 173 | 37.5 |
| 29-Jul | 360 | 86 | 76% | | | 320.5 | 52 | 190 | 38.5 |
| 1-Aug | 325 | 62 | 81% | | | | | | |
| 2-Aug | 294 | 76.25 | 74% | 300 | 67 | | | | |
| 3-Aug | 284 | 61.67 | 78% | 297 | 57 | | | | |
| 4-Aug | 252 | 80 | 68% | | | 610 | 56.5 | 350.5 | 32 |
| 5-Aug | 356 | 62 | 83% | | | 198 | 30.5 | 613 | 72 |
| 8-Aug | 355 | 66 | 81% | | | | | | |
| 9-Aug | 406 | 64.6 | 84% | 301 | 80 | | | | |
| 10-Aug | 314 | 61.45 | 80% | 422 | 91 | | | | |
| 11-Aug | 288 | 66 | 77% | | | 225.5 | 29.5 | 345 | 51.5 |
| 12-Aug | 274 | 64.71 | 76% | | | 240.5 | 30.5 | 546 | 105 |
| 15-Aug | 353.33 | 128 | 64% | | | | | | |
| 16-Aug | 560 | 83.75 | 85% | 314 | 93 | | | | |
| 17-Aug | 450 | 78 | 83% | 277 | 60 | | | | |
| 18-Aug | 387.5 | 59.2 | 85% | | | | | | |
| 19-Aug | | | | | | 247 | 36 | 404.5 | 43.5 |
| 20-Aug | | | | | | 231 | 47.5 | 296.5 | 44 |
| **Average** | **362.3** | **70.0** | **80%** | **291.0** | **66.4** | **297.1** | **48.4** | **354.3** | **51.4** |
| **Standard Deviation** | **83.4** | **14.9** | **5.5%** | **54.0** | **17.0** | **121.4** | **16.0** | **142.8** | **21.8** |
| **No. of Data Points** | **24** | | | **10** | | **10** | | **10** | |

| Pilot 2A (Aries 252) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pilot Data, 2017 | | | 2016 Historical Data | | 2015 Historical Data | | 2014 Historical Data | |
| Date | Influent TSS (mg/L) | Effluent TSS (mg/L) | % Removal | Influent TSS (mg/L) | Effluent TSS (mg/L) | Influent TSS (mg/L) | Effluent TSS (mg/L) | Influent TSS (mg/L) | Effluent TSS (mg/L) |
| 23-Aug | 624 | 101 | 84% | 252 | 117 | | | | |
| 24-Aug | 278 | 84 | 70% | 356 | 87 | | | | |
| 25-Aug | 182.7 | 71 | 61% | | | 247.5 | 65.5 | | |
| 26-Aug | 183.1 | 87 | 52% | | | 233 | 70.5 | 402.5 | 52 |
| 29-Aug | 241.3 | 84 | 65% | | | | | 430.5 | 53 |
| 30-Aug | 260 | 95 | 63% | | | | | | |
| 31-Aug | 298 | 93 | 69% | 252 | 79 | | | | |
| 1-Sep | 300 | 97 | 68% | 299 | 84 | | | | |
| 2-Sep | 306 | 94 | 69% | | | 332 | 80 | 743 | 85.5 |
| 5-Sep | 216 | 65 | 70% | | | 295 | 64 | 350 | 47 |
| 6-Sep | 165 | 82 | 50% | | | | | | |
| 7-Sep | 308.3 | 66 | 79% | 310.0 | 51.0 | | | | |
| 8-Sep | 160 | 69.23 | 57% | 292.0 | 59.0 | | | | |
| 9-Sep | 181 | 60 | 67% | | | 300.5 | 48 | 511.5 | 49 |
| 12-Sep | 200.0 | 82.0 | 59% | | | 279 | 53.5 | 459.5 | 45 |
| 13-Sep | 268.0 | 78.0 | 71% | 216.0 | 105.0 | | | | |
| 14-Sep | 336.0 | 80.0 | 76% | 341.0 | 66.0 | | | | |
| 15-Sep | 209.0 | 68.0 | 67% | | | 204.5 | 35.5 | | |
| 16-Sep | 207.0 | 60.7 | 71% | | | 2.17 | 40.5 | 369 | 37 |
| 19-Sep | 259.7 | 61.0 | 77% | | | | | 390.5 | 34 |
| 20-Sep | 347.7 | 69.8 | 80% | 235 | 140 | | | | |
| 21-Sep | 251.6 | 74.0 | 71% | 257 | 162 | | | | |
| 22-Sep | 318.0 | 110.0 | 65% | | | 244.5 | 34 | | |
| 23-Sep | 233.3 | 73.0 | 69% | | | 280.5 | 44.5 | 448.5 | 73 |
| 24-Sep | | | | | | | | 435.5 | 58.5 |
| **Average** | **263.9** | **79.4** | **67.9%** | **281.0** | **95.0** | **241.9** | **53.6** | **454.1** | **53.4** |
| **Standard Deviation** | **94.7** | **13.8** | **8.13%** | **46.1** | **35.9** | **92.0** | **15.7** | **111.8** | **15.7** |
| **No. of Data Points** | **24** | | | **10** | | **10** | | **10** | |

The key statistical test utilized for analysis of the data is the one-way ANOVA Test. The one-way ANOVA test is defined as a test which compares multiple data sets and based on variability existing within the data sets determines if the average or median value of the data set is statistically different from one another. If it was determined that the data sets were statistically different from one another, a t-Test was performed to test each pair of means to determine which data sets are significantly different or not significantly different from one another. Multiple ANOVA tests were performed as follows:



- An ANOVA test on the influent TSS values for each of the pilots vs. each other.
- An ANOVA test on the effluent TSS values for each of the pilots vs. each other.
- For each pilot test, an ANOVA test on the effluent TSS achieved at the low coagulant dose vs. at the high coagulant dose.
- An ANOVA test on the historic effluent TSS vs. each of the pilot effluent TSS values for the same time of year.

***Table 4-2*** presents the results of these statistical tests when the five pilot tests are compared to each other.

**Table 4-2 Statistical Comparisons: Pilot vs. Pilot**

| | | Average TSS (mg/L) | |
|---|---|---|---|
| *Pilot 1 (Aries 291) & Pilot 2 (Aries 252)* | | Pilot 1 | Pilot 2 |
| Influent: | Statistically different between Pilots | 233 | 318.1 |
| Effluent: | Statistically different between Pilots | 39.9 | 55.7 |
| *Pilot 1 (Aries 291) & Pilot 3 (Aries 2076)* | | Pilot 1 | Pilot 3 |
| Influent: | Statistically different between Pilots | 233 | 358.6 |
| Effluent: | Statistically different between Pilots | 39.9 | 70.3 |
| *Pilot 1 (Aries 291) & Pilot 3A (Aries 2076)* | | Pilot 1 | Pilot 3A |
| Influent: | Statistically different between Pilots | 233 | 362.3 |
| Effluent: | Statistically different between Pilots | 39.9 | 70 |
| *Pilot 1 (Aries 291) & Pilot 2A (Aries 252)* | | Pilot 1 | Pilot 2A |
| Influent: | Proved to be **not different** between Pilots | 233 | 263.9 |
| Effluent: | Statistically different between Pilots | 39.9 | 79.4 |
| *Pilot 2 (Aries 252) & Pilot 3 (Aries 2076)* | | Pilot 2 | Pilot 3 |
| Influent: | Proved to be **not different** between Pilots | 318.1 | 358.6 |
| Effluent: | Statistically different between Pilots | 55.7 | 70.3 |
| *Pilot 2 (Aries 252) & Pilot 3A (Aries 2076)* | | Pilot 2 | Pilot 3A |
| Influent: | Proved to be **not different** between Pilots | 318.1 | 362.3 |
| Effluent: | Statistically different between Pilots | 55.7 | 70 |
| *Pilot 2 (Aries 252) & Pilot 2A (Aries 252)* | | Pilot 2 | Pilot 2A |
| Influent: | Statistically different between Pilots | 318.1 | 263.9 |
| Effluent: | Statistically different between Pilots | 55.7 | 79.4 |
| *Pilot 3 (Aries 2076) & Pilot 2A (Aries 252)* | | Pilot 3 | Pilot 2A |
| Influent: | Statistically different between Pilots | 358.6 | 263.9 |
| Effluent: | Statistically different between Pilots | 70.3 | 79.4 |
| *Pilot 3 (Aries 2076) & Pilot 3A (Aries 2076)* | | Pilot 3 | Pilot 3A |
| Influent: | Proved to be **not different** between Pilots | 358.6 | 362.3 |
| Effluent: | Proved to be **not different** between Pilots | 70.3 | 70 |
| *Pilot 3A (Aries 2076) & Pilot 2A (Aries 252)* | | Pilot 3A | Pilot 2A |
| Influent: | Statistically different between Pilots | 362.3 | 263.9 |
| Effluent: | Statistically different between Pilots | 70 | 79.4 |

When statistically comparing the effluent TSS for each of the five pilots against each other the result was that all effluent values are statistically different from each other, with the exception of Pilot No. 3 and Pilot No. 3A. The effluent TSS values for Pilot No. 3 and 3A proved to be not statistically different from each other.

When comparing the influent TSS values for each of the five pilots against each other six of the ten comparisons were shown to have statistically different influent TSS values. The four comparisons with influent TSS values that were not statistically different from each other were Pilot No. 2 and Pilot No. 3, Pilot No. 2 and Pilot No. 3A, Pilot No. 3 and Pilot No. 3A, Pilot No. 1 and Pilot No. 2A. At the request of EPA, Underwood created plots for each pilot of influent TSS vs. effluent TSS (***Appendix E***). For all pilots, no correlation exists between these two parameters.

***Table 4-3*** below presents the results of statistical tests when comparing each pilot performance with historical effluent TSS values at the same time of year. From ***Table 4-3*** it can be seen that the Pilot No. 1 performance was not significantly different from historic performance. The performance of the other four pilots were all significantly different from the historic performance, and in all cases the historic effluent TSS values were lower than the effluent TSS values achieved during the pilots.

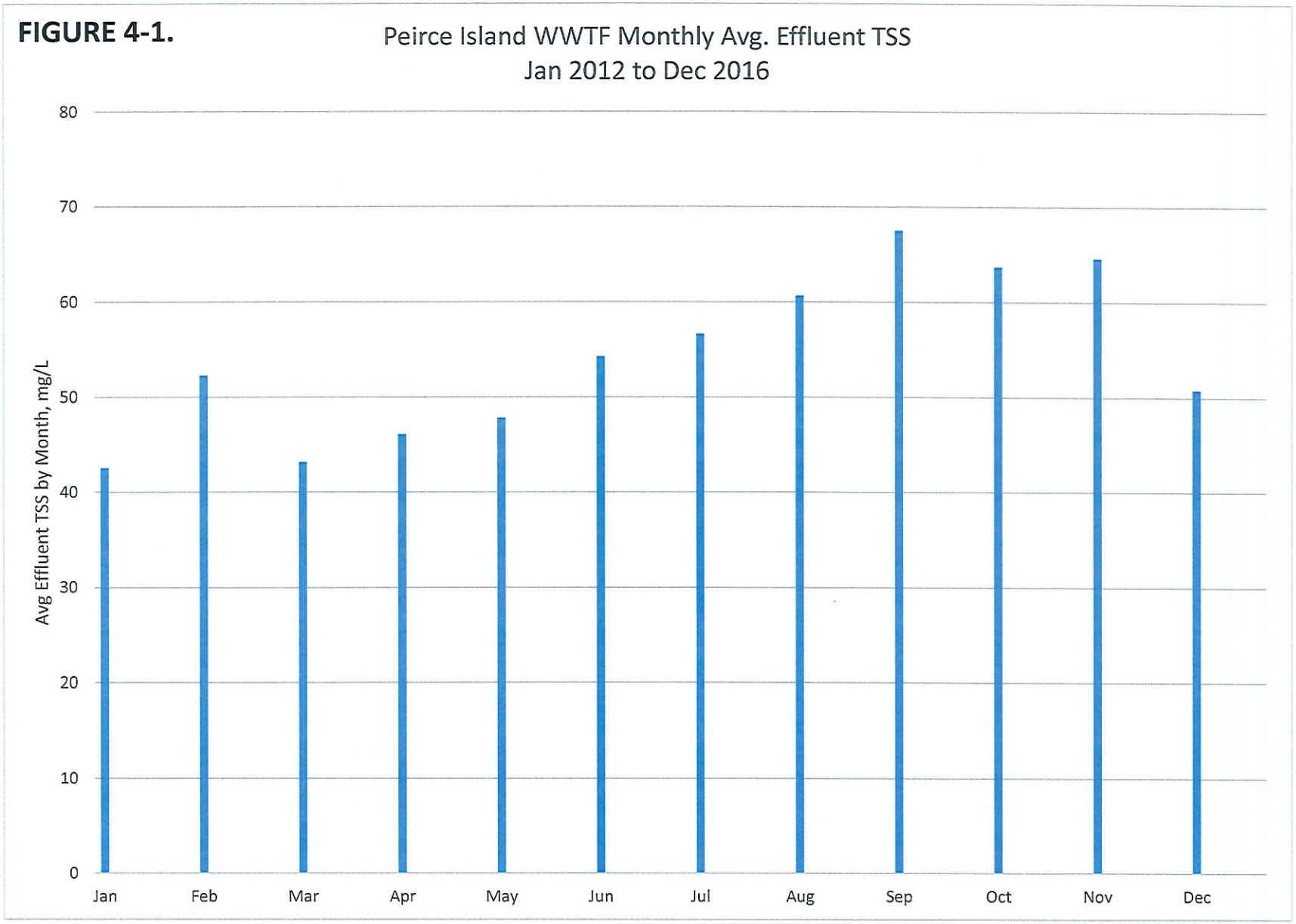
**Table 4-3 Statistical Comparisons: Pilot vs. Historical**

| | | Average TSS (mg/L) | |
|---|---|---|---|
| **Pilot 1** | *Aries 291* | Aries 291 | Historical |
| Influent: | Statistically different than Historical data (higher) | 233 | 181.9 |
| Effluent: | Proved to be **not different** than Historical data | 39.9 | 42.2 |
| **Pilot 2** | *Aries 252* | Aries 252 | Historical |
| Influent: | Proved to be **not different** than Historical data | 318.1 | 327.6 |
| Effluent: | Statistically different than Historical data (higher) | 55.7 | 43.1 |
| **Pilot 3** | *Aries 2076* | Aries 2076 | Historical |
| Influent: | Proved to be **not different** than Historical data | 358.6 | 400.4 |
| Effluent: | Statistically different than Historical data (higher) | 70.3 | 50.9 |
| **Pilot 3A** | *Aries 2076* | Aries 2076 | Historical |
| Influent: | Proved to be **not different** than Historical data | 362.3 | 320.1 |
| Effluent: | Statistically different than Historical data (higher) | 70 | 55.3 |
| **Pilot 2A** | *Aries 252* | Aries 252 | Historical |
| Influent: | Statistically different than Historical data (lower) | 263.9 | 332.7 |
| Effluent: | Statistically different than Historical data (higher) | 79.4 | 67.3 |

As stated earlier, it was noted that the Peirce Island CEPT WWTF historical effluent TSS data exhibits considerable seasonal variation in effluent quality. Historical monthly average effluent TSS data from 2012 to 2016 was 43 to 52 mg/L in colder months vs. 55 to 68 mg/L in warmer months. Additionally, data was obtained from the City of Gloucester, MA CEPT WWTF that shows the same seasonal trend in effluent TSS quality. Gloucester data from 2014 to 2017 clearly shows that effluent TSS quality is better in colder months than warmer months. Graphs of historical monthly effluent TSS data from both the Peirce Island WWTF and Gloucester WWTF can be found in ***Figures 4-1 and 4-2***.

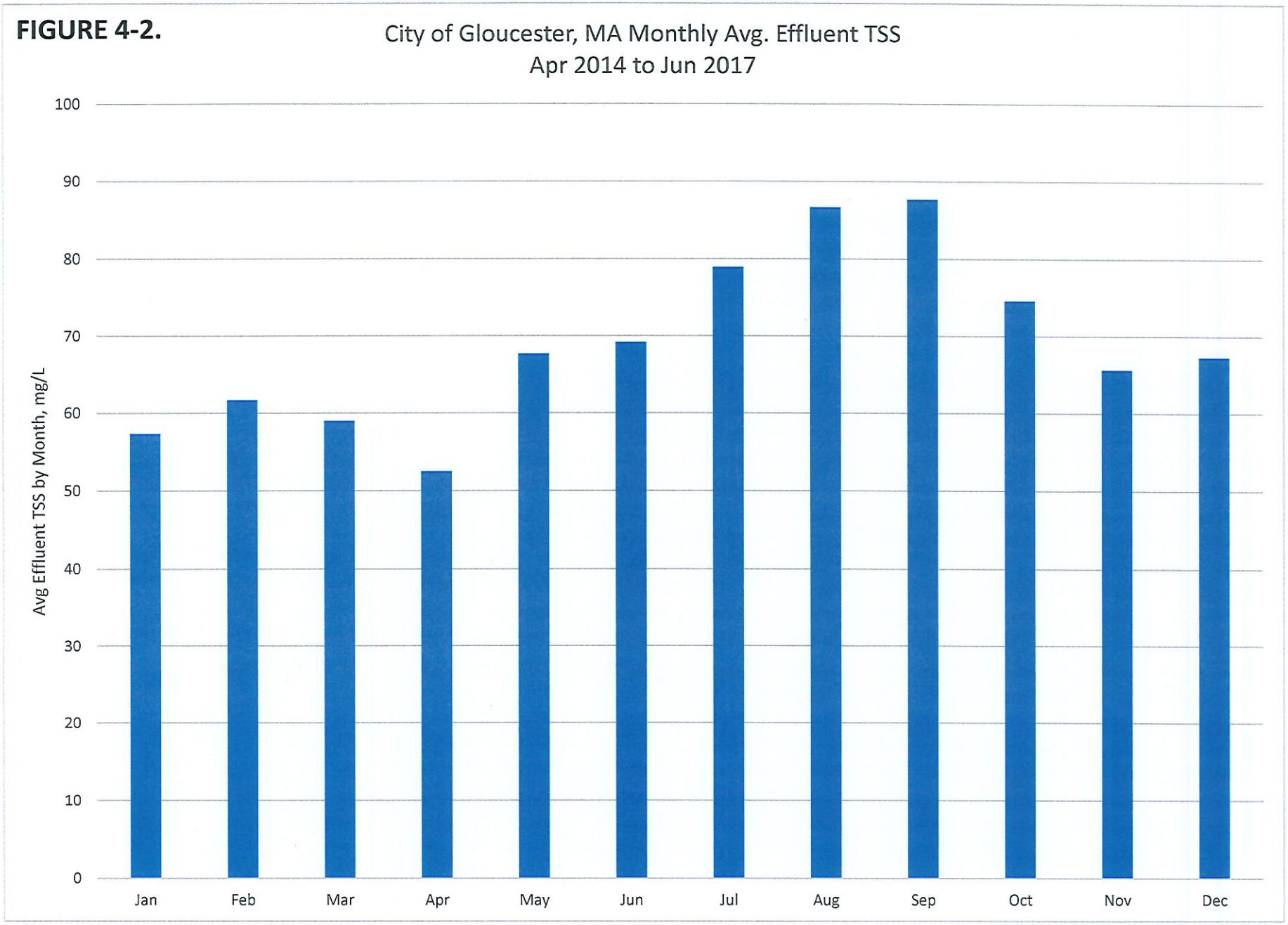


**FIGURE 4-1.**




N:\PROJECTS\PORTSMOUTH, NH\REALNUM\2120 Peirce Island WWTF CEPT Pilot\08_Comp\2120 Peirce Island Data - UE Pivot Tables.xlsx

**FIGURE 4-2.**


City of Gloucester, MA Monthly Avg. Effluent TSS
Apr 2014 to Jun 2017
Avg Effluent TSS by Month, mg/L
100
90
80
70
60
50
40
30
20
10
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

# 5. Conclusions and Recommendations

## *5.1 Conclusions*

- Pilot No. 1 with Aries 291 coagulant and Aries 3644 polymer was the only chemical combination that performed equally as well as historic performance (for the same time of year). The average effluent TSS achieved throughout Pilot No. 1 was 39.9 mg/L while the average historic effluent TSS at the same time of year was 42.2 mg/L. However, during pilot testing, the first chemical combination proved to be problematic for plant operations and had detrimental effects on clarifier and gravity thickener performance, resulting in internal recycling of solids between the two units and also resulted in thinner gravity thickener underflow solids and wetter sludge cake being produced for disposal. Further, it was noted that solids seemed to be passing through the system and settling out in the chlorine contact tanks which, when cleaned, resulted in solids being removed that were not accounted for in the effluent TSS 24-hour composite samples utilized to establish pilot performance.
- The Aries 252 coagulant and Aries 3644 polymer was the chemical combination for both Pilot No. 2 and Pilot No. 2A. Pilot No. 2, performed in April to June, resulted in poorer performance when compared to historical data (for the same time of year). Pilot No. 2 average effluent TSS was 55.7 mg/L compared to an average 43.1 mg/L historically. However, it did perform better than both Pilot No. 3 and Pilot No. 3A with the historic chemical combination. Pilot No. 2A was conducted in order to see if it could outperform the historic chemical combination in warmer temperatures. The average Pilot No. 2A effluent TSS value of 79.4 mg/L was worse than historical data and worse than any of the pilots. Further, the Aries 252 resulted in poor operating conditions with a high amount of solids settling in the chlorine contact tank and the production of thin, watery sludge.
- The Aries 2076 coagulant and Aries 3644 polymer was the chemical combination for both Pilot No. 3 and Pilot No. 3A and reflected the historic chemical combination. Pilot No. 3 was run at a low dose and a high dose of coagulant while Pilot No. 3A was run with varying doses controlled by the operator. Both pilots performed statistically equal to each other, but did not perform as well as historical data at the same time of year. However, this chemical combination performed markedly better than all of the other chemical combinations in terms of plant operability, plant stability, and solids dewaterability.
- All of the pilots achieved fairly consistent effluent TSS values despite large swings in influent TSS values. No correlation was found between influent and effluent TSS.
- Analysis of the Peirce Island WWTF historic effluent TSS values showed that significant seasonal variation occurs with lower effluent TSS achieved in colder times of the year. This explained why the effluent quality decreased throughout the pilot study as temperatures went from cold to warm.
- Although it appeared initially that the PAC coagulants (Pilot No. 1 and Pilot No. 2) outperformed the historic ferric chloride coagulant (Pilot No. 3), once PAC was retested at warm temperatures (Pilot No. 2A) it was shown to perform poorer than ferric chloride.

### *5.2 Recommendations*

- Although the first chemical combination utilizing Aries 291 performed well for effluent TSS, it did not yield a 10% better effluent TSS than historic data for the same time of year. Further, due to operational problems caused by the use of Aries 291 and additional costs that would be incurred for a more expensive chemical and higher sludge disposal costs, Underwood does not recommend switching to Aries 291.
- The Aries 252 PAC (the second chemical combination) did not perform as well as the historic Aries 2076 ferric chloride for the same time of year or during the piloting at the same time of year. Although the plant seemed to run better with Aries 252 PAC than Aries 291, it still caused operational issues that were not present in the historic chemical.
- Based on the data gathered during this pilot study, the statistical analysis of data performed, the evaluation of plant operations during use of the different chemicals, and the conclusions summarized in Section 5.1 above, Underwood recommends that the third chemical combination, or the historic chemical combination of Aries 2076 and Aries 3644, continue to be utilized long-term at the Peirce Island WWTF. The piloting proved that a 10% better effluent TSS could not be achieved with alternate chemicals.
- Additional tasks to implement a chemical dosage optimization plan is not recommended at this time.



# APPENDIX A

UNITED STATES DISTRICT COURT
DISTRICT OF NEW HAMPSHIRE

| | | |
|---|---|---|
| UNITED STATES OF AMERICA,<br><br>Plaintiff,<br><br>STATE OF NEW HAMPSHIRE,<br><br>Plaintiff-Intervenor,<br><br>CONSERVATION LAW FOUNDATION,<br><br>Plaintiff-Intervenor<br><br>v.<br><br>CITY OF PORTSMOUTH, NEW HAMPSHIRE,<br><br>Defendant. | ) | CIVIL ACTION<br><br>NO. 09-cv-283-PB |

CONSENT DECREE SECOND MODIFICATION

WHEREAS, Plaintiff, the United States of America ("United States"), on behalf of the United States Environmental Protection Agency ("EPA"), filed a Complaint in this action alleging that Defendant, the City of Portsmouth, New Hampshire ("City") violated Section 301(a) of the Clean Water Act ("CWA"), 33 U.S.C. § 1301(a);

WHEREAS, Plaintiff-Intervenor, the State of New Hampshire ("State"), filed a Complaint-in-Intervention alleging that the City violated the New Hampshire Water Pollution and Waste Disposal Act, NH RSA 485-A ("New Hampshire Act");

WHEREAS, the United States Complaint and State Complaint-in-Intervention allege that the City is violating its April 10, 2007 National Pollutant Discharge Elimination System ("NPDES") permit effluent limitations for discharges from the City's Peirce Island Wastewater

Treatment Facility ("Peirce Island WWTF") and permit conditions applicable to discharges from overflow points in the City's combined wastewater collection system;

WHEREAS, the April 10, 2007 NPDES permit does not contain monitoring or effluent limits for total nitrogen;

WHEREAS, the Court entered the Consent Decree ("Consent Decree") in this matter on September 24, 2009, requiring combined sewer overflow ("CSO") mitigation and achieving secondary treatment limits in accordance with the schedule set forth in the WWTF Work Plan to be submitted to EPA by September 1, 2010;

WHEREAS, the Court granted the motion by Conservation Law Foundation, Inc. ("CLF") to intervene as a plaintiff on October 9, 2012;

WHEREAS, the original Consent Decree was modified by agreement of the United States, State, and City, and approved by Order of this Court on February 15, 2013 ("First Modification");

WHEREAS, the First Modification required the City to complete construction of the secondary treatment facilities by March 1, 2017 and achieve compliance with treatment limits in its NPDES permit by May 1, 2017;

WHEREAS, all parties agree that the City will not complete construction of secondary treatment facilities or achieve compliance with treatment limits by the dates set forth in the First Modification;

WHEREAS, the United States, State, City, and CLF (collectively, the "Parties") participated in settlement negotiations related to City's anticipated failure to complete construction of the Peirce Island WWTF and achieve secondary treatment by the dates set forth in the First Modification, and have agreed to the terms of this Consent Decree Second

Modification ("Second Modification") that sets forth a revised construction and compliance schedule, mitigation measures related to the failure to comply with the First Modification, and related provisions;

WHEREAS, unless explicitly revised by the terms of this Second Modification, all provisions of the Consent Decree and First Modification, shall remain in effect; and

WHEREAS, the Parties agree, and the Court by entering this Second Modification finds, that this Second Modification is fair, reasonable, and in the public interest.

NOW, THEREFORE, it is hereby Ordered, Adjudged, and Decreed that:

## I. JURISDICTION

1. The Court has jurisdiction over the subject matter of this action and over the Parties to this Second Modification pursuant to Paragraphs 1 and 65 of the Consent Decree.

2. Pursuant to Paragraph 66 of the Consent Decree material modifications of the Consent Decree may be made by written agreement of the Parties, and shall be effective only upon approval of the Court.

## II. OBJECTIVES

3. It is the express purpose of the Parties entering this Second Modification to: effectuate the City's compliance with the CWA, 33 U.S.C. § 1251, *et seq.*; set forth an expeditious, reasonable, and binding schedule for achieving secondary treatment at the Peirce Island WWTF; and establish mitigation requirements related to City's failure to achieve secondary treatment in accordance with the schedule set forth in the First Modification.

4. To this end, it is the further objective of the Parties that: the City substantially complete construction of the Biologically Aerated Filters ("BAF") and all facilities necessary to allow startup by December 1, 2019; and the City achieve compliance with all NPDES permit limits

contained in the permit dated April 10, 2007, or any subsequently issued NPDES permit that is final and in effect after any appeals, by April 1, 2020.

III. MODIFICATION OF EXISTING PROVISIONS

5. Milestones and Schedules. Paragraph 1 of Appendix B.1 to the Consent Decree is hereby modified by revising paragraphs 5 k. through m. of the First Modification, which are hereby replaced with the following:

a. By July 1, 2016, the City shall execute a contract to construct a secondary treatment facilities with a capacity of 6.13 million gallons per day ("MGD") average, and 9.06 MGD maximum day flow (not including recycle flows), including BAF, and issue a Notice to Proceed on such construction.

b. By December 1, 2016, the City shall submit two additional construction milestones to EPA for approval based upon the detailed schedule to be provided to the City by the City's selected contractor. The City shall provide EPA with a copy of its contractor's detailed schedule along with its recommended milestones. Each such milestone shall be the completion of a substantial critical path activity, and neither can be substantial completion of BAF construction. By the dates set forth in each EPA approved milestone, the City shall complete all related construction work to achieve the applicable substantial critical path activity.

c. By December 1, 2019, the City shall substantially complete construction of the secondary treatment facilities, including the BAF, and all facilities necessary to allow startup.

d. By April 1, 2020, the City shall achieve compliance with NPDES permit limits contained in the permit dated April 10, 2007, or any subsequently issued NPDES permit that is final and in effect after any appeals.

6. Reporting. Paragraph 20.a. to the Consent Decree is hereby replaced with the following:

a. Monthly Reports on Compliance. Within 30 days after the end of each month, the City shall submit a written report to EPA, the State, and CLF for the preceding month that shall include a description or reporting of the following:

i) status of required construction, including major work items completed in the preceding month;
ii) projected work items to be undertaken in the next month;
iii) project percent complete based on payments to contractor for work completed;
iv) project percent complete based on time elapsed;

v) status of all required permit applications;
vi) status of Consent Decree milestones including identifying any problems encountered or anticipated, together with the proposed or implemented solutions; and
vii) the monthly average discharge concentrations of total nitrogen for the preceding month, as required in Paragraph 8.b.ii of the Second Modification.

The Consent Decree, First Modification, and Second Modification along with such Monthly Reports on Compliance shall be posted on the City's internet site, and maintained accessible to the public online until termination of the Consent Decree. In addition to the submission of Reports on Compliance, the Parties will participate in quarterly meetings or conference calls, if scheduled by EPA, to review the City's compliance with the terms of the Consent Decree.

## IV. ADDITIONAL PROVISIONS

7. Schedule Recovery Program. If the City fails to achieve any of the construction milestones by the dates set forth in or determined in accordance with Section III (Modification of Existing Provisions), the City shall use its contractual remedies, including without limitation, Part 2.01.F (Recovery Schedule) of Section 01311 (Construction Progress Schedules) of the City's contract for construction of the project, to maintain schedule compliance. At the discretion of the City, the schedule recovery program may include the application of extended shifts, second shifts, work on weekends, extra labor, or other atypical construction efforts and measures to return the project to schedule and meet required milestones. However, if implementing extended shifts, second shifts, work on weekends, or/and extra labor is the only means capable of achieving compliance, the schedule recovery program shall employ one or more of these methods.

8. Mitigation. The City agrees to implement the following initiatives as mitigation for the continued discharges of biochemical oxygen demand ("$BOD_5$") and total suspended solids ("TSS") resulting from the delayed implementation of secondary treatment.

a. Interim Enhanced Primary Treatment. The City shall engage a qualified engineer to perform an optimization study on the primary clarifiers for the chemically enhanced primary treatment system. The study work plan shall be submitted to the State and CLF for review, and to EPA for review and approval, within 60 days following Court approval of this Second Modification. The study shall be completed according to the work plan and the results shall be submitted to the State and CLF for review, and to EPA for review and approval. The review and approval process shall be in accordance with Paragraphs 14 through 19 of the Consent Decree. If clarifier performance for TSS can be improved by at least 10%, the City shall implement the recommendations of the approved study report within 90 days of EPA's approval and continue such implementation until the secondary treatment is operational. The percentage improvement shall be based upon the reduction in primary effluent average TSS concentration during testing of clarifier performance both with currently utilized chemical dosages and types, and with alternate/enhanced chemical addition, under as similar as possible operational conditions. If the approved study report finds that an increase of at least 10% cannot be achieved, the City will not be required to implement a chemical dosage optimization plan.

b. Nitrogen Removal.

i. For the five year period commencing June 1, 2020, the City shall operate the upgraded Peirce Island WWTF to achieve: (a) a seasonal average total nitrogen effluent concentration level no greater than 8 mg/l from May 1st through October 31st of each year; and (b) a monthly average total nitrogen effluent concentration level no greater than 8 mg/l from June 1st through October 31st of each year. This seasonal and monthly standard shall be referred to as the "8 mg/l TN Effluent Level."

ii. During this period, the City shall monitor and report to EPA, the State, and CLF in its Monthly Reports on Compliance the monthly average discharge

concentrations of total nitrogen for each month of each year. Such monitoring shall be conducted a minimum of twice per week using 24-hour composite samples.

iii. In the event an NPDES permit containing a total nitrogen effluent limit becomes final and takes effect that sets forth a total nitrogen effluent limit that is equal to or more stringent than the 8mg/l TN Effluent Level, the 8 mg/l TN Effluent Level and nitrogen monitoring requirements set forth in this Second Modification shall terminate.

iv. In the event an NPDES permit containing a total nitrogen effluent limit becomes final and takes effect that sets forth a total nitrogen effluent limit that is less stringent than the 8 mg/l TN Effluent Level, the City shall achieve the 8 mg/l TN Effluent Level and monitor as set forth in this Second Modification until June 1, 2025.

v. Nothing herein shall prevent any Party from appealing any part of any future NPDES permit.

vi. CLF reserves its rights to advocate lower total nitrogen limits in future NPDES permit processes.

c. Stormwater Project. The City shall commit funding in the amount of $500,000 to implement a green infrastructure project(s) using innovative low-impact development approaches to significantly reduce stormwater pollution from one or more existing sites in the City of Portsmouth. The City agrees to coordinate with the other Parties in identifying site(s) and project(s), with an emphasis on retrofitting sites with significant impervious cover and associated pollutant loads, and in developing an overall design. Planning and coordination efforts for the project(s) shall commence no later than 90 days after Court approval of this Second Modification. The project shall be completed no later than three years after Court approval of this Second Modification.

d. Sagamore Avenue Sewer Extension Project. The City shall implement, at an estimated project cost of $2.5 million, a sewer extension project to provide public sewer service to approximately 83 existing parcels adjacent to or near Sagamore Avenue, as depicted in the February 2011 Wright-Pierce Fig. 2 titled "Town [sic.] of Portsmouth, New Hampshire Sagamore Ave South Sewer Extension Study, Low Pressure Sewer," with the intent to improve water quality in Sagamore Creek. Planning, design and other pre-construction activities for the project shall be completed prior to substantial completion of the Peirce Island WWTF upgrade project. Construction of the sewer extension project shall begin no later than June 30, 2020 and shall be substantially completed on or before June 30, 2022.

e. Water Quality and Ecosystem Health Project. The City shall provide funding in the amount of $500,000 to support activities that advance the Great Bay 2020 vision as described in Great Bay 2020: A Five-Year Vision for Collective Investment, Action, and a Healthy Watershed dated July 27, 2015. Such activities will be identified and selected collectively by the entities currently comprising the Great Bay 2020 Steering Committee (Piscataqua Region Estuaries Partnership, Great Bay National Estuarine Research Reserve, New Hampshire Department of Environmental Services, The Nature Conservancy, and CLF) with input and concurrence of the City and may include, but not be limited to, restoration, public outreach and education, science and monitoring, strategic land protections, and other projects and activities that advance efforts to improve water quality and/or ecosystem health in the Great Bay estuary with direct or indirect benefits for Portsmouth. Funding shall be provided in five annual installments of $100,000, paid to an agreed upon fiscal agent and/or, by agreement by the Great Bay 2020 Steering Committee and the City, directly to implementing entities. The first payment shall be made no later than 60 days following Court approval of this Consent Decree Second

Modification, with subsequent annual payments occurring no later than the anniversary date of the prior year's payment due date. The first payment shall be directed in part, or in whole if necessary, to (1) the development and implementation of a water quality sampling plan for Sagamore Creek following QA/QC protocols, and including the participation of the City, the Great Bay-Piscataqua Waterkeeper, and New Hampshire Department of Environmental Services, with public engagement where appropriate, and (2) a regional symposium to educate and engage the public in sustainable lawn care / landscaping practices that reduce water pollution. The City's staff's participation shall not be counted as an offset or match toward the above-stated funding commitment, nor shall the City be reimbursed or otherwise compensated from such funds.

## IV. STIPULATED PENALTIES

9. The City shall be liable to the United States and the State for stipulated penalties for failing to complete any requirement of this Second Modification by the dates specified herein. Such stipulated penalties shall accrue per violation per day as follows:

| Penalty Per Violation Per Day | Period of Noncompliance |
|---|---|
| $500 | 1st through 14th Day |
| $750 | 15th through 30th Day |
| $1,000 | 31st and beyond |

10. Stipulated penalties shall be paid in accordance with Section VI of the Consent Decree.

## V. PUBLIC PARTICIPATION

11. This Second Modification shall be lodged with the Court for a period of not less than 30 days for public notice and comment in accordance with 28 C.F.R. Section 50.7. The United States reserves the right to withdraw or withhold its consent if the comments regarding the Second Modification disclose facts or considerations indicating that the Second Modification is

inappropriate, improper, or inadequate. The City consents to entry of this Second Modification without further notice and agrees not to withdraw from or oppose entry of this Second Modification by the Court or to challenge any provision of the Second Modification, unless the United States has notified the City in writing that it no longer supports entry of this Second Modification.

## VI. EFFECTIVE DATE

12. The Effective Date of this Second Modification shall be the date upon which this Second Modification is entered by the Court or a motion to enter the Second Modification is granted, whichever occurs first, as recorded on the Court's docket.

Dated and entered this _____ day of _____, 2016.

_____
UNITED STATES DISTRICT JUDGE
District of New Hampshire

FOR PLAINTIFF THE UNITED STATES OF AMERICA

Respectfully submitted,

JOHN C. CRUDEN
Assistant Attorney General
Environment and Natural Resources Division
United States Department of Justice
Washington, D.C. 20530

Date: 4/1/16

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FOR THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, REGION I

Date: 03/21/2016

Susan Studlien

SUSAN STUDLIEN
Director, Office of Environmental Stewardship
United States Environmental Protection Agency
Region I
5 Post Office Square, Suite 100
Boston, Massachusetts 02109-3912
studlien.susan@epa.gov

FOR THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Date: 3.28.16

MARK POLLINS
Director
Water Enforcement Division
Office of Enforcement and Compliance Assurance
United States Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

FOR PLAINTIFF-INTERVENOR THE STATE OF NEW HAMPSHIRE

State of New Hampshire
Department of Environmental Services

By its attorney,

JOSEPH A. FOSTER
New Hampshire Attorney General

Date: 3/15/16

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Senior Assistant Attorney General
Environmental Protection Bureau 33 Capitol Street
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(603) 271-3679

FOR PLAINTIFF-INTERVENOR CONSERVATION LAW FOUNDATION

Date: 3/15/16

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Concord, NH 03301
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tirwin@clf.org

FOR THE DEFENDANT, THE CITY OF PORTSMOUTH, NEW HAMPSHIRE

By: _____
JOHN P. BOHENKO, City Manager
Pursuant to vote of the City Council

Of March 14, 2016

McLANE MIDDLETON,
PROFESSIONAL ASSOCIATION

Date: March 16, 2016 _____
BRUCE W. FELMLY, NH Bar No. 787
900 Elm Street, P.O. Box 326
Manchester, NH 03105-0326
(603) 625-6464

# APPENDIX B

**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**
**Region 1**
**5 Post Office Square, Suite 100**
**Boston, MA 02109-3912**

**CERTIFIED MAIL**
**RETURN RECEIPT REQUESTED**

MAR 2 0 2017

Suzanne Woodland, Esq.
Deputy City Attorney
City of Portsmouth
1 Junkins Avenue
Portsmouth, NH 03801

Re: City of Portsmouth, New Hampshire
Consent Decree 09-cv-283-PB

Dear Attorney Woodland:

The City of Portsmouth ("City" or "Portsmouth") submitted the *Peirce Island WWTF Chemically Enhanced Primary Treatment Optimization Pilot Work Plan*, prepared by Underwood Engineers, Inc., dated February 28, 2017 ("CEPT Work Plan"), to EPA for review and approval per Section IV, item paragraph 8.a. of the Second Modification of Consent Decree 09-cv-283-PB. The CEPT Work Plan and schedule outlines the project tasks for full-scale testing of combinations of at least three coagulants and up to five polymers to optimize the chemically enhanced primary treatment plant performance.

By this letter, EPA approves and incorporates into the Consent Decree the City's CEPT Work Plan and implementation schedule. Following discussions, EPA and Portsmouth agreed that the City will also submit intermittent reports during full-scale testing that describe any necessary changes to the Work Plan and provide project status.

If you have any questions, please contact Tonia Bandrowicz at (617) 918-1734 or have the City's technical staff contact Joy Hilton at (617) 918-1877.

Sincerely,

Susan Studlien

Susan Studlien, Director
Office of Environmental Stewardship

cc: Mark Pollins, Director of Water Enforcement, USEPA
Joy Hilton, USEPA Region 1
Tracy L. Wood, NHDES, Wastewater Engineering Bureau Administrator
Allen Brooks, Esq., Department of Justice, Environmental Protection Bureau Chief
Tonia Bandrowicz, Senior Enforcement Counsel, USEPA Region 1
David Gordon, Esq., US Department of Justice
Tom Irwin, Esq., Conservation Law Foundation
John P. Bohenko, City Manager
Brian Goetz, Deputy Director of Public Works
Nancy Colbert-Puff, Deputy City Manager
Terry Desmarais, City Engineer, Portsmouth
Donald Song, Wastewater Project Manager

# PEIRCE ISLAND WWTF CHEMICALLY ENHANCED PRIMARY TREATMENT OPTIMIZATION PILOT WORK PLAN

## CITY OF PORTSMOUTH, NH
## DEPARTMENT OF PUBLIC WORKS

**February 28, 2017**

Underwood Engineers, Inc.
25 Vaughan Mall
Portsmouth, NH 03801
and
99 North State Street
Concord, NH 03301

Job No. 2120

UNDERWOOD engineers

## TABLE OF CONTENTS

## TABLES

## FIGURES

# SECTION 1 INTRODUCTION

## 1.1 General

The City of Portsmouth received a Consent Decree Modification from the EPA dated April 1, 2016. Condition No. 8a of that Consent Decree reads as follows:

*"...The City shall engage a qualified engineer to perform an optimization study on the primary clarifiers for the chemically enhanced primary treatment system. The study work plan shall be submitted to the State and CLF for review, and to EPA for review and approval, within 60 days following Court approval of this Second Modification. This study shall be completed according to the work plan and the results shall be submitted the State and CLF for review, and to EPA for review and approval. The review and approval process shall be in accordance with Paragraphs 14 through 19 of the Consent Decree. If clarifier performance for TSS can be improved by at least 10%, the City shall implement the recommendations of the approved study report within 90 days of EPA's approval and continue such implementation until the secondary treatment is operational. The percentage improvement shall be based upon the reduction in primary effluent average TSS concentration during testing of clarifier performance both with currently utilized chemical dosages and types, and with alternate/enhanced chemical addition, under as similar as possible operational conditions. If the approved study report finds that an increase of at least 10% cannot be achieved, the City will not be required to implement a chemical dosage optimization plan..."*

## 1.2 Purpose and Objectives

The purpose of this Work Plan is to present a summary of the full-scale pilot Chemically Enhanced Primary Treatment (CEPT) project that will be performed at the City of Portsmouth Peirce Island Wastewater Treatment Facility (WWTF).

The objective is to determine if significant improvement can be achieved in the concentration of total suspended solids (TSS) in the treated effluent. This objective will be achieved by comparing the results of a short term intensive full scale study using three different coagulants. The project will be performed for a five-week period for each new coagulant, with comparison to the existing coagulant.

The following text constitutes the proposed Work Plan to be followed during the CEPT Pilot Study. The final deliverable of this study will be a Letter Report with attachments and appendices that address the questions raised in Condition No. 8a of the Consent Decree Modification cited above. This letter report will be provided in draft to the City of Portsmouth for review and comment in advance of being submitted to the EPA and CLF for their review and approval.

# SECTION 2 BACKGROUND INFORMATION

## 2.1 Background

The City of Portsmouth (City) is in Rockingham County at the mouth of the Piscataqua River in the seacoast area of New Hampshire. The City of Portsmouth's sewerage system to Peirce Island consists of approximately 99 miles of sewers, 19 pumping stations, and a 4.8 million gallon per day (mgd) advanced primary wastewater treatment facility (WWTF) located on Peirce Island. The City has an inter-municipal agreement with the Town of New Castle, an island to the northeast of Portsmouth, to treat their wastewater at the City's Peirce Island WWTF. Additionally, the City has entered into a long-term Municipal Services Agreement (MSA) with the Pease Development Authority (PDA) to maintain and operate the wastewater collection and treatment facilities at the Pease International Tradeport (Pease). The Pease facilities are not included as part of this work plan because they are a separate collection and treatment system.

The collection system serving the Peirce Island WWTF is a combined sewer systems which conveys both sanitary sewage and storm water. During dry weather, sanitary sewage, consisting of domestic, industrial and commercial wastewater, and certain levels of infiltration are conveyed to the Peirce Island WWTF, where it receives advanced primary treatment and disinfection prior to being discharged to the Piscataqua River. During wet weather, the volume of combined storm water and sanitary flows can exceed the carrying capacity to the collection system causing surcharging of sewers, flooding into residences and combined sewer overflows (CSOs) to the South Mill Pond and the Piscataqua River.

Currently, there remain two permitted combined sewer overflows (CSOs) as follows:

- South Mill Pond – No. 10A and 10B, discharging to South Mill Pond
- Deer Street – No. 013, discharging to the Piscataqua River

## 2.2 Peirce Island WWTF

The Peirce Island WWTF is a 4.8 MGD chemically enhanced primary treatment facility with disinfection and dechlorination that discharges to the Piscataqua River.

The Peirce Island WWTF was upgraded to a chemically enhanced primary treatment facility in 2003. The facility, constructed in 1990 as a primary treatment facility with filtration and disinfection, was designed for an average daily flow of 4.8 MGD and a peak flow of 22 MGD. The facilities upgrade project constructed in 2002-2003 included a grit removal system upgrade, chemically enhanced primary treatment system, disinfection system upgrades, additional sludge storage, a new SCADA system, and relocation of septage receiving to the Pease Wastewater Treatment Facility. The discharge effluent from the facility enters the Piscataqua River, at a location approximately 378 feet east of the facility. The facility is currently under construction for

a major upgrade to an advanced treatment facility, which is scheduled to be substantially completed by December 1, 2019.

Primary treatment is accomplished by sedimentation in two primary clarifiers in which solids are removed by gravity settling. The chemically enhanced primary treatment system consists of introducing coagulant chemicals to the wastewater to increase the rate of solids settling in the primary clarifiers. Two chemicals are added to the wastewater upstream of the clarifiers. A ferric chloride polymer blend is added to the influent wastewater at the entrance to each aerated grit chamber. The chemical is thoroughly mixed by the action of the submerged aeration system. An anionic polymer is added to the grit chamber effluent channel at the entrance of the 36-inch pipe where the polymer mixes with the wastewater as it travels to the clarifier distribution structure.

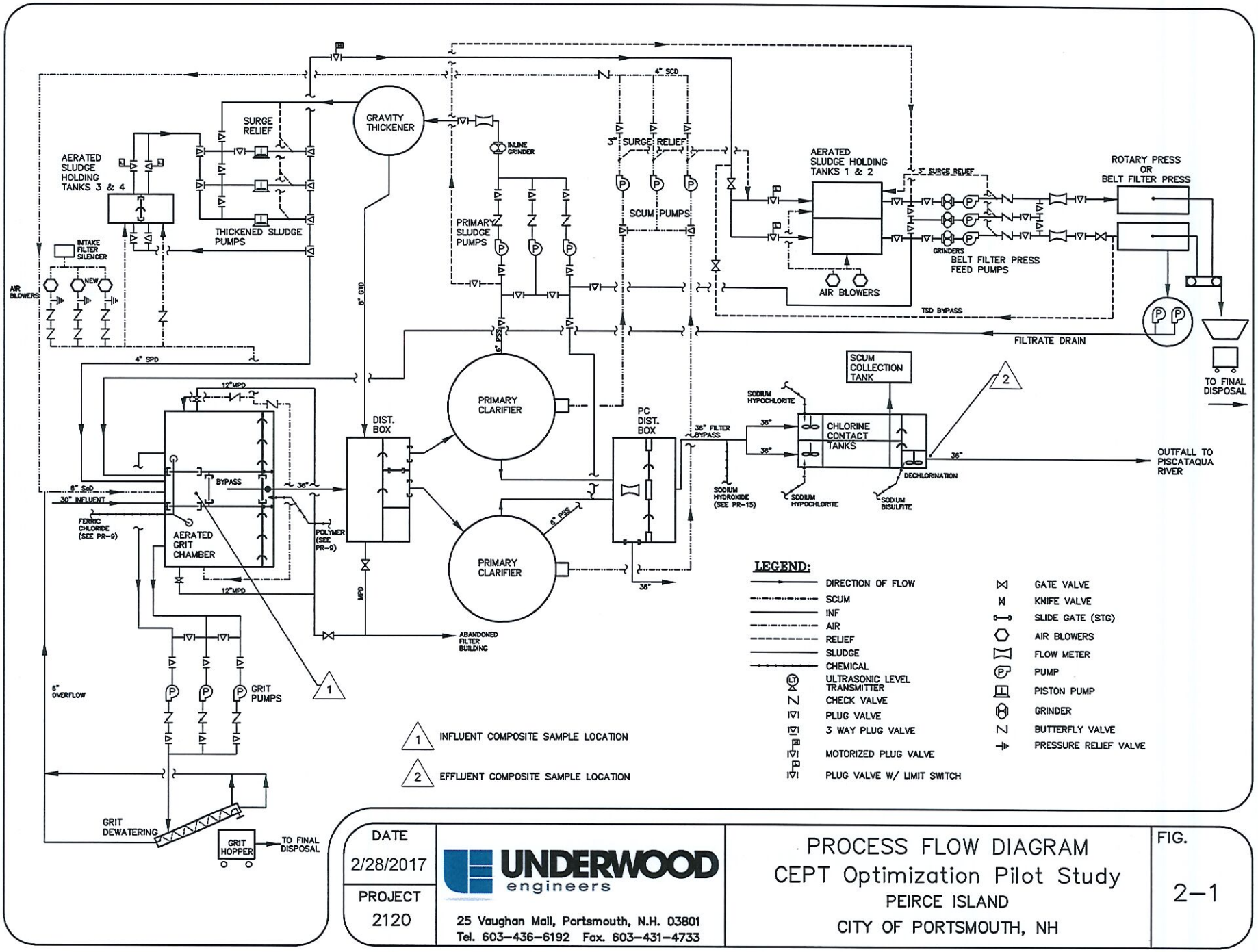
The design parameters for the primary clarifiers are shown in Table 2-1.

**Table 2-1 Primary Clarifier Design Parameters**

| Parameter | Value |
|---|---|
| Number of Primary Clarifiers | Two (2) |
| Type | Amwell, Center Column Supported |
| Diameter | 76 Feet |
| Side water depth | 11' - 9 ¼" |
| Floor slope | 1 inch in 12 inches |
| Surface area, each | 4,537 square feet |
| Feed well, diameter | 10 Feet |
| Center column, diameter | 30 inches |

Since 2003 the City has optimized their coagulant and flocculant chemicals with a series of jar tests and full scale optimization to achieve a high rate of TSS removal. The current coagulant, Aries 2076 (ferric and polymer blend) and the current flocculant (Aries 3644 anionic polymer) resulted in an annual average TSS percent removal of 73 to 85% over that past three years.

The process flow diagram is shown as Figure 2-1 on the next page.




DATE
2/28/2017

PROJECT
2120

UNDERWOOD engineers
25 Vaughan Mall, Portsmouth, N.H. 03801
Tel. 603-436-6192 Fax. 603-431-4733

# PROCESS FLOW DIAGRAM
## CEPT Optimization Pilot Study
PEIRCE ISLAND
CITY OF PORTSMOUTH, NH

FIG.
2-1

# SECTION 3 WWTF HISTORICAL PERFORMANCE

## 3.1 Background

In this section, historical data from the last three years are summarized in Table 3-1 and 3-2 in order to present the flow, TSS loads and TSS removal efficiencies. The data is taken from the City's data management software that was recently installed. Further review will be performed upon acceptance of the Work Plan as part of the study.

**Table 3-1 Historical Flow Rates**

| Parameter | 2013 | 2014 | 2015 |
|---|---|---|---|
| Annual Average Daily Flow, MGD | 4.43 | 3.7 | 3.75 |
| Maximum Month Average Daily Flow, MGD | 7.26 | 6.37 | 6.65 |
| Maximum Week Average Daily Flow, MGD | 8.88 | 9.38 | 8.11 |
| Maximum Day Flow, MGD | 14.02 | 15.05 | 14.74 |
| Peak Hour Flow, MGD* | 22 | 22 | 22 |
| Total Annual Volume, MG | 1,605 | 1,349 | 1,307 |

*Estimated

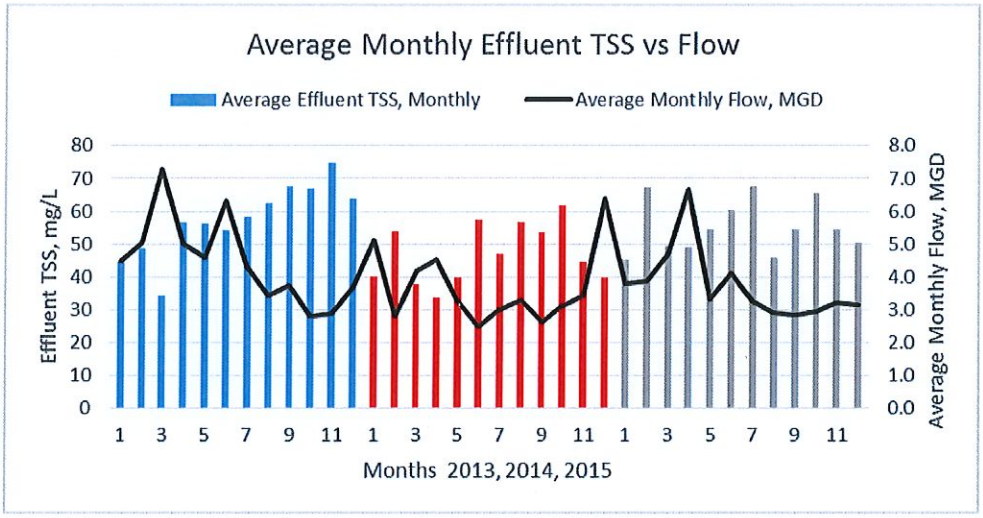
**Table 3-2 Historical Annual Average TSS Removal**

| Parameter | 2013 | 2014 | 2015 |
|---|---|---|---|
| Influent TSS, mg/L | 223 | 327 | 314 |
| Effluent TSS, mg/L | 57 | 47 | 56 |
| Effluent TSS Std.Dev.* | 16.6 | 15.0 | 18.1 |
| % Removal | 73 | 85 | 80 |
| Min, % Removal | 53 | 65 | 37 |
| Max, % Removal | 90 | 95 | 94 |
| % Removal Std.Dev.* | 6.9 | 4.5 | 8.9 |

*Standard deviations are calculated from individual values for each year.

Figure 3-1 presents the monthly average flow and treated effluent TSS concentration. Note that the criteria for changing coagulant and flocculant will be a 10% improvement in effluent TSS concentration.

**Figure 3-1 Monthly Effluent TSS Concentration and Flow**



# SECTION 4 WORK TASKS

The following work tasks shall be performed as part of the CEPT Pilot Study.

## 4.1 Review of Existing Data & Site Visit

Underwood shall review and compile graphical exhibits for the last three years' worth of primary clarifier performance and operational data to include effluent TSS concentration, TSS removal, hydraulic loading rate, organic loading rate, wastewater temperature, and chemical dosing. All raw data will be provided in electronic format by the City of Portsmouth. This shall serve as baseline data.

Underwood staff will conduct an initial site visit to view the existing conditions and operations at the facility and to discuss specifics of operation with plant staff to develop a solid understanding of how the facility is currently being operated.

## 4.2 Jar Testing

On August 11, 2016, Underwood coordinated and witnessed jar testing of nine different coagulant chemical combinations on the Peirce Island WWTF influent:

1. Aries 2076 (Currently used)
2. Aries 239
3. Aries 240
4. Aries 245
5. Aries 252
6. Aries 258
7. Aries 291
8. Aries 292
9. Aries 296

Of the 9 chemical combinations tested, the three with the top performance, ranked best to worst, were as follows:

1. Aries 2076 (currently in use at WWTF) – Ferric based blended coagulant
2. Aries 245 – Sulfonated Polyaluminum Chloride (PAC)
3. Aries 252 – Low Basicity PAC

The City and Underwood Engineers concluded that the top 3 coagulant chemicals identified by jar testing would be evaluated at full-scale.

A second round of jar testing will be performed using the top three coagulants and up to 5 polymers as recommended by Aries. If jar testing indicates any meaningful improvements may be had by using a different polymer, it will be tested at full scale with the appropriate coagulant. If jar testing

indicates that changing the polymer will have minimal impact on clarifier performance, no additional polymers will be piloted at full scale.

## 4.3 Pilot Testing

### 4.3.1 Existing Chemical

The City is installing a new dewatering process, scheduled to be completed by mid-January 2017. The equipment is being changed from belt filter presses to a rotary press. Underwood will not start the pilot until the end of January 2017, so that each phase of the pilot will be done under the same conditions.

- Should the new dewatering equipment not go in as scheduled, filtrate testing will be performed on the belt filter press filtrate and then at the end of the pilot with the existing chemicals and rotary press filtrate to determine if there is a significant filtrate difference. Dewatering filtrate samples will be tested for pH, TSS and VSS.
- Once the new rotary press has been started and is fully operational, pilot testing shall be started for the original chemical (Aries 2076 Ferric/Polymer blend). Testing shall be performed 5 days a week for 5 weeks.
- Testing procedure shall be as outlined is section 4.3.4 below.

### 4.3.2 Additional Chemicals

In addition to the existing chemical, two other chemicals will be piloted at full scale (Aries 245 Sulfonated PAC and Aries 252 Low Basicity PAC). Underwood will review the existing chemical storage and feed conditions and will make recommendations to the City for the procurement and temporary feeding of both new chemical combinations that shall be dosed to the wastewater proportional to flow rate. The procurement, installation and dosing of the temporary chemicals shall be the responsibility of the City.

- It is assumed that the new chemicals will be held in tote containers and dosed using the existing peristaltic dosing pumps and piping and the existing liquid polymer makeup system and piping.
- The suction piping of the existing coagulant dosing pumps can be modified by removing an existing PVC bend and adding a tee fitting with a valve and nipple fitting to allow the existing pumps to draw from either the existing chemical day tank or a new tote system.
- Currently the City is using approximately 30 to 100 gallons a day of coagulant. Assuming the new chemicals use a similar dose, the City should anticipate a tote lasting about 3 to 7 days of operation. This timeframe is anticipated to decrease if the facility sees high flows for an extended period.
- It is anticipated that the existing polymer will continue to be used for the piloting but the dose will likely vary with a new coagulant being used. Additional jar testing will be performed on the top 3 coagulants and up to 5 polymers as recommended

by the chemical supplier to determine if any significant improvement can be realized by using a different polymer.

### 4.3.3 Dose Optimization

Underwood will provide manpower for 40 hours of testing to identify the apparent optimal chemical dose to run each new chemical combination at full scale. Jar testing will be performed on both new coagulants (with their respective polymer as identified in jar testing) to identify the optimal dose range. Using these ranges, full scale optimization will be performed for each coagulant. Underwood will then collect hourly grab samples of influent and effluent for turbidity testing and will utilize Eastern Analytical for confirmatory TSS laboratory analysis. Underwood will provide evidence of proper QAQC procedures having been followed by Eastern Analytical as outlined in Section 6.

- Underwood will perform jar testing of both new coagulants using a range of doses.
- Based on the jar testing, Underwood Engineers will identify the dosing range that is optimal for each new chemical combination.
- Upon switching to each new chemical for full scale piloting, the first two days will be spent optimizing the coagulant and flocculant dosages.
- Over the course of these two (2) days, the dose will be adjusted through the identified range and hourly grab samples will be collected of screened influent and final effluent.
- These samples will be analyzed by Underwood for turbidity for indication of the chemical performance. Additionally, a separate 1,000 ml aliquot of each sample will be collected, split and sent to the City and Eastern Analytical for TSS analysis.
- Based on the removal rates for TSS and turbidity observed, a target full-scale chemical dose will be selected for the full scale testing.
- Composite sampling will then be performed three days per week for the remainder of the five-week trial per new chemical.

### 4.3.4 Data Collection

Once the new chemical combination target doses have been established and the City has begun dosing the new chemicals full-scale and full-time, the City shall perform 24-hour composite sampling for TSS five days a week on Monday, Tuesday, Wednesday, Thursday, and Friday for the duration of the pilot testing (15 weeks).

- The city shall collect 500 mls of each sample and store it in bottles in coolers provided by Underwood Engineers.
- Samples will be collected using the existing influent and effluent composite samplers using the same compositing methodology that is currently used by the City for its twice a week composite sampling.
- Underwood will coordinate for the samples to be picked up and analyzed for TSS at Eastern Analytical.

- In order to gather a minimum data set for proper comparison, samples will be collected 5 days a week and the full-scale piloting of the new chemical combinations will run for a period of 5 weeks each (including optimization) which shall yield a total of 25 data points for each new chemical combination. It is understood that the standard TSS sampling is performed at the Peirce Island WWTF twice a week on Tuesdays and Wednesdays. As pilot data for the new chemical combinations will be collected 5 days a week, it is not recommended that this data be compared to historical data which is primarily Tuesdays and Wednesdays only. Instead, it is recommended that pilot testing be performed on the existing chemical combination 5 days a week for 5 weeks to provide a comparable data set to compare to the performance data for the new chemical.
- If a significant loss in clarifier removal performance occurs during the pilot testing as determined by the City or Engineer, the piloting for that chemical combination shall be terminated and the next chemical combination shall be tested.
- If, during the piloting of any of the new chemical combinations, the seasonal wastewater characteristics are found to be substantially different than during the piloting of the existing chemical, Aries 2076, then Aries 2076 will be reinstated at the end of the pilot and tested for 2 weeks (3 days a week) to determine if the results have been skewed significantly from historical data.

## 4.4 Data Analysis and Report

Underwood shall analyze the data collected by both the City of Portsmouth and Eastern Analytical during the testing periods. Any significant difference found to exist between the three sets of data will be discussed. The data from Eastern Analytical will be utilized to compare the treated effluent TSS concentration produced by the new chemical combinations to the existing chemical combination. Factors such as hydraulic loading, solids loading, wastewater temperature, and chemical dosing shall be considered when comparing data points. Comparison results shall be tabulated and prepared in graphical format. A statistical analysis of variance will be performed to compare effluent TSS concentrations based on the three chemical combinations piloted and determine if there is a statistically significant difference between the three data sets generated.

The goal will be to determine if either of the new chemical combinations piloted for the five-week period can achieve a 10% reduction in effluent TSS concentration over the current chemical combination as demonstrated in a five-week pilot. If a 10% or greater improvement is achieved for any one of these chemical combinations, the City will authorize an additional task to implement a chemical dosage optimization plan.

Underwood will compile a letter report summarizing the results of the CEPT Pilot Study findings. Underwood will provide a conclusion as to whether a 10% or greater performance improvement was achieved with either new chemical combination over that which was achieved with the existing chemical combination. The draft report shall be delivered to the City for comment and the final report will be available for submittal to the EPA and CLF.

During the 15 weeks of full-scale pilot testing by the City, Underwood will be available for consultation should issues arise during the pilot testing resulting in significant operational or performance issues. An allowance of 80 manhours has been assumed to cover this work item.

Four (4) hard copies of the draft report and four (4) hard copies of the final report shall be delivered to the City. Electronic copies of each report shall also be provided to the City.

## SECTION 5 SCHEDULE

The proposed schedule is as follows. The schedule allows for a three-week review of the draft Work Plan and one week to resubmit the final Work Plan. Full scale piloting will be started the week of January 30, 2017, assuming the new dewatering equipment is installed and the new chemicals can be delivered and made operational within a one week period. The schedule shown in Table 5-1 will be revised depending on unplanned issues that may arise in the schedule.

**Table 5 -1 Proposed Schedule**

| Item No. | Milestone | Submittal Date |
|---|---|---|
| 1 | Submit Draft Work Plan | November 28, 2016 |
| 2 | Comments Received from Regulators | by December 19, 2016 |
| 3 | Finalize Work Plan | December 30, 2016 |
| 4 | Start Pilot Project | by January 30, 2017 |
| 5 | Polymer jar testing and full-scale pilot testing of new chemical combinations at recommended dose | January 30 – June 2, 2017 |
| 6 | Deliver draft report to City | June 29, 2017 |
| 7 | Deliver final report to EPA and CLF | 30 Days after comments received |

# SECTION 6 QUALITY ASSURANCE AND CONTROL

## 6.1 Purpose

The purpose of a Quality Assurance Project Plan (QAPP) is to identify the quality assurance/quality control measures that will be followed in implementing the project. A QAPP will be developed once the Work Plan has been approved. The following outlines key elements of the QAPP intended for this project.

## 6.2 Quality Assurance Objectives

Quantitative and qualitative data quality indicators commonly used in interpreting data are presented below. Definitions of the data quality indicators were provided by EPA quality assurance guidance documents. (DQO EPA QA/G-4 and EPA QA/G-5).

**Method Detection Limit:** A quantitative measure of the capability of an analytical method to distinguish between samples that do not contain a specific analyte from samples that contain low concentrations of the analyte. The method detection limit is particularly important when anticipated results, necessary for decision-making processes, are near the method detection limit.

For samples with duplicate measurements, precision will be calculated as relative percent difference. The relative percent difference is calculated instead of standard deviation because the replicate data sets will contain only two values.

**Accuracy:** A quantitative measure of the closeness of an individual measurement (or the average of a multiple measurements) to the true value. To determine accuracy, a reference material of known value must be available. Field-spiked samples are not planned for the project.

**Representativeness:** A qualitative measure of the degree to which data accurately and precisely represent a characteristic of a population parameter at a sampling point or environmental condition.

**Comparability:** A quantitative term that expresses the confidence that two data sets can contribute to a common analysis and interpolation. The following EPA-recommended conditions are provided to ensure comparability of data sets:

- The type and number of variables for each process remain the same for the testing events.
- Common units are used and standard units are used in expressing treatment efficiencies;
- Similar analytical and QA procedures are used for the processes;
- The detection level for the analytical measures is the same for each process;
- Rules for excluding observations will be applied equally among all testing processes;
- The sampling locations are similar for all the pilots/demonstrations;
- Chemicals used are of consistent strength and quality.

## 6.3 Sampling Procedures

The following summarizes the required QAPP elements for this section:

- List of analyses and sample volumes
- Sampling methods (grab samples)
- Preparation and cleaning of equipment
- Calibration of instruments
- Preservation, transportation, and storage
- Holding times of samples

Table 6-1 is an example table for analyses and sample volumes.

**Table 6-1 Example Field Measurements and Analysis for the Pilot Process**

| Analysis | Method | PQL | Units | Sample Container | Preservative | Hold Time | Laboratory QA/QC | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Blanks | Duplicate | Laboratory Control Sample (LCS) |
| TSS | EPA 160.2 | 2 | mg/L | 0.5 L HDPE | None | 7 days | 1 of 20 | 1 of 20 | 1 of 10 |
| VSS | EPA 160.4 | 10 | mg/L | 0.5 L HDPE | None | 7 days | 1 of 20 | 1 of 20 | 1 of 10 |

**Note: Laboratory blanks, duplicates and LCS will be performed a minimum of one per batch should samples batches be less than 20.**

Analytical testing is to be performed by Eastern Analytical, Inc. By reference, the standard operating procedures for TSS and VSS testing from the EAI laboratory QAPP manual will be followed.

## 6.4 Analytical Procedures and Calibration

QAPP requirements for analytical and calibration procedures will be documented separately by the testing laboratory.

## 6.5 Data Reduction, Validation, and Reporting

The following summarizes the required QAPP elements for this section:

- Data Reduction
  - Summary of data reduction procedures
  - Summary of statistical approach
  - Example data sheets
  - Description of how blanks will be used

- Data Validation
  - Procedures for determining outliers and flagging data
- Data Reporting
  - Flowchart of data handling process

Suspect data (i.e., outliers) may be identified and flagged at three different times.

- The first opportunity is during the testing process and sample generation. Testing personnel are familiar with wet weather water quality characteristics and the processes being studied in the project. Unusual field measurements of any kind will be documented and relayed to project management. All field activities and observations will be documented in field logs.
- The second opportunity is during the analytical analyses. The Eastern Analytical Laboratory has extensive quality assurance/quality control checks that are standard for the different analytical methods being run. Quality control checks that fail, or test results outside of a methods' range will be flagged and the information provided to project management.
- The third opportunity for identifying outliers is during the data analysis phase. During this time, the project team will be comparing and evaluating data. Results unique from the norm will be further investigated to identify a cause. A determination on whether the data shall be included in the analysis will be made after all available information on the data point is collected and reviewed.

## 6.6 Internal Quality Control Checks

Internal quality controls checks are performed by Eastern Analytical in accordance with their Quality Assurance manuals and/or standard operating procedures. The quality control checks include items such as sample blanks, matrix spikes and matrix spike duplicates, control charts calibration standards and proficiency testing of analysts

## 6.7 Calculation of Data Quality Indicators

Four data quality indicators will be calculated and reviewed in conjunction with the analytical analyses for this project. The data quality indicators are precision, accuracy, completeness and method detection limit.

- Precision - intralaboratory precision measurements will be made and reported in accordance with Eastern Analytical standard operating procedures.
- Accuracy - will be calculated by Eastern Analytical for measurements using matrix spikes and/or a standard reference material;
- Completeness - will be calculated for any set of parameters used for correlations showing significance. Because only one influent and one effluent sample is being collected for each parameter (per test), invalid data in either sample will limit the analyses that can be performed for that test.
- Method Detection Limits - are provided by Eastern Analytical for each analytical method.

## 6.8 Corrective Action

This section addresses conditions that may require corrective action and identifies appropriate response actions to address the condition.

If corrective action is necessary, the required action, the party responsible, and the results of the action will be documented. Any suspect data gathered during or before the implementation of the corrective action will be discarded or where possible reanalyzed.

# APPENDIX C

Peirce Island WWTF
Portsmouth, NH
Preliminary Chemical Screening
August 11, 2016

***Introduction***
Luke Sundean (UE) met with Nate Butterfield (Aries Chemical) and City staff at the Peirce Island WWTF to perform some preliminary jar testing to narrow down a selection of chemicals for the jar testing study and pilot study UE will be recommending.

***Purpose***
The purpose of today's field work was to determine which coagulants should be used in future jar testing study.

***Existing Conditions***
Currently Aries 2076 (Ferric) coagulant is used at the WWTF along with Aries 3644, an anionic polymer. The ferric was set at a set point of 45 ppm and the polymer at 0.64 ppm on the day of the jar testing.

***Preliminary Jar Testing***
The following nine (9) different coagulants were tested:

1. Aries 2076 (Currently used)
2. Aries 239
3. Aries 240
4. Aries 245
5. Aries 252
6. Aries 258
7. Aries 291
8. Aries 292
9. Aries 296

The same polymer was used in jar testing that is currently used at the facility (Aries 3644). The polymer solution made for jar testing was a 0.5% solution and was dosed at 1 ppm in all trials.

A separate one (1) liter sample of raw influent wastewater was used for all jar tests. 0.45 mL of a 10% coagulant solution was added to the 1 liter of wastewater and then rapidly mixed. Next 0.2 mL of 0.5% polymer solution was added to the sample and was rapidly mixed followed by extended slow mixing. Visual observations were made to determine which coagulants in conjunct with the polymer formed the largest flocs. The top four coagulants that performed the best are as follows in order from best performance to worst performance:

1. Aries 2076 (currently in use at WWTF) – Ferric based blended coagulant
2. Aries 245 – Sulfated Polyaluminum Chloride (PAC)
3. Aries 252 – Low Basicity PAC
4. Aries 291 – High Basicity PAC

Peirce Island WWTF
Portsmouth, NH
Polymer & Coagulant Screening
January 31, 2017; Rev 2-7-17

***Introduction***

Ransom Horner-Richardson & David Mercier (UE) met with Nate Butterfield (Aries Chemical) and Tim Babkirk and Kathy Sanborn (City of Portsmouth) at the Peirce Island WWTF to perform a second round of preliminary jar testing before CEPT pilot testing. The purpose of this second round of jar testing was to test each of the three top performing coagulants with several polymers to determine if better performance can be achieved than with the current polymer (Aries 3644). Additional jar testing was also performed to identify the coagulant dose which will be recommended to use at the start of piloting.

***Existing Conditions***

Currently Aries 2076 (Ferric) coagulant is used at the WWTF along with Aries 3644, an anionic polymer. Nate noted that Aries 2076 is a proprietary ferric blend formula that has been developed over the years specifically for the Peirce Island WWTF. To Nate's knowledge it is developed for and used exclusively by the Peirce Island facility. According to staff, the ferric was being dosed at approximately 20 ppm and the polymer at 0.08 ppm on the day of the jar testing (1/31/17).

***Preliminary Jar Testing***

The three coagulants used were the three that had the best performance during the August 11, 2016 jar testing. The following three (3) different coagulants were tested:

1. Aries 2076 (Currently used)
2. Aries 245
3. Aries 291

For this jar testing only anionic polymers were used based on past experience and testing by Aries at the Peirce Island plant. The following four (4) different polymers were tested:

1. Aries 3644 (Currently used)
2. Aries 3640 (previously used until 2015)
3. Aries 3638 (high molecular weight)
4. Aries 3620 (low molecular weight)

Each polymer was mixed to a 0.5% solution by volume for jar testing. This was dosed into the 1 liter samples at 0.2 ml to achieve 1 ppm of polymer & 0.4 ml to achieve 2 ppm of polymer.

Each coagulant was mixed to a 1% solution by volume so that 2 ml of solution dosed into a 1 liter sample would result in 20 ppm coagulant does by volume.

**The first round of jar tests** performed was to test Aries 2076 with the four different polymers. A separate one (1) liter sample of raw influent wastewater was used for all jar tests. 2 mL of a 1% coagulant solution was added to each 1 liter sample of wastewater and then rapidly mixed for 5 minutes. Next 0.2 mL of 0.5% polymer solution was added to each sample and was rapidly

mixed for 15 seconds followed by 5 minutes of slow mixing. Mixing paddles were then removed from the samples and they were allowed to settle. Visual observations were made to determine which polymer in conjunction with the coagulant formed the highest quality floc and produced the best clarity.

The results for the first test were difficult to discern, so it was decided that the test would be run again using 40 ppm of coagulant and 2 ppm of polymer. The same procedure was used. This time the results were, from best performance to worst performance:

1. Aries 3644 (Currently in use at the WWTF)
2. Aries 3640
3. Aries 3638
4. Aries 3620

**The second round of testing** used Aries 245 as the coagulant in all four (4) jars, dosed at 40 ppm, and each of the 4 polymers dosed at 2ppm. The same procedure was used as on test 1. Results from this test were visibly cloudier than in test 1 and were much more similar between polymers. It was observed that Aries 3620 performed noticeably worse than the other 3 but no noticeable difference was observed between Aries 3644, 3640, and 3638. The following results were recorded:

1. Aries 3644, Aries 3640, Aries 3638 (no difference)
2. Aries 3620

**The third round of testing** used Aries 291 as the coagulant in all four (4) jars, dosed at 40 ppm, and each of the 4 polymers dosed at 2ppm. The same procedure was used as on test 1. Results from this test were best of the three coagulants. The smallest floc occurred with the Aries 3644. Performance, best to worst, was:

1. Aries 3644
2. Aries 3620
3. Aries 3638, 3640 (no difference)

Following the first 3 tests it was determined that Aries 3644 was either the top performing polymer for each coagulant or it was at least as good as the other polymers. Based on this it is recommended that Aries 3644 be used for each of the three coagulants selected for full-scale piloting.

**The fourth round of testing** used all three coagulants (Aries 2076, Aries 245, and Aries 291) side by side, each with the 3644 polymer. Each jar was given a 40 ppm dose of coagulant and a 2 ppm dose of polymer and the same mixing method was used as the previous tests. The results were, from best performance to worst performance:

1. Aries 291
2. Aries 2076
3. Aries 245

The observations showed Aries 291 and Aries 2076 both to have significantly better performance than Aries 245. These results differed with what was observed on August 11, 2016 which showed Aries 2076 to perform much better than the other chemicals, including Aries 291. It is assumed that low flows and low temperatures are leading to a low coagulant demand at the plant

and this may be contributing to the results being different today than what was observed in August 2016.

**The fifth round of testing** used Aries 291 at various doses with Aries 3644 at a fixed dose. The coagulant (Aries 291) was dosed at 20 ppm, 30 ppm, and 40 ppm, and the polymer (Aries 3644) was dosed at 2 ppm. The results showed an improvement in performance between 20 ppm and 30 ppm, but no noticeable difference was observed between 30 ppm and 40 ppm. From this, it is recommended that full-scale pilot testing with Aries 291 start with a dose of 30 ppm by volume.

**The final round of testing** used Aries 245 at various doses with Aries 3644 at a fixed dose. The coagulant (Aries 245) was dosed at 30 ppm, 40 ppm, 50 ppm, and 60 ppm, and the polymer (Aries 3644) was dosed at 2 ppm. The results showed improvement in performance with higher coagulant dose across the entire range. The most significant difference was observed between 30 ppm and 40 ppm. From this, it is recommended that full-scale pilot testing with Aries 245 start with a dose of 40 ppm by volume.

Nate Butterfield noted that Aries 291 is a chemical that Aries stocks in their local warehouse and could be delivered to the WWTF relatively quickly. Aries 245 is not stocked locally and will have a longer lead time. It is therefore recommended that full-scale pilot testing be started with Aries 291.

**Follow-up testing:** on 2/7/17, a follow-up test was performed by Nate Butterfield of Aries comparing the top four coagulants identified in August, 2016 (Aries 2076, 245, 252, and 291). Each were dosed at 40 ppm of neat chemical with a polymer dose (Aries 3644) of 2 ppm of neat chemical. Based on visual observations of floc size and settleability, the coagulants were ranked in the following order from best to worst: 2076, 291, 252, and 245. Based on these results it was determined that 2076, 291, and 252 should be piloted at full scale. Jar tests in August, 2016 indicated that Aries 245 was in the top three, but it appears that the influent conditions have changed such that it no longer performs as well. It is recommended that piloting be performed with Aries 2076, Aries 291, and Aries 252.

# APPENDIX D

**Portsmouth, NH**
**Peirce Island WWTF**
**Pilot Testing Chemical dosing Results**

**Bold** indicates a change in dose

| | | *SCADA Set Doses* | | *PAC Pump Measured flow/dose* | | | *Poly Pump Measured flow/dose* | | *EAI Lab TSS Values* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | D-Box Flow (MGD) | PAC Setpoint (mg/L) | Poly Setpoint (mg/L) | PAC pump RPM | PAC pump flow rate | PAC Dose (mg/L) | Poly Pump Flowrate (ml/min) | Poly Dose (mg/L) | Influent (mg/L) | Effluent (mg/L) | Removal (%) | Notes |
| **2/27/2017 7:50** | 9.6 | **30** | | 26.1 | 5.33 | 13.33 | | | | | | **Pilot started with ARIES 291 PAC. Setpoints of 30ppm and 0.5ppm chosen for pilot startup. Poly SCADA changes had not been implemented. Coag SCADA not done correctly.** |
| **2/27/2017 9:00** | 9.7 | 30 | **0.49** | 52.2 | 10.66 | 26.39 | | | | | | **SCADA changes implemented for Poly and Coag. Setpoints set for both chemicals.** |
| **2/27/2017 9:30** | 10.1 | **19.94** | **0.25** | | | | | | | | | **Poor settling in clarifiers, poor quality effluent (visual) Doses were both reduced per operator judgement.** |
| 2/27/2017 9:55 | 10.6 | 19.94 | 0.25 | 34.2 | 6.99 | 15.82 | | | | | | Check of coagulant pump dose showed somewhat lower than SCADA dose. |
| 2/27/2017 11:00 | 11.8 | 19.94 | 0.25 | 39.9 | 8.15 | 16.58 | | | | | | Clarifiers look better, floc is sinking well. Check of coagulant pump again showed dose to be low. |
| **2/27/2017 11:20** | 11.8 | 19.94 | **0.19** | | | | | | | | | **Floc still looks good, but some of it is floating. Operator reduced poly dose.** |
| **2/27/2017 13:00** | 9.2 | **16.17** | 0.19 | 22 | 4.49 | 11.73 | | | | | | **Operator dropped PAC dose to 16ppm. Check of pump shows it is still low.** |
| 2/27/2017 13:10 | 9.8 | 16.17 | 0.19 | | | | 6.74 | 0.26 | | | | Flow test for poly pump is slightly high. |
| 2/27/2017 13:20 | 10.2 | 16.17 | 0.19 | | | | 5.88 | 0.22 | | | | Flow test for poly pump is slightly high. |
| 2/27/2017 14:00 | 10.2 | 16.17 | 0.19 | 22.5 | 4.60 | 10.82 | | | | | | Check of coagulant pump shows flows still too low. |
| 2/28/2017 8:00 | 7.5 | 16.17 | 0.19 | 9.3 | 1.90 | 6.08 | | | | | | Determined that SCADA programming was not quite right up till this point. |
| 2/28/2017 8:45 | 8.4 | 16.17 | 0.19 | 13.6 | 2.78 | 7.94 | | | | | | RHR troubleshot SCADA with Mike, determined problem. Mike made changes 2/28/17 afternoon. Need to verify that changes were correct |
| 2/28/2017 9:00 | | 16.17 | 0.19 | | | | | | 173 | 32.5 | 81.21 | Sample collected at 9:00 AM represents previous 24 hour period. |
| **3/1/2017 8:00** | 8.5 | **20** | **0.29** | | | | | | | | | **Doses at SCADA had been adjusted since day before - Verify when changes were made** |
| **3/1/2017 8:10** | 8.5 | **40.43** | 0.29 | | | | | | | | | **Poor clarifier performance (visual). It was decided to turn dose up to 40 ppm to see if performance improved.** |
| 3/1/2017 8:30 | 8.3 | 40.43 | 0.29 | 77.2 | 15.77 | 45.61 | | | | | | Flow test for PAC slightly high. |
| 3/1/2017 9:00 | | 40.43 | 0.29 | | | | | | 188 | 35.0 | 81.38 | Sample collected at 9:00 AM represents previous 24 hour period. |
| **3/1/2017 17:00** | | **30** | **2** | | | | | | | | | **Doses reset to jar test optimal levels of 30ppm and 2ppm and hold for 24 hrs.** |
| 3/2/2017 8:30 | 8.1 | 30 | 2 | 58.8 | 12.01 | 35.59 | 46.3 | 2.17 | | | | Clarifiers had lots of solids on top |
| 3/2/2017 9:00 | 7.9 | 30 | 2 | 55.1 | 11.26 | 34.20 | | | | | | Flow test for PAC slightly high. |
| 3/2/2017 9:00 | | 30 | 2 | | | | | | 186 | 29.0 | 84.41 | Sample collected at 9:00 AM represents previous 24 hour period. |
| **3/3/2017 8:00** | | **5.39** | **0.12** | | | | | | | | | **Frozen solids on top of tank caused skimmer arm to bind up. City backed dose off drastically.** |
| 3/3/2017 9:00 | | 30 | 2 | | | | | | 185 | 29.0 | 84.32 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/3/2017 11:00 | | 5.39 | 0.12 | | | | | | | | | Lower doses have resulted in significant improvement to clarifier performance (visual). City notes they can only process 30 gpm of sludge vs 50 gpm with ferric. |
| 3/4/2017 9:00 | | 5.39 | 0.12 | | | | | | 189 | 41.8 | 77.88 | Sample collected at 9:00 AM represents previous 24 hour period. |
| **3/7/2017 7:30** | **PILOT TESTING WITH ARIES 291 STOPPED DUE TO CONSTRUCTION ISSUES AT WWTF.** | | | | | | | | | | | **Plant staff need to catch up on sludge dewatering which has been adversely affected by change to PAC coagulant.** |
| **3/21/2017 7:00** | **PILOT TESTING WITH ARIES 291 RESTARTED.** | | | | | | | | | | | |
| **3/21/2017 9:00** | | **26.95** | **0.10** | | | | | | | | | **City restarted pilot with coagulant dose similar to jar testing doses.** |
| 3/22/2017 9:15 | | 26.95 | **0.19** | | | | | | 272 | 40.5 | 85.11 | Small Floc spreading over surface of Clarifiers, Not settling well, Still having Problems running PAC sludge through Fouriner Press. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/23/2017 9:00 | | 26.95 | 0.29 | | | | | | 238 | 29.5 | 87.61 | Small Floc spreading over surface of Clarifiers, Not settling well, Still having Problems running PAC sludge through Fouriner Press. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/24/2017 8:45 | | 26.95 | 0.29 | | | | | | 169 | 35.5 | 78.99 | Light gray floc observed in Gravity Thickener, not settling well. Only about 6" of sludge in thickener. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/25/2017 7:30 | | **24.26** | 0.29 | | | | | | 238 | 31.0 | 86.97 | **Sample collected at 9:00 AM represents previous 24 hour period. PAC dose decreased per Operator's judgement.** |
| **3/25/2017 10:15** | | **29** | 0.29 | | | | | | | | | **PAC dose was increased per Opertor's judgement** |
| **3/25/2017 16:45** | | **16.17** | **0.16** | | | | | | | | | **Both chemical doses were reduced per Opertor's judgement** |
| **3/26/2017 10:30** | | **8.09** | 0.16 | | | | | | | | | **PAC dose was reduced per Opertor's judgement** |
| 3/27/2017 9:30 | | 8.09 | 0.16 | | | | | | | | | Over the weekend the Thickener was all light gray suspended Floc top to bottom no separation showing in Sludge Judge |
| 3/28/2017 8:45 | | **6.47** | **0.12** | | | | | | 504 | 62.5 | 87.60 | Poor settling, very thin sludge, not pressing well, lots of Pin Floc in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/29/2017 9:00 | | 6.47 | 0.12 | | | | | | 221 | 71.0 | 67.84 | Poor settling, very thin sludge, not pressing well, lots of Pin Floc in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |

**Portsmouth, NH**
**Peirce Island WWTF**
**Pilot Testing Chemical dosing Results**

**Bold** indicates a change in dose

| | | SCADA Set Doses | | PAC Pump Measured flow/dose | | | Poly Pump Measured flow/dose | | EAI Lab TSS Values | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | D-Box Flow (MGD) | PAC Setpoint (mg/L) | Poly Setpoint (mg/L) | PAC pump RPM | PAC pump flow rate | PAC Dose (mg/L) | Poly Pump Flowrate (ml/min) | Poly Dose (mg/L) | Influent (mg/L) | Effluent (mg/L) | Removal (%) | Notes |
| 3/30/2017 8:30 | | 6.47 | 0.12 | | | | | | 244 | 55.5 | 77.25 | Poor settling, very thin sludge, not pressing well, lots of Pin Floc in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/31/2017 9:00 | | 6.47 | 0.12 | | | | | | 160 | 62.0 | 61.13 | Poor settling, very thin sludge, not pressing well, lots of Pin Floc in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/1/2017 9:00 | | 6.47 | 0.12 | | | | | | 210 | 71.0 | 66.19 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/3/2017 9:00 | | 6.47 | 0.12 | | | | | | | | | High flows from snow melt, small Pin Floc. Very thin gray Sludge |
| 4/4/2017 9:00 | | **2.7** | **0.08** | | | | | | 189 | 47.0 | 75.17 | **Heavy Rain, high flows, no settling, not much sludge. Doses for PAC and polymer reduced per Operator's judgement. Sample collected at 9:00 AM represents previous 24 hour period.** |
| 4/5/2017 9:00 | | **1.6** | **0.06** | | | | | | 248 | 45.5 | 81.63 | **Flows over 10 MGD, Smaller Floc in the Clarifiers. Doses for PAC and polymer reduced again per Operator's judgement. Sample collected at 9:00 AM represents previous 24 hour period.** |
| 4/6/2017 9:00 | | **4.3** | **0.1** | | | | | | 154 | 34.0 | 77.92 | **Heavy Rain, high flows, no settling. City ran out of sludge around 11:00AM had to shut down process. Chemical doses both increased. Sample collected at 9:00 AM represents previous 24 hour period.** |
| 4/7/2017 9:00 | | **5.4** | **0.19** | | | | | | 215.5 | 25.5 | 88.17 | **Flows still over 10 MGD, seeing some brown clumps floating on surface of both Clarifiers, only pressed 28 tons of Sludge all week. Doses for PAC and polymer reduced per Operator's judgement. Sample collected at 9:00 AM represents previous 24 hour period.** |
| 4/8/2017 9:00 | | 5.4 | 0.19 | | | | | | 168 | 34.5 | 79.46 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/10/2017 9:00 | | **6.5** | **0.23** | | | | | | | | | **Flows around 8 MGD. Medium sized Floc in the Clarifier. Doses for PAC and polymer increased per Operator's judgement.** |
| 4/11/2017 9:00 | | **8.1** | **0.29** | | | | | | 98 | 44.0 | 54.92 | **Large floc on surface on Clarifiers are not settling. Doses for PAC and polymer increased per Operator's judgement. Sample collected at 9:00 AM represents previous 24 hour period.** |
| 4/12/2017 9:00 | | 8.1 | **0.19** | | | | | | 280 | 35.5 | 87.32 | **Much larger Floc, Flows are down around 6.5MGD. Staff left PAC dose the same but reduced Polymer dose. Sample collected at 9:00 AM represents previous 24 hour period.** |
| 4/13/2017 9:00 | | 8.1 | 0.19 | | | | | | 377 | 40.7 | 89.20 | Still a very large Floc flows are down around 5 MGD, Floc is still staying on surface of Clarifiers and being pushed into the Scum. Tanks, PAC and poly reacting much different as the flows come down. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/14/2017 9:00 | | 8.1 | 0.19 | | | | | | 328 | 39.0 | 88.11 | Flows Around 5 MGD, Floc is now smaller. City ran out of Sludge on 4/13/17 and still not much Sludge today. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/15/2017 9:00 | | 8.1 | 0.19 | | | | | | 297 | 54.0 | 81.82 | Weekend Flows around 4 MGD, Clarifiers look ok but large clumps of Sludge forming in the Thickener. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/18/2017 9:00 | | **27** | **0.23** | | | | | | 216 | 28.5 | 86.81 | **PAC and Polymer doses increased for final week of Pilot 1 per UEI recommendation.** Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/19/2017 9:00 | | 27 | 0.23 | | | | | | 200 | 24.5 | 87.75 | 4 FT of Black watery Sludge in Thickener, Not as many large clumps floating on surface. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/20/2017 9:00 | | 27 | **0.31** | | | | | | 191 | 23.5 | 87.70 | Light Grey Floc in Thickener, not really settling. Sample collected at 9:00 AM represents previous 24 hour period. **Polymer dose increase per Operator's judgement.** |
| 4/21/2017 9:00 | | 27 | **0.19** | | | | | | 350 | 27.0 | 92.29 | **Polymer dose decrease per Operator's judgement.** Light Grey Floc in Thickener, not really settling. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/22/2017 9:00 | | 27 | 0.19 | | | | | | 270 | 28.0 | 89.63 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/23/2017 9:00 | | 27 | 0.19 | | | | | | 270 | 28.0 | 89.63 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/24/2017 7:00 | **PILOT 2 BEGUN WITH ARIES 252** | | | | | | | | | | | |
| 4/24/2017 7:00 | | **8.6** | **0.19** | | | | | | | | | **Pilot 2 begun with Aries 252. Pilot started with doses similar to "low doses" used in Pilot 1.** Sludge is still like black water it Pressing but very wet, Clarifiers look about the same Small pin Floc. |
| 4/25/2017 9:00 | | 8.6 | 0.19 | | | | | | 295 | 63.0 | 78.64 | Rain all day Flows between 8-16 MGD, Sludge became extremely thick which it usually does with high flows. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/26/2017 9:00 | | 8.6 | 0.19 | | | | | | 580 | 49.5 | 91.47 | Flows Around 7 MGD, Sludge is still very thick, Hard to tell how the 252 is working because of the rain and High Flows. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/27/2017 9:00 | | 8.6 | 0.19 | | | | | | 518 | 70.0 | 86.49 | Sample collected at 9:00 AM represents previous 24 hour period. Flows Around 7 MGD, Sludge is still very thick, Hard to tell how the 252 is working because of the rain and High Flows. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/28/2017 9:00 | | 8.6 | 0.19 | | | | | | 249 | 54.0 | 78.31 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/29/2017 9:00 | | 8.6 | 0.19 | | | | | | 226 | 57.0 | 74.78 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/2/2017 9:00 | | 8.6 | 0.19 | | | | | | 82 | 36.0 | 56.10 | Flows around 5 MGD, Clarifiers are cloudy light grey, Sludge is still very thick. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/3/2017 9:00 | | 8.6 | 0.19 | | | | | | 254 | 37.5 | 85.24 | Flows around 5 MGD, Clarifiers are cloudy light grey, Sludge is still very thick. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/4/2017 9:00 | | 8.6 | 0.19 | | | | | | 182 | 45.0 | 75.27 | Flows around 5 MGD, Clarifiers are cloudy light grey, Sludge is still very thick. Sample collected at 9:00 AM represents previous 24 hour period. |

**Portsmouth, NH**
**Peirce Island WWTF**
**Pilot Testing Chemical dosing Results**

**Bold** indicates a change in dose

| | | *SCADA Set Doses* | | *PAC Pump Measured flow/dose* | | | *Poly Pump Measured flow/dose* | | *EAI Lab TSS Values* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | D-Box Flow (MGD) | PAC Setpoint (mg/L) | Poly Setpoint (mg/L) | PAC pump RPM | PAC pump flow rate | PAC Dose (mg/L) | Poly Pump Flowrate (ml/min) | Poly Dose (mg/L) | Influent (mg/L) | Effluent (mg/L) | Removal (%) | Notes |
| 5/5/2017 9:00 | | 8.6 | 0.19 | | | | | | 233 | 48.0 | 79.40 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/6/2017 9:00 | | 8.6 | 0.19 | | | | | | 473 | 53.5 | 88.69 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/9/2017 9:00 | | 8.6 | 0.19 | | | | | | 230 | 50.0 | 78.26 | Flows around 5 MGD, Clarifiers are cloudy light grey, Sludge has thined out but still able to be pressed. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/10/2017 9:00 | | 8.6 | 0.19 | | | | | | 202 | 55.0 | 72.77 | Flows around 5 MGD, Clarifiers are cloudy light grey, Sludge has thined out but still able to be pressed. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/11/2017 9:00 | | 8.6 | 0.19 | | | | | | 296 | 63.0 | 78.72 | Cleaned Chlorine Contacts, Sludge on bottom was normal around 4", Sludge still very thin. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/12/2017 9:00 | | 8.6 | 0.19 | | | | | | 365 | 48.0 | 86.85 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/13/2017 9:00 | | 8.6 | 0.19 | | | | | | 283 | 70.0 | 75.27 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/16/2017 9:00 | | 8.6 | 0.19 | | | | | | 303 | 36.0 | 88.12 | Flows around 5.5 MGD, Thick Sludge, Clarifiers have a lot floating on surface. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/17/2017 9:00 | | 8.6 | 0.19 | | | | | | 261 | 50.0 | 80.84 | Flows around 5.5 MGD, Thick Sludge, Clarifiers have a lot floating on surface. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/18/2017 9:00 | | 8.6 | 0.19 | | | | | | 288 | 41.0 | 85.76 | Flows around 5 MGD, Sludge Thinned out, Some pin floc in Contacts. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/19/2017 9:00 | | 8.6 | 0.19 | | | | | | 240 | 64.0 | 73.33 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/20/2017 9:00 | | 8.6 | 0.19 | | | | | | 270 | 63.0 | 76.67 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/23/2017 9:00 | | **27** | 0.19 | | | | | | 534 | 76.0 | 85.77 | Went up on Pac Dose to 27mg/L, Floe around 4.5 MGD, Sludge thinned out. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/24/2017 9:00 | | 27 | 0.19 | | | | | | 280 | 72.0 | 74.29 | Went up on Pac Dose to 27mg/L, Floe around 4.5 MGD, Sludge thinned out. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/25/2017 9:00 | | 27 | 0.19 | | | | | | 345 | 66.7 | 80.68 | Floc in Clarifiers staying on top not settling well, Thin Sludge. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/26/2017 9:00 | | 27 | 0.19 | | | | | | 636 | 68.0 | 89.31 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/27/2017 9:00 | | 27 | 0.19 | | | | | | 263 | 47.0 | 82.13 | Weekend High flows due to Rain Pac and Poly in Manual Pace lots of sludge floating in Clarifiers. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/31/2017 9:00 | | 27 | 0.19 | | | | | | 310 | 39.0 | 87.42 | Thickener is now starting to show the grey Floc across the top and not settling well. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/1/2017 9:00 | | 27 | 0.19 | | | | | | 456 | 50.0 | 89.04 | Thickener showing more suspended solids, Sludge is getting thin, Flows around 4.5 MGD. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/2/2017 9:00 | | 27 | 0.19 | | | | | | 278 | 73.0 | 73.74 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/3/2017 9:00 | | 27 | 0.19 | | | | | | 292.7 | 70.0 | 76.08 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/5/2017 9:00 | **PILOT 3 BEGUN WITH ARIES 2076** | | | | | | | | | | | Started using Ferric at 8.6 mg\L Poly at 0.19 mg\L. |
| 6/6/2017 9:00 | | **8.6** | **0.19** | | | | | | 378 | 74.0 | 80.42 | Flows around 4.9 MGD, Large Floc in Clarifiers but still settling ok. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/7/2017 9:00 | | 8.6 | 0.19 | | | | | | 406 | 76.0 | 81.28 | Flows around 4.9 MGD, Large Floc in Clarifiers but still settling ok. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/8/2017 9:00 | | 8.6 | 0.19 | | | | | | 272 | 71.0 | 73.90 | Not Sure what happened on this day numbers are way off. EA determined two bottle values were swapped due to mis-labeling. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/9/2017 9:00 | | 8.6 | 0.19 | | | | | | 115 | 60.0 | 47.83 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/10/2017 9:00 | | 8.6 | 0.19 | | | | | | 328 | 67.0 | 79.57 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/13/2017 9:00 | | 8.6 | 0.19 | | | | | | 420 | 68.6 | 83.67 | Flows are down around 3 MGD, Seeing the Influent solids Concentration going up. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/14/2017 9:00 | | 8.6 | 0.19 | | | | | | 326 | 82.0 | 74.85 | Flows are down around 3 MGD, Seeing the Influent solids Concentration going up, Lots of solids floating on Clarifiers. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/15/2017 9:00 | | 8.6 | 0.19 | | | | | | 354 | 72.5 | 79.54 | Flows are down around 3 MGD, Seeing the Influent solids Concentration going up, Lots of solids floating on Clarifiers. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/16/2017 9:00 | | 8.6 | 0.19 | | | | | | 362 | 86.0 | 76.24 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/17/2017 9:00 | | 8.6 | 0.19 | | | | | | 286 | 90.0 | 68.53 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/20/2017 9:00 | | 8.6 | 0.19 | | | | | | 352 | 72.0 | 79.55 | Flows around 3.5 MGD, Not settling well in Clarifiers, Under normal operation I would make Poly adjustments to dial it in. Sample collected at 9:00 AM represents previous 24 hour period. |

**Portsmouth, NH**
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**Pilot Testing Chemical dosing Results**

**Bold** indicates a change in dose

| | | *SCADA Set Doses* | | *PAC Pump Measured flow/dose* | | | *Poly Pump Measured flow/dose* | | *EAI Lab TSS Values* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | D-Box Flow (MGD) | PAC Setpoint (mg/L) | Poly Setpoint (mg/L) | PAC pump RPM | PAC pump flow rate | PAC Dose (mg/L) | Poly Pump Flowrate (ml/min) | Poly Dose (mg/L) | Influent (mg/L) | Effluent (mg/L) | Removal (%) | Notes |
| 6/21/2017 9:00 | | 8.6 | 0.19 | | | | | | 360 | 66.0 | 81.67 | Flows around 3.5 MGD, Not settling well in Clarifiers, Under normal operation I would make Poly adjustments to dial it in. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/22/2017 9:00 | | 8.6 | 0.19 | | | | | | 362.5 | 76.0 | 79.03 | More consistent sludge back on Ferric, Pressing much better on Ferric. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/23/2017 9:00 | | 8.6 | 0.19 | | | | | | 404 | 74.7 | 81.52 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/24/2017 9:00 | | 8.6 | 0.19 | | | | | | 320 | 75.0 | 76.56 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/27/2017 9:00 | | 8.6 | 0.19 | | | | | | 503 | 82.0 | 83.71 | Flows around 2.8 MGD, Mechanic ST has been switching between Main and By-Pass Pumps leaving lots of rags and floating solids in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/28/2017 9:00 | | 8.6 | 0.19 | | | | | | 578 | 90.0 | 84.43 | Flows around 2.8 MGD, Mechanic ST has been switching between Main and By-Pass Pumps leaving lots of rags and floating solids in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/29/2017 9:00 | | 8.6 | 0.19 | | | | | | 370 | 62.7 | 83.06 | Flows around 2.8 MGD, Mechanic ST has been switching between Main and By-Pass Pumps leaving lots of rags and floating solids in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/30/2017 9:00 | | 8.6 | 0.19 | | | | | | 371 | 55.0 | 85.18 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/1/2017 9:00 | | 8.6 | 0.19 | | | | | | 403 | 62.7 | 84.45 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/6/2017 9:00 | | **27.0** | 0.19 | | | | | | 296 | 56.0 | 81.08 | Flows around 2.8 MGD, Thick Sludge, Clarifiers have more on surface due to Mech. ST running BY-Pass Pump. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/7/2017 9:00 | | 27.0 | 0.19 | | | | | | 223 | 57.0 | 74.42 | Flows around 2.8 MGD, Thick Sludge, Clarifiers have more on surface due to Mech. ST running BY-Pass Pump. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/8/2017 9:00 | | 27.0 | 0.19 | | | | | | 474 | 60.0 | 87.34 | Flows around 2.8 MGD, Thick Sludge, Clarifiers have more on surface due to Mech. ST running BY-Pass Pump. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/11/2017 9:00 | | 27.0 | 0.19 | | | | | | 343 | 64.0 | 81.31 | Flows around 2.8 MGD, Thick Sludge, Clarifiers have more on surface due to Mech. ST running BY-Pass Pump. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/12/2017 9:00 | | 27.0 | 0.19 | | | | | | 377 | 76.3 | 79.76 | Flows around 2.8 MGD, Thick Sludge, Clarifiers have more on surface due to Mech. ST running BY-Pass Pump. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/13/2017 9:00 | | 27.0 | 0.19 | | | | | | 330 | 52.9 | 83.98 | Flows around 2.8 MGD, Thick Sludge, Clarifiers have more on surface due to Mech. ST running BY-Pass Pump. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/14/2017 9:00 | | 27.0 | 0.19 | | | | | | 454 | 73.0 | 83.93 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/15/2017 9:00 | | 27.0 | 0.19 | | | | | | 272 | 65.0 | 76.10 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/17/2017 9:00 | **Aries 2076 Operator Optimized started** | | | | | | | | | | | Started making adjustments to Ferric and Poly trying to fine tune it, Flows around 2.8 MGD, Still lots of thick sludge |
| 7/18/2017 9:00 | | 32.0 | 0.29 | | | | | | 393 | 66.7 | 83.05 | Started making adjustments to Ferric and Poly trying to fine tune it, Flows around 2.8 MGD, Still lots of thick sludge. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/19/2017 9:00 | | 37.0 | 0.39 | | | | | | 360 | 62.0 | 82.78 | Clarifiers are black till afternoon hard to see what Floc looks like, still have thick sludge pressing very well. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/20/2017 9:00 | | 40.0 | 0.49 | | | | | | 290 | 64.3 | 77.83 | Clarifiers are black till afternoon hard to see what Floc looks like, still have thick sludge pressing very well. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/21/2017 9:00 | | 42.0 | 0.58 | | | | | | 314 | 60.0 | 80.91 | Flows still low around 2.8 MGD, Mech st by pass pump on, lot's of rags and floating solids in Clarifiers, Thick sludge. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/22/2017 9:00 | | 42.0 | 0.58 | | | | | | 374 | 58.6 | 84.33 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/25/2017 9:00 | | 32.0 | 0.48 | | | | | | 610 | 71.7 | 88.25 | Rain Flows around 5 MGD, High Influent and Effluent #s due to rain but % removal was still good. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/26/2017 9:00 | | 32.0 | 0.29 | | | | | | 350 | 62.0 | 82.29 | Construction Problems with Ferric Tanks and pumps clogging all day never got the correct dose. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/27/2017 9:00 | | 45.0 | 0.58 | | | | | | 374 | 78.0 | 79.14 | Flows around 2.8 MGD, Black Clarifiers till afternoon, Thick Sludge Pressing very well. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/28/2017 9:00 | | 45.0 | 0.58 | | | | | | 370 | 58.0 | 84.32 | Flows around 2.8 MGD, Black Clarifiers till afternoon, Thick Sludge Pressing very well. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/29/2017 9:00 | | 45.0 | 0.58 | | | | | | 360 | 86.0 | 76.11 | Flows around 2.8 MGD, Black Clarifiers till afternoon, Thick Sludge Pressing very well. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/1/2017 9:00 | | 43.0 | 0.68 | | | | | | 325 | 62.0 | 80.92 | Problems with Ferric system getting plugged again, Not sure how many hours it was plugged Happened overnight. Sample collected at 9:00 AM represents previous 24 hour period. |

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**Bold** indicates a change in dose

| | | *SCADA Set Doses* | | *PAC Pump Measured flow/dose* | | | *Poly Pump Measured flow/dose* | | *EAI Lab TSS Values* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | D-Box Flow (MGD) | PAC Setpoint (mg/L) | Poly Setpoint (mg/L) | PAC pump RPM | PAC pump flow rate | PAC Dose (mg/L) | Poly Pump Flowrate (ml/min) | Poly Dose (mg/L) | Influent (mg/L) | Effluent (mg/L) | Removal (%) | Notes |
| 8/2/2017 9:00 | | 43.0 | 0.58 | | | | | | 294 | 76.3 | 74.06 | Still having problems with Ferric strainer plugging, Ordered larger mesh strainer to help with the problem, Thick Sludge. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/3/2017 9:00 | | 43.0 | 0.58 | | | | | | 284 | 61.7 | 78.29 | Still having problems with Ferric strainer plugging, Ordered larger mesh strainer to help with the problem, Thick Sludge. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/4/2017 9:00 | | 43.0 | 0.58 | | | | | | 252 | 80.0 | 68.25 | Problems with Ferric are getting better the Y strainer isn't getting plugged up as fast. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/5/2017 9:00 | | 43.0 | 0.58 | | | | | | 356 | 62.0 | 82.58 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/8/2017 9:00 | | 43.0 | 0.58 | | | | | | 355 | 66.0 | 81.41 | Had to clean remainder of Ferric from Bulk Tank into grit chambers so tank could be removed, May have messed with the numbers. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/9/2017 9:00 | | 43.0 | 0.58 | | | | | | 406 | 64.6 | 84.09 | Had to clean remainder of Ferric from Bulk Tank into grit chambers so tank could be removed, May have messed with the numbers. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/10/2017 9:00 | | 52.0 | 0.58 | | | | | | 314 | 61.5 | 80.43 | Increased Ferric and Poly trying to back on track after all the problems with the Ferric Tanks. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/11/2017 9:00 | | 52.0 | 0.58 | | | | | | 288 | 66.0 | 77.08 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/12/2017 9:00 | | 52.0 | 0.58 | | | | | | 274 | 64.7 | 76.38 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/15/2017 9:00 | | 43.0 | 0.58 | | | | | | 353 | 128.0 | 63.77 | Construction Problems with Ferric Tanks and pumps clogging all day never got the correct dose. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/16/2017 9:00 | | 43.0 | 0.68 | | | | | | 560 | 83.8 | 85.04 | Construction Problems with Ferric Tanks and pumps clogging all day never got the correct dose. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/17/2017 9:00 | | 0.0 | 0.00 | | | | | | 450 | 78.0 | 82.67 | Rain Flows around 5 MGD, High Influent and Effluent #s due to rain but % removal was still good. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/18/2017 9:00 | | 0.0 | 0.00 | | | | | | 388 | 59.2 | 84.72 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/19/2017 9:00 | | 0.0 | 0.00 | | | | | | 0 | 0.0 | #DIV/0! | Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/23/2017 9:00 | **Pilot 2A BEGAN WITH ARIES 252** | | | | | | | | | | | Heavy Rain overnight made for high Influent and Effluent TSS, Thick Sludge. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/23/2017 9:00 | | 8.6 | 0.19 | | | | | | 624 | 101.0 | 83.81 | Flows around 4 MGD due to rain the night before, First full 24 hours of PAC 252, Clarifiers still black till afternoon. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/24/2017 9:00 | | 8.6 | 0.19 | | | | | | 278 | 84.0 | 69.78 | Flows around 2.9 MGD Influent has cleared up after the rain not coming in black right now, Sludge is ok just a little thin. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/25/2017 9:00 | | 8.6 | 0.19 | | | | | | 183 | 71.0 | 61.14 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/26/2017 9:00 | | 8.6 | 0.19 | | | | | | 183.1 | 87.0 | 52.48 | Thick Foam and Sludge floating on surface of thickener not sure why, Sludge starting to get thin. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/29/2017 9:00 | | 8.6 | 0.19 | | | | | | 241.3 | 84.0 | 65.19 | Flows around 2.8 MGD, Very thin Sludge and not much of it Thickener only at 1.5 FT. |
| 8/30/2017 9:00 | | 8.6 | 0.19 | | | | | | 260.0 | 95.0 | 63.46 | Sludge is very watery Thickener showing less than a foot, Yesterdays sludge can was only 5 ton. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/31/2017 9:00 | | 8.6 | 0.19 | | | | | | 298.0 | 93.0 | 68.79 | Ran out of sludge, Coming into the holding tanks like Gray Water. Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/1/2017 9:00 | | 8.6 | 0.19 | | | | | | 300.0 | 97.0 | 67.67 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/2/2017 9:00 | | 8.6 | 0.19 | | | | | | 306.0 | 94.0 | 69.28 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/5/2017 9:00 | | 8.6 | 0.19 | | | | | | 216.0 | 65.0 | 69.91 | Sludge thickened up over the weekend, TSS still high with low % removal. Flows around 2.6 MGD, Not settling well only 43% removal. Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/6/2017 9:00 | | 8.6 | 0.19 | | | | | | 165.0 | 82.0 | 50.30 | Heavy Rain on and off, Sludge looks ok about 2' in Thickener. Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/7/2017 9:00 | | **27.0** | 0.19 | | | | | | 308.3 | 66.0 | 78.59 | Day after some rain, Sludge thickened up a little bit, The Fournier Press hasn't been running great the pressure keeps jumping around. Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/8/2017 9:00 | | 27.0 | 0.19 | | | | | | 160.0 | 69.2 | 56.73 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/9/2017 9:00 | | 27.0 | 0.19 | | | | | | 181.0 | 60.0 | 66.85 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/12/2017 9:00 | | 27.0 | 0.19 | | | | | | 200.0 | 82.0 | 59.00 | Running on one Clarifier (starting on 9/11), Sludge is thin and watery. Flows around 2.7 MGD, Sludge is very thin having a hard time getting enough Sludge to press before it turns into water. Sample collected at 9:00 AM represents previous 24 hour period. |

**Portsmouth, NH**
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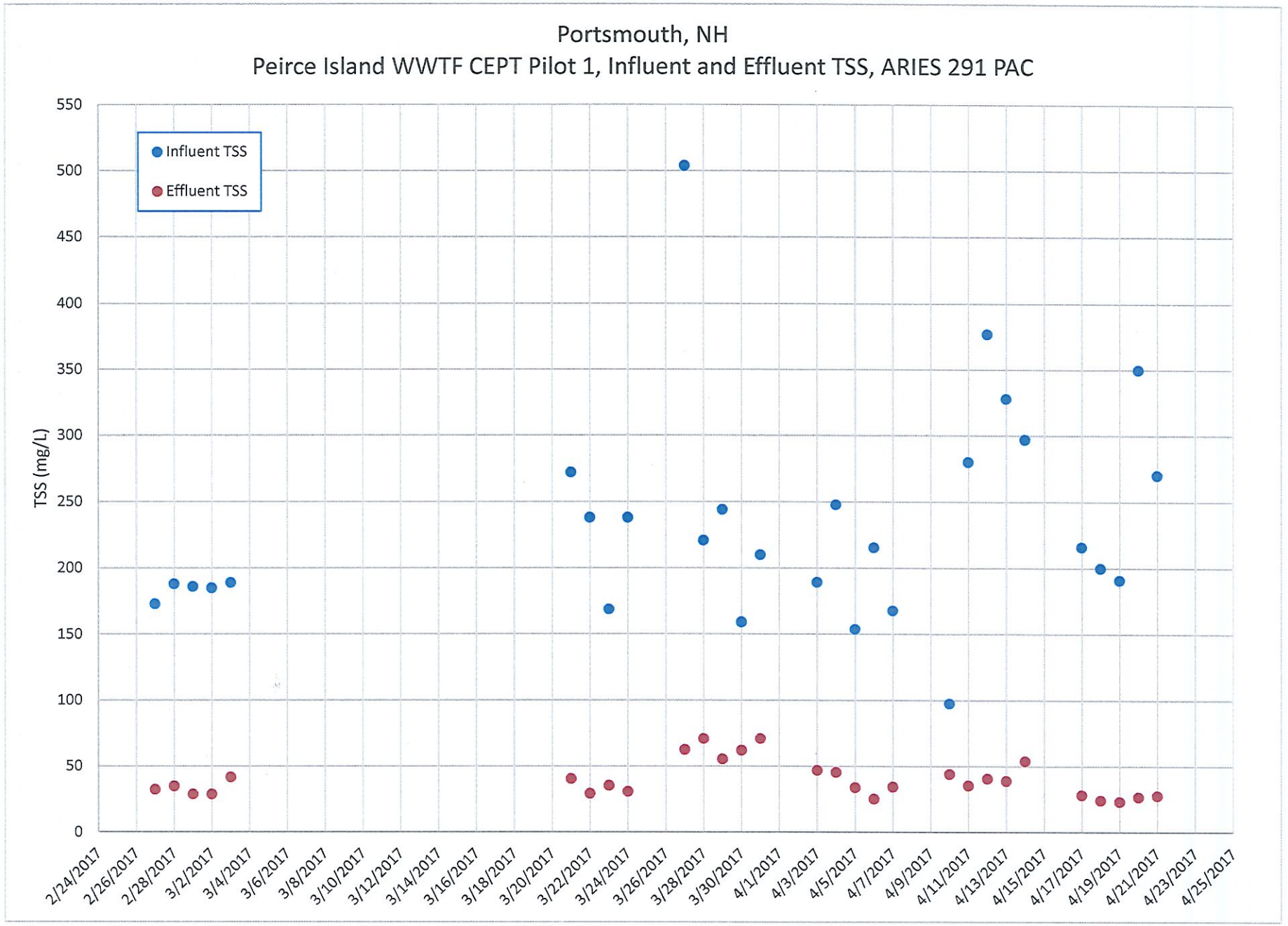
**Pilot Testing Chemical dosing Results**

**Bold** indicates a change in dose

| | | *SCADA Set Doses* | | *PAC Pump Measured flow/dose* | | | *Poly Pump Measured flow/dose* | | *EAI Lab TSS Values* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | D-Box Flow (MGD) | PAC Setpoint (mg/L) | Poly Setpoint (mg/L) | PAC pump RPM | PAC pump flow rate | PAC Dose (mg/L) | Poly Pump Flowrate (ml/min) | Poly Dose (mg/L) | Influent (mg/L) | Effluent (mg/L) | Removal (%) | Notes |
| 9/13/2017 9:00 | | 27.0 | 0.19 | | | | | | 268.0 | 78.0 | 70.90 | Flows around 2.7 MGD, Sludge is very thin having a hard time getting enough Sludge to press before it turns into water. Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/14/2017 9:00 | | 27.0 | 0.19 | | | | | | 336.0 | 80.0 | 76.19 | Sludge is very thin, Ran out of Sludge Thursday around noon had to shut down the press and wait till Friday AM to fill sludge can. Clarifier #1 back online. Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/15/2017 9:00 | | 27.0 | 0.19 | | | | | | 209.0 | 68.0 | 67.46 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/16/2017 9:00 | | 27.0 | 0.19 | | | | | | 207.0 | 60.7 | 70.69 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/19/2017 9:00 | | 27.0 | 0.19 | | | | | | 259.7 | 61.0 | 76.51 | Thick Sludge Monday morning only lasted to about 12:30 then right to water had to shut pumps off. Running Clarifier #2 only, Ran out of Sludge around 10:00 had to shut the press down. Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/20/2017 9:00 | | 27.0 | 0.19 | | | | | | 347.7 | 69.8 | 79.93 | Running Clarifier #2 only, Ran out of Sludge around 10:00 had to shut the press down. Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/21/2017 9:00 | | 27.0 | 0.19 | | | | | | 251.6 | 74.0 | 70.59 | Last day of Pilot Testing. Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/22/2017 9:00 | | 27.0 | 0.19 | | | | | | 318.0 | 110.0 | 65.41 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/23/2017 9:00 | | 27.0 | 0.19 | | | | | | 233.3 | 73.0 | 68.71 | Sample collected at 9:00 AM represents previous 24 hour period. |

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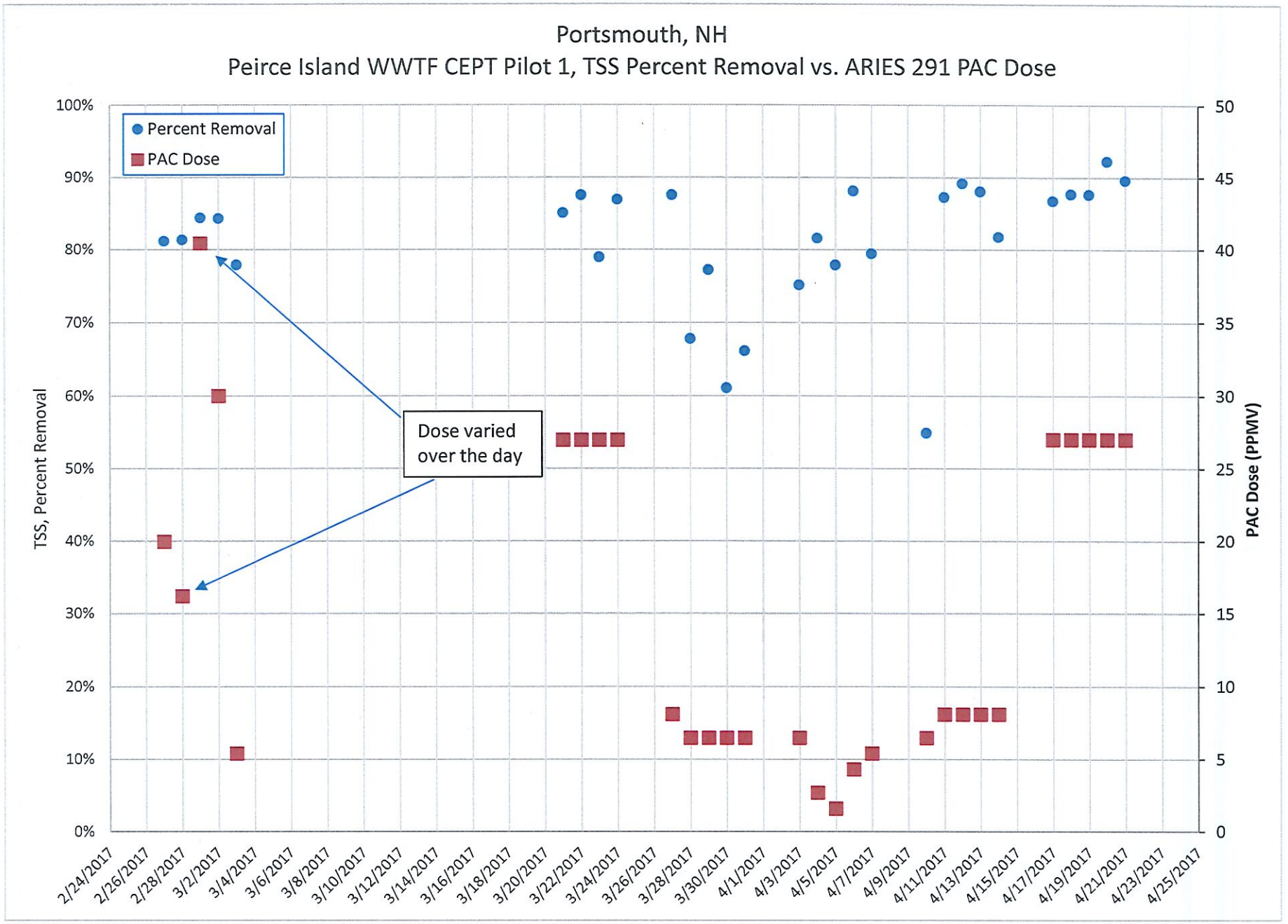


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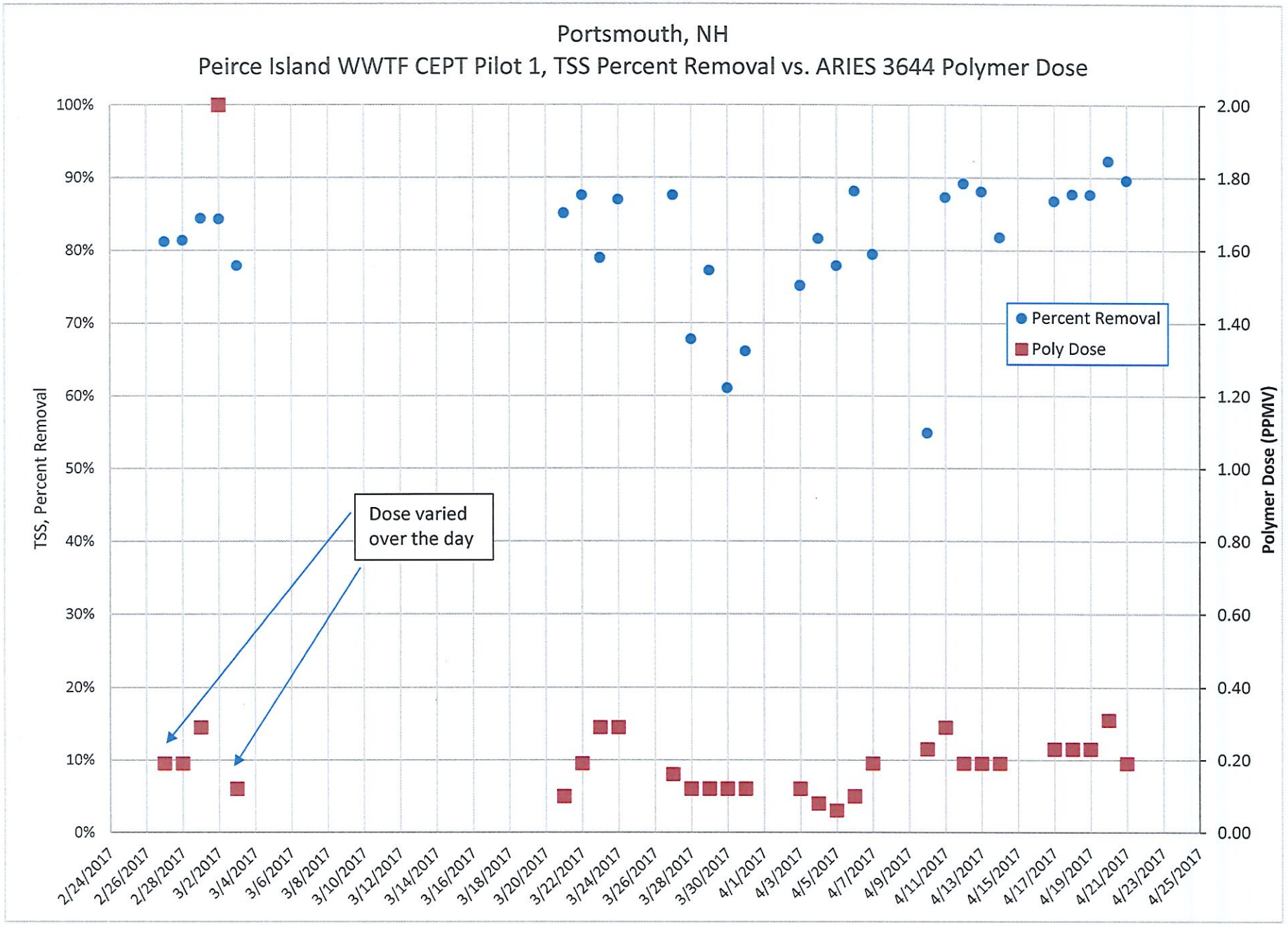
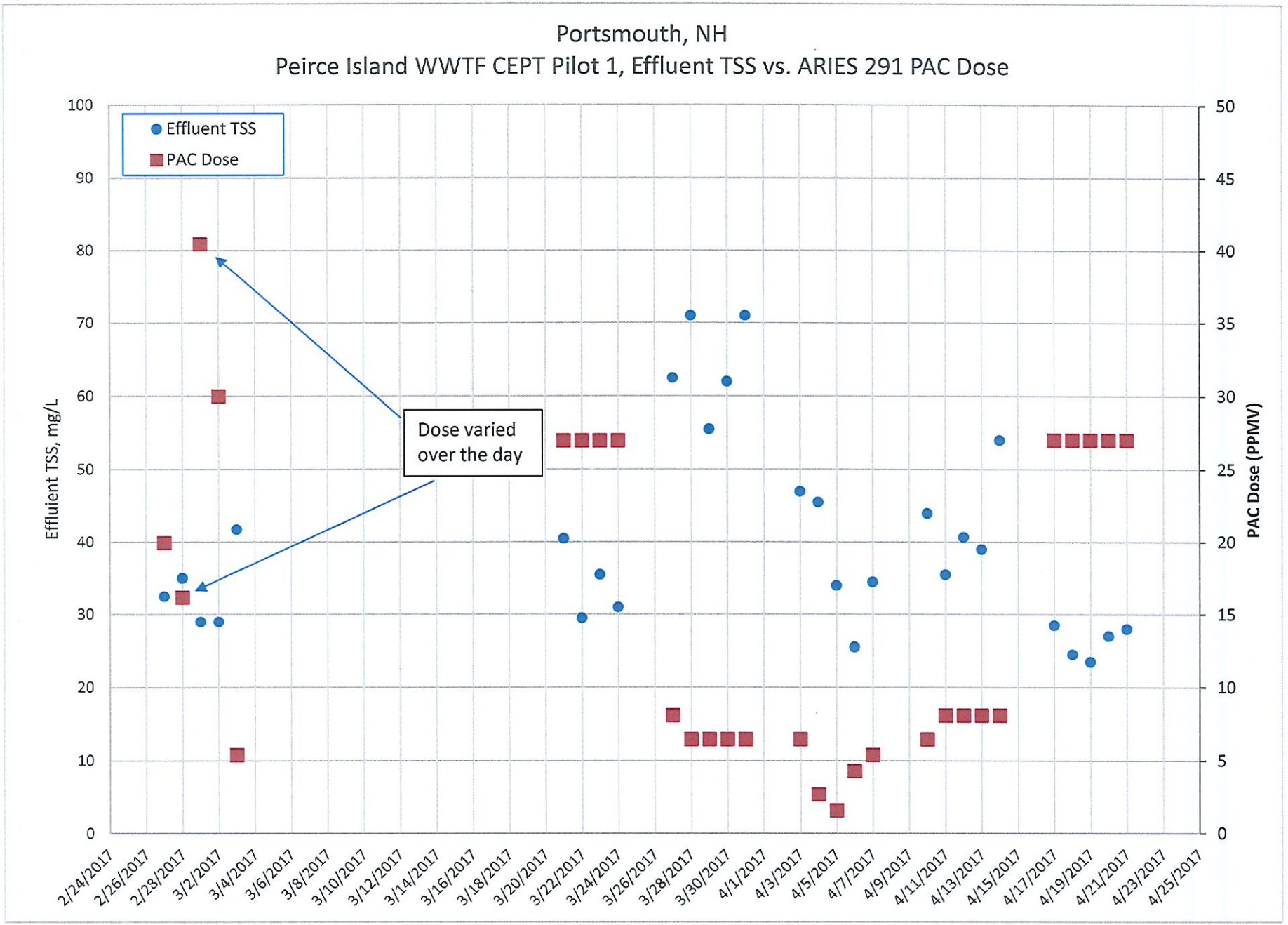

Portsmouth, NH
Peirce Island WWTF CEPT Pilot 1, TSS Percent Removal vs. ARIES 3644 Polymer Dose
TSS, Percent Removal
Polymer Dose (PPMV)
Percent Removal
Poly Dose
Dose varied over the day
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
2/24/2017
2/26/2017
2/28/2017
3/2/2017
3/4/2017
3/6/2017
3/8/2017
3/10/2017
3/12/2017
3/14/2017
3/16/2017
3/18/2017
3/20/2017
3/22/2017
3/24/2017
3/26/2017
3/28/2017
3/30/2017
4/1/2017
4/3/2017
4/5/2017
4/7/2017
4/9/2017
4/11/2017
4/13/2017
4/15/2017
4/17/2017
4/19/2017
4/21/2017
4/23/2017
4/25/2017

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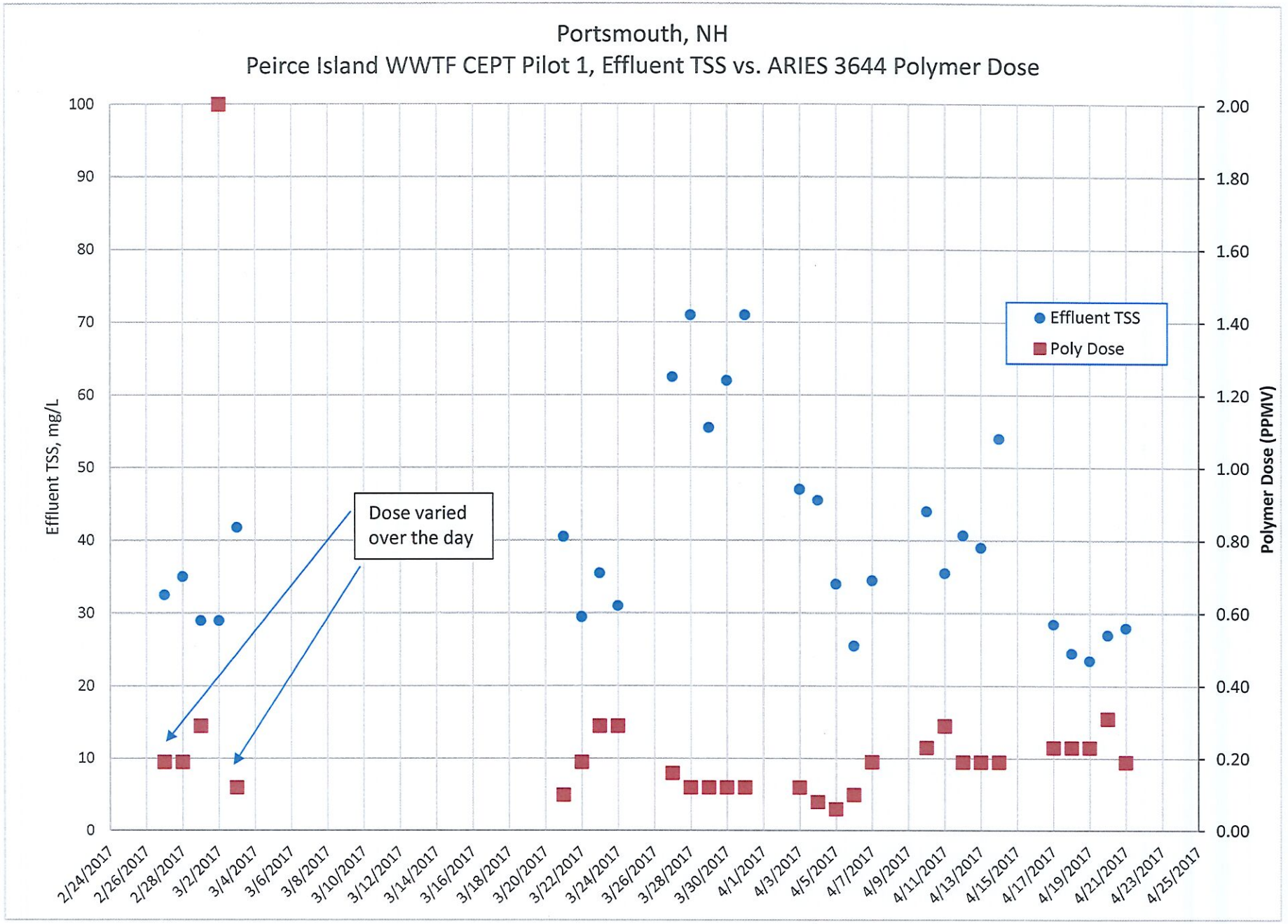
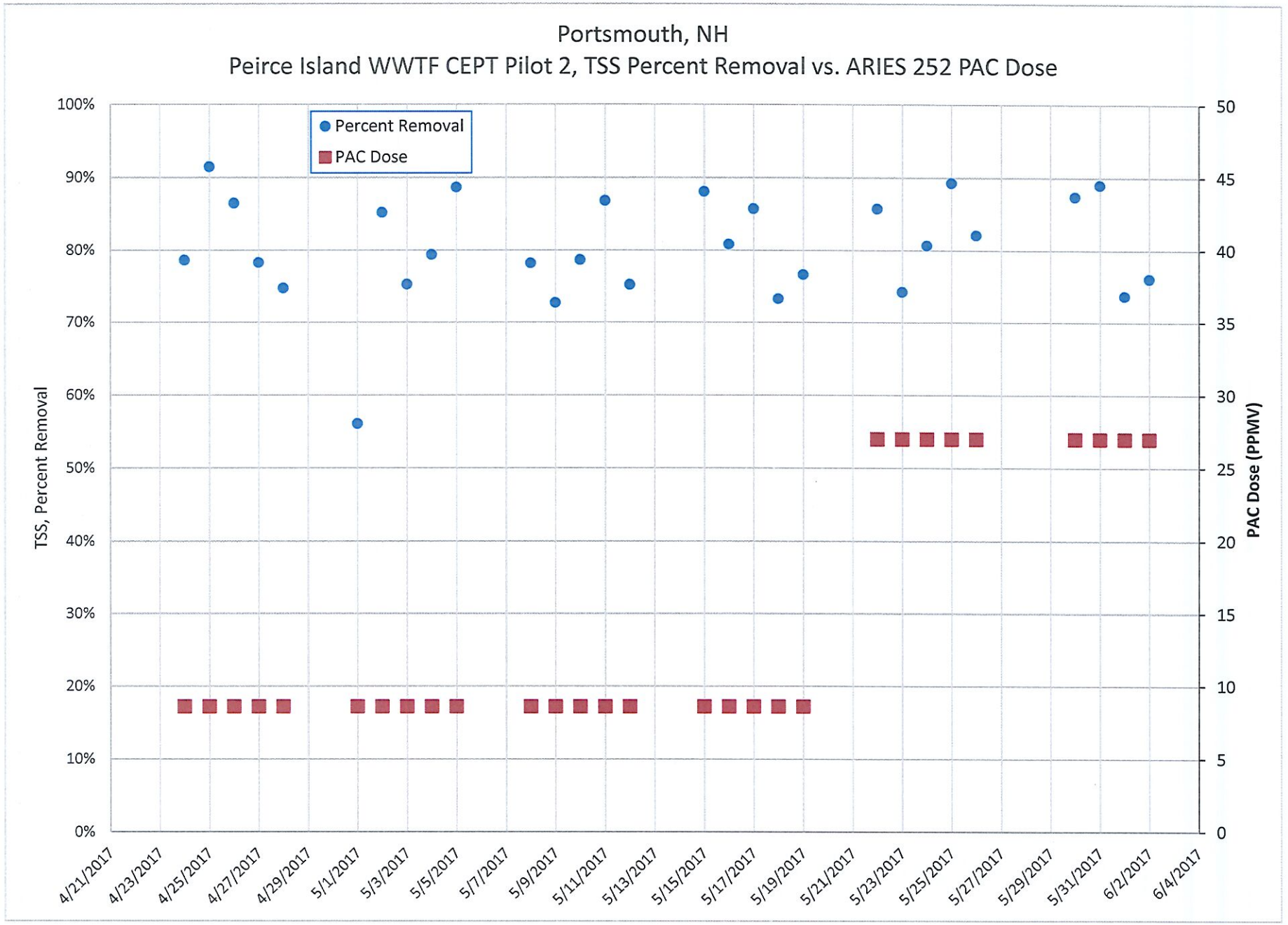

Portsmouth, NH
Peirce Island WWTF CEPT Pilot 1, Effluent TSS vs. ARIES 3644 Polymer Dose
Effluent TSS, mg/L
Polymer Dose (PPMV)
Effluent TSS
Poly Dose
Dose varied over the day
100
90
80
70
60
50
40
30
20
10
0
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
2/24/2017
2/26/2017
2/28/2017
3/2/2017
3/4/2017
3/6/2017
3/8/2017
3/10/2017
3/12/2017
3/14/2017
3/16/2017
3/18/2017
3/20/2017
3/22/2017
3/24/2017
3/26/2017
3/28/2017
3/30/2017
4/1/2017
4/3/2017
4/5/2017
4/7/2017
4/9/2017
4/11/2017
4/13/2017
4/15/2017
4/17/2017
4/19/2017
4/21/2017
4/23/2017
4/25/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 2, TSS Percent Removal vs. ARIES 252 PAC Dose
Percent Removal
PAC Dose
TSS, Percent Removal
PAC Dose (PPMV)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
50
45
40
35
30
25
20
15
10
5
0
4/21/2017
4/23/2017
4/25/2017
4/27/2017
4/29/2017
5/1/2017
5/3/2017
5/5/2017
5/7/2017
5/9/2017
5/11/2017
5/13/2017
5/15/2017
5/17/2017
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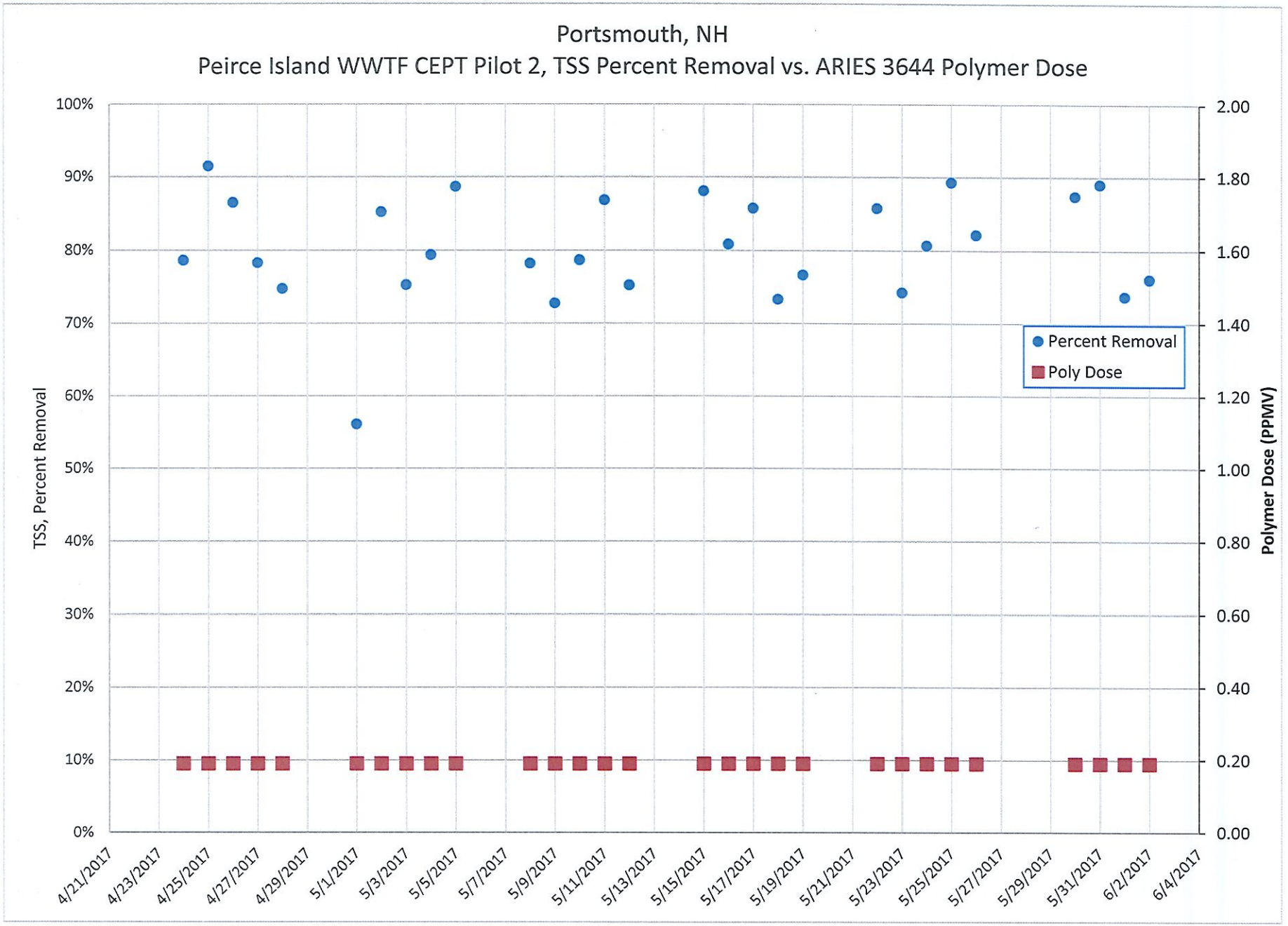
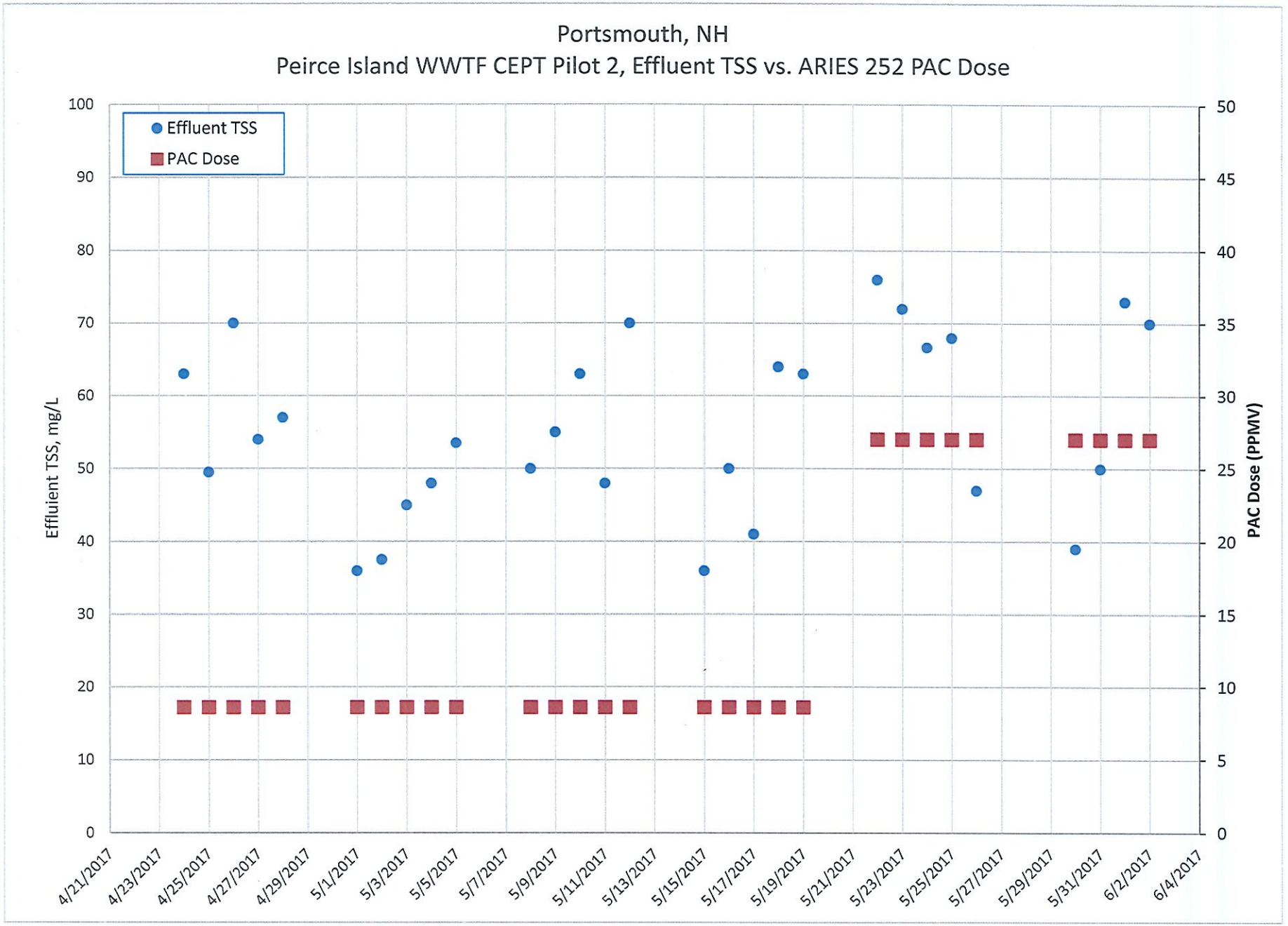
5/31/2017
6/2/2017
6/4/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 2, TSS Percent Removal vs. ARIES 3644 Polymer Dose
TSS, Percent Removal
Polymer Dose (PPMV)
Percent Removal
Poly Dose
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
4/21/2017
4/23/2017
4/25/2017
4/27/2017
4/29/2017
5/1/2017
5/3/2017
5/5/2017
5/7/2017
5/9/2017
5/11/2017
5/13/2017
5/15/2017
5/17/2017
5/19/2017
5/21/2017
5/23/2017
5/25/2017
5/27/2017
5/29/2017
5/31/2017
6/2/2017
6/4/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 2, Effluent TSS vs. ARIES 252 PAC Dose
Effluent TSS
PAC Dose
Effluent TSS, mg/L
PAC Dose (PPMV)
0
10
20
30
40
50
60
70
80
90
100
0
5
10
15
20
25
30
35
40
45
50
4/21/2017
4/23/2017
4/25/2017
4/27/2017
4/29/2017
5/1/2017
5/3/2017
5/5/2017
5/7/2017
5/9/2017
5/11/2017
5/13/2017
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5/17/2017
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5/31/2017
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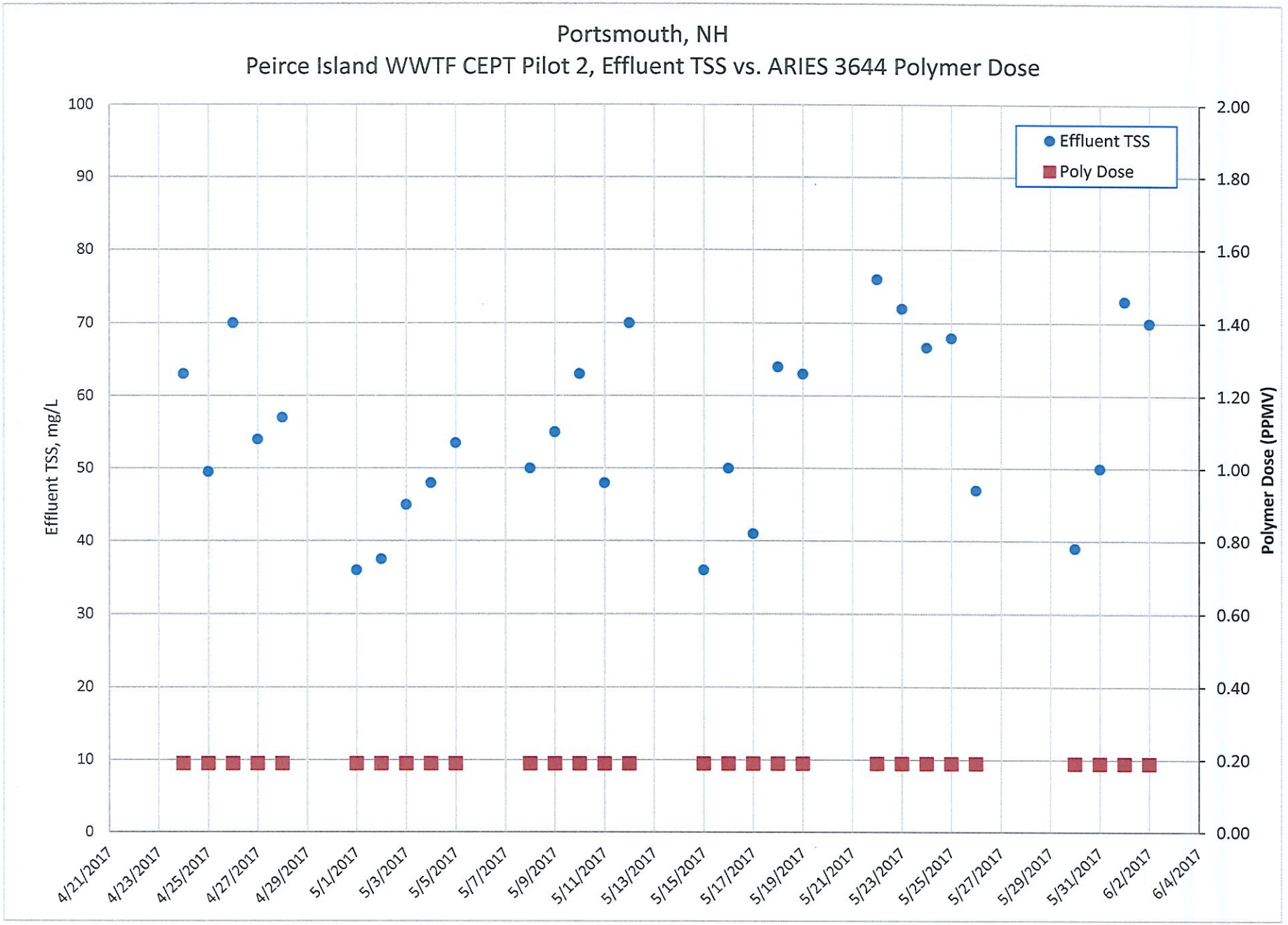
6/4/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 2, Effluent TSS vs. ARIES 3644 Polymer Dose
Effluent TSS
Poly Dose
Effluent TSS, mg/L
Polymer Dose (PPMV)
100
90
80
70
60
50
40
30
20
10
0
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
4/21/2017
4/23/2017
4/25/2017
4/27/2017
4/29/2017
5/1/2017
5/3/2017
5/5/2017
5/7/2017
5/9/2017
5/11/2017
5/13/2017
5/15/2017
5/17/2017
5/19/2017
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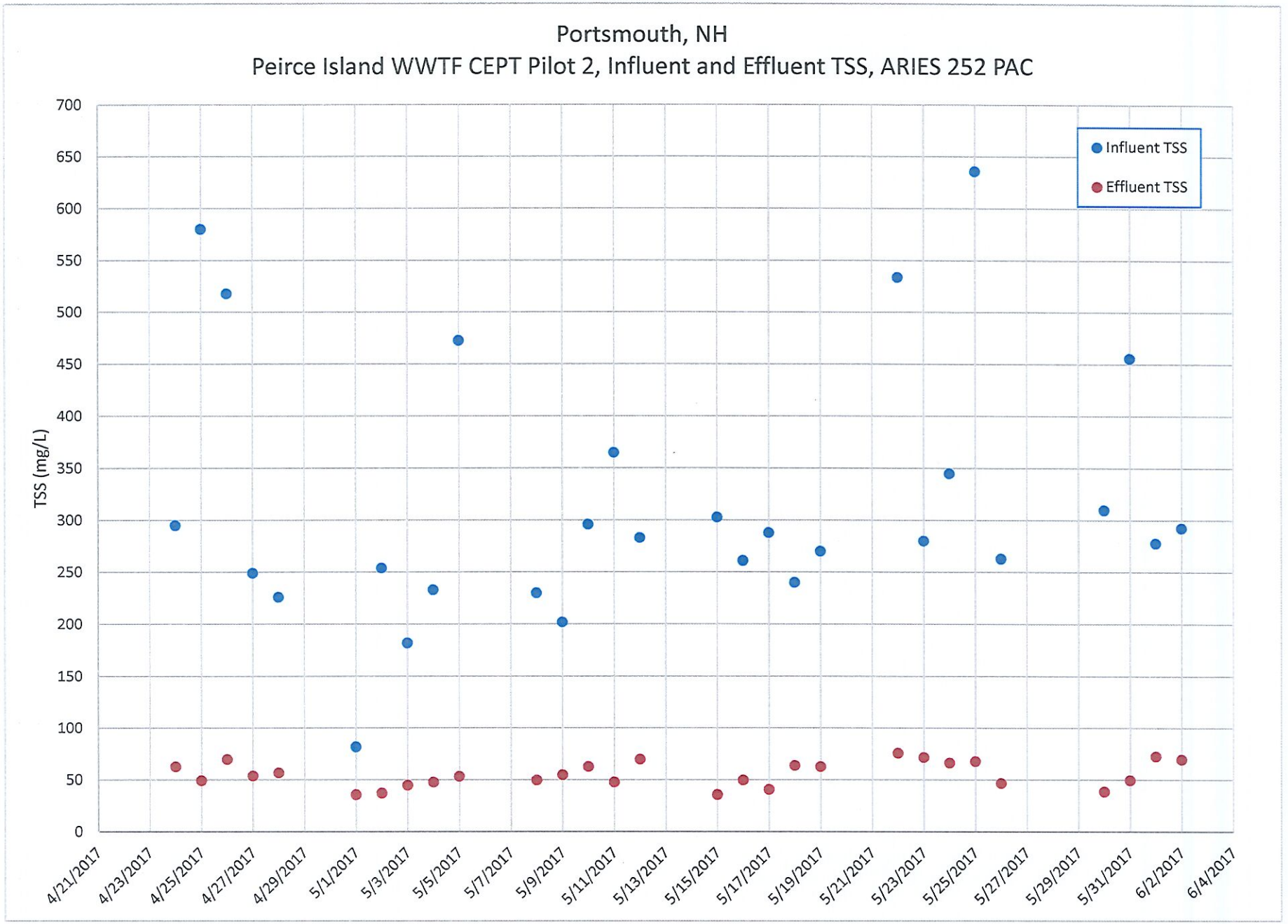
6/2/2017
6/4/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 2, Influent and Effluent TSS, ARIES 252 PAC
TSS (mg/L)
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
Influent TSS
Effluent TSS
4/21/2017
4/23/2017
4/25/2017
4/27/2017
4/29/2017
5/1/2017
5/3/2017
5/5/2017
5/7/2017
5/9/2017
5/11/2017
5/13/2017
5/15/2017
5/17/2017
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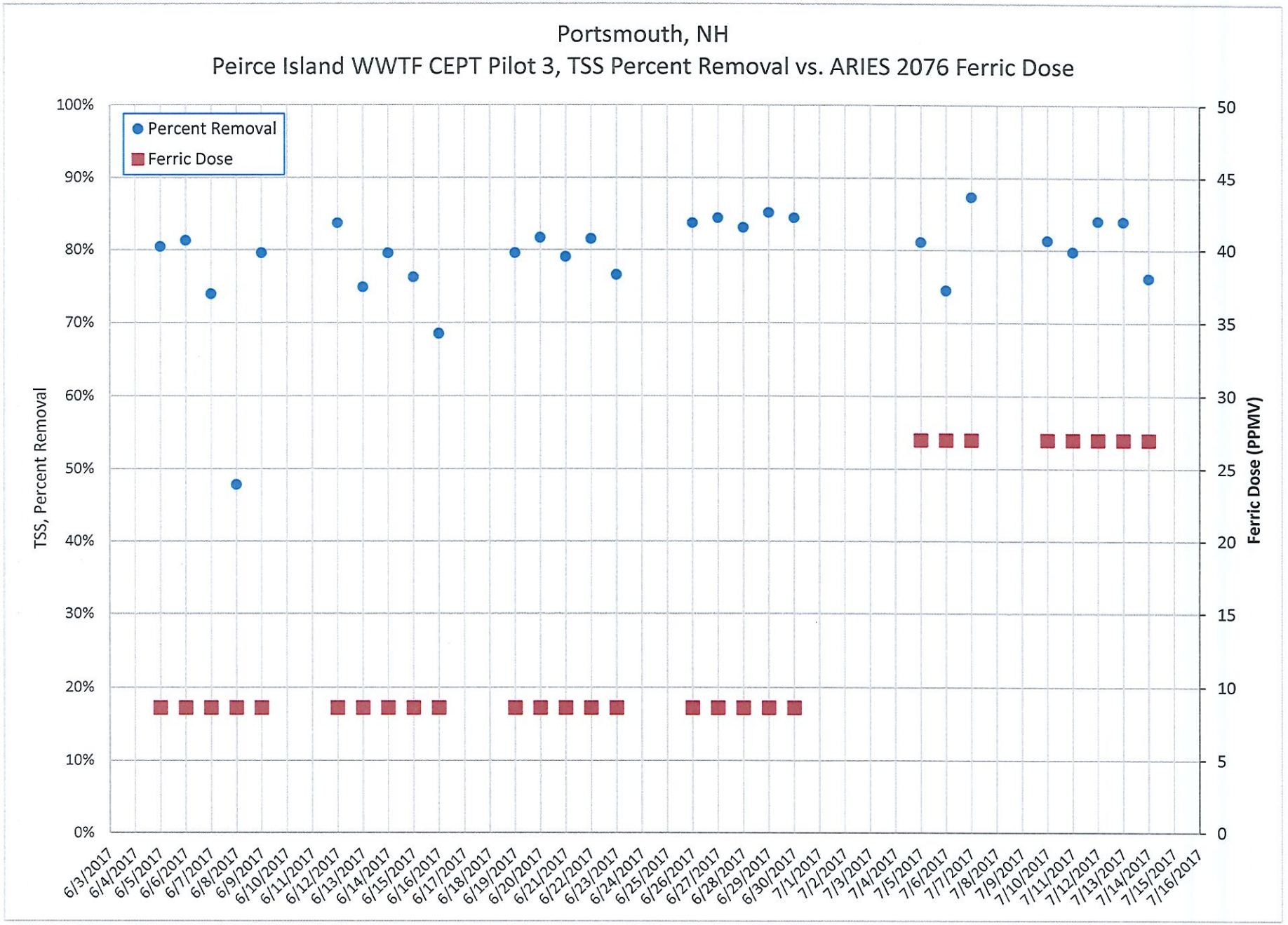
6/2/2017
6/4/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 3, TSS Percent Removal vs. ARIES 2076 Ferric Dose
Percent Removal
Ferric Dose
TSS, Percent Removal
Ferric Dose (PPMV)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
50
45
40
35
30
25
20
15
10
5
0
6/3/2017
6/4/2017
6/5/2017
6/6/2017
6/7/2017
6/8/2017
6/9/2017
6/10/2017
6/11/2017
6/12/2017
6/13/2017
6/14/2017
6/15/2017
6/16/2017
6/17/2017
6/18/2017
6/19/2017
6/20/2017
6/21/2017
6/22/2017
6/23/2017
6/24/2017
6/25/2017
6/26/2017
6/27/2017
6/28/2017
6/29/2017
6/30/2017
7/1/2017
7/2/2017
7/3/2017
7/4/2017
7/5/2017
7/6/2017
7/7/2017
7/8/2017
7/9/2017
7/10/2017
7/11/2017
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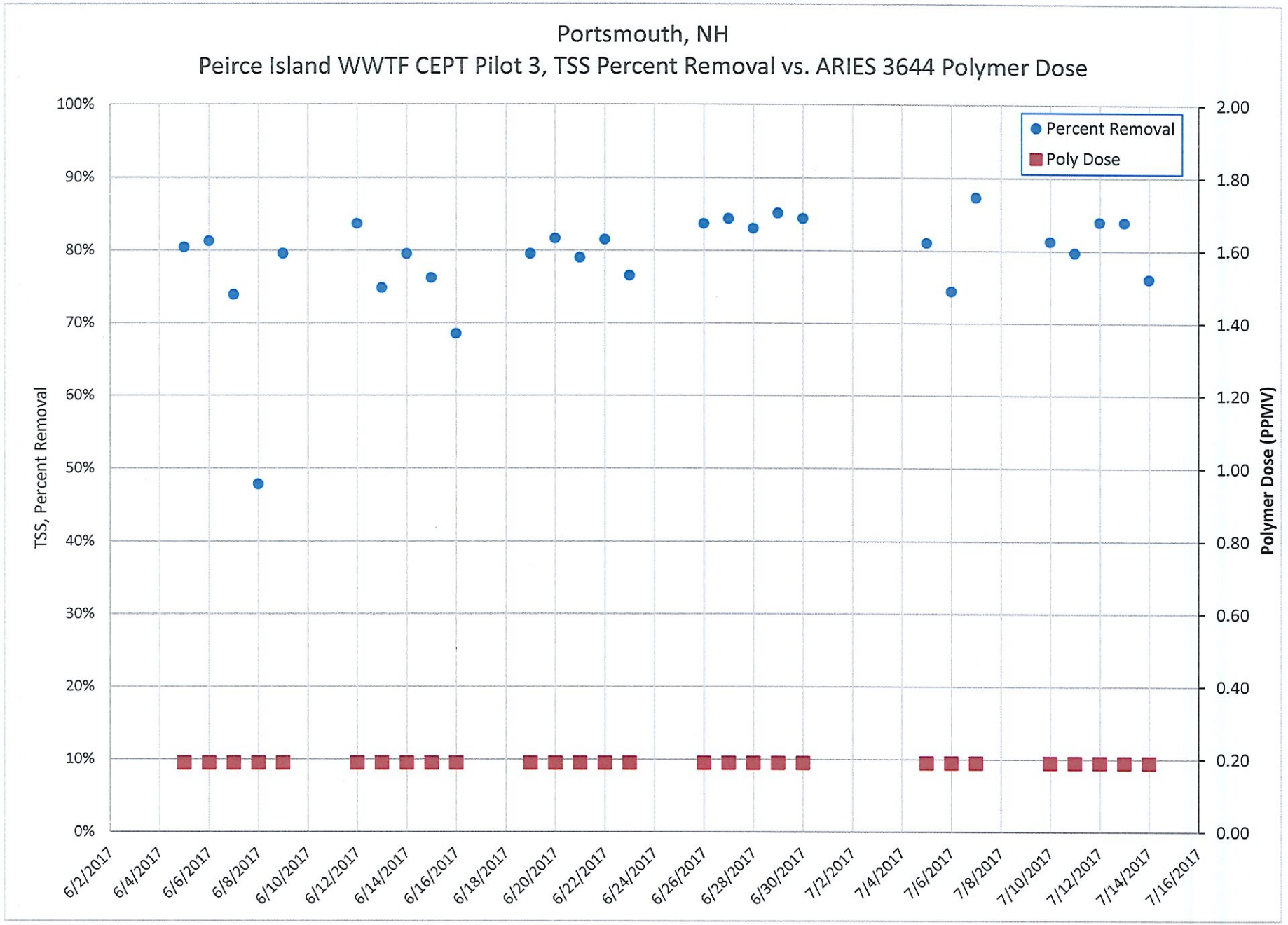
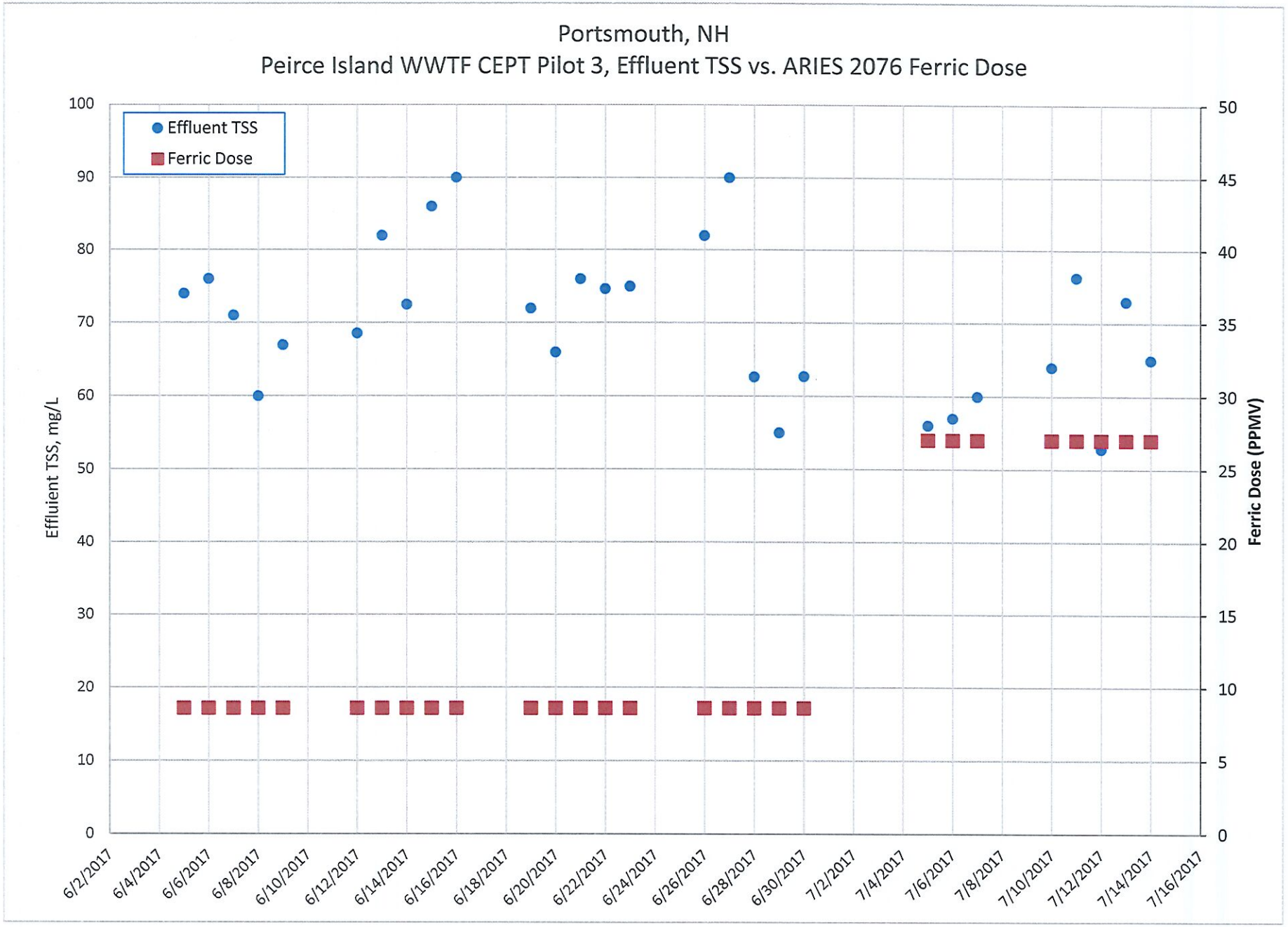
7/13/2017
7/14/2017
7/15/2017
7/16/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 3, TSS Percent Removal vs. ARIES 3644 Polymer Dose
TSS, Percent Removal
Polymer Dose (PPMV)
Percent Removal
Poly Dose
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
6/2/2017
6/4/2017
6/6/2017
6/8/2017
6/10/2017
6/12/2017
6/14/2017
6/16/2017
6/18/2017
6/20/2017
6/22/2017
6/24/2017
6/26/2017
6/28/2017
6/30/2017
7/2/2017
7/4/2017
7/6/2017
7/8/2017
7/10/2017
7/12/2017
7/14/2017
7/16/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 3, Effluent TSS vs. ARIES 2076 Ferric Dose
Effluent TSS
Ferric Dose
Effluent TSS, mg/L
Ferric Dose (PPMV)
100
90
80
70
60
50
40
30
20
10
0
50
45
40
35
30
25
20
15
10
5
0
6/2/2017
6/4/2017
6/6/2017
6/8/2017
6/10/2017
6/12/2017
6/14/2017
6/16/2017
6/18/2017
6/20/2017
6/22/2017
6/24/2017
6/26/2017
6/28/2017
6/30/2017
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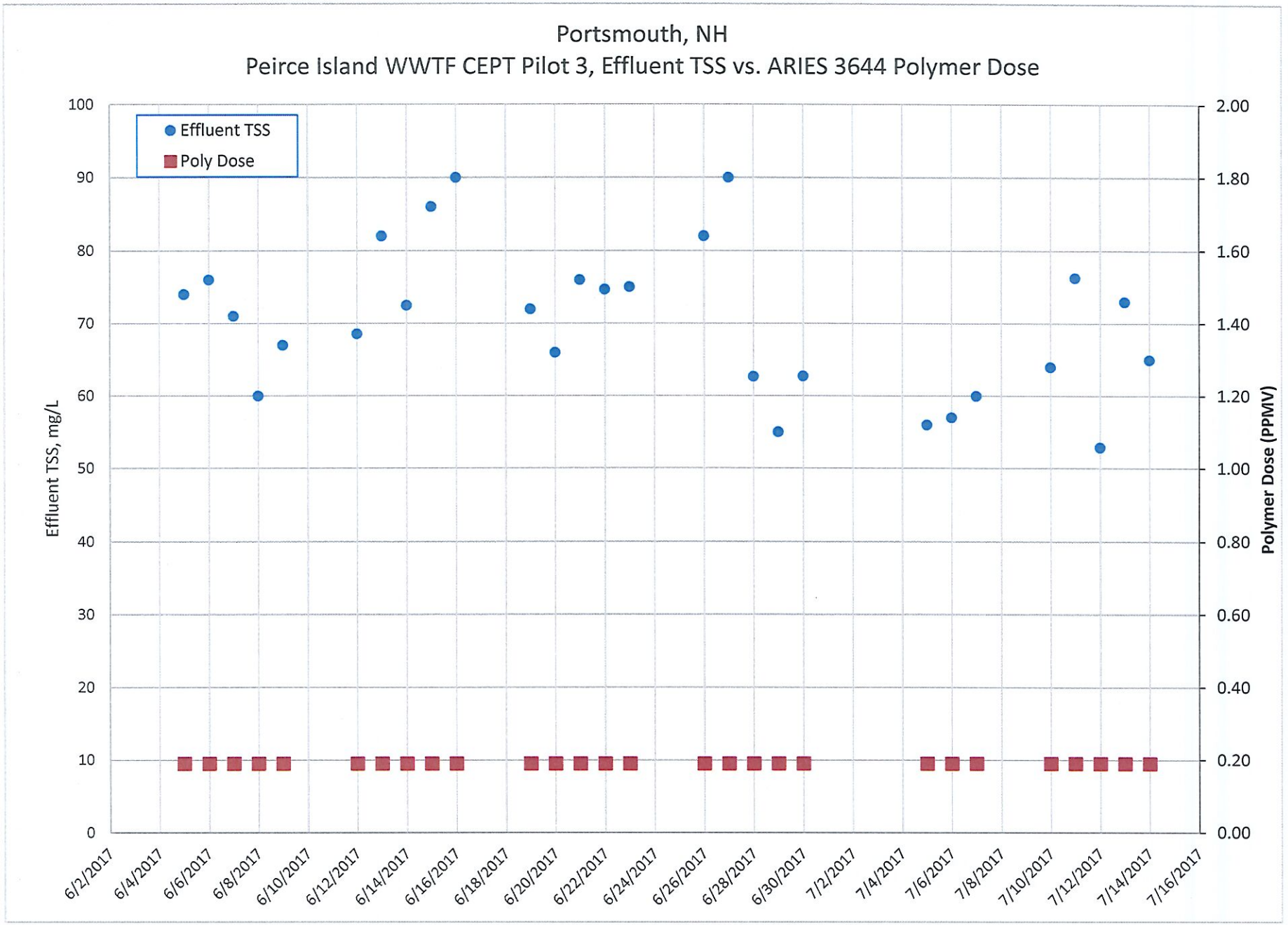
7/16/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 3, Effluent TSS vs. ARIES 3644 Polymer Dose
Effluent TSS
Poly Dose
Effluent TSS, mg/L
Polymer Dose (PPMV)
100
90
80
70
60
50
40
30
20
10
0
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
6/2/2017
6/4/2017
6/6/2017
6/8/2017
6/10/2017
6/12/2017
6/14/2017
6/16/2017
6/18/2017
6/20/2017
6/22/2017
6/24/2017
6/26/2017
6/28/2017
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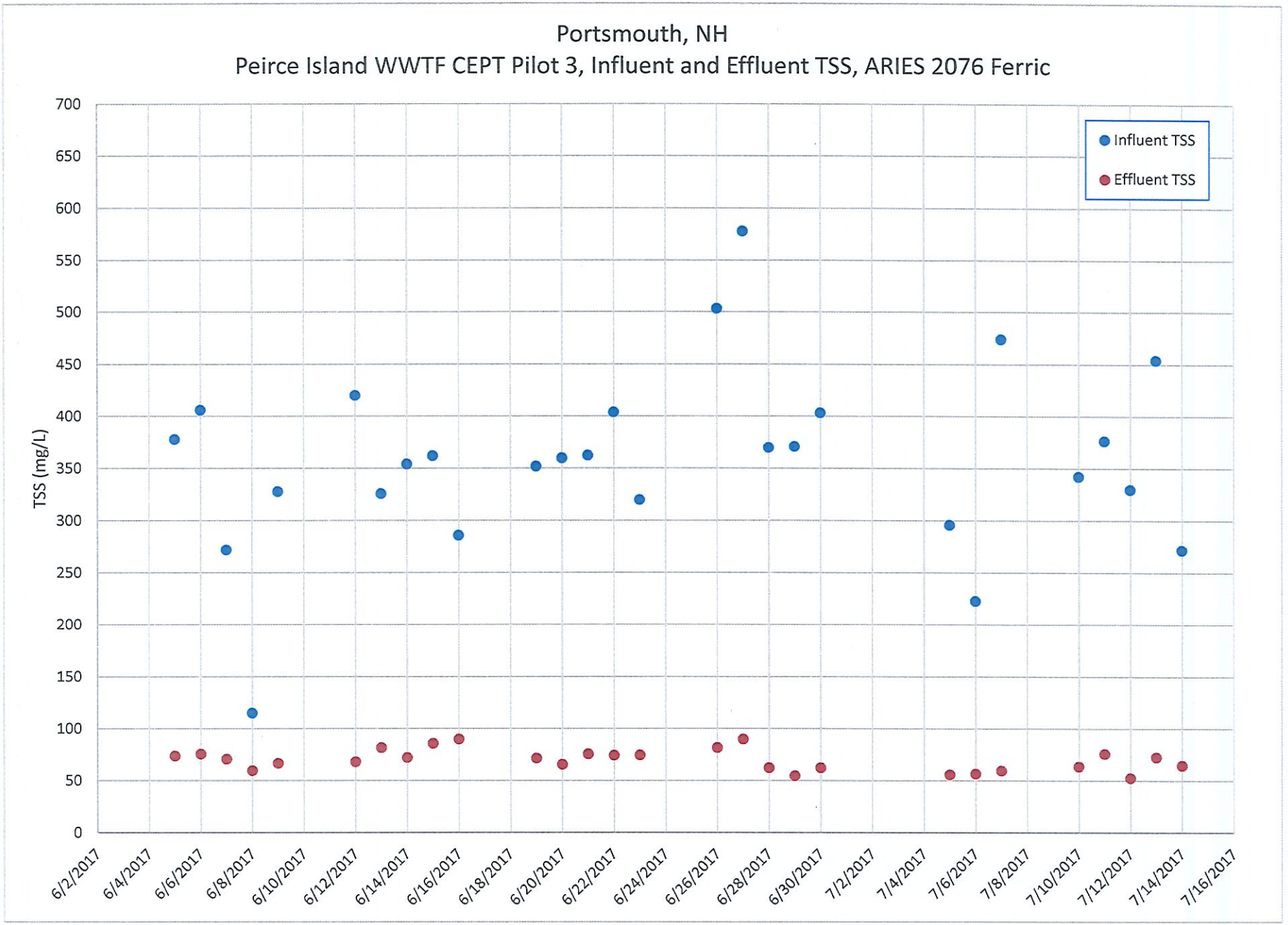
7/10/2017
7/12/2017
7/14/2017
7/16/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 3, Influent and Effluent TSS, ARIES 2076 Ferric
TSS (mg/L)
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
Influent TSS
Effluent TSS
6/2/2017
6/4/2017
6/6/2017
6/8/2017
6/10/2017
6/12/2017
6/14/2017
6/16/2017
6/18/2017
6/20/2017
6/22/2017
6/24/2017
6/26/2017
6/28/2017
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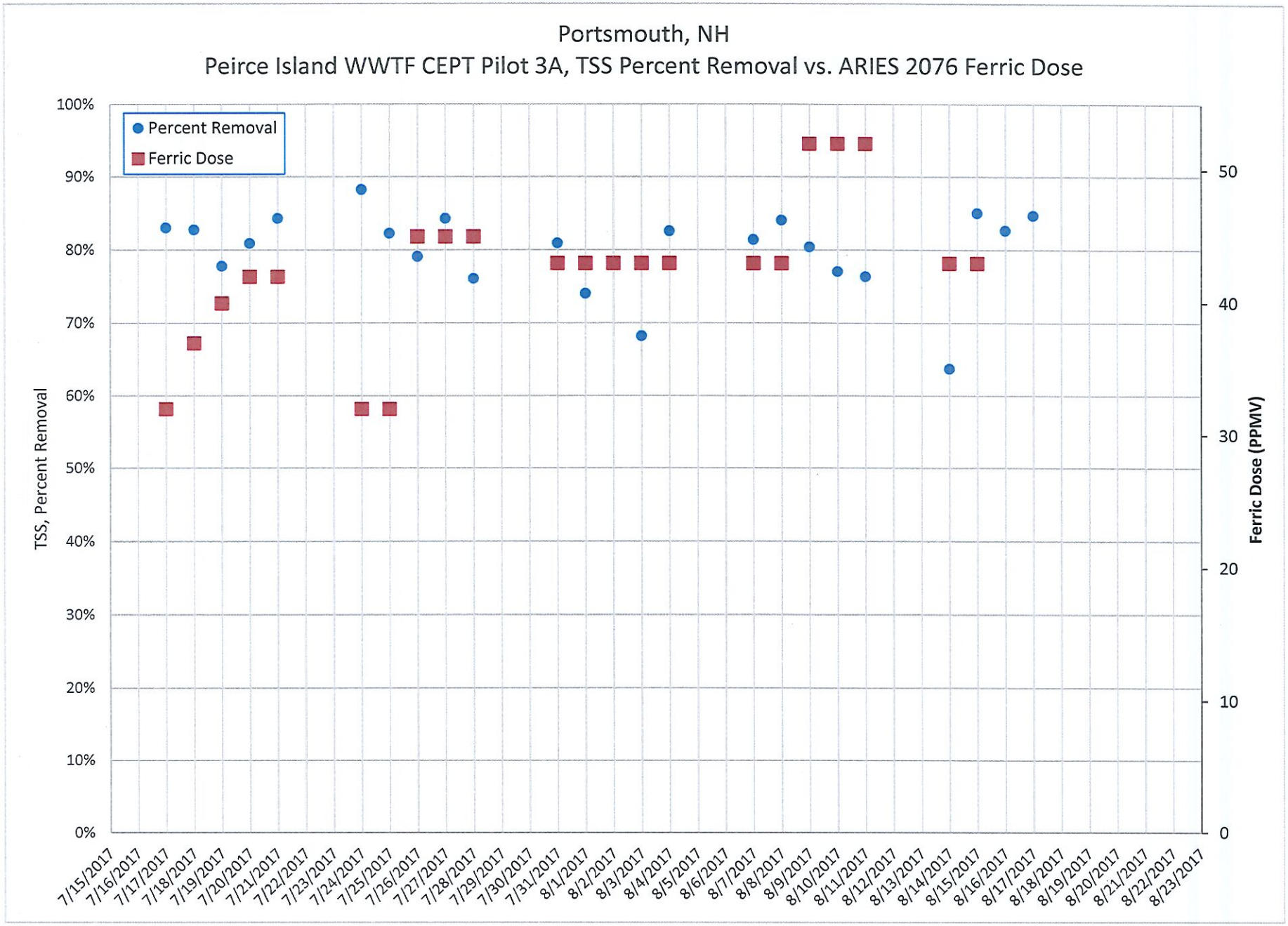
7/14/2017
7/16/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 3A, TSS Percent Removal vs. ARIES 2076 Ferric Dose
Percent Removal
Ferric Dose
TSS, Percent Removal
Ferric Dose (PPMV)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
50
40
30
20
10
0
7/15/2017
7/16/2017
7/17/2017
7/18/2017
7/19/2017
7/20/2017
7/21/2017
7/22/2017
7/23/2017
7/24/2017
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8/12/2017
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8/14/2017
8/15/2017
8/16/2017
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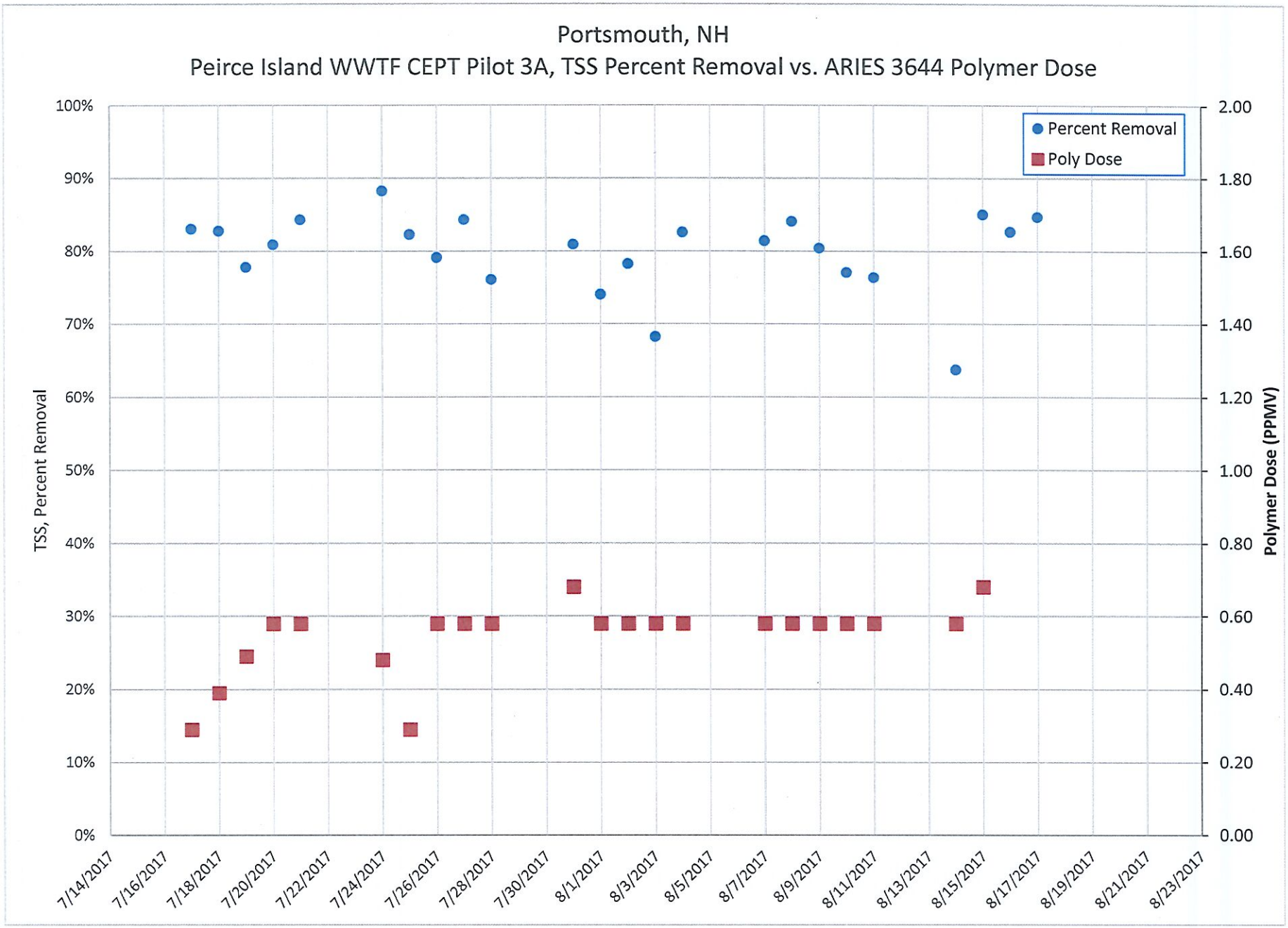
8/19/2017
8/20/2017
8/21/2017
8/22/2017
8/23/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 3A, TSS Percent Removal vs. ARIES 3644 Polymer Dose
TSS, Percent Removal
Polymer Dose (PPMV)
Percent Removal
Poly Dose
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
7/14/2017
7/16/2017
7/18/2017
7/20/2017
7/22/2017
7/24/2017
7/26/2017
7/28/2017
7/30/2017
8/1/2017
8/3/2017
8/5/2017
8/7/2017
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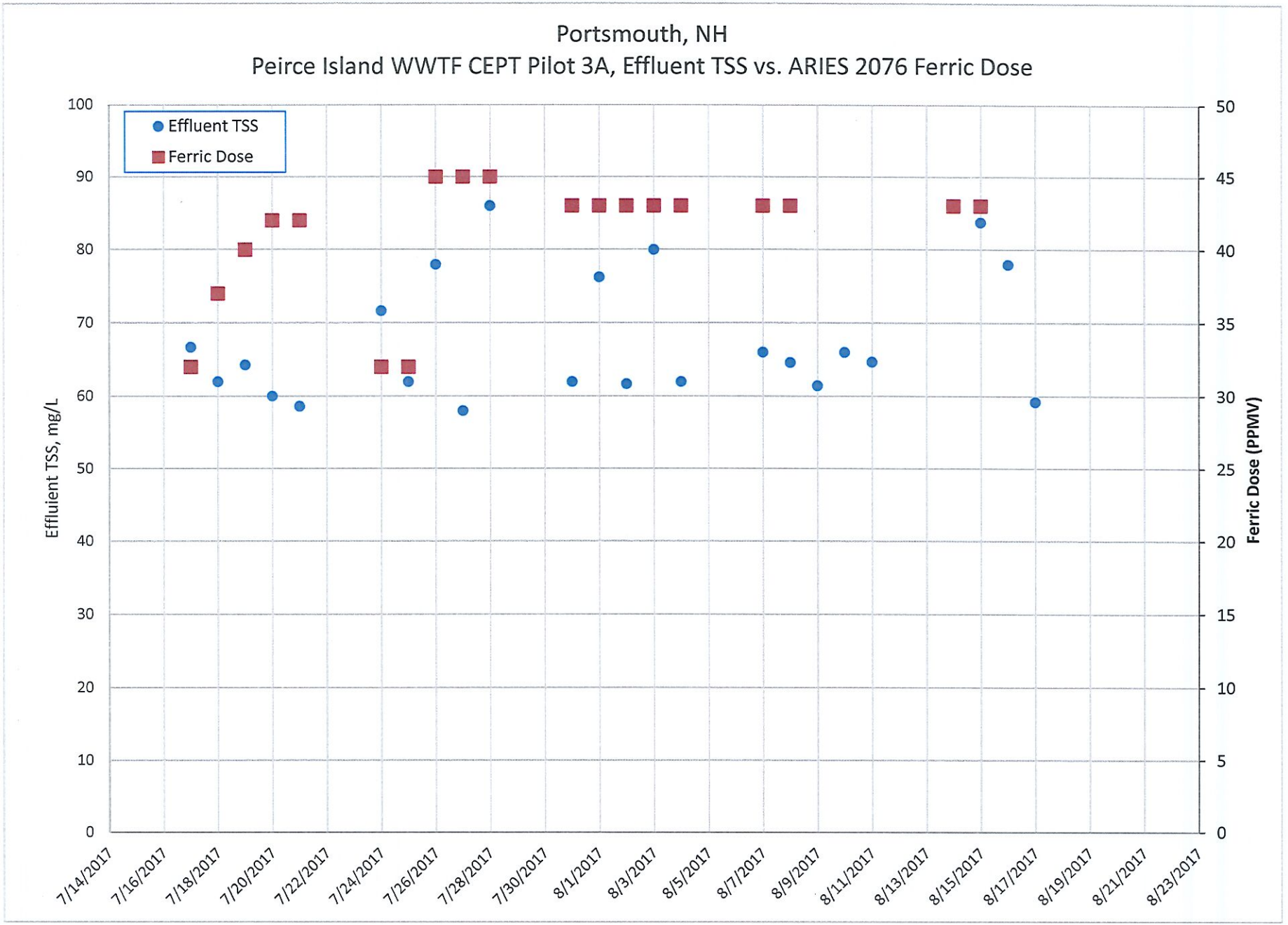
8/19/2017
8/21/2017
8/23/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 3A, Effluent TSS vs. ARIES 2076 Ferric Dose
Effluent TSS
Ferric Dose
Effluent TSS, mg/L
Ferric Dose (PPMV)
100
90
80
70
60
50
40
30
20
10
0
50
45
40
35
30
25
20
15
10
5
0
7/14/2017
7/16/2017
7/18/2017
7/20/2017
7/22/2017
7/24/2017
7/26/2017
7/28/2017
7/30/2017
8/1/2017
8/3/2017
8/5/2017
8/7/2017
8/9/2017
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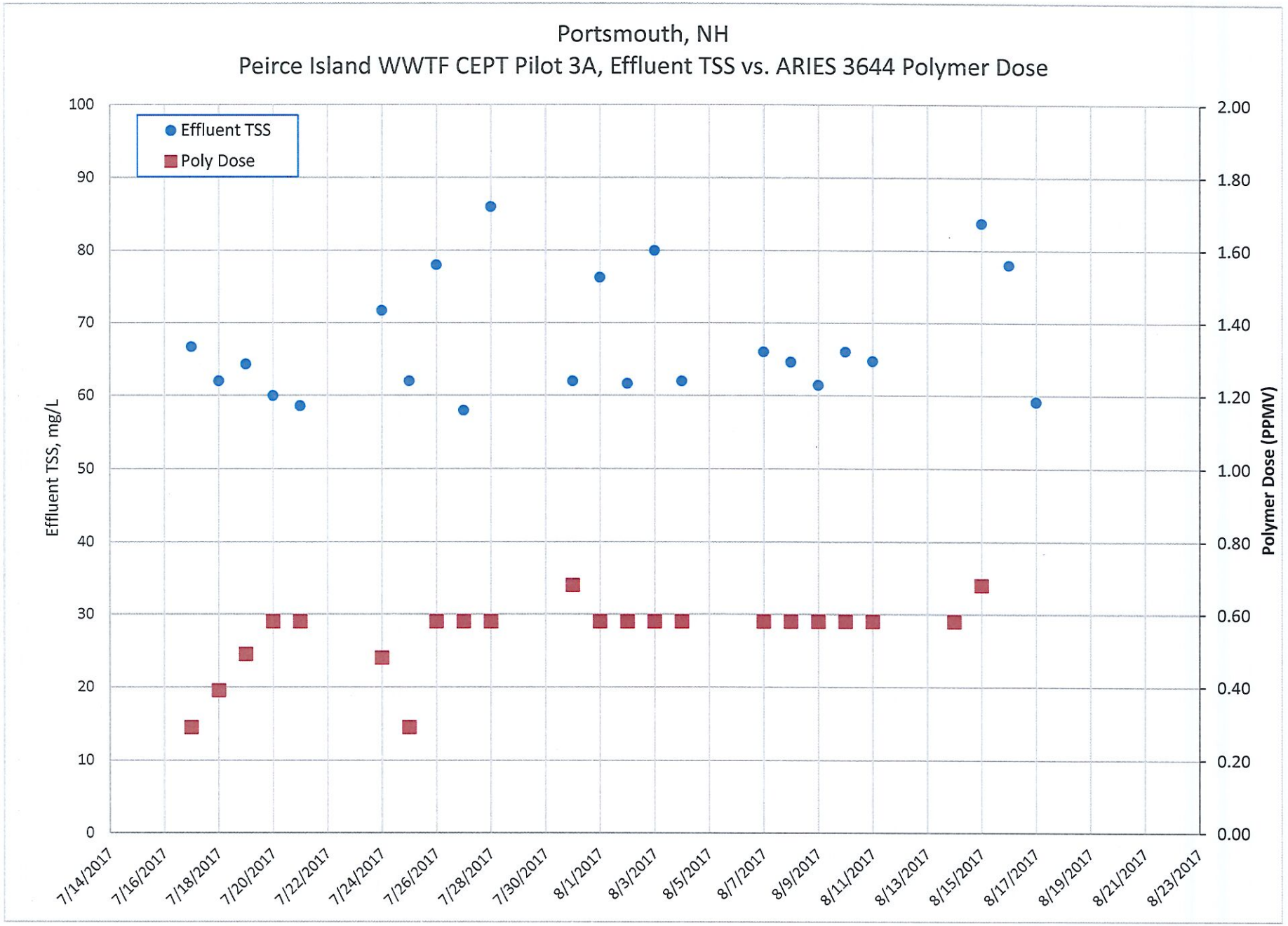
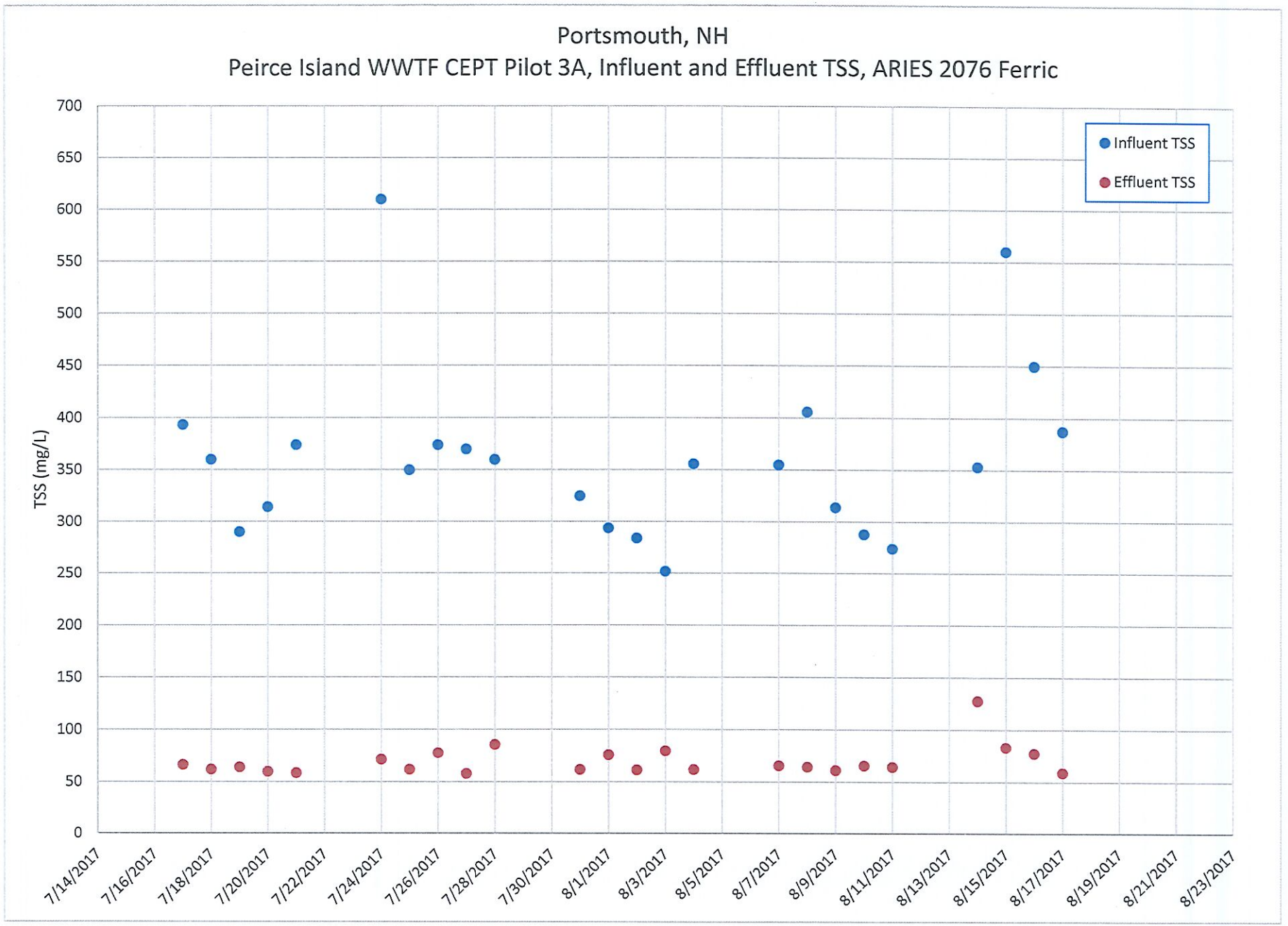
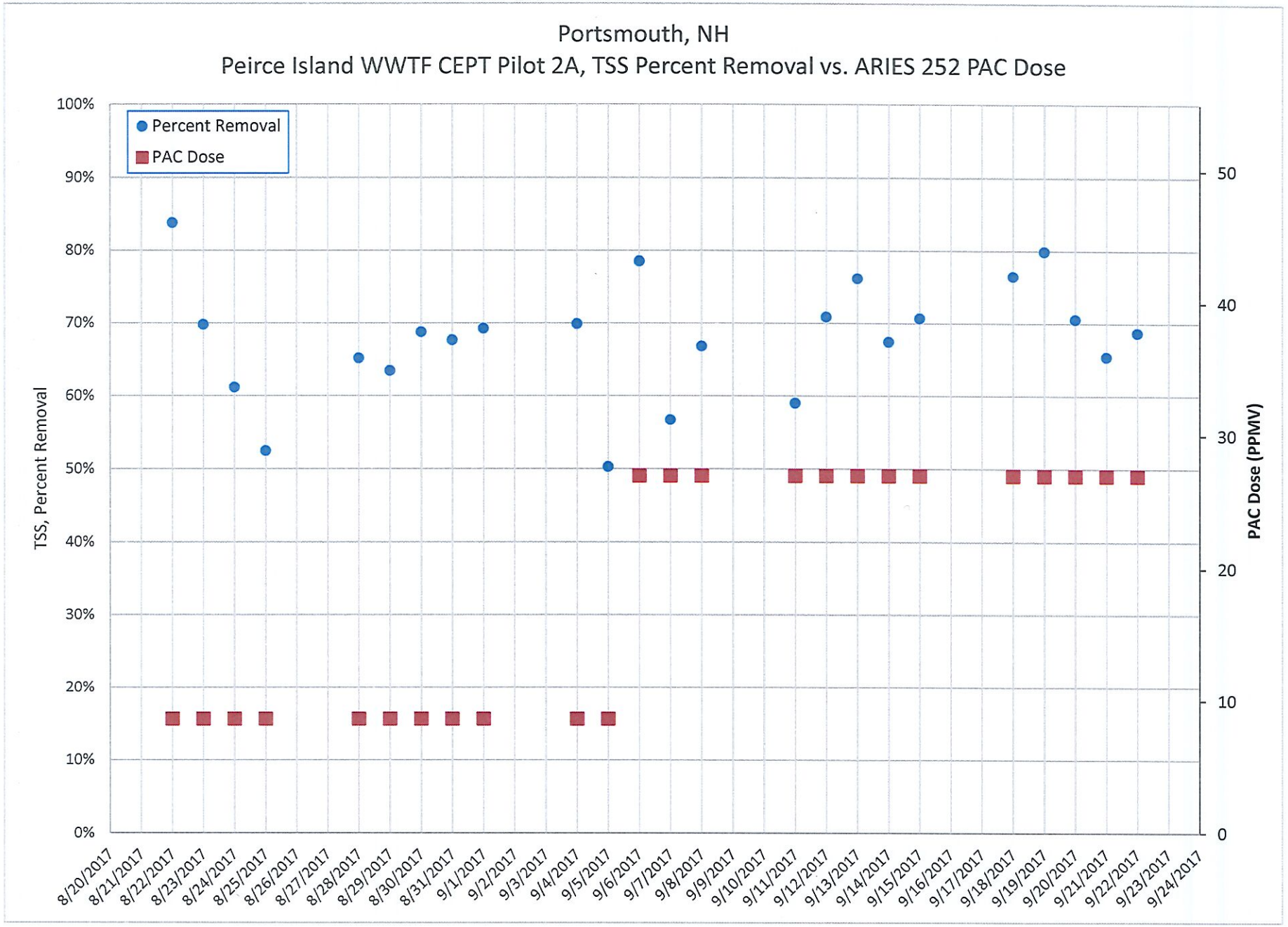
8/17/2017
8/19/2017
8/21/2017
8/23/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 3A, Effluent TSS vs. ARIES 3644 Polymer Dose
Effluent TSS
Poly Dose
Effluent TSS, mg/L
Polymer Dose (PPMV)
100
90
80
70
60
50
40
30
20
10
0
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
7/14/2017
7/16/2017
7/18/2017
7/20/2017
7/22/2017
7/24/2017
7/26/2017
7/28/2017
7/30/2017
8/1/2017
8/3/2017
8/5/2017
8/7/2017
8/9/2017
8/11/2017
8/13/2017
8/15/2017
8/17/2017
8/19/2017
8/21/2017
8/23/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 3A, Influent and Effluent TSS, ARIES 2076 Ferric
TSS (mg/L)
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
Influent TSS
Effluent TSS
7/14/2017
7/16/2017
7/18/2017
7/20/2017
7/22/2017
7/24/2017
7/26/2017
7/28/2017
7/30/2017
8/1/2017
8/3/2017
8/5/2017
8/7/2017
8/9/2017
8/11/2017
8/13/2017
8/15/2017
8/17/2017
8/19/2017
8/21/2017
8/23/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 2A, TSS Percent Removal vs. ARIES 252 PAC Dose
Percent Removal
PAC Dose
TSS, Percent Removal
PAC Dose (PPMV)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
50
40
30
20
10
0
8/20/2017
8/21/2017
8/22/2017
8/23/2017
8/24/2017
8/25/2017
8/26/2017
8/27/2017
8/28/2017
8/29/2017
8/30/2017
8/31/2017
9/1/2017
9/2/2017
9/3/2017
9/4/2017
9/5/2017
9/6/2017
9/7/2017
9/8/2017
9/9/2017
9/10/2017
9/11/2017
9/12/2017
9/13/2017
9/14/2017
9/15/2017
9/16/2017
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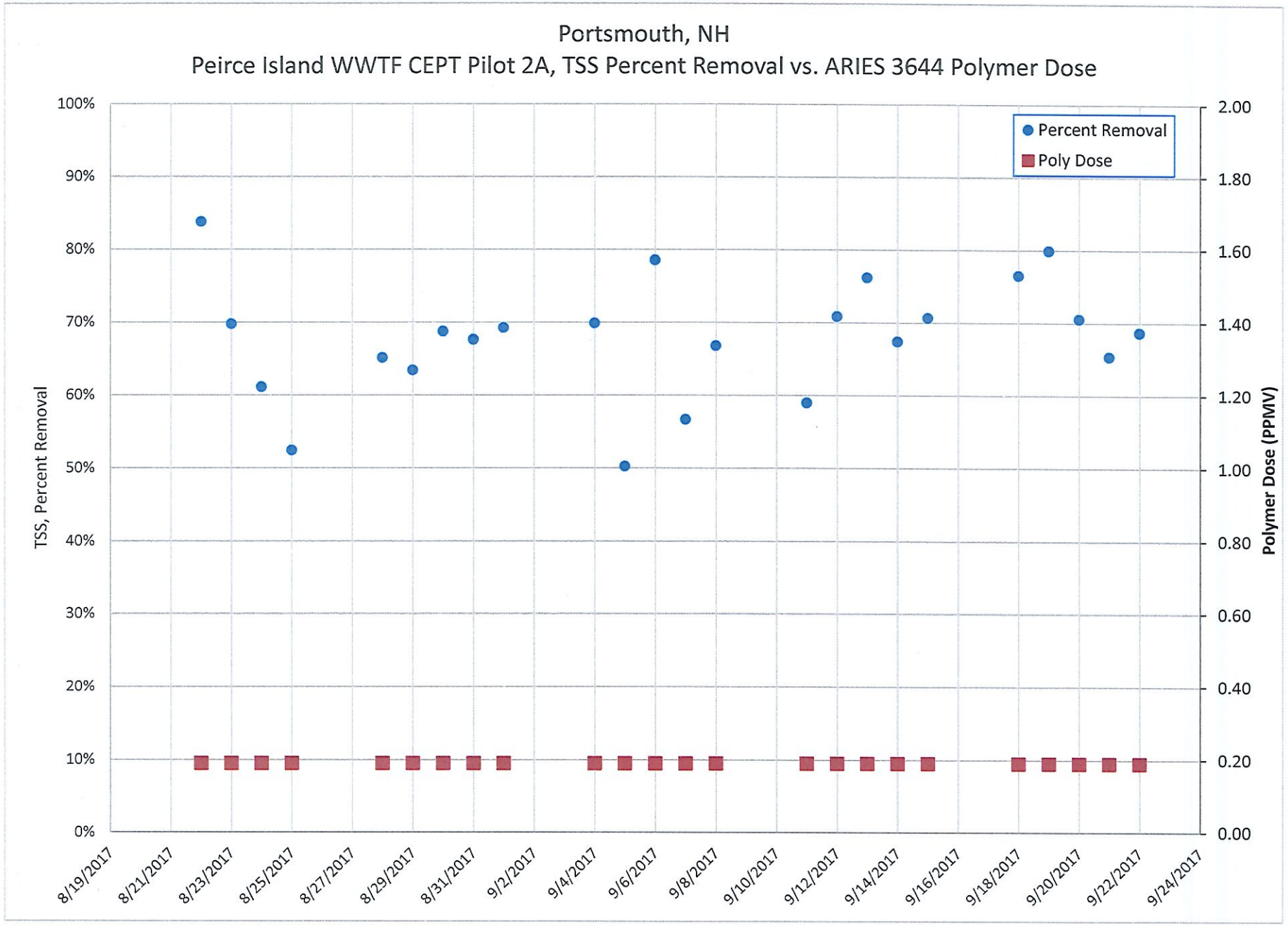
9/22/2017
9/23/2017
9/24/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 2A, TSS Percent Removal vs. ARIES 3644 Polymer Dose
TSS, Percent Removal
Polymer Dose (PPMV)
Percent Removal
Poly Dose
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
8/19/2017
8/21/2017
8/23/2017
8/25/2017
8/27/2017
8/29/2017
8/31/2017
9/2/2017
9/4/2017
9/6/2017
9/8/2017
9/10/2017
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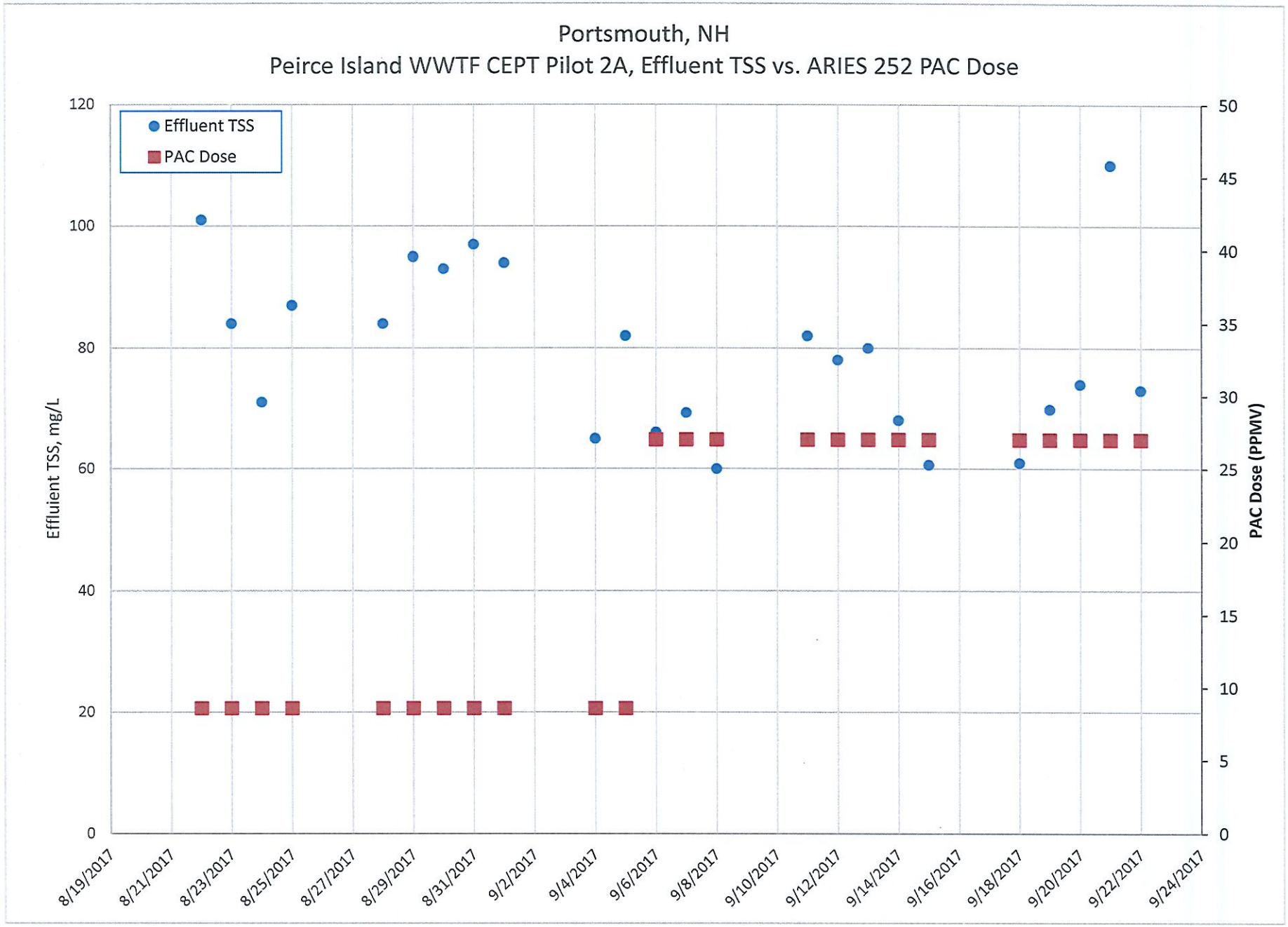
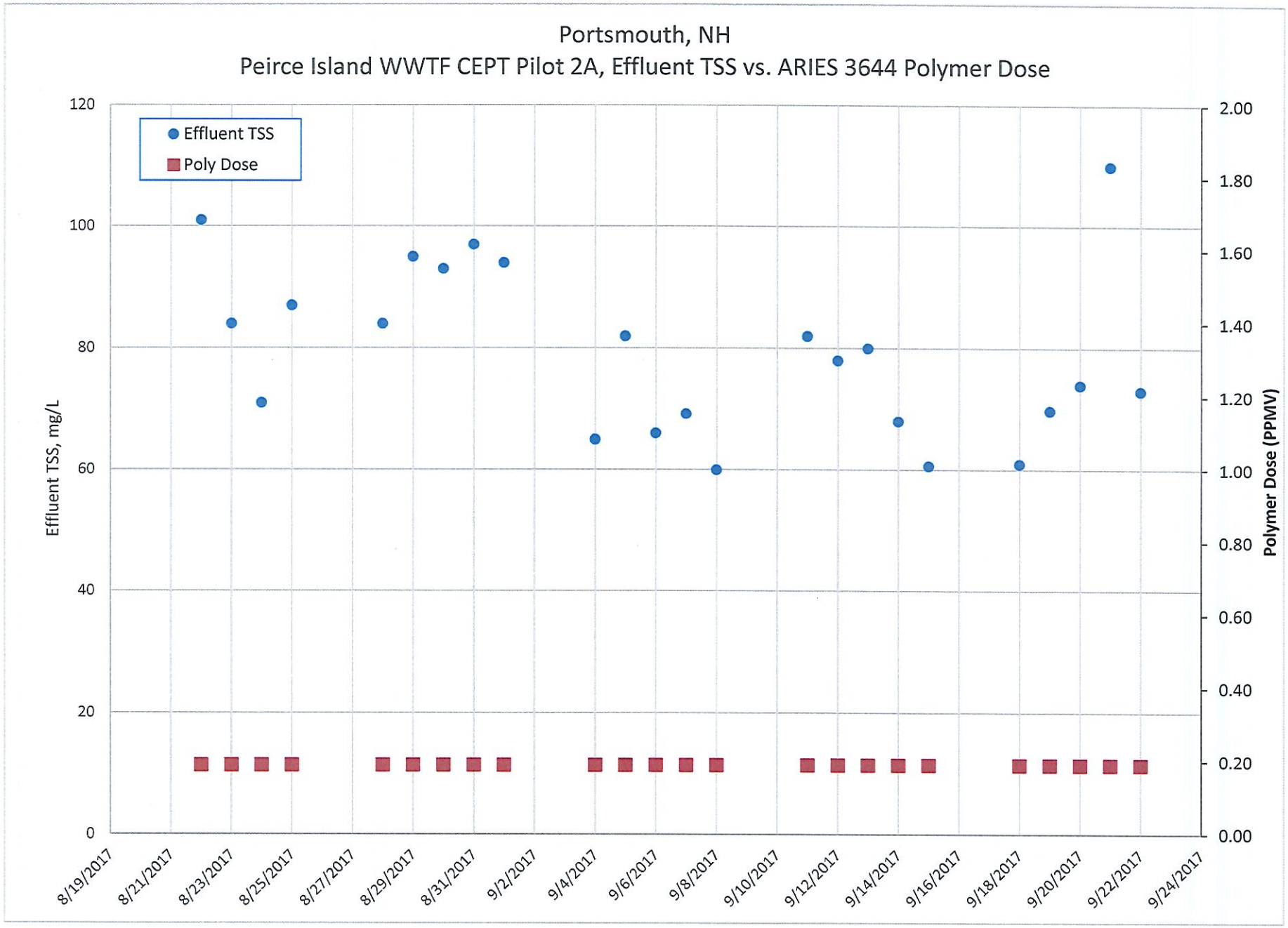
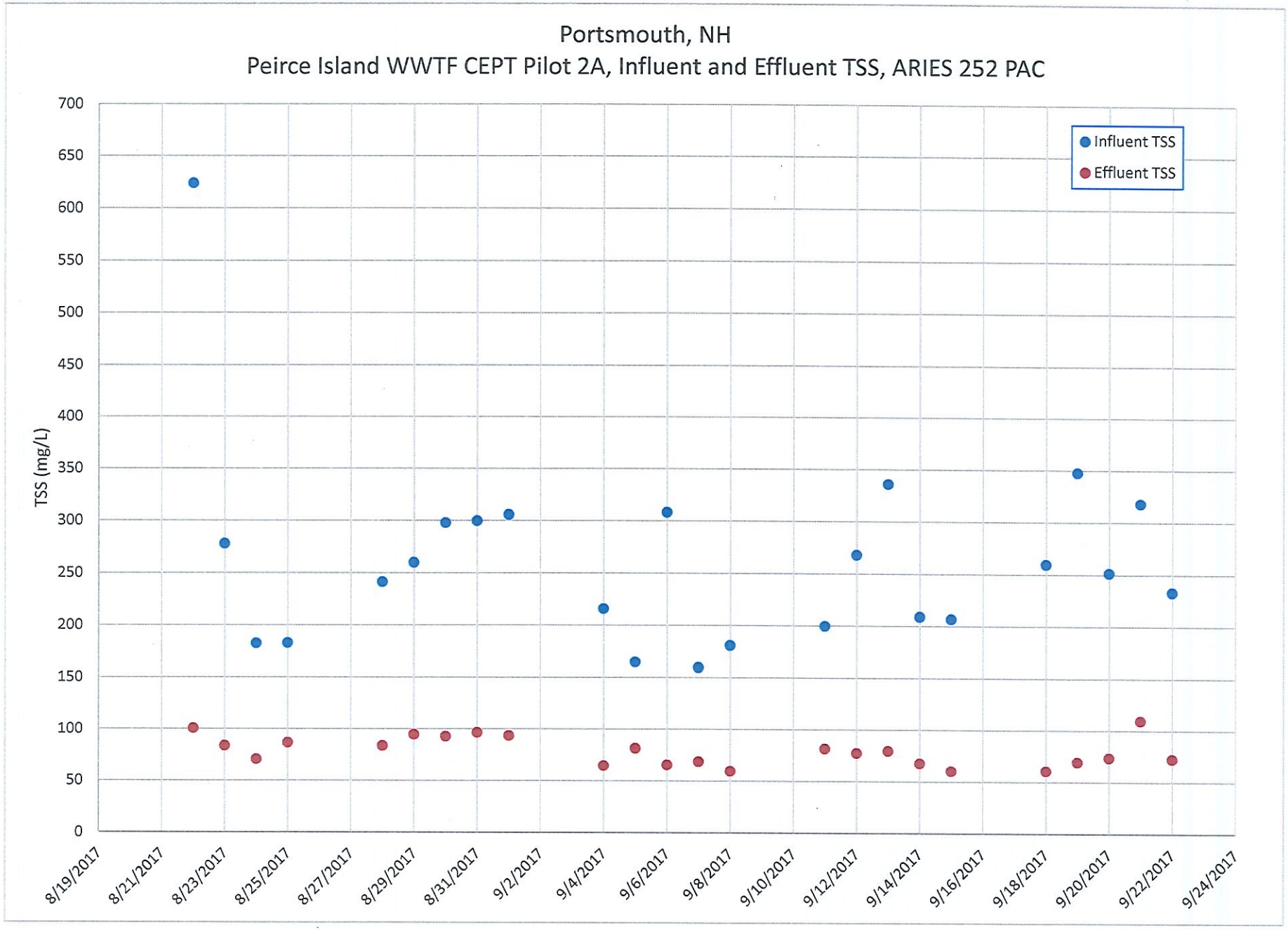
9/14/2017
9/16/2017
9/18/2017
9/20/2017
9/22/2017
9/24/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 2A, Effluent TSS vs. ARIES 252 PAC Dose
Effluent TSS
PAC Dose
Effluent TSS, mg/L
PAC Dose (PPMV)
120
100
80
60
40
20
0
50
45
40
35
30
25
20
15
10
5
0
8/19/2017
8/21/2017
8/23/2017
8/25/2017
8/27/2017
8/29/2017
8/31/2017
9/2/2017
9/4/2017
9/6/2017
9/8/2017
9/10/2017
9/12/2017
9/14/2017
9/16/2017
9/18/2017
9/20/2017
9/22/2017
9/24/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 2A, Effluent TSS vs. ARIES 3644 Polymer Dose
Effluent TSS
Poly Dose
Effluent TSS, mg/L
Polymer Dose (PPMV)
120
100
80
60
40
20
0
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
8/19/2017
8/21/2017
8/23/2017
8/25/2017
8/27/2017
8/29/2017
8/31/2017
9/2/2017
9/4/2017
9/6/2017
9/8/2017
9/10/2017
9/12/2017
9/14/2017
9/16/2017
9/18/2017
9/20/2017
9/22/2017
9/24/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 2A, Influent and Effluent TSS, ARIES 252 PAC
TSS (mg/L)
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
8/19/2017
8/21/2017
8/23/2017
8/25/2017
8/27/2017
8/29/2017
8/31/2017
9/2/2017
9/4/2017
9/6/2017
9/8/2017
9/10/2017
9/12/2017
9/14/2017
9/16/2017
9/18/2017
9/20/2017
9/22/2017
9/24/2017
Influent TSS
Effluent TSS

2120-01

PEIRCE ISLAND WWTF CEPT PILOT
PORTSMOUTH, NH

**Pilot Testing Kickoff Meeting NOTES**
**February 8, 2017 at 2:00 PM**

**ATTENDEES**

| | |
|---|---|
| • Don Song | City of Portsmouth |
| • Timothy Babkirk | City of Portsmouth |
| • Kathy Sanborn | City of Portsmouth |
| • Steve Clifton | Underwood Engineers |
| • David Mercier | Underwood Engineers |
| • Ransom Horner-Richardson | Underwood Engineers |

Work Completed Since Last Meeting:

- Completed Work Plan to submit to NHDES & EPA
- Performed additional jar testing on top 4 coagulants with 4 different polymers (see attached). The positions changed from last testing with the previous #4 (Aries 291) becoming showing similar or better performance to the existing coagulant and the previous #3 (Aries 245) showing significantly poorer performance. UE proposes to test Aries 2076, Aries 291, and Aries 252 based on most recent testing results. All coagulants should be paired with the existing polymer.
- Begun working with Mike Merrill to revise SCADA control for coagulant and polymer dosing pumps to allow better control during pilot.
-

Work Planned for the Next Month:

- Implement SCADA changes for control of the coagulant and polymer dosing.
- **Begin full scale operation (2/27).** Underwood recommends starting with Aries 291 as it is readily available. Recommended starting dose is 30 ppm.
    - Has the City ordered any chemical yet? **Not yet.**
    - Chemical dosing pipework will need to be modified.
- Pilot will be run 5 days a week for 5 weeks.
- Over the course of the first day or two the chemical dose will be dialed in. Will dose be held steady or should staff vary the dose based on observations and judgement?
- Samples will be picked up by Eastern Analytical at Pease on Tuesdays and Fridays. Samples should be moved from Peirce Island to Pease on Mondays and Thursdays. **UEI**

**to confirm all bottles to go to Pease. City lab uses 100 mL TSS sample, what will EAI use?**

- **City uses 11.0cm NCL 934-AH filters for TSS. What does EAI use?**
- **City to take a couple grab samples at beginning of each 5 week test to get quickest initial results.**

Other:

- We understand that the polymer used for dewatering may be changing? Should piloting be delayed until polymer changeover? **Yes. Pilot start moved to 2/27.**
- **UEI will email EPA to make them aware of a revised schedule in order to switch over dewatering polymer. Postpone pilot testing 2 weeks.**
- **City to determine if they can get out of dewatering polymer contract.**
- **UEI to confirm availability and pricing of 252 chemical with Aries.**
- **Should FSS/DSS tests be performed? UEI to consider.**
- **During pilot, how do we want to handle dosing at 10 MGD? Lock pumps out at 10 MGD? No, staff will use normal procedure which is to switch to manual dosing. Staff to log when this happens during the pilot.**
- **UEI to email Mike programming changes for polymer feed.**

Peirce Island WWTF
Portsmouth, NH
Polymer & Coagulant Screening
January 31, 2017

***Introduction***

Ransom Horner-Richardson & David Mercier (UE) met with Nate Butterfield (Aries Chemical) and Tim Babkirk and Kathy Sanborn (City of Portsmouth) at the Peirce Island WWTF to perform a second round of preliminary jar testing before CEPT pilot testing. The purpose of this second round of jar testing was to test each of the three top performing coagulants with several polymers to determine if better performance can be achieved than with the current polymer (Aries 3644). Additional jar testing was also performed to identify the coagulant dose which will be recommended to use at the start of piloting.

***Existing Conditions***

Currently Aries 2076 (Ferric) coagulant is used at the WWTF along with Aries 3644, an anionic polymer. Nate noted that Aries 2076 is a proprietary ferric blend formula that has been developed over the years specifically for the Peirce Island WWTF. To Nate's knowledge it is developed for and used exclusively by the Peirce Island facility. According to staff, the ferric was being dosed at approximately 20 ppm and the polymer at 0.08 ppm on the day of the jar testing (1/31/17).

***Preliminary Jar Testing***

The three coagulants used were the three that had the best performance during the August 11, 2016 jar testing. The following three (3) different coagulants were tested:

1. Aries 2076 (Currently used)
2. Aries 245
3. Aries 291

For this jar testing only anionic polymers were used based on past experience and testing by Aries at the Peirce Island plant. The following four (4) different polymers were tested:

1. Aries 3644 (Currently used)
2. Aries 3640 (previously used until 2015)
3. Aries 3638 (high molecular weight)
4. Aries 3620 (low molecular weight)

Each polymer was mixed to a 0.5% solution by volume for jar testing. This was dosed into the 1 liter samples at 0.2 ml to achieve 1 ppm of polymer & 0.4 ml to achieve 2 ppm of polymer.

Each coagulant was mixed to a 1% solution by volume so that 2 ml of solution dosed into a 1 liter sample would result in 20 ppm coagulant does by volume.

**The first round of jar tests** performed was to test Aries 2076 with the four different polymers. A separate one (1) liter sample of raw influent wastewater was used for all jar tests. 2 mL of a 1% coagulant solution was added to each 1 liter sample of wastewater and then rapidly mixed for 5 minutes. Next 0.2 mL of 0.5% polymer solution was added to each sample and was rapidly mixed for 15 seconds followed by 5 minutes of slow mixing. Mixing paddles were then removed from

the samples and they were allowed to settle. Visual observations were made to determine which polymer in conjunction with the coagulant formed the highest quality floc and produced the best clarity.

The results for the first test were difficult to discern, so it was decided that the test would be run again using 40 ppm of coagulant and 2 ppm of polymer. The same procedure was used. This time the results were, from best performance to worst performance:

1. Aries 3644 (Currently in use at the WWTF)
2. Aries 3640
3. Aries 3638
4. Aries 3620

**The second round of testing** used Aries 245 as the coagulant in all four (4) jars, dosed at 40 ppm, and each of the 4 polymers dosed at 2ppm. The same procedure was used as on test 1. Results from this test were visibly cloudier than in test 1 and were much more similar between polymers. It was observed that Aries 3620 performed noticeably worse than the other 3 but no noticeable difference was observed between Aries 3644, 3640, and 3638. The following results were recorded:

1. Aries 3644, Aries 3640, Aries 3638 (no difference)
2. Aries 3620

**The third round of testing** used Aries 291 as the coagulant in all four (4) jars, dosed at 40 ppm, and each of the 4 polymers dosed at 2ppm. The same procedure was used as on test 1. Results from this test were best of the three coagulants. The smallest floc occurred with the Aries 3644. Performance, best to worst, was:

1. Aries 3644
2. Aries 3620
3. Aries 3638, 3640 (no difference)

Following the first 3 tests it was determined that Aries 3644 was either the top performing polymer for each coagulant or it was at least as good as the other polymers. Based on this it is recommended that Aries 3644 be used for each of the three coagulants selected for full-scale piloting.

**The fourth round of testing** used all three coagulants (Aries 2076, Aries 254, and Aries 291) side by side, each with the 3644 polymer. Each jar was given a 40 ppm dose of coagulant and a 2 ppm dose of polymer and the same mixing method was used as the previous tests. The results were, from best performance to worst performance:

1. Aries 291
2. Aries 2076
3. Aries 245

The observations showed Aries 291 and Aries 2076 both to have significantly better performance than Aries 245. These results differed with what was observed on August 11, 2016 which showed Aries 2076 to perform much better than the other chemicals, including Aries 291. It is assumed that low flows and low temperatures are leading to a low coagulant demand at the plant and this may be contributing to the results being different today than what was observed in August 2016.

**The fifth round of testing** used Aries 291 at various doses with Aries 3644 at a fixed dose. The coagulant (Aries 291) was dosed at 20 ppm, 30 ppm, and 40 ppm, and the polymer (Aries 3644) was dosed at 2 ppm. The results showed an improvement in performance between 20 ppm and 30 ppm, but no noticeable difference was observed between 30 ppm and 40 ppm. From this, it is recommended that full-scale pilot testing with Aries 291 start with a dose of 30 ppm by volume.

**The final round of testing** used Aries 245 at various doses with Aries 3644 at a fixed dose. The coagulant (Aries 245) was dosed at 30 ppm, 40 ppm, 50 ppm, and 60 ppm, and the polymer (Aries 3644) was dosed at 2 ppm. The results showed improvement in performance with higher coagulant dose across the entire range. The most significant difference was observed between 30 ppm and 40 ppm. From this, it is recommended that full-scale pilot testing with Aries 245 start with a dose of 40 ppm by volume.

Nate Butterfield noted that Aries 291 is a chemical that Aries stocks in their local warehouse and could be delivered to the WWTF relatively quickly. Aries 245 is not stocked locally and will have a longer lead time. It is therefore recommended that full-scale pilot testing be started with Aries 291.

**Ransom Horner-Richardson**

| | |
|---|---|
| **From:** | Nate Butterfield <nate@butterfieldenv.com> |
| **Sent:** | Wednesday, February 8, 2017 8:46 AM |
| **To:** | dmercier@underwoodengineers.com |
| **Cc:** | nate@butterfieldenv.com Butterfield; 'Ransom Horner-Richardson'; 'W. Steven Clifton' |
| **Subject:** | RE: Peirce Island WWTF |
| **Attachments:** | 20170207_125652.jpg |

Hi Dave,

I ran the test as described below. 2976 was #1 performer, 291 was 2nd, 252 was 3rd and 245 was 4th. See attached picture as well.

Thanks,
Nate

Sent from my Verizon, Samsung Galaxy smartphone

-------- Original message --------
From: David Mercier <dmercier@underwoodengineers.com>
Date: 2/7/17 11:33 AM (GMT-05:00)
To: 'Nathaniel Butterfield' <nate@butterfieldenv.com>
Cc: 'Ransom Horner-Richardson' <ransom@underwoodengineers.com>, "'W. Steven Clifton'" <sclifton@underwoodengineers.com>
Subject: Peirce Island WWTF

Nate:

Thanks for taking my call just now. While you are on site today (2/7), please run a jar test on the raw influent wastewater using the following four coagulants at 40 ppm: 2076, 245, 252 & 291. Dose the 3644 polymer at 2 ppm for all four jars. Please do a visual confirmation of the performance for each coagulant and reply to us with a ranking of 1 to 4. Thanks and please call with any questions.

David J. Mercier, P.E.

Senior Project Manager

Underwood Engineers, Inc.

99 North State Street

## David Mercier

**From:** David Mercier [dmercier@underwoodengineers.com]
**Sent:** Monday, February 06, 2017 3:19 PM
**To:** 'Michael W. Merrill'
**Cc:** 'Terry L. Desmarais'; 'ransom@underwoodengineers.com'; 'sclifton@underwoodengineers.com'; 'Donald Song'
**Subject:** Portsmouth Peirce Island CEPT - New Chemicals

Mike:

Thank you for speaking with me during the jar testing last week. We discussed that the current programming in the SCADA system and PLC for the chemical feed dosing is chemical specific and flow meter specific and we need to change the programming to be specific for the pump but adjustable for the flow meter it is paced off of and generic for the chemical being fed to complete the CEPT pilot study. To that end, I am suggesting the following SCADA programming changes be made in advance of piloting, TO BE CONFIRMED BY DON SONG BEFORE IMPLEMENTATION.

For the coagulant dosing, Tim requested that you remove the ability at the local PLC to change the chemical dose. Suggested PLC/SCADA programming changes are as follows with the user adjustable features only being available at SCADA:

Program PLC/SCADA to pace off flow. Run pump at 0% speed at flow of 0 MGD and 100% speed at flow of 20.0 MGD.
D-box 4-20 mA = 0-20.0 MGD. Pump pacing 4-20 mA = 0-100% speed. Dose delivered will be 63.6 ppm for W-M 520U pump.
1272 gpd / 20 MGD = 63.6 ppm

Need the following programming changes made at SCADA:
1: Need a user adjustable input for the default dose delivered at 0 to 20 MGD with chem feed pump.

2. Need hard programmed adjustment factor when D-box flow is selected for chemical pacing.
4-20mA adjustment should be 20 MGD / 20 MGD = 1.0. 63.6 * 1.0 = 63.6 ppm

3. Need hard programmed adjustment factor when Mechanic St flow is selected for chemical pacing.
4-20mA adjustment should be 20 MGD / 22 MGD = 0.909. 63.6 * 0.909 = 57.8 ppm

4. Need hard programmed adjustment factor when Mechanic St Bypass flow is selected for chemical pacing.
4-20mA adjustment should be 20 MGD / 11.52 MGD = 1.736. 63.6 * 1.736 = 110.4 ppm

5. Need user adjustable adjustment factor to increase/decrease dose below default dose. Newly calculated dose
should display on screen. For example, when D-box flow is selected, and a 0.5 adjustment factor is entered, calculated dose should be Default dose (63.6) * 1.0 * 0.5 = 31.8 ppm.

Please review and provide your thoughts. Thank you.

David J. Mercier, P.E.
Senior Project Manager
Underwood Engineers, Inc.
99 North State Street
Concord, NH 03301
ph (603) 230-9898
fax (603) 230-9899

Polymer Dosing Results for LMI Model No. AA751-86PBA

**Pump Speed Variable and Pump Stroke constant at 50%**

| Speed % | Dosing Rate 1 L/min | Dosing Rate 2 L/min | Composite Dosing Rate L/min | Dosing Rate gpm | Dosing Rate gph | Dosing Rate gpd |
|---|---|---|---|---|---|---|
| 10 | 0.00395 | 0.0041 | 0.004025 | 0.0010634 | 0.06 | 1.5 |
| 20 | 0.0085 | 0.0087 | 0.0086 | 0.0022721 | 0.14 | 3.3 |
| 30 | 0.0125 | 0.01294 | 0.01272 | 0.0033606 | 0.20 | 4.8 |
| 40 | 0.0169 | 0.0174 | 0.01715 | 0.004531 | 0.27 | 6.5 |
| 50 | 0.021 | 0.0218 | 0.0214 | 0.0056539 | 0.34 | 8.1 |
| 60 | 0.0255 | 0.0261 | 0.0258 | 0.0068164 | 0.41 | 9.8 |
| 70 | 0.0298 | 0.0306 | 0.0302 | 0.0079789 | 0.48 | 11.5 |
| 80 | 0.0337 | 0.0348 | 0.03425 | 0.0090489 | 0.54 | 13.0 |
| 90 | 0.038 | | 0.038 | 0.0100396 | 0.60 | 14.5 |
| 100 | 0.0424 | 0.04378 | 0.04309 | 0.0113844 | 0.68 | 16.4 |

SUMMARY:
Program PLC/SCADA to pace off flow. Run pump at 0% speed at flow of 0 MGD and 100% speed at flow of 20.0 MGD.
D-box 4-20 mA = 0-20.0 MGD. Pump pacing 4-20 mA = 0-100% speed. Dose delivered will be 0.82 ppm with stroke at 50%.
Dose delivered will be 0.82 ppm for LMI AA751-86PBA. 16.4 gpd / 20 MGD = 0.82 ppm
Need the following programming changes made at SCADA:
1. Need a user adjustable input for the default dose delivered at 0 to 20 MGD with chem feed pump.
2. Need hard programmed adjustment factor when D-box flow is selected for chemical pacing.
4-20mA adjustment should be 20 MGD / 20 MGD = 1.0. 0.82 * 1.0 = 0.82 ppm
3. Need hard programmed adjustment factor when Mechanic St flow is selected for chemical pacing.
4-20mA adjustment should be 20 MGD / 22 MGD = 0.909. 0.82 * 0.909 = 0.75 ppm
4. Need hard programmed adjustment factor when Mechanic St Bypass flow is selected for chemical pacing.
4-20mA adjustment should be 20 MGD / 11.52 MGD = 1.736. 0.82 * 1.736 = 1.42 ppm
5. Need user adjustable adjustment factor to increase/decrease dose below default dose. Newly calculated dose should display on screen. For example, when D-box flow is selected, and a 0.5 adjustment factor is entered, calculated dose should be Default dose (0.82) * 1.0 * 0.5 = 0.41 ppm.

2120-01

PEIRCE ISLAND WWTF CEPT PILOT
PORTSMOUTH, NH

**Pilot Test 1 Meeting NOTES**
**April 13, 2017 at 12:00 PM**

**ATTENDEES (Via Conference Call)**

| | |
|---|---|
| • Terry Desmarias | City of Portsmouth |
| • Don Song | City of Portsmouth |
| • Timothy Babkirk | City of Portsmouth |
| • Steve Clifton | Underwood Engineers |
| • David Mercier | Underwood Engineers |
| • Ransom Horner-Richardson | Underwood Engineers |

Work Completed Since Last Meeting:

- WWTF has been running with Aries 291 chemical dosing since 2/27/17. Pilot was stopped on 3/7/17 due to dewatering issues and then restarted 3/21/17.
- 23 data points have been collected to date (of 25 targeted); only 14 have been received back from the lab to date.

Discussion of Results:

- During the first week of dosing, the applied dose of PAC varied as optimal dose was dialed in, but performance was strong throughout the week (mostly <40 mg/L TSS effluent and >80% removal).
- Since restarting the pilot, dosing was held at ~27 PPMV of PAC and ~0.29 PPMV of polymer for a week and then reduced to ~ 6.5 PPMV of PAC and ~0.16 PPMV of polymer based on visual results. With the data received so far, it appears that the lower dose seems to correlate to lower plant performance.
- City noted that they have increased dose back up to ~8.0 PPMV of PAC.
- The City noted that during the week showing high percent removal, sludge was accumulating in the Gravity Thickeners throughout the water column and recycling back to the Primary Clarifiers. Staff observed low percent solids in the Gravity Thickener underflow and gray suspended solids in the thickener overflow. In the Primary Clarifiers the solids settled well and were sent back to Gravity Thickeners. That weekend, heavy storms sent high flow through the plant and flushed the solids out.
- UEI recommends the dose be increased to ~27 PPMV of PAC again for the last week to confirm if gravity thickener issues and better effluent TSS numbers return.
- For the duration of Pilot Test 1 the City has observed wetter solids from the Fournier Press and a reduction in the overall tonnage of solids produced. They have also observed

increased solids deposits within the chlorine contact tanks. CCTs were cleaned this Monday (4/10/17) and found ~12" of solids buildup since last cleaning 2 weeks ago. Typical would be 3" or 4".

- It was decided that for the remainder of Pilot Test 1 and for the next chemicals, TSS samples should be gathered from Gravity Thickener overflow and underflow to assess the impact on solids capture. City to start this collection today (4/13/17).

Work Planned for Remainder of Pilot Test 1:

- City to hold low chemical doses through tomorrow (4/14/17) and then increase doses over the weekend back to starting doses of ~27 PPMV of PAC and ~0.29 PPMV of polymer and hold these for the final week of Pilot Test 1.
- City will collect Gravity Thickener underflow and overflow TSS samples for the remaining 2 days of this week and all of next week. TSS testing for these will be done in-house.
- City to provide UEI with in-house TSS data and dosing log since beginning of Pilot Test 1.
- UEI to continue to analyze data as it is received from Eastern Analytical.

Work Planned for Pilot Test 2:

- Pilot Test 2 will begin on 4/24/17 with Aries 252. City has 5 totes on site and 5 more on the way.
- The new chemical will be started at a dose of ~8 PPMV of PAC and ~0.16 PPMV of polymer based on the results of Pilot Test 1 and can be increased depending on visual results.
- City will run grab samples and composites in-house for the first week in addition to sending composites to the lab and provide data to UEI to allow quicker feedback on results.
- Based on the experience of Pilot Test 1, it was not beneficial for UEI to be on site for the first several days of pilot testing as proposed in the Work Plan. It was decided that for Pilot Test 2 and 3, this protocol should be changed so that the City staff will handle the startup and collect grab samples and composites to analyze and optimize the dose in-house. UEI will be on-call and an on-site meeting will be held Monday 5/1/17 with UEI to review optimization based on in-house data collected. If the City is experiencing significant issues, a meeting can be held on Friday 4/28/17.
- Based on the Pilot Test 1 experience, it appears to take several days to a week for the system as a whole to reflect change in coagulant. As such, UEI recommends sampling for 6 weeks after the new chemical is started.

Other:

- UEI to provide meeting notes from this meeting to the City to be issued to EPA.

Portsmouth, NH
Peirce Island WWTF
Pilot Testing Chemical dosing Results

Bold indicates a change in dose

| | | *SCADA Set Doses* | | *PAC Pump Measured flow/dose* | | | *Poly Pump Measured flow/dose* | | *EAI Lab TSS Values* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | D-Box Flow (MGD) | PAC Setpoint (mg/L) | Poly Setpoint (mg/L) | PAC pump RPM | PAC pump flow rate (GPH) | PAC Dose (mg/L) | Poly Pump Flowrate (ml/min) | Poly Dose (mg/L) | Influent (mg/L) | Effluent (mg/L) | Removal (%) | Notes |
| **2/27/2017 7:50** | 9.6 | **30** | | 26.1 | 5.33 | 13.33 | | | | | | **Pilot started with ARIES 291 PAC. Setpoints of 30ppm and 0.5ppm chosen for pilot startup. Poly SCADA changes had not been implemented. Coag SCADA not done correctly.** |
| **2/27/2017 9:00** | 9.7 | 30 | **0.49** | 52.2 | 10.66 | 26.39 | | | | | | **SCADA changes implemented for Poly and Coag. Setpoints set for both chemicals.** |
| **2/27/2017 9:30** | 10.1 | **19.94** | **0.25** | | | | | | | | | **Poor settling in clarifiers, poor quality effluent (visual) Doses were both reduced per operator judgement.** |
| 2/27/2017 9:55 | 10.6 | 19.94 | 0.25 | 34.2 | 6.99 | 15.82 | | | | | | Check of coagulant pump dose showed somewhat lower than SCADA dose. |
| 2/27/2017 11:00 | 11.8 | 19.94 | 0.25 | 39.9 | 8.15 | 16.58 | | | | | | Clarifiers look better, floc is sinking well. Check of coagulant pump again showed dose to be low. |
| **2/27/2017 11:20** | 11.8 | 19.94 | **0.19** | | | | | | | | | **Floc still looks good, but some of it is floating. Operator reduced poly dose.** |
| **2/27/2017 13:00** | 9.2 | **16.17** | 0.19 | 22 | 4.49 | 11.73 | | | | | | **Operator dropped PAC dose to 16ppm. Check of pump shows it is still low.** |
| 2/27/2017 13:10 | 9.8 | 16.17 | 0.19 | | | | 6.74 | 0.26 | | | | Flow test for poly pump is slightly high. |
| 2/27/2017 13:20 | 10.2 | 16.17 | 0.19 | | | | 5.88 | 0.22 | | | | Flow test for poly pump is slightly high. |
| 2/27/2017 14:00 | 10.2 | 16.17 | 0.19 | 22.5 | 4.60 | 10.82 | | | | | | Check of coagulant pump shows flows still too low. |
| 2/28/2017 8:00 | 7.5 | 16.17 | 0.19 | 9.3 | 1.90 | 6.08 | | | | | | Determined that SCADA programming was not quite right up till this point. |
| 2/28/2017 8:45 | 8.4 | 16.17 | 0.19 | 13.6 | 2.78 | 7.94 | | | | | | RHR troubleshot SCADA with Mike, determined problem. Mike made changes 2/28/17 afternoon. Need to verify that changes were correct |
| 2/28/2017 9:00 | | 16.17 | 0.19 | | | | | | 173 | 32.5 | 81.21 | Sample collected at 9:00 AM represents previous 24 hour period. |
| **3/1/2017 8:00** | 8.5 | **20** | **0.29** | | | | | | | | | **Doses at SCADA had been adjusted since day before - Verify when changes were made** |
| **3/1/2017 8:10** | 8.5 | **40.43** | 0.29 | | | | | | | | | **Poor clarifier performance (visual). It was decided to turn dose up to 40 ppm to see if performance improved.** |
| 3/1/2017 8:30 | 8.3 | 40.43 | 0.29 | 77.2 | 15.77 | 45.61 | | | | | | Flow test for PAC slightly high. |
| 3/1/2017 9:00 | | 40.43 | 0.29 | | | | | | 188 | 35.0 | 81.38 | Sample collected at 9:00 AM represents previous 24 hour period. |
| **3/1/2017 17:00** | | **30** | **2** | | | | | | | | | **Doses reset to jar test optimal levels of 30ppm and 2ppm and hold for 24 hrs.** |
| 3/2/2017 8:30 | 8.1 | 30 | 2 | 58.8 | 12.01 | 35.59 | 46.3 | 2.17 | | | | Clarifiers had lots of solids on top |
| 3/2/2017 9:00 | 7.9 | 30 | 2 | 55.1 | 11.26 | 34.20 | | | | | | Flow test for PAC slightly high. |
| 3/2/2017 9:00 | | 30 | 2 | | | | | | 186 | 29.0 | 84.41 | Sample collected at 9:00 AM represents previous 24 hour period. |
| **3/3/2017 8:00** | | **5.39** | **0.12** | | | | | | | | | **Frozen solids on top of tank caused skimmer arm to bind up. City backed dose off drastically.** |
| 3/3/2017 9:00 | | 30 | 2 | | | | | | 185 | 29.0 | 84.32 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/3/2017 11:00 | | 5.39 | 0.12 | | | | | | | | | Lower doses have resulted in significant improvement to clarifier performance (visual). City notes they can only process 30 gpm of sludge vs 50 gpm with ferric. |
| 3/4/2017 9:00 | | 5.39 | 0.12 | | | | | | 189 | 41.8 | 77.88 | Sample collected at 9:00 AM represents previous 24 hour period. |
| **3/7/2017 7:30** | **PILOT TESTING WITH ARIES 219 STOPPED DUE TO CONSTRUCTION ISSUES AT WWTF.** | | | | | | | | | | | **Plant staff need to catch up on sludge dewatering which has been adversely affected by change to PAC coagulant.** |
| **3/21/2017 7:00** | **PILOT TESTING WITH ARIES 219 RESTARTED.** | | | | | | | | | | | |
| **3/21/2017 9:00** | | **26.95** | **0.10** | | | | | | | | | **City restarted pilot with coagulant dose similar to jar testing doses.** |
| 3/22/2017 9:15 | | 26.95 | **0.19** | | | | | | 272 | 40.5 | 85.11 | Small Floc spreading over surface of Clarifiers, Not settling well, Still having Problems running PAC sludge through Fouriner Press. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/23/2017 9:00 | | 26.95 | 0.29 | | | | | | 238 | 29.5 | 87.61 | Small Floc spreading over surface of Clarifiers, Not settling well, Still having Problems running PAC sludge through Fouriner Press. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/24/2017 8:45 | | 26.95 | 0.29 | | | | | | 169 | 35.5 | 78.99 | Light gray floc observed in Gravity Thickener, not settling well. Only about 6" of sludge in thickener. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/25/2017 7:30 | | **24.26** | 0.29 | | | | | | 238 | 31.0 | 86.97 | **Sample collected at 9:00 AM represents previous 24 hour period. PAC dose decreased per Operator's judgement.** |
| **3/25/2017 10:15** | | **29** | 0.29 | | | | | | | | | **PAC dose was increased per Opertor's judgement** |
| **3/25/2017 16:45** | | **16.17** | **0.16** | | | | | | | | | **Both chemical doses were reduced per Opertor's judgement** |
| **3/26/2017 10:30** | | **8.09** | 0.16 | | | | | | | | | **PAC dose was reduced per Opertor's judgement** |
| 3/27/2017 9:30 | | 8.09 | 0.16 | | | | | | | | | Over the weekend the Thickener was all light gray suspended Floc top to bottom no separation showing in Sludge Judge |
| 3/28/2017 8:45 | | **6.47** | **0.12** | | | | | | 504 | 62.5 | 87.60 | Poor settling, very thin sludge, not pressing well, lots of Pin Floc in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |

**Portsmouth, NH**
**Peirce Island WWTF**
**Pilot Testing Chemical dosing Results**

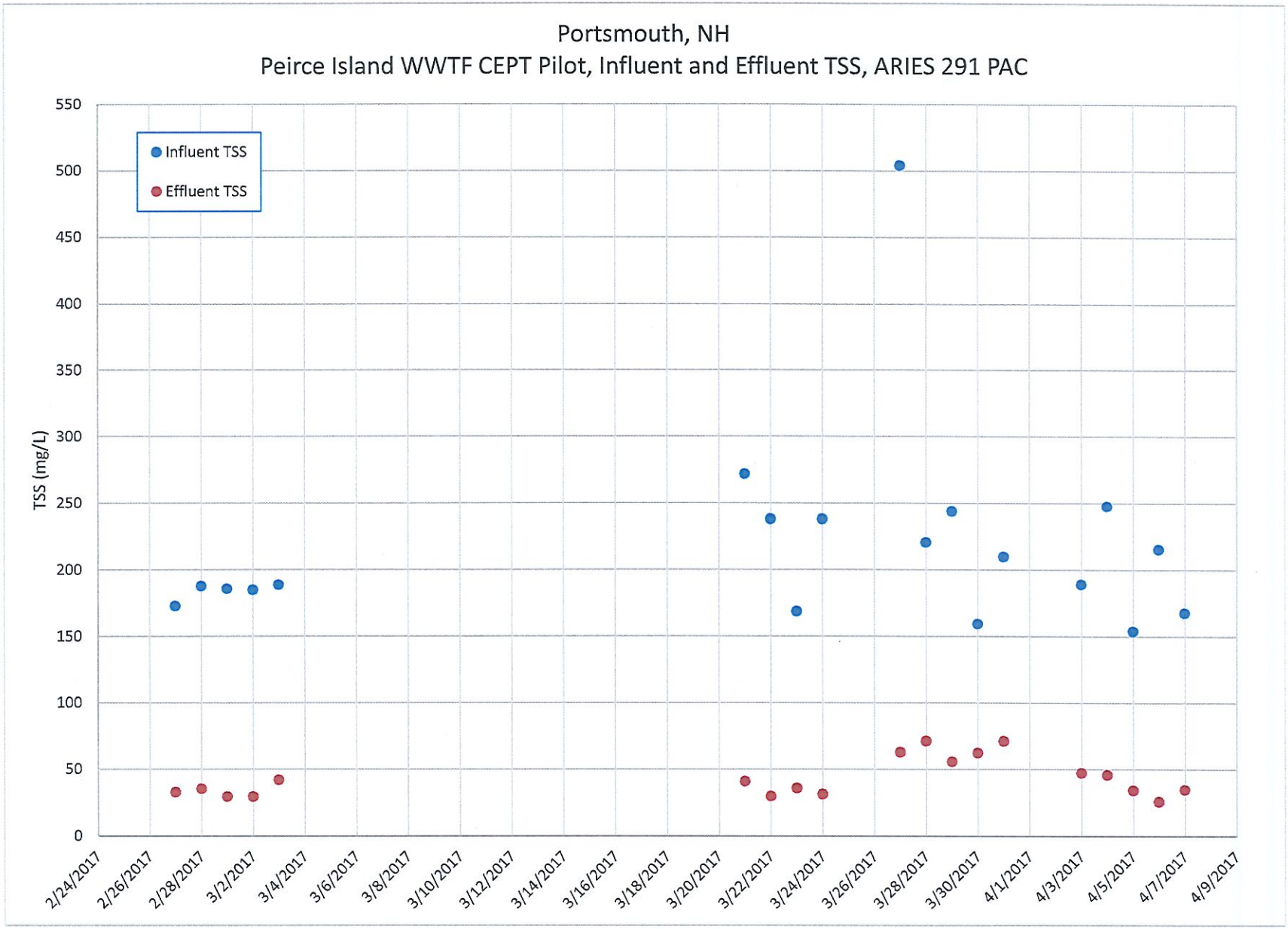
**Bold** indicates a change in dose

| | | *SCADA Set Doses* | | *PAC Pump Measured flow/dose* | | | *Poly Pump Measured flow/dose* | | *EAI Lab TSS Values* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | D-Box Flow (MGD) | PAC Setpoint (mg/L) | Poly Setpoint (mg/L) | PAC pump RPM | PAC pump flow rate (GPH) | PAC Dose (mg/L) | Poly Pump Flowrate (ml/min) | Poly Dose (mg/L) | Influent (mg/L) | Effluent (mg/L) | Removal (%) | Notes |
| 3/29/2017 9:00 | | 6.47 | 0.12 | | | | | | 221 | 71.0 | 67.84 | Poor settling, very thin sludge, not pressing well, lots of Pin Floc in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/30/2017 8:30 | | 6.47 | 0.12 | | | | | | 244 | 55.5 | 77.25 | Poor settling, very thin sludge, not pressing well, lots of Pin Floc in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/31/2017 9:00 | | 6.47 | 0.12 | | | | | | 160 | 62.0 | 61.13 | Poor settling, very thin sludge, not pressing well, lots of Pin Floc in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/1/2017 9:00 | | 6.47 | 0.12 | | | | | | 210 | 71.0 | 66.19 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/3/2017 9:00 | | 6.47 | 0.12 | | | | | | | | | High flows from snow melt, small Pin Floc. Very thin gray Sludge |
| 4/4/2017 9:00 | | **2.7** | **0.08** | | | | | | 189 | 47.0 | 75.17 | **Heavy Rain, high flows, no settling, not much sludge. Doses for PAC and polymer reduced per Operator's judgement. Sample collected at 9:00 AM represents previous 24 hour period.** |
| 4/5/2017 9:00 | | **1.6** | **0.06** | | | | | | 248 | 45.5 | 81.63 | **Flows over 10 MGD, Smaller Floc in the Clarifiers. Doses for PAC and polymer reduced again per Operator's judgement. Sample collected at 9:00 AM represents previous 24 hour period.** |
| 4/6/2017 9:00 | | **4.3** | **0.1** | | | | | | 154 | 34.0 | 77.92 | **Heavy Rain, high flows, no settling. City ran out of sludge around 11:00AM had to shut down process. Chemical doses both increased. Sample collected at 9:00 AM represents previous 24 hour period.** |
| 4/7/2017 9:00 | | **5.4** | **0.19** | | | | | | 215.5 | 25.5 | 88.17 | **Flows still over 10 MGD, seeing some brown clumps floating on surface of both Clarifiers, only pressed 28 tons of Sludge all week. Doses for PAC and polymer reduced per Operator's judgement. Sample collected at 9:00 AM represents previous 24 hour period.** |
| 4/8/2017 9:00 | | 5.4 | 0.19 | | | | | | 168 | 34.5 | 79.46 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/10/2017 9:00 | | **6.5** | **0.23** | | | | | | | | | **Flows around 8 MGD. Medium sized Floc in the Clarifier. Doses for PAC and polymer increased per Operator's judgement.** |
| 4/11/2017 9:00 | | **8.1** | **0.29** | | | | | | | | | **Large floc on surface on Clarifiers are not settling. Doses for PAC and polymer increased per Operator's judgement.** |
| 4/12/2017 9:00 | | 8.1 | **0.19** | | | | | | | | | **Much larger Floc, Flows are down around 6.5MGD. Staff left PAC dose the same but reduced Polymer dose.** |

**Portsmouth, NH**
**Peirce Island WWTF**
**Pilot Testing Chemical dosing Results**

**Pilot Lab Data:**

| Sample ID | Sample Date | Nominal Date | Start Date (8am) | End Date (8am) | Influent TSS (mg/L) | Effluent TSS (mg/L) | % Removal | PAC Dose (mg/L) | Poly Dose (mg/L) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| Influent/Effluent (Mon-Tue) | 2/28/2017 | 2/27/2017 | 2/27/2017 | 2/28/2017 | 173 | 32.5 | 81% | *19.94* | *0.19* | Dose varied over the course of the day. |
| Influent/Effluent (Tue-Wed) | 3/1/2017 | 2/28/2017 | 2/28/2017 | 3/1/2017 | 188 | 35 | 81% | 16.17 | 0.19 | |
| Influent/Effluent (Wed-Thu) | 3/2/2017 | 3/1/2017 | 3/1/2017 | 3/2/2017 | 186 | 29 | 84% | *40.43* | *0.29* | Dose varied over the course of the day. |
| Influent/Effluent (Thu-Fri) | 3/3/2017 | 3/2/2017 | 3/2/2017 | 3/3/2017 | 185 | 29 | 84% | 30.00 | 2.00 | |
| Influent/Effluent (Fri-Sat) | 3/4/2017 | 3/3/2017 | 3/3/2017 | 3/4/2017 | 189 | 41.76 | 78% | 5.39 | 0.12 | |
| Influent/Effluent (Tue-Wed) | 3/22/2017 | 3/21/2017 | 3/21/2017 | 3/22/2017 | 272 | 40.5 | 85% | 26.95 | 0.10 | |
| Influent/Effluent (Wed-Thu) | 3/23/2017 | 3/22/2017 | 3/22/2017 | 3/23/2017 | 238 | 29.5 | 88% | 26.95 | 0.19 | |
| Influent/Effluent (Thu-Fri) | 3/24/2017 | 3/23/2017 | 3/23/2017 | 3/24/2017 | 169 | 35.5 | 79% | 26.95 | 0.29 | |
| Influent/Effluent (Fri-Sat) | 3/25/2017 | 3/24/2017 | 3/24/2017 | 3/25/2017 | 238 | 31 | 87% | 26.95 | 0.29 | |
| Influent/Effluent (Mon-Tue) | 3/28/2017 | 3/27/2017 | 3/27/2017 | 3/28/2017 | 504 | 62.5 | 88% | 8.09 | 0.16 | |
| Influent/Effluent (Tue-Wed) | 3/29/2017 | 3/28/2017 | 3/28/2017 | 3/29/2017 | 220.8 | 71 | 68% | 6.47 | 0.12 | |
| Influent/Effluent (Wed-Thu) | 3/30/2017 | 3/29/2017 | 3/29/2017 | 3/30/2017 | 244 | 55.5 | 77% | 6.47 | 0.12 | |
| Influent/Effluent (Thu-Fri) | 3/31/2017 | 3/30/2017 | 3/30/2017 | 3/31/2017 | 159.5 | 62 | 61% | 6.47 | 0.12 | |
| Influent/Effluent (Fri-Sat) | 4/1/2017 | 3/31/2017 | 3/31/2017 | 4/1/2017 | 210 | 71 | 66% | 6.47 | 0.12 | |
| Influent/Effluent (Mon-Tue) | 4/4/2017 | 4/3/2017 | 4/3/2017 | 4/4/2017 | 189.3 | 47 | 75% | 6.47 | 0.12 | |
| Influent/Effluent (Tue-Wed) | 4/5/2017 | 4/4/2017 | 4/4/2017 | 4/5/2017 | 247.7 | 45.5 | 82% | 2.7 | 0.08 | |
| Influent/Effluent (Wed-Thu) | 4/6/2017 | 4/5/2017 | 4/5/2017 | 4/6/2017 | 154 | 34 | 78% | 1.6 | 0.06 | |
| Influent/Effluent (Thu-Fri) | 4/7/2017 | 4/6/2017 | 4/6/2017 | 4/7/2017 | 215.5 | 25.5 | 88% | 4.3 | 0.1 | |
| Influent/Effluent (Fri-Sat) | 4/8/2017 | 4/7/2017 | 4/7/2017 | 4/8/2017 | 168 | 34.5 | 79% | 5.4 | 0.19 | |

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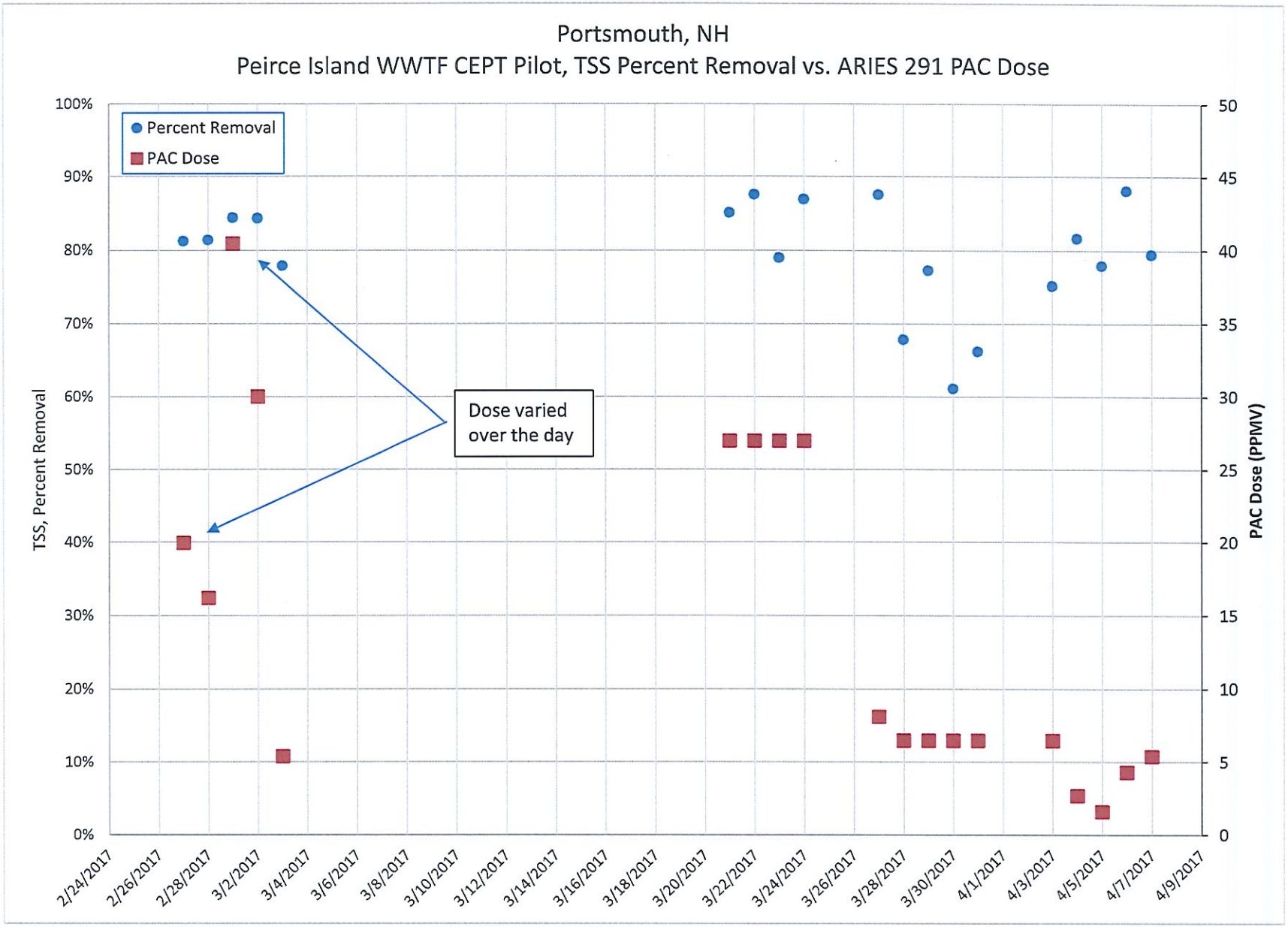


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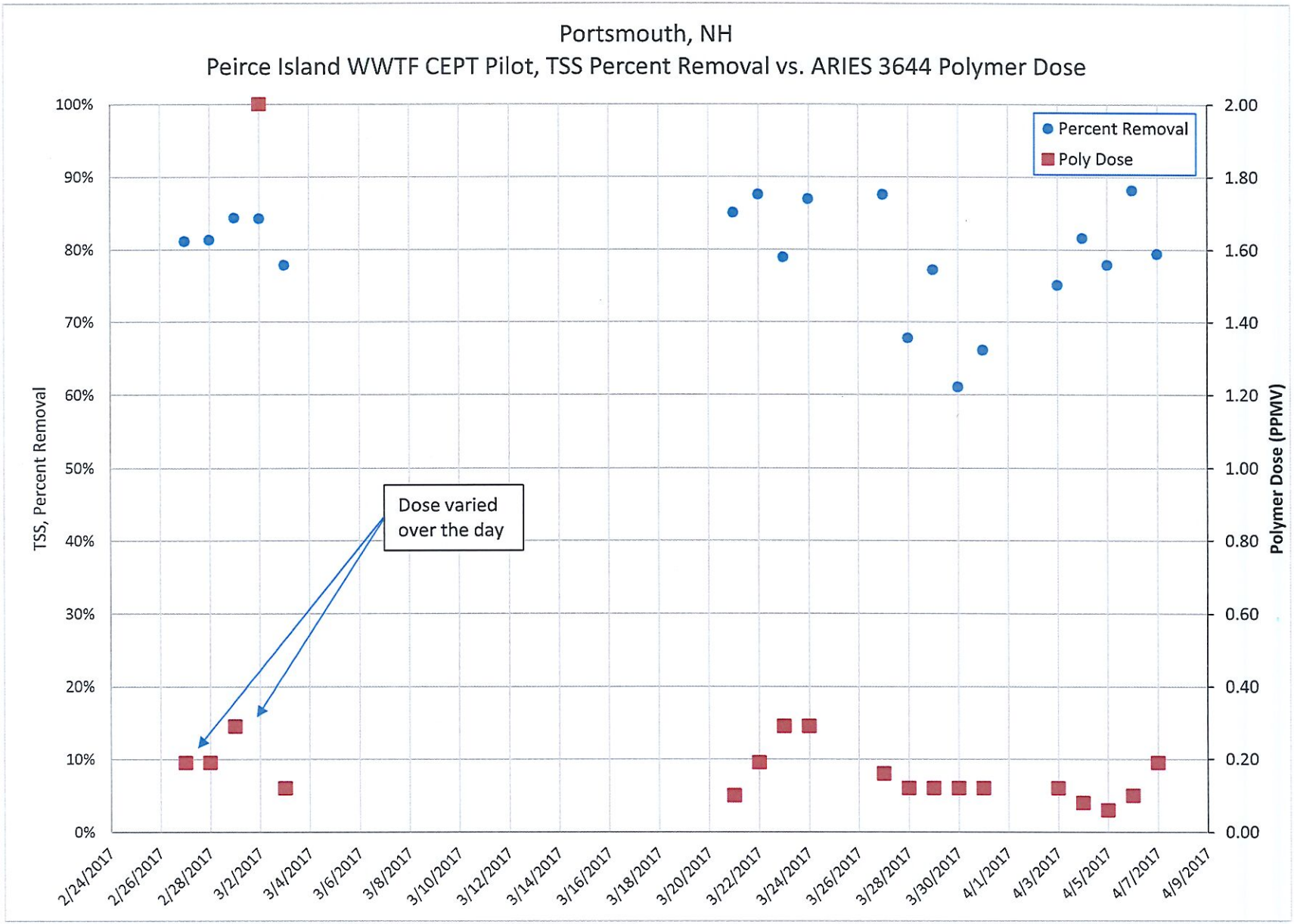

Portsmouth, NH
Peirce Island WWTF CEPT Pilot, TSS Percent Removal vs. ARIES 3644 Polymer Dose
TSS, Percent Removal
Polymer Dose (PPMV)
Percent Removal
Poly Dose
Dose varied over the day
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
2/24/2017
2/26/2017
2/28/2017
3/2/2017
3/4/2017
3/6/2017
3/8/2017
3/10/2017
3/12/2017
3/14/2017
3/16/2017
3/18/2017
3/20/2017
3/22/2017
3/24/2017
3/26/2017
3/28/2017
3/30/2017
4/1/2017
4/3/2017
4/5/2017
4/7/2017
4/9/2017

2120-01

PEIRCE ISLAND WWTF CEPT PILOT
PORTSMOUTH, NH

**Pilot Test 2 Meeting NOTES**
**May 1, 2017 at 9:30 AM**

**ATTENDEES**

- Terry Desmarais — City of Portsmouth
- Don Song — City of Portsmouth
- Timothy Babkirk — City of Portsmouth
- Kathy Sanborn — City of Portsmouth
- Steve Clifton — Underwood Engineers
- David Mercier — Underwood Engineers
- Ransom Horner-Richardson — Underwood Engineers

Work Completed Since Last Meeting:

- WWTF ran with Aries 291 chemical dosing from 2/27/17 through 4/23/17. Pilot was stopped on 3/7/17 due to dewatering issues and then restarted 3/21/17.
- 29 data points were collected (first 5 are currently not being used given startup issue the first week). For the other 24 data points, the average effluent TSS was 41 (15 standard deviation) and average percent removal was 81 (10 standard deviation). This compares to the following long term results using Aries 2076:

**Table 3-2 Historical Annual Average TSS Removal**

| Parameter | 2013 | 2014 | 2015 |
|---|---|---|---|
| Influent TSS, mg/L | 223 | 327 | 314 |
| Effluent TSS, mg/L | 57 | 47 | 56 |
| Effluent TSS Std.Dev.* | 16.6 | 15.0 | 18.1 |
| % Removal | 73 | 85 | 80 |
| Min, % Removal | 53 | 65 | 37 |
| Max, % Removal | 90 | 95 | 94 |
| % Removal Std.Dev.* | 6.9 | 4.5 | 8.9 |

*Standard deviations are calculated from individual values for each year.

- Started Pilot Test 2 with Aries 252 on 4/24/17. The new chemical was started at a dose of 8.6 PPMV of PAC and 0.19 PPMV of polymer based on the results of Pilot Test 1 and is still there as of today, 5/1/17.
- No EAI results are available yet but the City results suggest the 252 is working acceptably, i.e. 85.3% removal first 3 days.

Discussion of Pilot Test 1 Results:

- During the first week of dosing, the applied dose of PAC varied as optimal dose was dialed in, but performance was strong throughout the week (mostly <40 mg/L TSS effluent and >80% removal).
- After restarting the pilot, dosing was held at ~27 PPMV of PAC and ~0.29 PPMV of polymer for a week and then reduced to ~ 6.5 PPMV of PAC and ~0.16 PPMV of polymer based on visual results. With the initial data received, it appeared that the lower dose seemed to correlate to lower plant performance and this was confirmed with the last two weeks of data (see attached graphs).
- The City noted that during the first week of the restart at higher doses, sludge was accumulating in the Gravity Thickeners throughout the water column and recycling back to the Primary Clarifiers. Staff observed low percent solids in the Gravity Thickener underflow and gray suspended solids in the thickener overflow. The last week of the pilot when doses were increased the same phenomenon was observed.
- It was decided that for the last week of Pilot Test 1 and for the next chemicals, TSS **grab** samples would be gathered from Gravity Thickener overflow and underflow to assess the impact on solids capture. **Due to miscommunication no samples have been taken yet. It was agreed that moving forward Gravity Thickener grab samples will be taken M/W/F on overflow and underflow at 9:30 AM. TSS on overflow and TS on underflow.**

Work Planned for Pilot Test 2:

- Based on the Pilot Test 1 experience, it appears to take several days to a week for the system as a whole to reflect change in coagulant. As such, UEI recommends sampling for 6 weeks after the new chemical is started.
- Thoughts after the first week with 252? **Sludge is thick; may be due to high flow and grease flush.**
- How do the gravity thickeners look? **Good; not gray.**
- How is dewatering going? **OK but lines have plugged due to thick sludge.**
- When should dose be changed? **Hold dose for now. Conference call next Monday, 5/8. Dave to send invite email.**
- **Dave to ask EAI for more sample bottles.**
- **During Pilot 1, chlorine demand went way up. Solids in CCT was much higher during Pilot 1 during cleanout every 2 weeks.**

Other:

- UEI to provide meeting notes from this meeting to the City to be issued to EPA.
- **What has effluent BOD been during Pilot 1?**
- **At higher dose last week of Pilot 1, the daily dewatered sludge was 16 wet tons vs. 10 wet tons normally (with Aries 2076).**

- **Plant staff are running chemical in hand/manual while rain brings flow over 10MGD.**
- **At both high dose periods with 291, high flows on the weekend washed solids out of plant and gravity thickeners looked better. This was not captured in samples collected Mon-Friday. What would happen long term in dry weather? Would effluent deteriorate over time?**

**Portsmouth, NH**
**Peirce Island WWTF**
**Pilot Testing Chemical dosing Results**

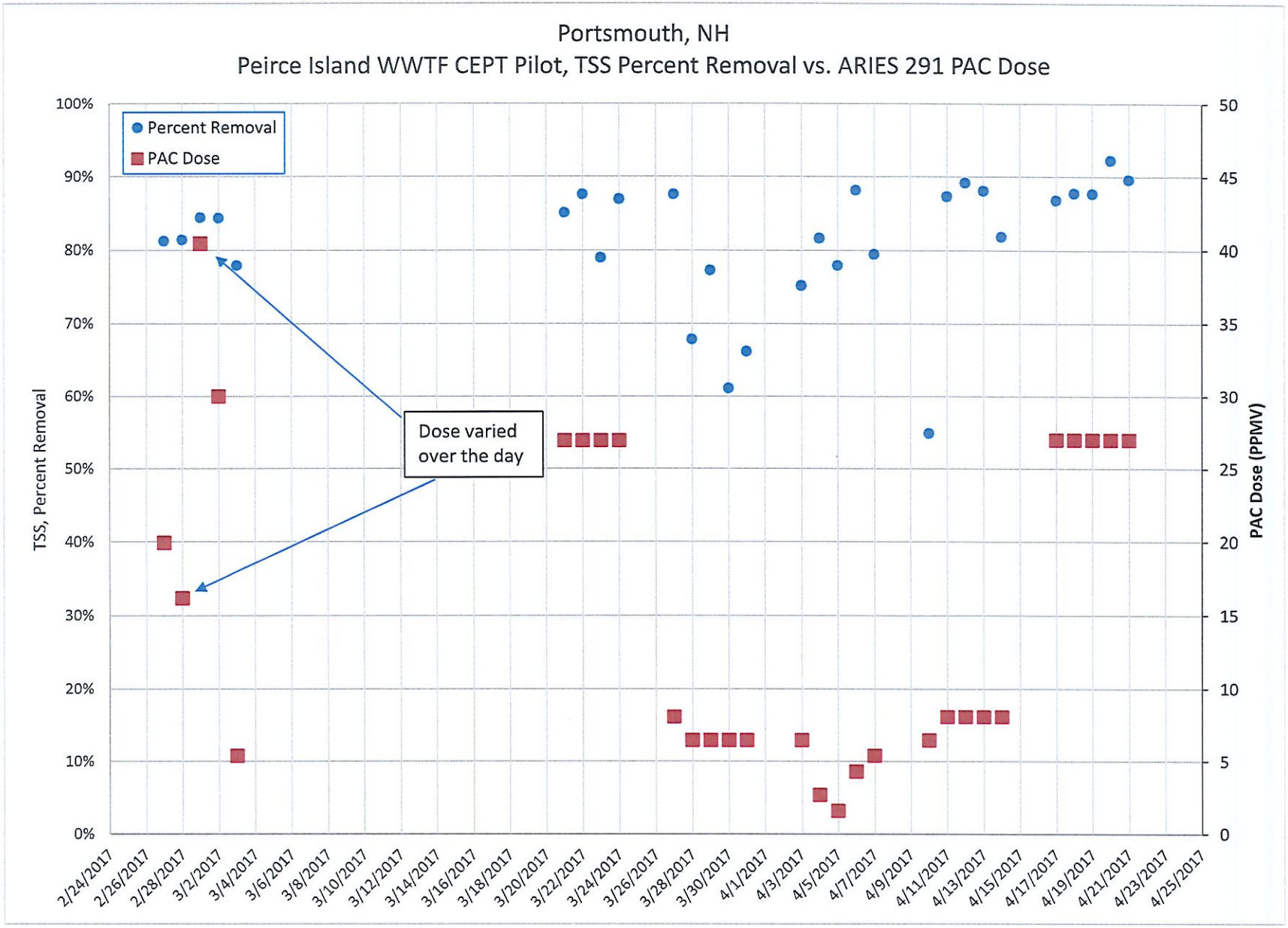
**Bold** indicates a change in dose

| | | *SCADA Set Doses* | | *PAC Pump Measured flow/dose* | | | *Poly Pump Measured flow/dose* | | *EAI Lab TSS Values* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | D-Box Flow (MGD) | PAC Setpoint (mg/L) | Poly Setpoint (mg/L) | PAC pump RPM | PAC pump flow rate (GPH) | PAC Dose (mg/L) | Poly Pump Flowrate (ml/min) | Poly Dose (mg/L) | Influent (mg/L) | Effluent (mg/L) | Removal (%) | Notes |
| **2/27/2017 7:50** | 9.6 | **30** | | 26.1 | 5.33 | 13.33 | | | | | | **Pilot started with ARIES 291 PAC. Setpoints of 30ppm and 0.5ppm chosen for pilot startup. Poly SCADA changes had not been implemented. Coag SCADA not done correctly.** |
| **2/27/2017 9:00** | 9.7 | 30 | **0.49** | 52.2 | 10.66 | 26.39 | | | | | | **SCADA changes implemented for Poly and Coag. Setpoints set for both chemicals.** |
| **2/27/2017 9:30** | 10.1 | **19.94** | **0.25** | | | | | | | | | **Poor settling in clarifiers, poor quality effluent (visual) Doses were both reduced per operator judgement.** |
| 2/27/2017 9:55 | 10.6 | 19.94 | 0.25 | 34.2 | 6.99 | 15.82 | | | | | | Check of coagulant pump dose showed somewhat lower than SCADA dose. |
| 2/27/2017 11:00 | 11.8 | 19.94 | 0.25 | 39.9 | 8.15 | 16.58 | | | | | | Clarifiers look better, floc is sinking well. Check of coagulant pump again showed dose to be low. |
| **2/27/2017 11:20** | 11.8 | 19.94 | **0.19** | | | | | | | | | **Floc still looks good, but some of it is floating. Operator reduced poly dose.** |
| **2/27/2017 13:00** | 9.2 | **16.17** | 0.19 | 22 | 4.49 | 11.73 | | | | | | **Operator dropped PAC dose to 16ppm. Check of pump shows it is still low.** |
| 2/27/2017 13:10 | 9.8 | 16.17 | 0.19 | | | | 6.74 | 0.26 | | | | Flow test for poly pump is slightly high. |
| 2/27/2017 13:20 | 10.2 | 16.17 | 0.19 | | | | 5.88 | 0.22 | | | | Flow test for poly pump is slightly high. |
| 2/27/2017 14:00 | 10.2 | 16.17 | 0.19 | 22.5 | 4.60 | 10.82 | | | | | | Check of coagulant pump shows flows still too low. |
| 2/28/2017 8:00 | 7.5 | 16.17 | 0.19 | 9.3 | 1.90 | 6.08 | | | | | | Determined that SCADA programming was not quite right up till this point. |
| 2/28/2017 8:45 | 8.4 | 16.17 | 0.19 | 13.6 | 2.78 | 7.94 | | | | | | RHR troubleshot SCADA with Mike, determined problem. Mike made changes 2/28/17 afternoon. Need to verify that changes were correct |
| 2/28/2017 9:00 | | 16.17 | 0.19 | | | | | | 173 | 32.5 | 81.21 | Sample collected at 9:00 AM represents previous 24 hour period. |
| **3/1/2017 8:00** | 8.5 | **20** | **0.29** | | | | | | | | | **Doses at SCADA had been adjusted since day before - Verify when changes were made** |
| **3/1/2017 8:10** | 8.5 | **40.43** | 0.29 | | | | | | | | | **Poor clarifier performance (visual). It was decided to turn dose up to 40 ppm to see if performance improved.** |
| 3/1/2017 8:30 | 8.3 | 40.43 | 0.29 | 77.2 | 15.77 | 45.61 | | | | | | Flow test for PAC slightly high. |
| 3/1/2017 9:00 | | 40.43 | 0.29 | | | | | | 188 | 35.0 | 81.38 | Sample collected at 9:00 AM represents previous 24 hour period. |
| **3/1/2017 17:00** | | **30** | **2** | | | | | | | | | **Doses reset to jar test optimal levels of 30ppm and 2ppm and hold for 24 hrs.** |
| 3/2/2017 8:30 | 8.1 | 30 | 2 | 58.8 | 12.01 | 35.59 | 46.3 | 2.17 | | | | Clarifiers had lots of solids on top |
| 3/2/2017 9:00 | 7.9 | 30 | 2 | 55.1 | 11.26 | 34.20 | | | | | | Flow test for PAC slightly high. |
| 3/2/2017 9:00 | | 30 | 2 | | | | | | 186 | 29.0 | 84.41 | Sample collected at 9:00 AM represents previous 24 hour period. |
| **3/3/2017 8:00** | | **5.39** | **0.12** | | | | | | | | | **Frozen solids on top of tank caused skimmer arm to bind up. City backed dose off drastically.** |
| 3/3/2017 9:00 | | 30 | 2 | | | | | | 185 | 29.0 | 84.32 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/3/2017 11:00 | | 5.39 | 0.12 | | | | | | | | | Lower doses have resulted in significant improvement to clarifier performance (visual). City notes they can only process 30 gpm of sludge vs 50 gpm with ferric. |
| 3/4/2017 9:00 | | 5.39 | 0.12 | | | | | | 189 | 41.8 | 77.88 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/7/2017 7:30 | PILOT TESTING WITH ARIES 219 STOPPED DUE TO CONSTRUCTION ISSUES AT WWTF. | | | | | | | | | | | **Plant staff need to catch up on sludge dewatering which has been adversely affected by change to PAC coagulant.** |
| **3/21/2017 7:00** | PILOT TESTING WITH ARIES 219 RESTARTED. | | | | | | | | | | | |
| **3/21/2017 9:00** | | **26.95** | **0.10** | | | | | | | | | **City restarted pilot with coagulant dose similar to jar testing doses.** |
| 3/22/2017 9:15 | | 26.95 | **0.19** | | | | | | 272 | 40.5 | 85.11 | Small Floc spreading over surface of Clarifiers, Not settling well, Still having Problems running PAC sludge through Fouriner Press. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/23/2017 9:00 | | 26.95 | 0.29 | | | | | | 238 | 29.5 | 87.61 | Small Floc spreading over surface of Clarifiers, Not settling well, Still having Problems running PAC sludge through Fouriner Press. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/24/2017 8:45 | | 26.95 | 0.29 | | | | | | 169 | 35.5 | 78.99 | Light gray floc observed in Gravity Thickener, not settling well. Only about 6" of sludge in thickener. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/25/2017 7:30 | | **24.26** | 0.29 | | | | | | 238 | 31.0 | 86.97 | **Sample collected at 9:00 AM represents previous 24 hour period. PAC dose decreased per Operator's judgement.** |
| **3/25/2017 10:15** | | **29** | 0.29 | | | | | | | | | **PAC dose was increased per Opertor's judgement** |
| **3/25/2017 16:45** | | **16.17** | **0.16** | | | | | | | | | **Both chemical doses were reduced per Opertor's judgement** |
| **3/26/2017 10:30** | | **8.09** | 0.16 | | | | | | | | | **PAC dose was reduced per Opertor's judgement** |
| 3/27/2017 9:30 | | 8.09 | 0.16 | | | | | | | | | Over the weekend the Thickener was all light gray suspended Floc top to bottom no separation showing in Sludge Judge |
| 3/28/2017 8:45 | | **6.47** | **0.12** | | | | | | 504 | 62.5 | 87.60 | Poor settling, very thin sludge, not pressing well, lots of Pin Floc in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |

**Portsmouth, NH**
**Peirce Island WWTF**
**Pilot Testing Chemical dosing Results**

**Bold** indicates a change in dose

| | | *SCADA Set Doses* | | *PAC Pump Measured flow/dose* | | | *Poly Pump Measured flow/dose* | | *EAI Lab TSS Values* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | D-Box Flow (MGD) | PAC Setpoint (mg/L) | Poly Setpoint (mg/L) | PAC pump RPM | PAC pump flow rate (GPH) | PAC Dose (mg/L) | Poly Pump Flowrate (ml/min) | Poly Dose (mg/L) | Influent (mg/L) | Effluent (mg/L) | Removal (%) | Notes |
| 3/29/2017 9:00 | | 6.47 | 0.12 | | | | | | 221 | 71.0 | 67.84 | Poor settling, very thin sludge, not pressing well, lots of Pin Floc in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/30/2017 8:30 | | 6.47 | 0.12 | | | | | | 244 | 55.5 | 77.25 | Poor settling, very thin sludge, not pressing well, lots of Pin Floc in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/31/2017 9:00 | | 6.47 | 0.12 | | | | | | 160 | 62.0 | 61.13 | Poor settling, very thin sludge, not pressing well, lots of Pin Floc in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/1/2017 9:00 | | 6.47 | 0.12 | | | | | | 210 | 71.0 | 66.19 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/3/2017 9:00 | | 6.47 | 0.12 | | | | | | | | | High flows from snow melt, small Pin Floc. Very thin gray Sludge |
| 4/4/2017 9:00 | | **2.7** | **0.08** | | | | | | 189 | 47.0 | 75.17 | **Heavy Rain, high flows, no settling, not much sludge. Doses for PAC and polymer reduced per Operator's judgement. Sample collected at 9:00 AM represents previous 24 hour period.** |
| 4/5/2017 9:00 | | **1.6** | **0.06** | | | | | | 248 | 45.5 | 81.63 | **Flows over 10 MGD, Smaller Floc in the Clarifiers. Doses for PAC and polymer reduced again per Operator's judgement. Sample collected at 9:00 AM represents previous 24 hour period.** |
| 4/6/2017 9:00 | | **4.3** | **0.1** | | | | | | 154 | 34.0 | 77.92 | **Heavy Rain, high flows, no settling. City ran out of sludge around 11:00AM had to shut down process. Chemical doses both increased. Sample collected at 9:00 AM represents previous 24 hour period.** |
| 4/7/2017 9:00 | | **5.4** | **0.19** | | | | | | 215.5 | 25.5 | 88.17 | **Flows still over 10 MGD, seeing some brown clumps floating on surface of both Clarifiers, only pressed 28 tons of Sludge all week. Doses for PAC and polymer reduced per Operator's judgement. Sample collected at 9:00 AM represents previous 24 hour period.** |
| 4/8/2017 9:00 | | 5.4 | 0.19 | | | | | | 168 | 34.5 | 79.46 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/10/2017 9:00 | | **6.5** | **0.23** | | | | | | | | | **Flows around 8 MGD. Medium sized Floc in the Clarifier. Doses for PAC and polymer increased per Operator's judgement.** |
| 4/11/2017 9:00 | | **8.1** | **0.29** | | | | | | 98 | 44.0 | 54.92 | **Large floc on surface on Clarifiers are not settling. Doses for PAC and polymer increased per Operator's judgement. Sample collected at 9:00 AM represents previous 24 hour period.** |
| 4/12/2017 9:00 | | 8.1 | 0.29 | | | | | | 280 | 35.5 | 87.32 | **Much larger Floc, Flows are down around 6.5MGD. Staff left PAC dose the same but reduced Polymer dose. Sample collected at 9:00 AM represents previous 24 hour period.** |
| 4/13/2017 9:00 | | 8.1 | **0.19** | | | | | | 377 | 40.7 | 89.20 | Still a very large Floc flows are down around 5 MGD, Floc is still staying on surface of Clarifiers and being pushed into the Scum. Tanks, PAC and poly reacting much different as the flows come down. **Polymer dose reduced per Operator's judgement.** Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/14/2017 9:00 | | 8.1 | 0.19 | | | | | | 328 | 39.0 | 88.11 | Flows Around 5 MGD, Floc is now smaller. City ran out of Sludge on 4/13/17 and still not much Sludge today. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/15/2017 9:00 | | 8.1 | 0.19 | | | | | | 297 | 54.0 | 81.82 | Weekend Flows around 4 MGD, Clarifiers look ok but large clumps of Sludge forming in the Thickener. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/18/2017 9:00 | | **27** | **0.23** | | | | | | 216 | 28.5 | 86.81 | **PAC and Polymer doses increased for final week of Pilot 1 per UEI recommendation.** Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/19/2017 9:00 | | 27 | 0.23 | | | | | | 200 | 24.5 | 87.75 | 4 FT of Black watery Sludge in Thickener, Not as many large clumps floating on surface. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/20/2017 9:00 | | 27 | 0.23 | | | | | | 191 | 23.5 | 87.70 | Light Grey Floc in Thickener, not really settling. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/21/2017 9:00 | | 27 | **0.31** | | | | | | 350 | 27.0 | 92.29 | **Polymer dose increase per Operator's judgement.** Light Grey Floc in Thickener, not really settling. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/22/2017 9:00 | | 27 | **0.19** | | | | | | 270 | 28.0 | 89.63 | **Polymer dose increase per Operator's judgement.** Sample collected at 9:00 AM represents previous 24 hour period. |
| | | | | | | | | average | 243 | 41 | 81 | |
| | | | | | | | | count | 24 | 24 | 24 | |
| | | | | | | | | 1 standard dev. | 86 | 15 | 10 | |

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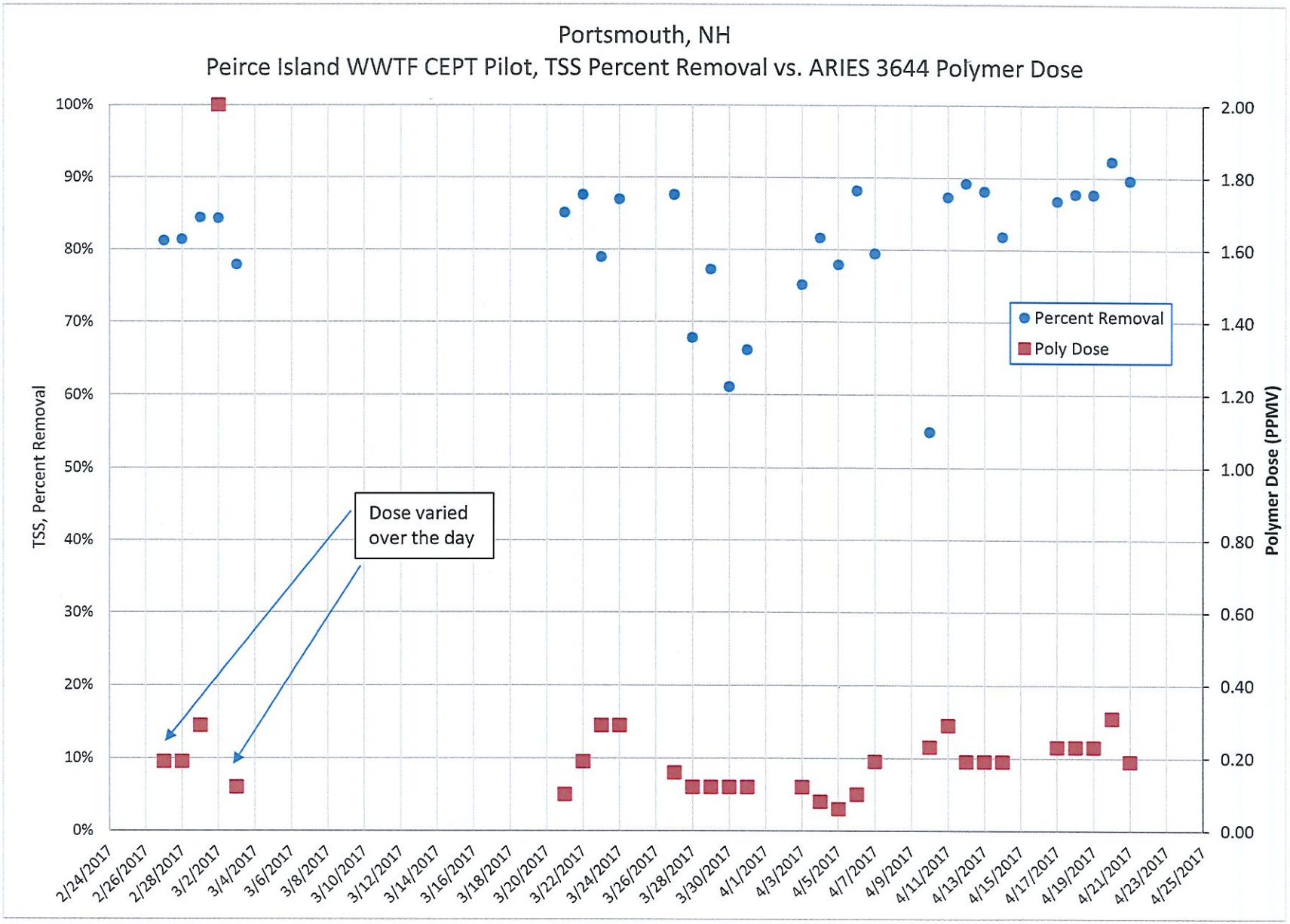
Portsmouth, NH
Peirce Island WWTF CEPT Pilot, TSS Percent Removal vs. ARIES 3644 Polymer Dose
TSS, Percent Removal
Polymer Dose (PPMV)
Percent Removal
Poly Dose
Dose varied over the day
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
2/24/2017
2/26/2017
2/28/2017
3/2/2017
3/4/2017
3/6/2017
3/8/2017
3/10/2017
3/12/2017
3/14/2017
3/16/2017
3/18/2017
3/20/2017
3/22/2017
3/24/2017
3/26/2017
3/28/2017
3/30/2017
4/1/2017
4/3/2017
4/5/2017
4/7/2017
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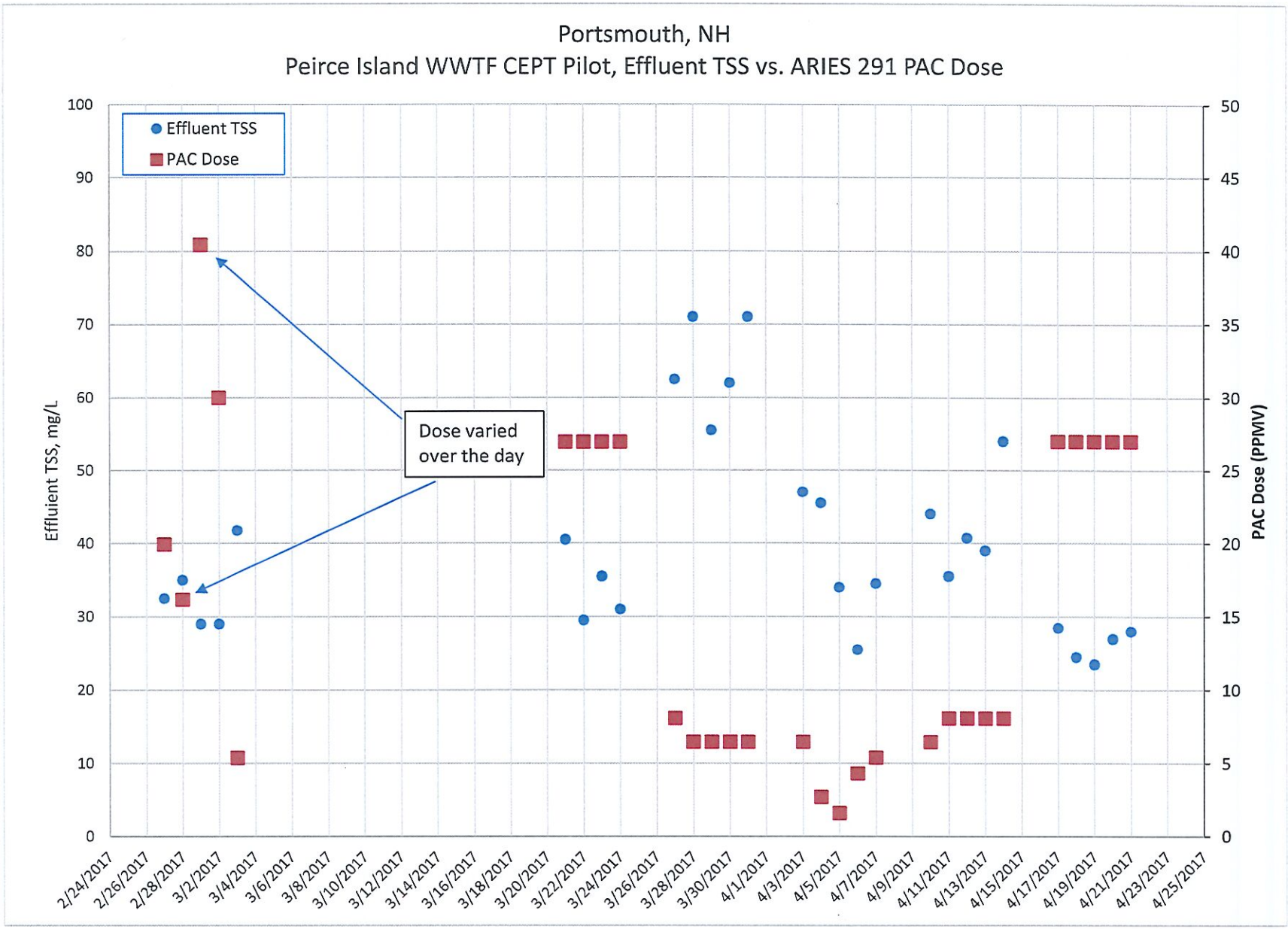
4/25/2017

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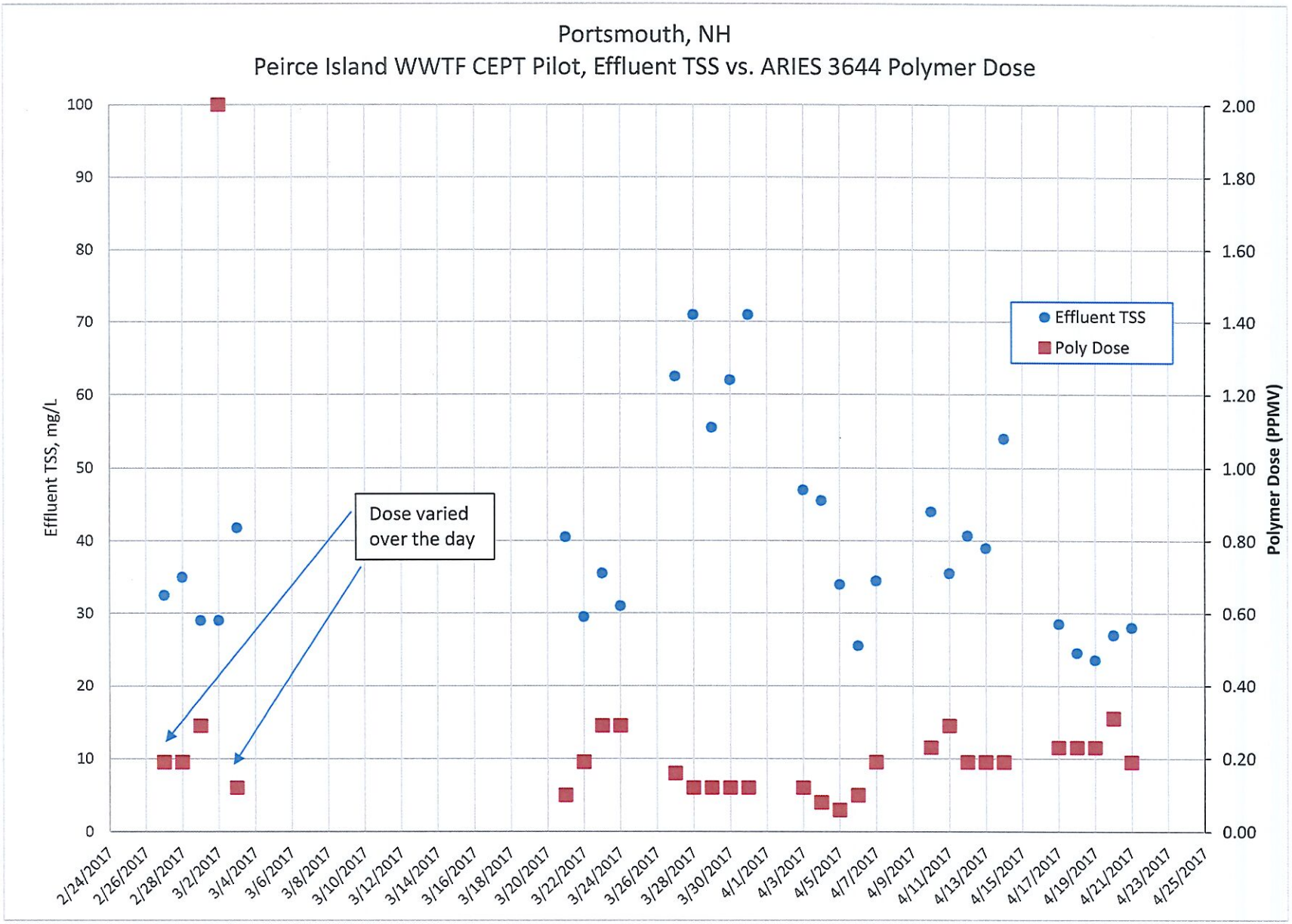

Portsmouth, NH
Peirce Island WWTF CEPT Pilot, Effluent TSS vs. ARIES 3644 Polymer Dose
Effluent TSS, mg/L
Polymer Dose (PPMV)
Effluent TSS
Poly Dose
Dose varied over the day
0
10
20
30
40
50
60
70
80
90
100
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
1.80
2.00
2/24/2017
2/26/2017
2/28/2017
3/2/2017
3/4/2017
3/6/2017
3/8/2017
3/10/2017
3/12/2017
3/14/2017
3/16/2017
3/18/2017
3/20/2017
3/22/2017
3/24/2017
3/26/2017
3/28/2017
3/30/2017
4/1/2017
4/3/2017
4/5/2017
4/7/2017
4/9/2017
4/11/2017
4/13/2017
4/15/2017
4/17/2017
4/19/2017
4/21/2017
4/23/2017
4/25/2017

# CEPT Pilot TSS Results PAC 291

| DATE | Influent mg/L | Effluent mg/L | Percent Removal | PAC mg/L | Poly mg/L | |
|---|---|---|---|---|---|---|
| **February** | | | | | | |
| 2/27/2017 | 211.0 | 40.0 | 81.0 | 30.1 | 0.49 | Large Floc in Clarifiers, Not settling, 1 - 3" Sludge Mat forming on surface |
| **March** | | | | | | |
| 3/3/2017 | 195.0 | 39.0 | 80.0 | 30.7 | 0.20 | Large Floc in Clarifiers, Not settling, 2 - 3" Sludge Mat on surface was frozen at 6:44AM Rake Arm hung up went into over Torque |
| 3/4/2017 | 201.0 | 56.0 | 72.1 | 2.7 | 0.08 | Went down on PAC and Poly dose to achieve better settling and remove surface sludge to avoid freezing again |
| 3/5/2017 | 231.0 | 67.5 | 70.8 | 2.7 | 0.05 | Surface sludge now gone, settling better, we were able to start pumping sludge again |
| 3/21/2017 | 304.5 | 36.0 | 88.2 | 27.0 | 0.10 | Started Pilot study back up at lower Dose after we put study on hold due to multiple process upsets |
| 3/22/2017 | 257.5 | 29.0 | 88.7 | 27.0 | 0.19 | Small Floc spreading over surface of Clarifiers, Not settling well, Still having Problems running PAC sludge through Fourlner Press |
| 3/23/2017 | 222.5 | 24.5 | 89.0 | 27.0 | 0.29 | Small Floc spreading over surface of Clarifiers, Not settling well, Still having Problems running PAC sludge through Fourlner Press |
| 3/24/2017 | 287.5 | 17.0 | 94.0 | 27.0 | 0.29 | Starting to see a light gray Floc in Gravity Thickener, Not settling well, only about 6 inches of sludge in Thickener |
| 3/27/2017 | 496.5 | 77.0 | 84.5 | 8.1 | 0.16 | Over the weekend the Thickener was all light gray suspended Floc top to bottom no separation showing in Sludge Judge |
| 3/30/2017 C | 198.0 | 57.0 | 71.2 | 6.5 | 0.12 | Poor settling, real thin Sludge, not pressing well, lots of Pin Floc in Clarifier |
| 3/30/2017 G | 87.5 | 48.0 | 45.1 | 6.5 | 0.12 | " " |
| 3/31/2017 G | 97.0 | 39.0 | 59.8 | 6.5 | 0.12 | " " |
| 3/31/2017 G | 111.0 | 54.0 | 51.4 | 6.5 | 0.12 | " " |
| **April** | | | | | | |
| 4/3/2017 G | 63.0 | 45.0 | 28.6 | 6.5 | 0.12 | Hight flows from snow melt, small Pin Floc, we have real thin gray Sludge |
| 4/3/2017 C | 228.5 | 49.0 | 78.6 | 6.5 | 0.12 | " " |
| 4/4/2017 G | 70.0 | 43.0 | 38.6 | 2.7 | 0.08 | Heavy Rain, High Flows, no settling, not much sludge |
| 4/4/2017 G | 59.0 | 53.0 | 10.2 | 2.7 | 0.08 | " " |
| 4/4/2017 C | 237.0 | 52.5 | 77.8 | 2.7 | 0.08 | Flows still over 10 MGD, still not settling well, we are running out of sludge |
| 4/5/2017 G | 72.0 | 23 | 68.1 | 1.6 | 0.06 | Flows over 10 MGD, Smaller Floc in the Clarifiers |
| 4/5/2017 G | 55.0 | 39 | 29.1 | 1.6 | 0.06 | " " |
| 4/5/2017 C | 166.0 | 39.5 | 76.2 | 1.6 | 0.06 | " " |
| 4/6/2017 G | 72.0 | 48.0 | 33.3 | 4.3 | 0.10 | Heavy Rain, High Flows, no settling, ran out of Sludge around 11:00AM had to shut down process |
| 4/6/2017 G | 79.0 | 45.0 | 43.0 | 4.3 | 0.10 | " " |
| 4/6/2017 C | 246.5 | 40.0 | 84.0 | 4.3 | 0.10 | " " |
| 4/7/2017 G | 49.0 | 14.0 | 71.0 | 5.4 | 0.19 | Flows still over 10 MGD, seeing some brown clumps floating on surface of both Clarifiers, only pressed 28 tons of Sludge all week |
| 4/7/2017 G | 56.0 | 43.0 | 23.0 | 5.4 | 0.19 | " " |
| 4/10/2017 G | 50.0 | 25.0 | 50.0 | 6.5 | 0.23 | Flows around 8 MGD, MED Sized Floc in the Clarifier, |
| 4/10/2017 G | 99.0 | 36.0 | 63.6 | 6.5 | 0.23 | " " |
| 4/10/2017 C | 99.5 | 39.0 | 60.8 | 6.5 | 0.23 | " " |
| 4/11/2017 G | 97.0 | 31.0 | 68.0 | 8.1 | 0.29 | 4/11/17 8:25AM Large Floc surface of Clarifiers not settling |
| 4/11/2017 G | 110.0 | 29.0 | 73.6 | 8.1 | 0.29 | " " |
| 4/11/2017 C | 295.0 | 34.5 | 88.5 | 8.1 | 0.29 | " " |
| 4/12/2017 G | 103.0 | 35.0 | 65.0 | 8.1 | 0.19 | Much larger Floc, Flows are down around 6.5MGD, Left PAC Dose the same went down on Poly mg/L |
| 4/12/2017 G | 116.0 | 35.0 | 69.8 | 8.1 | 0.19 | Floc is starting to collect on Surface of Clarifiers |
| 4/12/2017 C | 435.5 | 39.5 | 90.9 | 8.1 | 0.19 | " " |
| 4/13/2017 G | 48.0 | 46.0 | 4.2 | 8.1 | 0.19 | Still a very large Floc flows are down around 5 MGD, Floc is still staying on surface of Clarifiers and being pushed into the Scum |
| 4/13/2017 G | 103.0 | 38.0 | 63.1 | 8.1 | 0.19 | Tanks, PAC and Poly reacting much different as the Flows come down |
| 4/13/2017 C | 426.0 | 33.5 | 92.1 | 8.1 | 0.19 | " " |
| 4/14/2017 G | 181.0 | 61.0 | 66.3 | 8.1 | 0.19 | Flows Around 5 MGD, Floc is now smaller, we ran out of Sludge on 4/13/17 and still not much Sludge today |
| 4/15 - 4/16 | | | | | | Weekend Flows around 4 MGD, Clarifiers look ok but large clumps of Sludge forming in the Thickener |
| 4/17/2017 C | 385.5 | 28.0 | 92.7 | 27.0 | 0.23 | Flows Around 5 MGD, small pin Floc in Clarifiers, large floating clumps in the Thickener, Sludge is real thin |
| 4/17/2017 G | 74.0 | 38.0 | 48.6 | 27.0 | 0.23 | " " |
| 4/17/2017 G | 160.0 | 27.0 | 83.1 | 27.0 | 0.23. | " " |
| 4/18/2017 G | 87.0 | 24.0 | 72.4 | 27.0 | 0.23 | |
| 4/18/2017 G | 290.0 | 10.0 | 96.5 | 27.0 | 0.23 | |
| 4/18/2017 C | 398.0 | 11.0 | 97.2 | 27.0 | 0.23 | |
| 4/19/2017 G | 303.0 | 18.0 | 94.1 | 27.0 | 0.23 | 4 FT of Black watery Sludge in Thickener, Not as many Large clumps floating on surface |
| 4/19/2017 G | 354.0 | 16.0 | 95.5 | 27.0 | 0.23 | " " |
| 4/19/2017 C | 415.0 | 24.5 | 94.1 | 27.0 | 0.23 | " " |
| 4/20/2017 G | 101.0 | 18.0 | 82.2 | 27.0 | 0.31 | Light Gray Floc in Thickener, not really Settling |
| 4/20/2017 G | 154.0 | 22.0 | 85.7 | 27.0 | 0.31 | " " |
| 4/20/2017 C | 421.0 | 19.5 | 95.3 | 27.0 | 0.31 | " " |
| 4/21/2017 G | 237.0 | 26.0 | 89.0 | 27.0 | 0.19 | " " |
| 4/21/2017 G | 138.0 | 32.0 | 76.8 | 27.0 | 0.19 | " " |
| **ARIES 252** | | | | | | |
| 4/24/2017 C | 380.5 | 68.5 | 82.0 | 8.6 | 0.19 | Started using PAC 252, Sludge is still like black water it Pressing but very wet, Clarifiers look about the same Small pin Floc |
| 4/25/2017 C | 558.0 | 71.0 | 87.3 | 8.6 | 0.19 | Rain all day Flows between 8-15 MGD, Sludge became extremely thick which is usually does with high flows |
| 4/26/2017 C | 538.5 | 71.5 | 86.7 | 8.6 | 0.19 | Flows Around 7 MGD, Sludge is still very thick, Hard to tell how the 252 is working because of the rain and High Flows |

2120-02

PEIRCE ISLAND WWTF CEPT PILOT
PORTSMOUTH, NH

**Pilot Test 2 Meeting NOTES**
**May 8, 2017 at 9:30 AM**

**ATTENDEES (By Conference Call):**

| | |
|---|---|
| • Terry Desmarais | City of Portsmouth |
| • Don Song | City of Portsmouth |
| • Timothy Babkirk | City of Portsmouth |
| • Kathy Sanborn | City of Portsmouth |
| • Steve Clifton | Underwood Engineers |
| • David Mercier | Underwood Engineers |
| • Ransom Horner-Richardson | Underwood Engineers |

Work Completed Since Last Meeting:

- Started Pilot Test 2 with Aries 252 on 4/24/17. The new chemical was started at a dose of 8.6 PPMV of PAC and 0.19 PPMV of polymer based on the results of Pilot Test 1 and is still there as of today, 5/8/17.

Discussion of Pilot Test 2 Results:

- Summary on how new coagulant is doing (Aries 252). City observations:
  - Thick sludge. This is not out of the ordinary with high flows because of FOG.
  - No process issues.
  - Clarifiers look good/normal.
  - Sludge weight between 7 and 10 wet tons/day.
  - TSS removal = 79-92%.
- TSS Removals: High 70s/Mid 80s Percent Removal. Thick sludge is causing plugging but otherwise it's behaving more like their normal chemical (Aries 2076). Sludge hauling weight is more similar to normal. On 4$^{th}$ cake was 37% cake; on 5$^{th}$ cake was 38%.
- Effluent TSS numbers:
  - Last week: 40, 41.5, 41, 47 mg/L
  - From an operator perspective, this is a much better chemical (than 291). Not sure if sludge pipe clogging is due to chemical or rain events.
- Thickener Overflow and Underflow:
  - Overflow TSS: 130, 67 mg/L
  - Underflow: 3.9% solids; 3.1% solids.

Continued Plan for Pilot Test 2:

- UE recommends one more week at low dose, then decide if bump up or run one more week at low dose since Fournier PLC is down. Fournier PLC is not communicating with plunger pumps. Running it today but will switch to BFP tomorrow.
- City is adding caustic and averaging 6.5 pH out. City stopped caustic at Pilot 1 start, then started again but cut dose by ~50%; still dosing @ 50% during Pilot 2. Lower dose required than with ferric.
- CCT flush is scheduled for this Friday (5/12).
- Ransom to send costs for all three pilot coagulants:

Tote costs from Aries

| | | | |
|---|---|---|---|
| 2076 | 275 gal@ | 3445 lb | $0.401 lb |
| 291 | 275 gal@ | 3100 lb | $0.47 lb |
| 252 | 275 gal@ | 2750 lb | $0.449 lb |

| | | |
|---|---|---|
| 2076 | 12.53 lb/gal | $5.024/gal |
| 291 | 11.27 lb/gal | $5.297/gal |
| 252 | 10.00 lb/gal | $4.49/gal |

Costs are less if purchased in bulk.

2120-02

PEIRCE ISLAND WWTF CEPT PILOT
PORTSMOUTH, NH

**Pilot Test 2 Meeting NOTES**
**June 1, 2017 at 2:30 PM**

**ATTENDEES (By Conference Call):**

| | |
|---|---|
| • Don Song | City of Portsmouth |
| • Timothy Babkirk | City of Portsmouth |
| • Steve Clifton | Underwood Engineers |
| • David Mercier | Underwood Engineers |

Work Completed Since Last Meeting:

- Pilot Test 2 with Aries 252 concluded on 6/3/17. Pilot Test 2 was ended with a higher dose of 27.0 PPMV of PAC and 0.19 PPMV of polymer. Still awaiting the final results from the last week of sampling.

Discussion of Pilot Test 2 Results:

- Summary on how new coagulant is doing (Aries 252). City observations:
  - Aries 252 acting much like the historic chemical.
  - Continued thicker sludge with lower dose of 8.6 PPMV of PAC and 0.19 PPMV of polymer.
  - Higher dose resulted in more consistent thick to average sludge. Sludge was not watery like the previous chemical.
  - Higher dose resulting in similar values as low dose.
  - Aries 252 not causing detrimental effects like Aries 291. No noticeable graying in gravity thickeners.
  - Bi-weekly cleaning is being performed on chlorine contact tank. Build up is about average compared to ferric, which maybe 1" light sludge at the bottom. Aries 291 had about 8" sludge on the bottom.
  - As of 5/9/2017, the Fournier press was switched to the belt press due to pump motor issues. Replacement motors will be in as of next week (6/5 to 6/9).
  - WET Testing is not being performed.
  - PAC seems to eliminate toxic and reduces the need.
- TSS Removals:
  - High 70s/Mid 80s Percent Removal.
- Effluent TSS numbers:
  - Last recorded week: 76, 72, and 67 mg/L (5/23, 5/24, 5/25 respectively)

- Thickener Overflow and Underflow:
    - Overflow TSS: 306.5, 293.5 mg/L (5/23 – 5/24)
    - Underflow: 3.78% solids, 3.91% solids

Plan for Pilot Test 3:

- Pilot Test 3 with Aries 2076 (normal chemical) to begin with the same low dose.

2120-02

PEIRCE ISLAND WWTF CEPT PILOT
PORTSMOUTH, NH

**Pilot Test 5 Meeting NOTES**
**July 5, 2017 at 2:00 PM**

**ATTENDEES (By Conference Call):**

| | |
|---|---|
| • Terry Desmarais | City of Portsmouth |
| • Don Song | City of Portsmouth |
| • Timothy Babkirk | City of Portsmouth |
| • Steve Clifton | Underwood Engineers |
| • David Mercier | Underwood Engineers |
| • Daniel Jacobson | Underwood Engineers |

Work Completed Since Last Meeting:

- Started Pilot Test 3 with Aries 2076 on 6/5/2017. The chemical was started at a dose of 8.6 PPMV of Ferric and 0.19 PPMV of polymer. The ferric dose was increased to 27 PPMV on 7/3/2017.

Discussion of Pilot Test 3 Performance:

- Summary on how new coagulant is doing (Aries 2076).
    - So far, the results are showing that the ferric chemical is not doing as well as it has historically as an annual average.
        - The average TSS effluent (mg/L) for Pilots 1, 2, and 3 are 40, 56, and 74, respectively. The average TSS influent (mg/L) for Pilots 1, 2, and 3 are 233, 318, and 336, respectively.
    - The City reports that they have had no problems with sludge with the ferric chemical. They have had thick sludge since starting Aries 2076, and no issues at the gravity thickener.
    - The high dose of 27 PPMV was started on 7/3. So far, the results have been close to the low dose results, but maybe doing better, too early to tell. The floc is changing a little bit.
    - Dave mentioned running the second PAC (Aries 252) again if the Ferric high dose does not improve results. The Aries 252 results were quite similar when compared to historical numbers.
        - The City was concerned that the Aries 252 did not produce great sludge. The quality of the sludge would vary, with thick sludge for a few days and then water for a few days. Also, the end of the Aries 252 pilot with high doses resulted in a graying of the gravity thickener.
        - The first PAC (Aries 291) had the best effluent results short-term, but the most operational issues.

- The City mentioned doing 'operator optimized' runs for Ferric where the doses would be varied day-to-day. This may improve performance.
- It was decided that Ferric would be run with operator optimized doses starting on 7/17 and continuing for 2 weeks. This could be done instead of or in addition to re-running the second PAC chemical.
    - A conference call will be scheduled to decide if re-running the second PAC is necessary once statistical analysis is done on data.
- Steve asked about the current flows, temperature, and pH:
    - Average flows of 3.2 MGD. Morning flows around 2.1 MGD and increasing to 3.1 or 3.2 MGD at noon time. The average flows for May, June, and July are 5.6 MGD, 3.9 MGD, and 3.3 MGD, respectively.
    - The temperature has been changing with incoming flows. The temperature was 11.4°C when pilot started and is now 18.8°C. The pH has not really changed, around 7.5 to 7.8.

- TSS Removals:
    - Low 70s/Low 80s Percent Removal. Average percent removal of 76.3, so far.
- Effluent TSS numbers:
    - Last recorded week: 72, 66, 76, 74.7, 75 mg/L (6/20, 6/21, 6/22, 6/23, 6/24 respectively)
- Thickener Overflow and Underflow:
    - Overflow TSS: 287, 194, 165, 175 mg/L (6/27 – 6/30)
    - Underflow: -

Planned:

- Compare Pilot 3 data to historical seasonal data
- 44 week wastewater characterization with data and Phase 2 Pilot Report on website to download.
    - Can contact John Pearson of AECOM to request.
- Send email containing averages of influent and effluent for Terry to give EPA.
- Dave to receive email containing wastewater process sheets from Tim.
- Re-run ferric chemical with operator optimized dose from 7/17 - 7/31.

**Portsmouth, NH**
**Peirce Island WWTF**
**Pilot Testing Chemical dosing Results**

**Bold indicates a change in dose**

| | | *SCADA Set Doses* | | *PAC Pump Measured flow/dose* | | | *Poly Pump Measured flow/dose* | | *EAI Lab TSS Values* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | D-Box Flow (MGD) | PAC Setpoint (mg/L) | Poly Setpoint (mg/L) | PAC pump RPM | PAC pump flow rate (GPH) | PAC Dose (mg/L) | Poly Pump Flowrate (ml/min) | Poly Dose (mg/L) | Influent (mg/L) | Effluent (mg/L) | Removal (%) | Notes |
| 2/27/2017 7:50 | 9.6 | 30 | | 26.1 | 5.33 | 13.33 | | | | | | Pilot started with ARIES 291 PAC. Setpoints of 30ppm and 0.5ppm chosen for pilot startup. Poly SCADA changes had not been implemented. Coag SCADA not done correctly. |
| 2/27/2017 9:00 | 9.7 | 30 | 0.49 | 52.2 | 10.66 | 26.39 | | | | | | SCADA changes implemented for Poly and Coag. Setpoints set for both chemicals. |
| 2/27/2017 9:30 | 10.1 | 19.94 | 0.25 | | | | | | | | | Poor settling in clarifiers, poor quality effluent (visual) Doses were both reduced per operator judgement. |
| 2/27/2017 9:55 | 10.6 | 19.94 | 0.25 | 34.2 | 6.99 | 15.82 | | | | | | Check of coagulant pump dose showed somewhat lower than SCADA dose. |
| 2/27/2017 11:00 | 11.8 | 19.94 | 0.25 | 39.9 | 8.15 | 16.58 | | | | | | Clarifiers look better, floc is sinking well. Check of coagulant pump again showed dose to be low. |
| 2/27/2017 11:20 | 11.8 | 19.94 | 0.19 | | | | | | | | | Floc still looks good, but some of it is floating. Operator reduced poly dose. |
| 2/27/2017 13:00 | 9.2 | 16.17 | 0.19 | 22 | 4.49 | 11.73 | | | | | | Operator dropped PAC dose to 16ppm. Check of pump shows it is still low. |
| 2/27/2017 13:10 | 9.8 | 16.17 | 0.19 | | | | 6.74 | 0.26 | | | | Flow test for poly pump is slightly high. |
| 2/27/2017 13:20 | 10.2 | 16.17 | 0.19 | | | | 5.88 | 0.22 | | | | Flow test for poly pump is slightly high. |
| 2/27/2017 14:00 | 10.2 | 16.17 | 0.19 | 22.5 | 4.60 | 10.82 | | | | | | Check of coagulant pump shows flows still too low. |
| 2/28/2017 8:00 | 7.5 | 16.17 | 0.19 | 9.3 | 1.90 | 6.08 | | | | | | Determined that SCADA programming was not quite right up till this point. |
| 2/28/2017 8:45 | 8.4 | 16.17 | 0.19 | 13.6 | 2.78 | 7.94 | | | | | | RHR troubleshot SCADA with Mike, determined problem. Mike made changes 2/28/17 afternoon. Need to verify that changes were correct |
| 2/28/2017 9:00 | | 16.17 | 0.19 | | | | | | 173 | 32.5 | 81.21 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/1/2017 8:00 | 8.5 | 20 | 0.29 | | | | | | | | | Doses at SCADA had been adjusted since day before - Verify when changes were made |
| 3/1/2017 8:10 | 8.5 | 40.43 | 0.29 | | | | | | | | | Poor clarifier performance (visual). It was decided to turn dose up to 40 ppm to see if performance improved. |
| 3/1/2017 8:30 | 8.3 | 40.43 | 0.29 | 77.2 | 15.77 | 45.61 | | | | | | Flow test for PAC slightly high. |
| 3/1/2017 9:00 | | 40.43 | 0.29 | | | | | | 188 | 35.0 | 81.38 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/1/2017 17:00 | | 30 | 2 | | | | | | | | | Doses reset to jar test optimal levels of 30ppm and 2ppm and hold for 24 hrs. |
| 3/2/2017 8:30 | 8.1 | 30 | 2 | 58.8 | 12.01 | 35.59 | 46.3 | 2.17 | | | | Clarifiers had lots of solids on top |
| 3/2/2017 9:00 | 7.9 | 30 | 2 | 55.1 | 11.26 | 34.20 | | | | | | Flow test for PAC slightly high. |
| 3/2/2017 9:00 | | 30 | 2 | | | | | | 186 | 29.0 | 84.41 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/3/2017 8:00 | | 5.39 | 0.12 | | | | | | | | | Frozen solids on top of tank caused skimmer arm to bind up. City backed dose off drastically. |
| 3/3/2017 9:00 | | 30 | 2 | | | | | | 185 | 29.0 | 84.32 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/3/2017 11:00 | | 5.39 | 0.12 | | | | | | | | | Lower doses have resulted in significant improvement to clarifier performance (visual). City notes they can only process 30 gpm of sludge vs 50 gpm with ferric. |
| 3/4/2017 9:00 | | 5.39 | 0.12 | | | | | | 189 | 41.8 | 77.88 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/7/2017 7:30 | PILOT TESTING WITH ARIES 291 STOPPED DUE TO CONSTRUCTION ISSUES AT WWTF. | | | | | | | | | | | Plant staff need to catch up on sludge dewatering which has been adversely affected by change to PAC coagulant. |
| 3/21/2017 7:00 | PILOT TESTING WITH ARIES 291 RESTARTED. | | | | | | | | | | | |
| 3/21/2017 9:00 | | 26.95 | 0.10 | | | | | | | | | City restarted pilot with coagulant dose similar to jar testing doses. |
| 3/22/2017 9:15 | | 26.95 | 0.19 | | | | | | 272 | 40.5 | 85.11 | Small Floc spreading over surface of Clarifiers, Not settling well, Still having Problems running PAC sludge through Fouriner Press. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/23/2017 9:00 | | 26.95 | 0.29 | | | | | | 238 | 29.5 | 87.61 | Small Floc spreading over surface of Clarifiers, Not settling well, Still having Problems running PAC sludge through Fouriner Press. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/24/2017 8:45 | | 26.95 | 0.29 | | | | | | 169 | 35.5 | 78.99 | Light gray floc observed in Gravity Thickener, not settling well. Only about 6" of sludge in thickener. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/25/2017 7:30 | | 24.26 | 0.29 | | | | | | 238 | 31.0 | 86.97 | Sample collected at 9:00 AM represents previous 24 hour period. PAC dose decreased per Operator's judgement. |
| 3/25/2017 10:15 | | 29 | 0.29 | | | | | | | | | PAC dose was increased per Opertor's judgement |
| 3/25/2017 16:45 | | 16.17 | 0.16 | | | | | | | | | Both chemical doses were reduced per Opertor's judgement |
| 3/26/2017 10:30 | | 8.09 | 0.16 | | | | | | | | | PAC dose was reduced per Opertor's judgement |
| 3/27/2017 9:30 | | 8.09 | 0.16 | | | | | | | | | Over the weekend the Thickener was all light gray suspended Floc top to bottom no separation showing in Sludge Judge |
| 3/28/2017 8:45 | | 6.47 | 0.12 | | | | | | 504 | 62.5 | 87.60 | Poor settling, very thin sludge, not pressing well, lots of Pin Floc in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |

**Portsmouth, NH**
**Peirce Island WWTF**
**Pilot Testing Chemical dosing Results**

**Bold indicates a change in dose**

| | | *SCADA Set Doses* | | *PAC Pump Measured flow/dose* | | | *Poly Pump Measured flow/dose* | | *EAI Lab TSS Values* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | D-Box Flow (MGD) | PAC Setpoint (mg/L) | Poly Setpoint (mg/L) | PAC pump RPM | PAC pump flow rate (GPH) | PAC Dose (mg/L) | Poly Pump Flowrate (ml/min) | Poly Dose (mg/L) | Influent (mg/L) | Effluent (mg/L) | Removal (%) | Notes |
| 3/29/2017 9:00 | | 6.47 | 0.12 | | | | | | 221 | 71.0 | 67.84 | Poor settling, very thin sludge, not pressing well, lots of Pin Floc in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/30/2017 8:30 | | 6.47 | 0.12 | | | | | | 244 | 55.5 | 77.25 | Poor settling, very thin sludge, not pressing well, lots of Pin Floc in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/31/2017 9:00 | | 6.47 | 0.12 | | | | | | 160 | 62.0 | 61.13 | Poor settling, very thin sludge, not pressing well, lots of Pin Floc in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/1/2017 9:00 | | 6.47 | 0.12 | | | | | | 210 | 71.0 | 66.19 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/3/2017 9:00 | | 6.47 | 0.12 | | | | | | | | | High flows from snow melt, small Pin Floc. Very thin gray Sludge |
| 4/4/2017 9:00 | | 2.7 | 0.08 | | | | | | 189 | 47.0 | 75.17 | Heavy Rain, high flows, no settling, not much sludge. Doses for PAC and polymer reduced per Operator's Judgement. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/5/2017 9:00 | | 1.6 | 0.06 | | | | | | 248 | 45.5 | 81.63 | Flows over 10 MGD, Smaller Floc in the Clarifiers. Doses for PAC and polymer reduced again per Operator's judgement. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/6/2017 9:00 | | 4.3 | 0.1 | | | | | | 154 | 34.0 | 77.92 | Heavy Rain, high flows, no settling. City ran out of sludge around 11:00AM had to shut down process. Chemical doses both increased. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/7/2017 9:00 | | 5.4 | 0.19 | | | | | | 215.5 | 25.5 | 88.17 | Flows still over 10 MGD, seeing some brown clumps floating on surface of both Clarifiers, only pressed 28 tons of Sludge all week. Doses for PAC and polymer reduced per Operator's judgement. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/8/2017 9:00 | | 5.4 | 0.19 | | | | | | 168 | 34.5 | 79.46 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/10/2017 9:00 | | 6.5 | 0.23 | | | | | | | | | Flows around 8 MGD. Medium sized Floc in the Clarifier. Doses for PAC and polymer increased per Operator's judgement. |
| 4/11/2017 9:00 | | 8.1 | 0.29 | | | | | | 98 | 44.0 | 54.92 | Large floc on surface on Clarifiers are not settling. Doses for PAC and polymer increased per Operator's judgement. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/12/2017 9:00 | | 8.1 | 0.19 | | | | | | 280 | 35.5 | 87.32 | Much larger Floc, Flows are down around 6.5MGD. Staff left PAC dose the same but reduced Polymer dose. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/13/2017 9:00 | | 8.1 | 0.19 | | | | | | 377 | 40.7 | 89.20 | Still a very large Floc flows are down around 5 MGD, Floc is still staying on surface of Clarifiers and being pushed into the Scum. Tanks, PAC and poly reacting much different as the flows come down. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/14/2017 9:00 | | 8.1 | 0.19 | | | | | | 328 | 39.0 | 88.11 | Flows Around 5 MGD, Floc is now smaller. City ran out of Sludge on 4/13/17 and still not much Sludge today. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/15/2017 9:00 | | 8.1 | 0.19 | | | | | | 297 | 54.0 | 81.82 | Weekend Flows around 4 MGD, Clarifiers look ok but large clumps of Sludge forming in the Thickener. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/18/2017 9:00 | | 27 | 0.23 | | | | | | 216 | 28.5 | 86.81 | PAC and Polymer doses increased for final week of Pilot 1 per UEI recommendation. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/19/2017 9:00 | | 27 | 0.23 | | | | | | 200 | 24.5 | 87.75 | 4 FT of Black watery Sludge in Thickener, Not as many large clumps floating on surface. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/20/2017 9:00 | | 27 | 0.31 | | | | | | 191 | 23.5 | 87.70 | Light Grey Floc in Thickener, not really settling. Sample collected at 9:00 AM represents previous 24 hour period. Polymer dose increase per Operator's judgement. |
| 4/21/2017 9:00 | | 27 | 0.19 | | | | | | 350 | 27.0 | 92.29 | Polymer dose decrease per Operator's judgement. Light Grey Floc in Thickener, not really settling. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/22/2017 9:00 | | 27 | 0.19 | | | | | | 270 | 28.0 | 89.63 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/23/2017 9:00 | | 27 | 0.19 | | | | | | 270 | 28.0 | 89.63 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/24/2017 7:00 | **PILOT 2 BEGUN WITH ARIES 252** | | | | | | | | | | | |
| 4/24/2017 7:00 | | 8.6 | 0.19 | | | | | | | | | Pilot 2 begun with Aries 252. Pilot started with doses similar to "low doses" used in Pilot 1. Sludge is still like black water it Pressing but very wet, Clarifiers look about the same Small pin Floc. |
| 4/25/2017 9:00 | | 8.6 | 0.19 | | | | | | 295 | 63.0 | 78.64 | Rain all day Flows between 8-16 MGD, Sludge became extremely thick which it usually does with high flows. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/26/2017 9:00 | | 8.6 | 0.19 | | | | | | 580 | 49.5 | 91.47 | Flows Around 7 MGD, Sludge is still very thick, Hard to tell how the 252 is working because of the rain and High Flows. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/27/2017 9:00 | | 8.6 | 0.19 | | | | | | 518 | 70.0 | 86.49 | Sample collected at 9:00 AM represents previous 24 hour period. Flows Around 7 MGD, Sludge is still very thick, Hard to tell how the 252 is working because of the rain and High Flows. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/28/2017 9:00 | | 8.6 | 0.19 | | | | | | 249 | 54.0 | 78.31 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/29/2017 9:00 | | 8.6 | 0.19 | | | | | | 226 | 57.0 | 74.78 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/2/2017 9:00 | | 8.6 | 0.19 | | | | | | 82 | 36.0 | 56.10 | Flows around 5 MGD, Clarifiers are cloudy light grey, Sludge is still very thick. Sample collected at 9:00 AM represents previous 24 hour period. |

**Portsmouth, NH**
**Peirce Island WWTF**
**Pilot Testing Chemical dosing Results**

Bold indicates a change in dose

| | | *SCADA Set Doses* | | *PAC Pump Measured flow/dose* | | | *Poly Pump Measured flow/dose* | | *EAI Lab TSS Values* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | D-Box Flow (MGD) | PAC Setpoint (mg/L) | Poly Setpoint (mg/L) | PAC pump RPM | PAC pump flow rate (GPH) | PAC Dose (mg/L) | Poly Pump Flowrate (ml/min) | Poly Dose (mg/L) | Influent (mg/L) | Effluent (mg/L) | Removal (%) | Notes |
| 5/3/2017 9:00 | | 8.6 | 0.19 | | | | | | 254 | 37.5 | 85.24 | Flows around 5 MGD, Clarifiers are cloudy light grey, Sludge is still very thick. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/4/2017 9:00 | | 8.6 | 0.19 | | | | | | 182 | 45.0 | 75.27 | Flows around 5 MGD, Clarifiers are cloudy light grey, Sludge is still very thick. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/5/2017 9:00 | | 8.6 | 0.19 | | | | | | 233 | 48.0 | 79.40 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/6/2017 9:00 | | 8.6 | 0.19 | | | | | | 473 | 53.5 | 88.69 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/9/2017 9:00 | | 8.6 | 0.19 | | | | | | 230 | 50.0 | 78.26 | Flows around 5 MGD, Clarifiers are cloudy light grey, Sludge has thined out but still able to be pressed. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/10/2017 9:00 | | 8.6 | 0.19 | | | | | | 202 | 55.0 | 72.77 | Flows around 5 MGD, Clarifiers are cloudy light grey, Sludge has thined out but still able to be pressed. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/11/2017 9:00 | | 8.6 | 0.19 | | | | | | 296 | 63.0 | 78.72 | Cleaned Chlorine Contacts, Sludge on bottom was normal around 4", Sludge still very thin. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/12/2017 9:00 | | 8.6 | 0.19 | | | | | | 365 | 48.0 | 86.85 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/13/2017 9:00 | | 8.6 | 0.19 | | | | | | 283 | 70.0 | 75.27 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/16/2017 9:00 | | 8.6 | 0.19 | | | | | | 303 | 36.0 | 88.12 | Flows around 5.5 MGD, Thick Sludge, Clarifiers have a lot floating on surface. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/17/2017 9:00 | | 8.6 | 0.19 | | | | | | 261 | 50.0 | 80.84 | Flows around 5.5 MGD, Thick Sludge, Clarifiers have a lot floating on surface. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/18/2017 9:00 | | 8.6 | 0.19 | | | | | | 288 | 41.0 | 85.76 | Flows around 5 MGD, Sludge Thinned out, Some pin floc in Contacts. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/19/2017 9:00 | | 8.6 | 0.19 | | | | | | 240 | 64.0 | 73.33 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/20/2017 9:00 | | 8.6 | 0.19 | | | | | | 270 | 63.0 | 76.67 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/23/2017 9:00 | | 27 | 0.19 | | | | | | 534 | 76.0 | 85.77 | Went up on Pac Dose to 27mg/L, Floe around 4.5 MGD, Sludge thinned out. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/24/2017 9:00 | | 27 | 0.19 | | | | | | 280 | 72.0 | 74.29 | Went up on Pac Dose to 27mg/L, Floe around 4.5 MGD, Sludge thinned out. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/25/2017 9:00 | | 27 | 0.19 | | | | | | 345 | 66.7 | 80.68 | Floc in Clarifiers staying on top not settling well, Thin Sludge. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/26/2017 9:00 | | 27 | 0.19 | | | | | | 636 | 68.0 | 89.31 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/27/2017 9:00 | | 27 | 0.19 | | | | | | 263 | 47.0 | 82.13 | Weekend High flows due to Rain Pac and Poly in Manual Pace lots of sludge floating in Clarifiers. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/31/2017 9:00 | | 27 | 0.19 | | | | | | 310 | 39.0 | 87.42 | Thickener is now starting to show the grey Floc across the top and not settling well. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/1/2017 9:00 | | 27 | 0.19 | | | | | | 456 | 50.0 | 89.04 | Thickener showing more suspended solids, Sludge is getting thin, Flows around 4.5 MGD. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/2/2017 9:00 | | 27 | 0.19 | | | | | | 278 | 73.0 | 73.74 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/3/2017 9:00 | | 27 | 0.19 | | | | | | 292.7 | 70.0 | 76.08 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/5/2017 9:00 | PILOT 3 BEGUN WITH ARIES 2076 | | | | | | | | | | | Started using Ferric at 8.6 mg\L Poly at 0.19 mg\L. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/6/2017 9:00 | | 8.6 | 0.19 | | | | | | 378 | 74.0 | 80.42 | Flows around 4.9 MGD, Large Floc in Clarifiers but still settling ok. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/7/2017 9:00 | | 8.6 | 0.19 | | | | | | 406 | 76.0 | 81.28 | Flows around 4.9 MGD, Large Floc in Clarifiers but still settling ok. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/8/2017 9:00 | | 8.6 | 0.19 | | | | | | 272 | 71.0 | 73.90 | Not Sure what happened on this day numbers are way off. EA determined two bottle values were swapped due to mis-labeling. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/9/2017 9:00 | | 8.6 | 0.19 | | | | | | 115 | 60.0 | 47.83 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/10/2017 9:00 | | 8.6 | 0.19 | | | | | | 328 | 67.0 | 79.57 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/13/2017 9:00 | | 8.6 | 0.19 | | | | | | 420 | 68.6 | 83.67 | Flows are down around 3 MGD, Seeing the Influent solids Concentration going up. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/14/2017 9:00 | | 8.6 | 0.19 | | | | | | 326 | 82.0 | 74.85 | Flows are down around 3 MGD, Seeing the Influent solids Concentration going up, Lots of solids floating on Clarifiers. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/15/2017 9:00 | | 8.6 | 0.19 | | | | | | 354 | 72.5 | 79.54 | Flows are down around 3 MGD, Seeing the Influent solids Concentration going up, Lots of solids floating on Clarifiers. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/16/2017 9:00 | | 8.6 | 0.19 | | | | | | 362 | 86.0 | 76.24 | Sample collected at 9:00 AM represents previous 24 hour period. |

**Portsmouth, NH**
**Peirce Island WWTF**
**Pilot Testing Chemical dosing Results**

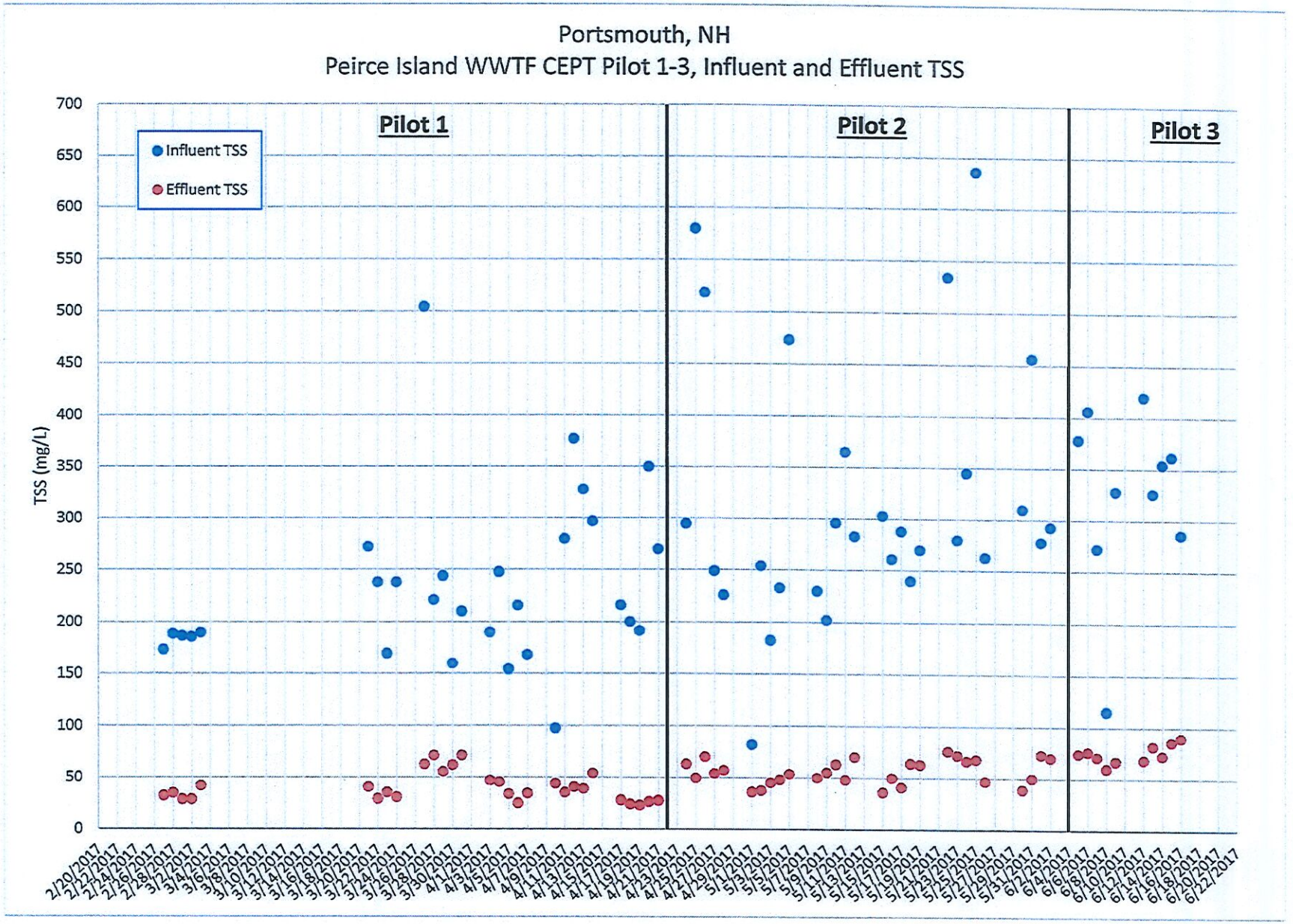
Bold indicates a change in dose

| | | *SCADA Set Doses* | | *PAC Pump Measured flow/dose* | | | *Poly Pump Measured flow/dose* | | *EAI Lab TSS Values* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | D-Box Flow (MGD) | PAC Setpoint (mg/L) | Poly Setpoint (mg/L) | PAC pump RPM | PAC pump flow rate (GPH) | PAC Dose (mg/L) | Poly Pump Flowrate (ml/min) | Poly Dose (mg/L) | Influent (mg/L) | Effluent (mg/L) | Removal (%) | Notes |
| 6/17/2017 9:00 | | 8.6 | 0.19 | | | | | | 286 | 90.0 | 68.53 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/20/2017 9:00 | | 8.6 | 0.19 | | | | | | 352 | 72.0 | 79.55 | Flows around 3.5 MGD, Not settling well in Clarifiers, Under normal operation I would make Poly adjustments to dial it in. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/21/2017 9:00 | | 8.6 | 0.19 | | | | | | 360 | 66.0 | 81.67 | Flows around 3.5 MGD, Not settling well in Clarifiers, Under normal operation I would make Poly adjustments to dial it in. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/22/2017 9:00 | | 8.6 | 0.19 | | | | | | 362.5 | 76.0 | 79.03 | More consistent sludge back on Ferric, Pressing much better on Ferric. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/23/2017 9:00 | | 8.6 | 0.19 | | | | | | 404 | 74.7 | 81.52 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/24/2017 9:00 | | 8.6 | 0.19 | | | | | | 320 | 75.0 | 76.56 | Sample collected at 9:00 AM represents previous 24 hour period. |

Portsmouth, NH
Peirce Island WWTF
Pilot Testing Chemical dosing Results

Pilot Lab Data:

| Sample ID | Sample Date | Nominal Date | Start Date (8am) | End Date (8am) | Influent TSS (mg/L) | Effluent TSS (mg/L) | % Removal | PAC Dose (mg/L) | Poly Dose (mg/L) | Coagulant Type | Coagulant Dose (Hi/Med/Low) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Influent/Effluent (Mon-Tue) | 2/28/2017 | 2/27/2017 | 2/27/2017 | 2/28/2017 | 173 | 32.5 | 81% | 19.94 | 0.19 | Aries 291 | MED | Dose varied over the course of the day. |
| Influent/Effluent (Tue-Wed) | 3/1/2017 | 2/28/2017 | 2/28/2017 | 3/1/2017 | 188 | 35 | 81% | 16.17 | 0.19 | Aries 291 | MED | |
| Influent/Effluent (Wed-Thu) | 3/2/2017 | 3/1/2017 | 3/1/2017 | 3/2/2017 | 186 | 29 | 84% | 40.43 | 0.29 | Aries 291 | HIGH | Dose varied over the course of the day. |
| Influent/Effluent (Thu-Fri) | 3/3/2017 | 3/2/2017 | 3/2/2017 | 3/3/2017 | 185 | 29 | 84% | 30.00 | 2.00 | Aries 291 | HIGH | |
| Influent/Effluent (Fri-Sat) | 3/4/2017 | 3/3/2017 | 3/3/2017 | 3/4/2017 | 189 | 41.76 | 78% | 5.39 | 0.12 | Aries 291 | LOW | |
| Influent/Effluent (Tue-Wed) | 3/22/2017 | 3/21/2017 | 3/21/2017 | 3/22/2017 | 272 | 40.5 | 85% | 26.95 | 0.10 | Aries 291 | HIGH | |
| Influent/Effluent (Wed-Thu) | 3/23/2017 | 3/22/2017 | 3/22/2017 | 3/23/2017 | 238 | 29.5 | 88% | 26.95 | 0.19 | Aries 291 | HIGH | |
| Influent/Effluent (Thu-Fri) | 3/24/2017 | 3/23/2017 | 3/23/2017 | 3/24/2017 | 169 | 35.5 | 79% | 26.95 | 0.29 | Aries 291 | HIGH | |
| Influent/Effluent (Fri-Sat) | 3/25/2017 | 3/24/2017 | 3/24/2017 | 3/25/2017 | 238 | 31 | 87% | 26.95 | 0.29 | Aries 291 | HIGH | |
| Influent/Effluent (Mon-Tue) | 3/28/2017 | 3/27/2017 | 3/27/2017 | 3/28/2017 | 504 | 62.5 | 88% | 8.09 | 0.16 | Aries 291 | LOW | |
| Influent/Effluent (Tue-Wed) | 3/29/2017 | 3/28/2017 | 3/28/2017 | 3/29/2017 | 220.8 | 71 | 68% | 6.47 | 0.12 | Aries 291 | LOW | |
| Influent/Effluent (Wed-Thu) | 3/30/2017 | 3/29/2017 | 3/29/2017 | 3/30/2017 | 244 | 55.5 | 77% | 6.47 | 0.12 | Aries 291 | LOW | |
| Influent/Effluent (Thu-Fri) | 3/31/2017 | 3/30/2017 | 3/30/2017 | 3/31/2017 | 159.5 | 62 | 61% | 6.47 | 0.12 | Aries 291 | LOW | |
| Influent/Effluent (Fri-Sat) | 4/1/2017 | 3/31/2017 | 3/31/2017 | 4/1/2017 | 210 | 71 | 66% | 6.47 | 0.12 | Aries 291 | LOW | |
| Influent/Effluent (Mon-Tue) | 4/4/2017 | 4/3/2017 | 4/3/2017 | 4/4/2017 | 189.3 | 47 | 75% | 6.47 | 0.12 | Aries 291 | LOW | |
| Influent/Effluent (Tue-Wed) | 4/5/2017 | 4/4/2017 | 4/4/2017 | 4/5/2017 | 247.7 | 45.5 | 82% | 2.7 | 0.08 | Aries 291 | LOW | |
| Influent/Effluent (Wed-Thu) | 4/6/2017 | 4/5/2017 | 4/5/2017 | 4/6/2017 | 154 | 34 | 78% | 1.6 | 0.06 | Aries 291 | LOW | |
| Influent/Effluent (Thu-Fri) | 4/7/2017 | 4/6/2017 | 4/6/2017 | 4/7/2017 | 215.5 | 25.5 | 88% | 4.3 | 0.1 | Aries 291 | LOW | |
| Influent/Effluent (Fri-Sat) | 4/8/2017 | 4/7/2017 | 4/7/2017 | 4/8/2017 | 168 | 34.5 | 79% | 5.4 | 0.19 | Aries 291 | LOW | |
| Influent/Effluent (Mon-Tue) | 4/11/2017 | 4/10/2017 | 4/10/2017 | 4/11/2017 | 97.6 | 44 | 55% | 6.5 | 0.23 | Aries 291 | LOW | |
| Influent/Effluent (Tue-Wed) | 4/12/2017 | 4/11/2017 | 4/11/2017 | 4/12/2017 | 280 | 35.5 | 87% | 8.1 | 0.29 | Aries 291 | LOW | |
| Influent/Effluent (Wed-Thu) | 4/13/2017 | 4/12/2017 | 4/12/2017 | 4/13/2017 | 377 | 40.7 | 89% | 8.1 | 0.19 | Aries 291 | LOW | |
| Influent/Effluent (Thu-Fri) | 4/14/2017 | 4/13/2017 | 4/13/2017 | 4/14/2017 | 328 | 39 | 88% | 8.1 | 0.19 | Aries 291 | LOW | |
| Influent/Effluent (Fri-Sat) | 4/15/2017 | 4/14/2017 | 4/14/2017 | 4/15/2017 | 297 | 54 | 82% | 8.1 | 0.19 | Aries 291 | LOW | |
| Influent/Effluent (Mon-Tue) | 4/18/2017 | 4/17/2017 | 4/17/2017 | 4/18/2017 | 216 | 28.5 | 87% | 27.0 | 0.23 | Aries 291 | HIGH | |
| Influent/Effluent (Tue-Wed) | 4/19/2017 | 4/18/2017 | 4/18/2017 | 4/19/2017 | 200 | 24.5 | 88% | 27.0 | 0.23 | Aries 291 | HIGH | |
| Influent/Effluent (Wed-Thu) | 4/20/2017 | 4/19/2017 | 4/19/2017 | 4/20/2017 | 191 | 23.5 | 88% | 27.0 | 0.23 | Aries 291 | HIGH | |
| Influent/Effluent (Thu-Fri) | 4/21/2017 | 4/20/2017 | 4/20/2017 | 4/21/2017 | 350 | 27 | 92% | 27.0 | 0.31 | Aries 291 | HIGH | |
| Influent/Effluent (Fri-Sat) | 4/22/2017 | 4/21/2017 | 4/21/2017 | 4/22/2017 | 270 | 28 | 90% | 27.0 | 0.19 | Aries 291 | HIGH | |
| Influent/Effluent (Mon-Tue) | 4/25/2017 | 4/24/2017 | 4/24/2017 | 4/25/2017 | 295 | 63 | 79% | 8.6 | 0.19 | Aries 252 | LOW | |
| Influent/Effluent (Tue-Wed) | 4/26/2017 | 4/25/2017 | 4/25/2017 | 4/26/2017 | 580 | 49.5 | 91% | 8.6 | 0.19 | Aries 252 | LOW | |
| Influent/Effluent (Wed-Thu) | 4/27/2017 | 4/26/2017 | 4/26/2017 | 4/27/2017 | 518 | 70 | 86% | 8.6 | 0.19 | Aries 252 | LOW | |
| Influent/Effluent (Thu-Fri) | 4/28/2017 | 4/27/2017 | 4/27/2017 | 4/28/2017 | 249 | 54 | 78% | 8.6 | 0.19 | Aries 252 | LOW | |
| Influent/Effluent (Fri-Sat) | 4/29/2017 | 4/28/2017 | 4/28/2017 | 4/29/2017 | 226 | 57 | 75% | 8.6 | 0.19 | Aries 252 | LOW | |
| Influent/Effluent (Mon-Tue) | 5/2/2017 | 5/1/2017 | 5/1/2017 | 5/2/2017 | 82 | 36 | 56% | 8.6 | 0.19 | Aries 252 | LOW | |
| Influent/Effluent (Tue-Wed) | 5/3/2017 | 5/2/2017 | 5/2/2017 | 5/3/2017 | 254 | 37.5 | 85% | 8.6 | 0.19 | Aries 252 | LOW | |
| Influent/Effluent (Wed-Thu) | 5/4/2017 | 5/3/2017 | 5/3/2017 | 5/4/2017 | 182 | 45 | 75% | 8.6 | 0.19 | Aries 252 | LOW | |
| Influent/Effluent (Thu-Fri) | 5/5/2017 | 5/4/2017 | 5/4/2017 | 5/5/2017 | 233 | 48 | 79% | 8.6 | 0.19 | Aries 252 | LOW | |
| Influent/Effluent (Fri-Sat) | 5/6/2017 | 5/5/2017 | 5/5/2017 | 5/6/2017 | 473 | 53.5 | 89% | 8.6 | 0.19 | Aries 252 | LOW | |
| Influent/Effluent (Mon-Tue) | 5/9/2017 | 5/8/2017 | 5/8/2017 | 5/9/2017 | 230 | 50 | 78% | 8.6 | 0.19 | Aries 252 | LOW | |
| Influent/Effluent (Tue-Wed) | 5/10/2017 | 5/9/2017 | 5/9/2017 | 5/10/2017 | 202 | 55 | 73% | 8.6 | 0.19 | Aries 252 | LOW | |
| Influent/Effluent (Wed-Thu) | 5/11/2017 | 5/10/2017 | 5/10/2017 | 5/11/2017 | 296 | 63 | 79% | 8.6 | 0.19 | Aries 252 | LOW | |
| Influent/Effluent (Thu-Fri) | 5/12/2017 | 5/11/2017 | 5/11/2017 | 5/12/2017 | 365 | 48 | 87% | 8.6 | 0.19 | Aries 252 | LOW | |
| Influent/Effluent (Fri-Sat) | 5/13/2017 | 5/12/2017 | 5/12/2017 | 5/13/2017 | 283 | 70 | 75% | 8.6 | 0.19 | Aries 252 | LOW | |
| Influent/Effluent (Mon-Tue) | 5/16/2017 | 5/15/2017 | 5/15/2017 | 5/16/2017 | 303 | 36 | 88% | 8.6 | 0.19 | Aries 252 | LOW | |
| Influent/Effluent (Tue-Wed) | 5/17/2017 | 5/16/2017 | 5/16/2017 | 5/17/2017 | 261 | 50 | 81% | 8.6 | 0.19 | Aries 252 | LOW | |
| Influent/Effluent (Wed-Thu) | 5/18/2017 | 5/17/2017 | 5/17/2017 | 5/18/2017 | 288 | 41 | 86% | 8.6 | 0.19 | Aries 252 | LOW | |
| Influent/Effluent (Thu-Fri) | 5/19/2017 | 5/18/2017 | 5/18/2017 | 5/19/2017 | 240 | 64 | 73% | 8.6 | 0.19 | Aries 252 | LOW | |
| Influent/Effluent (Fri-Sat) | 5/20/2017 | 5/19/2017 | 5/19/2017 | 5/20/2017 | 270 | 63 | 77% | 8.6 | 0.19 | Aries 252 | LOW | |
| Influent/Effluent (Mon-Tue) | 5/23/2017 | 5/22/2017 | 5/22/2017 | 5/23/2017 | 534 | 76 | 86% | 27.0 | 0.19 | Aries 252 | HIGH | |
| Influent/Effluent (Tue-Wed) | 5/24/2017 | 5/23/2017 | 5/23/2017 | 5/24/2017 | 280 | 72 | 74% | 27.0 | 0.19 | Aries 252 | HIGH | |
| Influent/Effluent (Wed-Thu) | 5/25/2017 | 5/24/2017 | 5/24/2017 | 5/25/2017 | 345 | 66.67 | 81% | 27.0 | 0.19 | Aries 252 | HIGH | |
| Influent/Effluent (Thu-Fri) | 5/26/2017 | 5/25/2017 | 5/25/2017 | 5/26/2017 | 636 | 68 | 89% | 27.0 | 0.19 | Aries 252 | HIGH | |
| Influent/Effluent (Fri-Sat) | 5/27/2017 | 5/26/2017 | 5/26/2017 | 5/27/2017 | 263 | 47 | 82% | 27.0 | 0.19 | Aries 252 | HIGH | |
| Influent/Effluent (Tue-Wed) | 5/31/2017 | 5/30/2017 | 5/30/2017 | 5/31/2017 | 310 | 39 | 87% | 27.0 | 0.19 | Aries 252 | HIGH | |
| Influent/Effluent (Wed-Thu) | 6/1/2017 | 5/31/2017 | 5/31/2017 | 6/1/2017 | 456 | 50 | 89% | 27.0 | 0.19 | Aries 252 | HIGH | No results for Memorial Day, 5/29 (Mon-Tue) |
| Influent/Effluent (Thu-Fri) | 6/2/2017 | 6/1/2017 | 6/1/2017 | 6/2/2017 | 278 | 73 | 74% | 27.0 | 0.19 | Aries 252 | HIGH | |
| Influent/Effluent (Fri-Sat) | 6/3/2017 | 6/2/2017 | 6/2/2017 | 6/3/2017 | 292.7 | 70 | 76% | 27.0 | 0.19 | Aries 252 | HIGH | |
| Influent/Effluent (Mon-Tue) | 6/6/2017 | 6/5/2017 | 6/5/2017 | 6/6/2017 | 378 | 74 | 80% | 8.6 | 0.19 | Aries 2076 | LOW | |
| Influent/Effluent (Tue-Wed) | 6/7/2017 | 6/6/2017 | 6/6/2017 | 6/7/2017 | 406 | 76 | 81% | 8.6 | 0.19 | Aries 2076 | LOW | |
| Influent/Effluent (Wed-Thu) | 6/8/2017 | 6/7/2017 | 6/7/2017 | 6/8/2017 | 272 | 71 | 74% | 8.6 | 0.19 | Aries 2076 | LOW | |
| Influent/Effluent (Thu-Fri) | 6/9/2017 | 6/8/2017 | 6/8/2017 | 6/9/2017 | 115 | 60 | 48% | 8.6 | 0.19 | Aries 2076 | LOW | |
| Influent/Effluent (Fri-Sat) | 6/10/2017 | 6/9/2017 | 6/9/2017 | 6/10/2017 | 328 | 67 | 80% | 8.6 | 0.19 | Aries 2076 | LOW | |
| Influent/Effluent (Mon-Tue) | 6/13/2017 | 6/12/2017 | 6/12/2017 | 6/13/2017 | 420 | 68.57 | 84% | 8.6 | 0.19 | Aries 2076 | LOW | |
| Influent/Effluent (Tue-Wed) | 6/14/2017 | 6/13/2017 | 6/13/2017 | 6/14/2017 | 326 | 82 | 75% | 8.6 | 0.19 | Aries 2076 | LOW | |
| Influent/Effluent (Wed-Thu) | 6/15/2017 | 6/14/2017 | 6/14/2017 | 6/15/2017 | 354.28 | 72.5 | 80% | 8.6 | 0.19 | Aries 2076 | LOW | |
| Influent/Effluent (Thu-Fri) | 6/16/2017 | 6/15/2017 | 6/15/2017 | 6/16/2017 | 362 | 86 | 76% | 8.6 | 0.19 | Aries 2076 | LOW | |
| Influent/Effluent (Fri-Sat) | 6/17/2017 | 6/16/2017 | 6/16/2017 | 6/17/2017 | 286 | 90 | 69% | 8.6 | 0.19 | Aries 2076 | LOW | |

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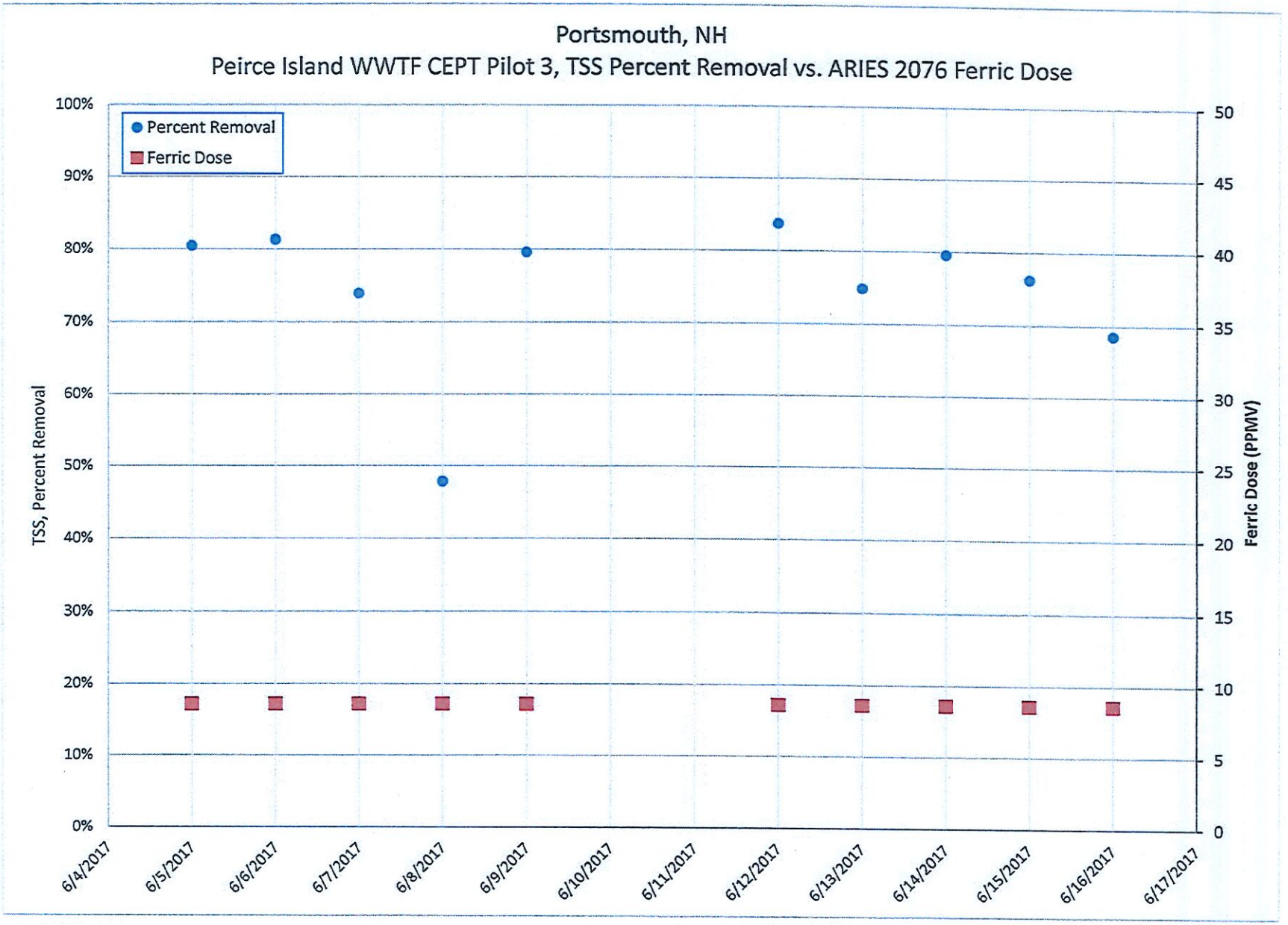
Portsmouth, NH
Peirce Island WWTF CEPT Pilot 3, TSS Percent Removal vs. ARIES 2076 Ferric Dose
Percent Removal
Ferric Dose
TSS, Percent Removal
Ferric Dose (PPMV)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
50
45
40
35
30
25
20
15
10
5
0
6/4/2017
6/5/2017
6/6/2017
6/7/2017
6/8/2017
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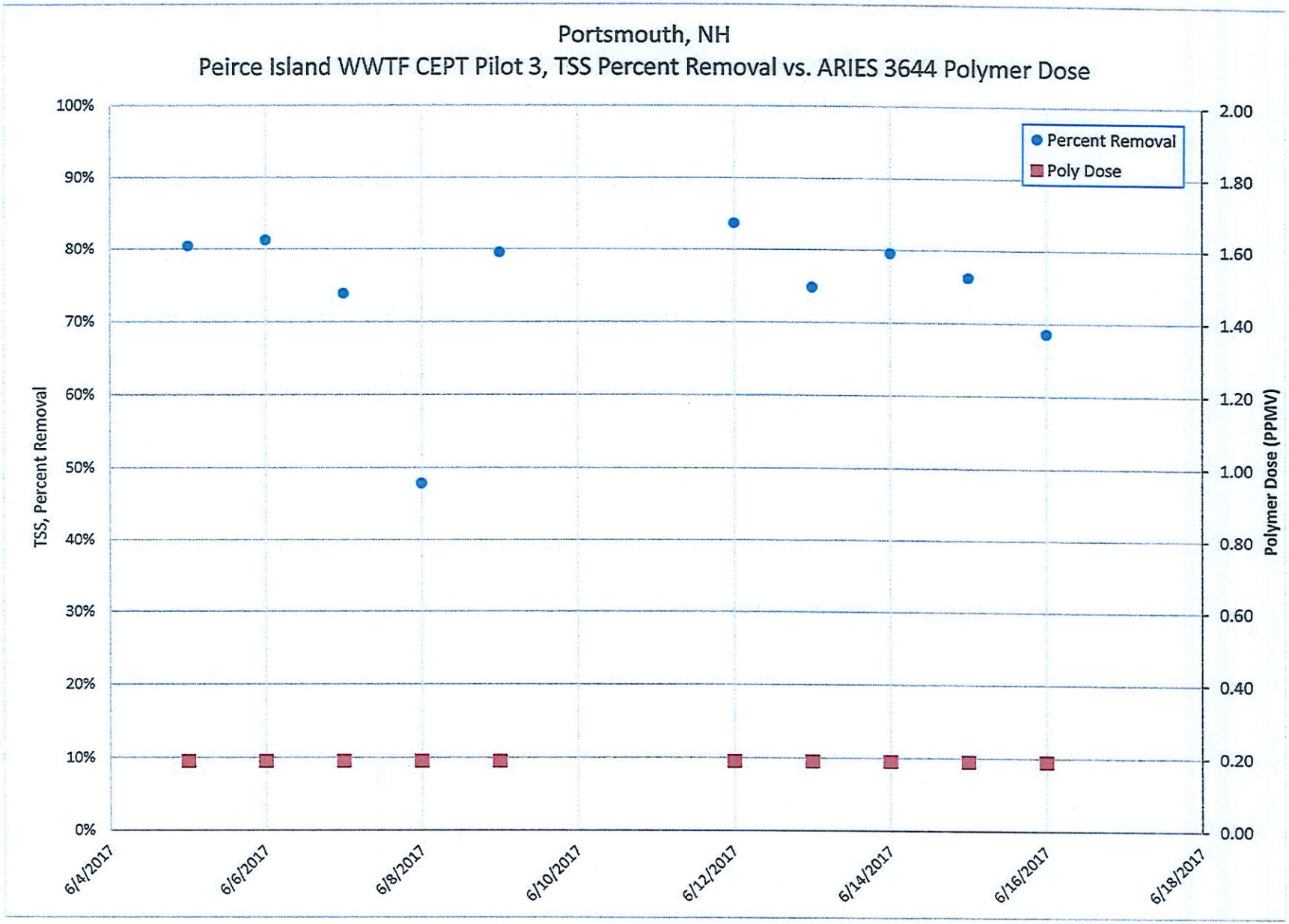
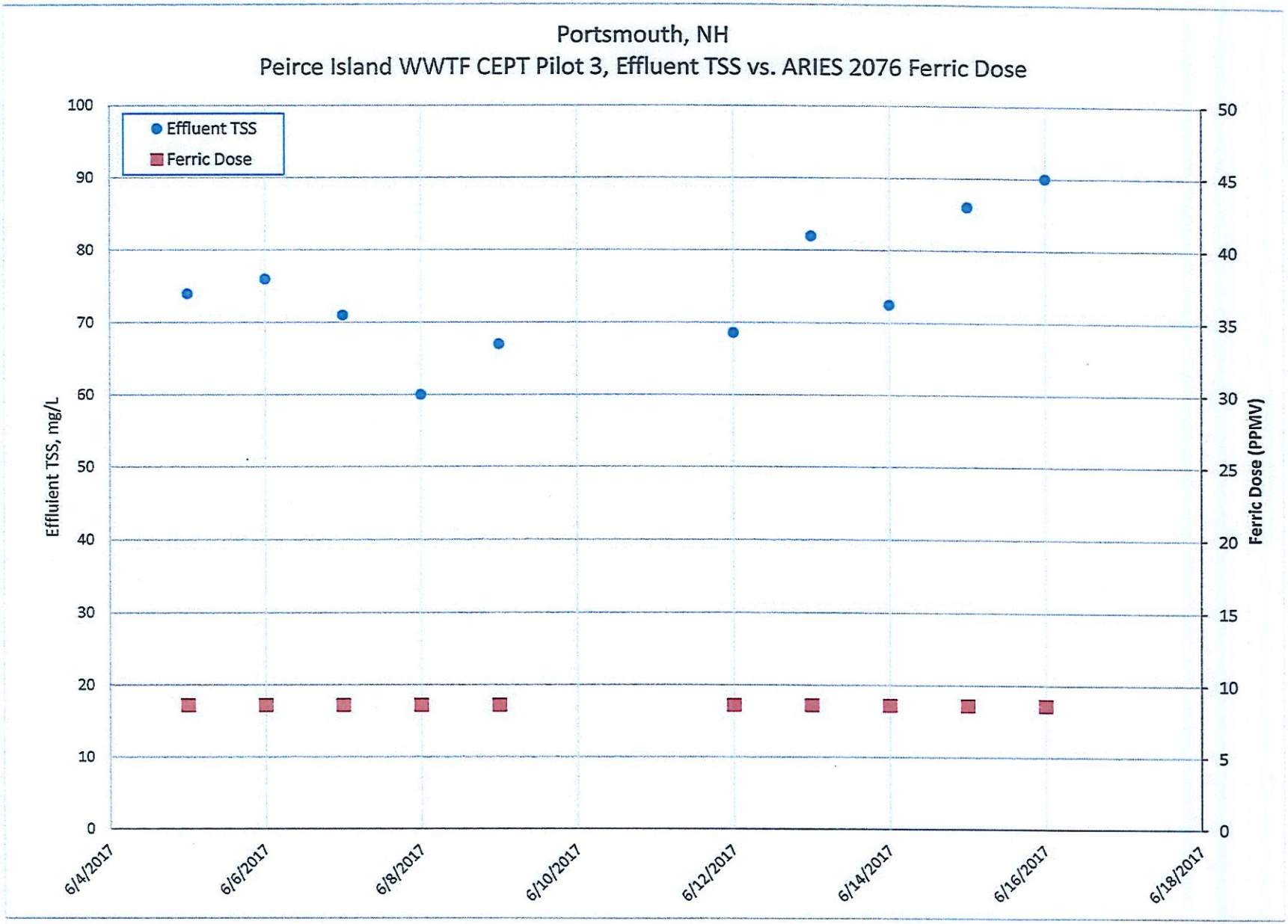
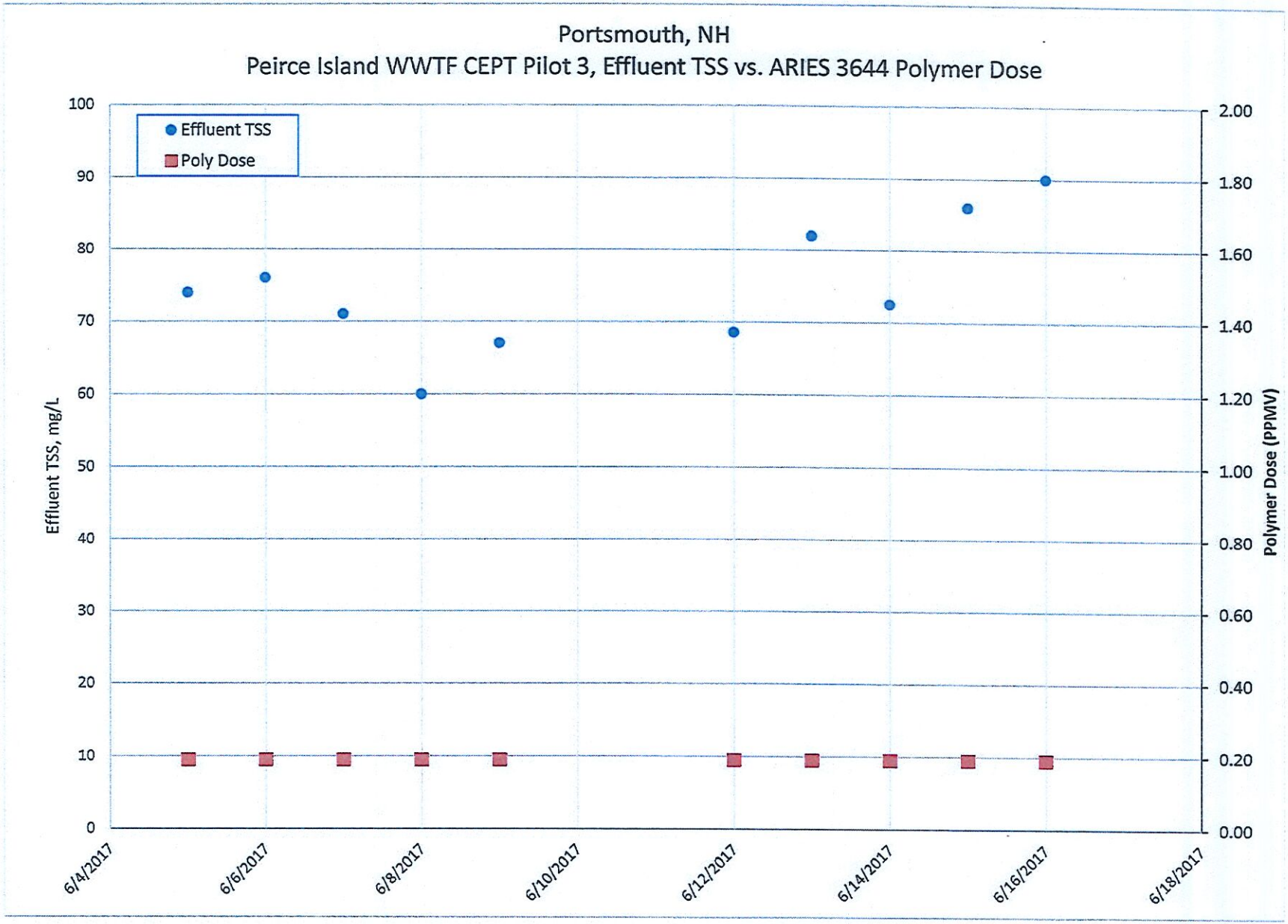
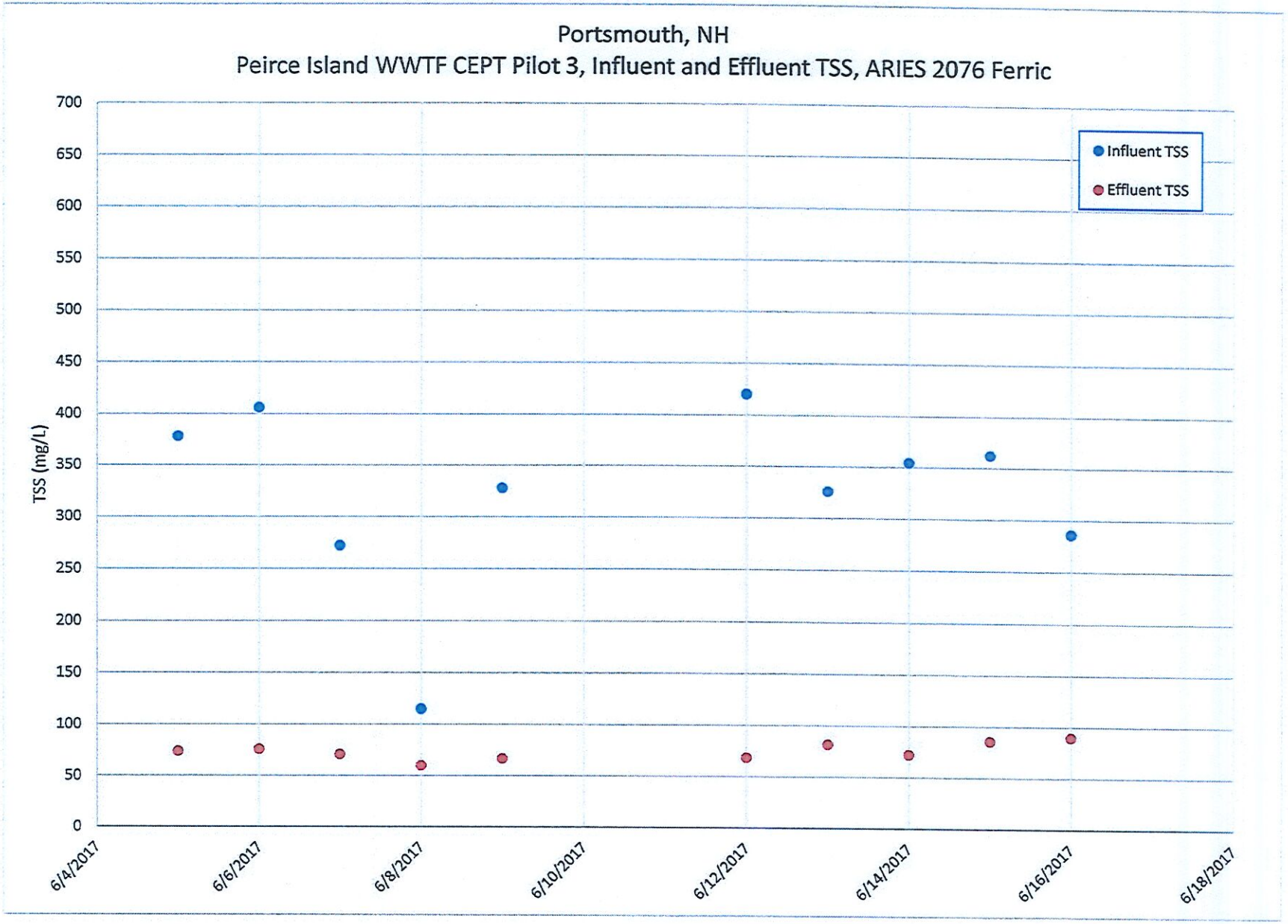
6/16/2017
6/17/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 3, TSS Percent Removal vs. ARIES 3644 Polymer Dose
TSS, Percent Removal
Polymer Dose (PPMV)
Percent Removal
Poly Dose
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
6/4/2017
6/6/2017
6/8/2017
6/10/2017
6/12/2017
6/14/2017
6/16/2017
6/18/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 3, Effluent TSS vs. ARIES 2076 Ferric Dose
Effluent TSS
Ferric Dose
Effluent TSS, mg/L
Ferric Dose (PPMV)
100
90
80
70
60
50
40
30
20
10
0
50
45
40
35
30
25
20
15
10
5
0
6/4/2017
6/6/2017
6/8/2017
6/10/2017
6/12/2017
6/14/2017
6/16/2017
6/18/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 3, Effluent TSS vs. ARIES 3644 Polymer Dose
Effluent TSS
Poly Dose
Effluent TSS, mg/L
Polymer Dose (PPMV)
100
90
80
70
60
50
40
30
20
10
0
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
6/4/2017
6/6/2017
6/8/2017
6/10/2017
6/12/2017
6/14/2017
6/16/2017
6/18/2017


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 3, Influent and Effluent TSS, ARIES 2076 Ferric
TSS (mg/L)
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
6/4/2017
6/6/2017
6/8/2017
6/10/2017
6/12/2017
6/14/2017
6/16/2017
6/18/2017
Influent TSS
Effluent TSS

2120-02

PEIRCE ISLAND WWTF CEPT PILOT
PORTSMOUTH, NH

**Pilot Test 6 Meeting NOTES**
**August 1, 2017 at 9:00 AM**

**ATTENDEES (By Conference Call):**

| | |
|---|---|
| • Terry Desmarais | City of Portsmouth |
| • Don Song | City of Portsmouth |
| • Timothy Babkirk | City of Portsmouth |
| • Steve Clifton | Underwood Engineers |
| • David Mercier | Underwood Engineers |

Work Completed Since Last Meeting:

- Completed Pilot Test 3 with Aries 2076 on 7/15/2017.
- Due to higher TSS vales than normal being achieved during Pilot Test 3, it was decided to continue sampling five days a week for a couple more weeks to see of dose adjustments by the operator as per the normal procedure would bring the effluent TSS values back to historic values. This is being called Pilot Test 3A.
- Pilot Test 3A began on 7/17/17 at a chemical dose of 32 PPMV of Ferric and 0.29 PPMV of polymer and was slowly increased to 45 PPMV of Ferric and 0.58 PPMV of polymer by 7/27/17.

Discussion of Pilot Test 3 Performance:

- Summary on how coagulant Aries 2076 performed
  - Test was run from 6/5/17 to 7/15/17
  - Mean Inf TSS during test was 359 mg/L and mean Eff TSS during test was 70 mg/L.
  - Historically the Aries 2076 achieved 53 mg/L on an annual average basis but for the month of June and July the historical averages were 55 and 58 mg/L, respectively, and continued to increase in August-November before coming back down in December.
  - The City has had no problems with sludge during Pilot 3 with the ferric chemical. They have had adequate quantities of thick sludge to process and no issues at the gravity thickener.

Discussion of Pilot Test 3 Performance:

- Underwood only has 5 data points back from lab so far but mean Inf TSS has been 344 mg/L and mean Eff TSS has been 62 mg/L.

- Test should be continued for at least 2 more weeks to 8/12/17 to allow adequate samples to be collected once the chemical dose is up to historic levels (vs. where is was for Pilot 3 which was lower than historic doses for this time of year)

Additional Discussion:

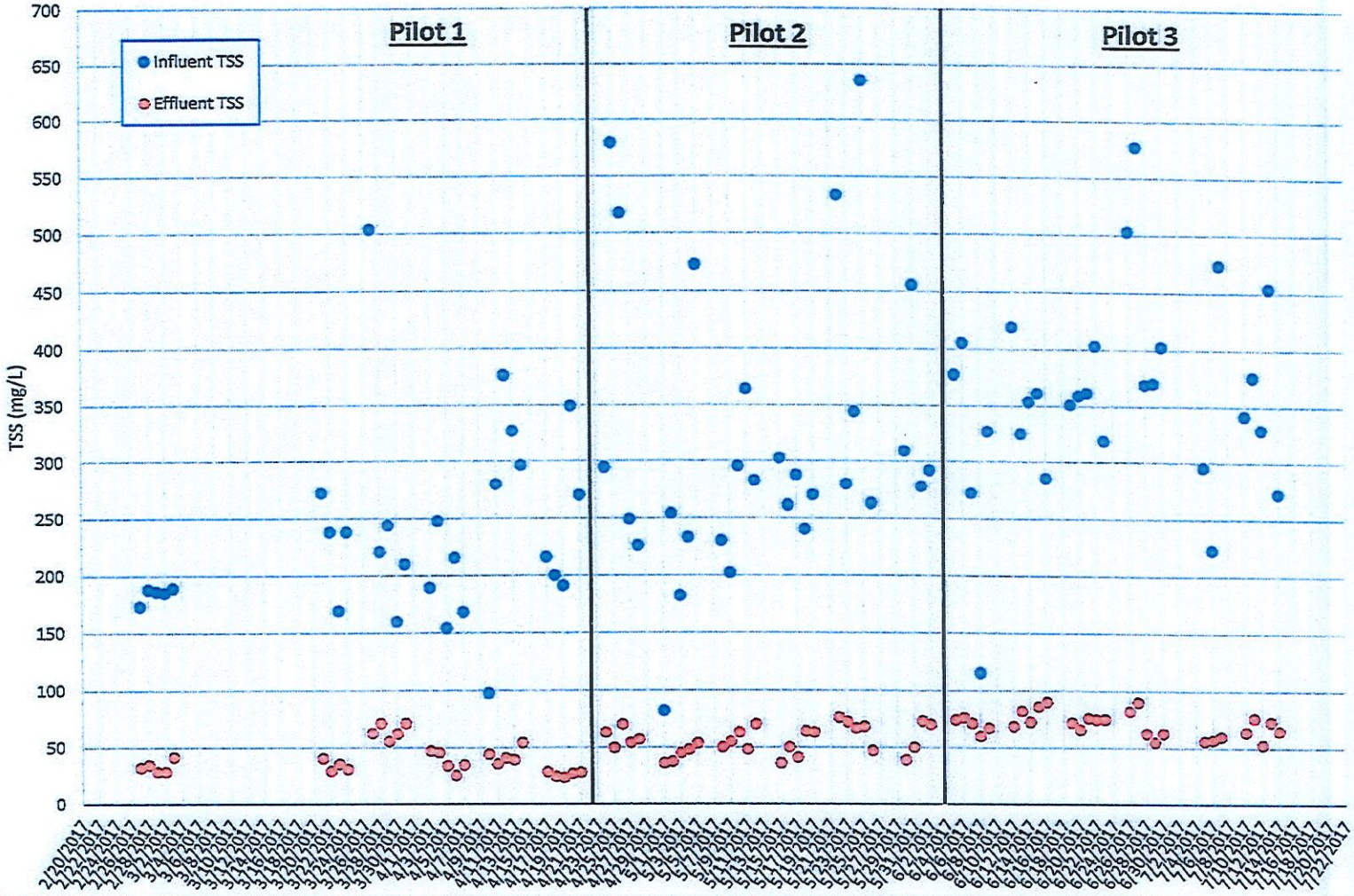
- Statistical analysis so far yields the following:
  - The mean for the pilot Inf TSS was Pilot 1 = 233 mg/L, Pilot 2 = 318 mg/L and Pilot 3 = 359 mg/L.
  - The mean for the pilot Eff TSS was Pilot 1 = 40 mg/L, Pilot 2 = 56 mg/L and Pilot 3 = 70 mg/L.
  - The Pilot 1 Inf TSS was significantly different and lower than for Pilots 2 and 3 which were not significantly different from each other.
  - The Pilot 1 Eff TSS was significantly different and lower than the Pilot 2 Eff TSS which was significantly different and lower than the Pilot 3 Eff TSS
- Since meeting on 7/5/17, Underwood has done additional analysis on historic TSS effluent data which supports the concept that the plant performance varies over the course of the year with lower TSS being produced in the colder months of the year (December-May) and higher TSS being produced in the warmer months (June-November). In fact, the lowest TSS has historically been produced in January, March and April.
- The new chemicals Aries 291 PAC and Aries 252 PAC were tested between March and May so that may have enhanced their performance

Planned:

- Underwood will perform additional statistical analysis on the historical monthly average data to see how the historical chemical compares to each pilot rather than comparing each pilot to one another given the potentially confounding parameter of time of year.
- Conduct another conference call/meeting on August 8 at 9AM to discuss new statistics and second week of data from Pilot 3A
- Discuss the need to run additional pilots
- Portsmouth will need to start processing sludge straight out of the gravity thickener come September due to construction activities during the plant upgrades that are underway. Staff are concerned that the issues the PAC products caused with the graying of the gravity thicker could negatively impact solids handling operations if those chemicals are used after September.
- Tim will get Underwood specific dates during the piloting when the belt filter press was being used vs. the Fournier press.

Portsmouth, NH

Peirce Island WWTF CEPT Pilot 1-3, Influent and Effluent TSS

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**Analysis of Variance: INFLUENT TSS**
**Portsmouth CEPT Pilot**

| Number of Treatments: | 3 |
|---|---|

| Aries 291 | | Aries 252 | | Aries 2076 | | Total |
|---|---|---|---|---|---|---|
| *Inf. TSS* | *SS* | *Inf. TSS* | *SS* | *Inf. TSS* | *SS* | |
| 173 | 16791.04 | 295 | 57.46 | 378 | 5688.14 | |
| 188 | 13128.63 | 580 | 76961.73 | 406 | 10695.65 | |
| 186 | 13590.95 | 518 | 46405.68 | 272 | 935.15 | |
| 185 | 13825.11 | 249 | 2870.84 | 115 | 35186.34 | |
| 189 | 12900.47 | 226 | 5864.53 | 328 | 646.16 | |
| 272 | 935.15 | 82 | 48655.64 | 420 | 13787.40 | |
| 238 | 4170.61 | 254 | 2360.04 | 326 | 548.49 | |
| 169 | 17843.68 | 182 | 14539.59 | 354.28 | 2672.87 | |
| 238 | 4170.61 | 233 | 4841.41 | 362 | 3530.71 | |
| 504 | 40569.92 | 473 | 29042.90 | 286 | 274.90 | |
| 220.8 | 6688.01 | 230 | 5267.89 | 352 | 2442.31 | |
| 244 | 3431.64 | 202 | 10116.38 | 360 | 3297.03 | |
| 159.5 | 20471.95 | 296 | 43.30 | 362.5 | 3590.38 | |
| 210 | 8571.10 | 365 | 3896.23 | 404 | 10285.97 | |
| 189.3 | 12832.41 | 283 | 383.39 | 320 | 303.45 | |
| 247.7 | 3011.84 | 303 | 0.18 | 503.3 | 40288.43 | |
| 154 | 22076.09 | 261 | 1728.92 | 578 | 75856.05 | |
| 215.5 | 7582.97 | 288 | 212.58 | 370 | 4545.43 | |
| 168 | 18111.84 | 240 | 3916.29 | 371.1 | 4694.96 | |
| 97.6 | 42016.90 | 270 | 1061.47 | 403.3 | 10144.47 | |
| 280 | 509.87 | 534 | 53555.11 | 296 | 43.30 | |
| 377 | 5538.30 | 280 | 509.87 | 222.86 | 6355.32 | |
| 328 | 646.16 | 345 | 1799.44 | 474 | 29384.74 | |
| 297 | 31.14 | 636 | 111168.74 | 342.5 | 1593.59 | |
| 216 | 7496.14 | 263 | 1566.59 | 376.67 | 5489.29 | |
| 200 | 10522.70 | 310 | 55.05 | 330 | 751.84 | |
| 191 | 12450.15 | 456 | 23537.63 | 454.29 | 23015.85 | |
| 350 | 2248.63 | 278 | 604.19 | 272 | 935.15 | |
| 270 | 1061.47 | 292.7 | 97.62 | - | | |
| **Sum** | 6757.4 | 323225.47 | 9224.7 | 451120.664 | 10039.8 | 296983.363 | |
| **Mean** | 233.014 | | 318.093 | | 358.564 | | **302.580** |
| **St. Dev.** | 80.817 | | 125.945 | | 88.029 | | **112.267** |
| **Variance** | 6531.438 | | 15862.209 | | 7749.088 | | **12603.88** |

SUMMARY

| *Groups* | *Count* | *Sum* | *Average* | *Variance* |
|---|---|---|---|---|
| Aries 291 | 29 | 6757.4 | 233.01 | 6531.44 |
| Aries 252 | 29 | 9224.7 | 318.09 | 15862.209 |
| Aries 2076 | 28 | 10039.8 | 358.564 | 7749.088 |
| *Total* | *86* | *26021.9* | *42.66* | *212.163963* |

ANOVA

| *Source of Variation* | *SS* | *df* | *MS* | *F* | *F crit* |
|---|---|---|---|---|---|
| Coagulant | 235082 | 2 | 117541.01 | 11.67 | 2.34 |
| Error | 836247.5 | 83 | 10075.27 | | |
| Total | 1071329 | 85 | | | |

*If F > F crit, we reject the null hypothesis and the populations are not all equal. At least one of the means is different. Perform a t-test to test each pair of means.*

*F crit can be looked up from an F distribution table (any statistics book or the internet) using the chosen alpha (significance interval), the degrees of freedom from the numberator (df_coagulant), and degrees of freedom for the denomenator (df_error). Shown here is F crit =* $f_{0.10,2,55}$

**TSS Influent t-Test** **a = 0.1**

**Arles 291 vs. Arles 252**

t-Test: Two-Sample Assuming Unequal Variances

| | *252* | *291* | |
|---|---|---|---|
| Mean | 318.0931 | 233.0138 | |
| Variance | 15862.21 | 6531.438 | |
| Observations | 29 | 29 | |
| Hypothesized Mean Difference | 0 | | |
| df | 48 | | |
| t Stat | 3.061685 | | |
| P(T<=t) one-tail | 0.0018 | | |
| t Critical one-tail | 1.299439 | | |
| P(T<=t) two-tail | 0.0036 | | |
| t Critical two-tail | 1.677224 | | Reject Ho |

| IF | THEN |
|---|---|
| tstat > tcrit | Reject Ho |
| tstat < tcrit | Do NOT Reject Ho |
| p value < a | Reject Ho |
| p value > a | Do NOT Reject Ho |

Ho: Means *are not* significant
H1: Means *are* significantly di

**Arles 291 vs. Arles 2076**

t-Test: Two-Sample Assuming Unequal Variances

| | *2076* | *291* | |
|---|---|---|---|
| Mean | 358.5643 | 233.0138 | |
| Variance | 7749.088 | 6531.438 | |
| Observations | 28 | 29 | |
| Hypothesized Mean Difference | 0 | | |
| df | 54 | | |
| t Stat | 5.603731 | | |
| P(T<=t) one-tail | 3.65E-07 | | |
| t Critical one-tail | 1.297426 | | |
| P(T<=t) two-tail | 7.3E-07 | | |
| t Critical two-tail | 1.673565 | | Reject Ho |

**Arles 252 vs. Arles 2076**

t-Test: Two-Sample Assuming Unequal Variances

| | *2076* | *252* | |
|---|---|---|---|
| Mean | 358.5643 | 318.0931 | |
| Variance | 7749.088 | 15862.21 | |
| Observations | 28 | 29 | |
| Hypothesized Mean Difference | 0 | | |
| df | 50 | | |
| t Stat | 1.410115 | | |
| P(T<=t) one-tail | 0.082348 | | |
| t Critical one-tail | 1.298714 | | |
| P(T<=t) two-tail | 0.164696 | | |
| t Critical two-tail | 1.675905 | | Do NOT Reject Ho |

*When comparing Arles 291 with both Arles 252 and Arles 2076, the t-Test results in the rejection of the Null Hypothesis. The difference in the means is not equal to zero. The means are significantly different. When comparing Arles 252 vs. Arles 2076, the t-Test results in the acception of the Null Hypothesis. These two means are not significantly different. Therefore, the TSS Influent values for Arles 291 are significantly different than the other two chemicals.*

**Analysis of Variance: TSS EFFLUENT**
**Portsmouth CEPT Pilot**

| Number of Treatments: | 3 |
|---|---|

| Aries 291 | | Aries 252 | | Aries 2076 | | Total |
|---|---|---|---|---|---|---|
| *Eff. TSS* | *SS* | *Eff. TSS* | *SS* | *Eff. TSS* | *SS* | |
| 32.5 | 511.22 | 63 | 62.25 | 74 | 356.83 | |
| 35 | 404.42 | 49.5 | 31.47 | 76 | 436.39 | |
| 29 | 681.74 | 70 | 221.71 | 71 | 252.49 | |
| 29 | 681.74 | 54 | 1.23 | 60 | 23.91 | |
| 41.76 | 178.22 | 57 | 3.57 | 67 | 141.37 | |
| 40.5 | 213.45 | 36 | 365.20 | 68.57 | 181.17 | |
| 29.5 | 655.88 | 37.5 | 310.11 | 82 | 723.07 | |
| 35.5 | 384.56 | 45 | 102.21 | 72.5 | 302.41 | |
| 31 | 581.30 | 48 | 50.55 | 86 | 954.19 | |
| 62.5 | 54.61 | 53.5 | 2.59 | 90 | 1217.31 | |
| 71 | 252.49 | 50 | 26.11 | 72 | 285.27 | |
| 55.5 | 0.15 | 55 | 0.01 | 66 | 118.59 | |
| 62 | 47.47 | 63 | 62.25 | 76 | 436.39 | |
| 71 | 252.49 | 48 | 50.55 | 74.7 | 383.76 | |
| 47 | 65.77 | 70 | 221.71 | 75 | 395.61 | |
| 45.5 | 92.35 | 36 | 365.20 | 82 | 723.07 | |
| 34 | 445.64 | 50 | 26.11 | 90 | 1217.31 | |
| 25.5 | 876.76 | 41 | 199.09 | 62.7 | 57.61 | |
| 34.5 | 424.78 | 64 | 79.03 | 55 | 0.01 | |
| 44 | 123.43 | 63 | 62.25 | 62.73 | 58.06 | |
| 35.5 | 384.56 | 76 | 436.39 | 56 | 0.79 | |
| 40.7 | 207.65 | 72 | 285.27 | 57 | 3.57 | |
| 39 | 259.53 | 66.7 | 134.33 | 60 | 23.91 | |
| 54 | 1.23 | 68 | 166.15 | 64 | 79.03 | |
| 28.5 | 708.10 | 47 | 65.77 | 76.25 | 446.90 | |
| 24.5 | 936.98 | 39 | 259.53 | 52.857 | 5.08 | |
| 23.5 | 999.20 | 50 | 26.11 | 73 | 320.05 | |
| 27 | 790.18 | 73 | 320.05 | 65 | 97.81 | |
| 28 | 734.96 | 70 | 221.71 | - | - | |
| **Sum** | 1156.96 | 11950.8291 | 1615.2 | 4158.5441 | 1967.307 | 9241.945 | |
| **Mean** | 39.895 | | 55.697 | | 70.261 | | **55.110** |
| **St. Dev.** | 13.677 | | 12.172 | | 10.210 | | **17.270** |
| **Variance** | 187.054 | | 148.163 | | 104.243 | | **298.2508** |

SUMMARY

| *Groups* | *Count* | *Sum* | *Average* | *Variance* |
|---|---|---|---|---|
| Aries 291 | 29 | 1157.0 | 39.90 | 187.05 |
| Aries 252 | 29 | 1615.2 | 55.70 | 148.163 |
| Aries 2076 | 28 | 1967.307 | 70.261 | 104.243 |
| *Total* | *86* | *4739.5* | *42.66* | *212.164* |

ANOVA

| *Source of Variation* | *SS* | *df* | *MS* | *F* | *F crit* |
|---|---|---|---|---|---|
| Coagulant | 13150.66 | 2 | 6575.33 | 44.73 | 2.34 |
| Error | 12200.65 | 83 | 147.00 | | |
| Total | 25351.32 | 85 | | | |

*If F > F crit, we reject the null hypothesis and the populations are not all equal. At least one of the means is different. Perform a t-test to test each pair of means.*

*F crit can be looked up from an F distribution table (any statistics book or the Internet) using the chosen alpha (significance interval), the degrees of freedom from the numberator (df_coagulant), and degrees of freedom for the denomenator (df_error). Shown here is F crit = $f_{0.10,2,55}$*

TSS Effluent a = 0.1

**Arles 291 vs. Arles 252**

t-Test: Two-Sample Assuming Unequal Variances

| | *252* | *291* |
|---|---|---|
| Mean | 55.69655172 | 39.89517241 |
| Variance | 148.163202 | 187.0542473 |
| Observations | 29 | 29 |
| Hypothesized Mean Difference | 0 | |
| df | 55 | |
| t Stat | 4.647620822 | |
| P(T<=t) one-tail | 1.07055E-05 | |
| t Critical one-tail | 1.2971343 | |
| P(T<=t) two-tail | 2.1411E-05 | |
| t Critical two-tail | 1.673033965 | Reject Ho |

| IF | THEN |
|---|---|
| tstat > tcrit | Reject Ho |
| tstat < tcrit | Do NOT Reject Ho |
| p value < a | Reject Ho |
| p value > a | Do NOT Reject Ho |

Null Ho: Difference in means is equal to zero (Means are not significantly different).

Alternative H1: Difference in means is not equal to zero (Means are significantly different)

**Arles 291 vs. Arles 2076**

t-Test: Two-Sample Assuming Unequal Variances

| | *2076* | *291* |
|---|---|---|
| Mean | 70.26096429 | 39.89517241 |
| Variance | 104.2431809 | 187.0542473 |
| Observations | 28 | 29 |
| Hypothesized Mean Difference | 0 | |
| df | 52 | |
| t Stat | 9.520452423 | |
| P(T<=t) one-tail | 2.75848E-13 | |
| t Critical one-tail | 1.298045016 | |
| P(T<=t) two-tail | 5.51697E-13 | |
| t Critical two-tail | 1.674689154 | Reject Ho |

**Arles 252 vs. Arles 2076**

t-Test: Two-Sample Assuming Unequal Variances

| | *2076* | *252* |
|---|---|---|
| Mean | 70.26096429 | 55.69655172 |
| Variance | 104.2431809 | 148.163202 |
| Observations | 28 | 29 |
| Hypothesized Mean Difference | 0 | |
| df | 54 | |
| t Stat | 4.900747136 | |
| P(T<=t) one-tail | 4.54991E-06 | |
| t Critical one-tail | 1.297426488 | |
| P(T<=t) two-tail | 9.09983E-06 | |
| t Critical two-tail | 1.673564906 | Reject Ho |

*Each t-Test resulted in the rejection of the Null Hypothesis. The means for all three chemicals are significantly different from one another.*

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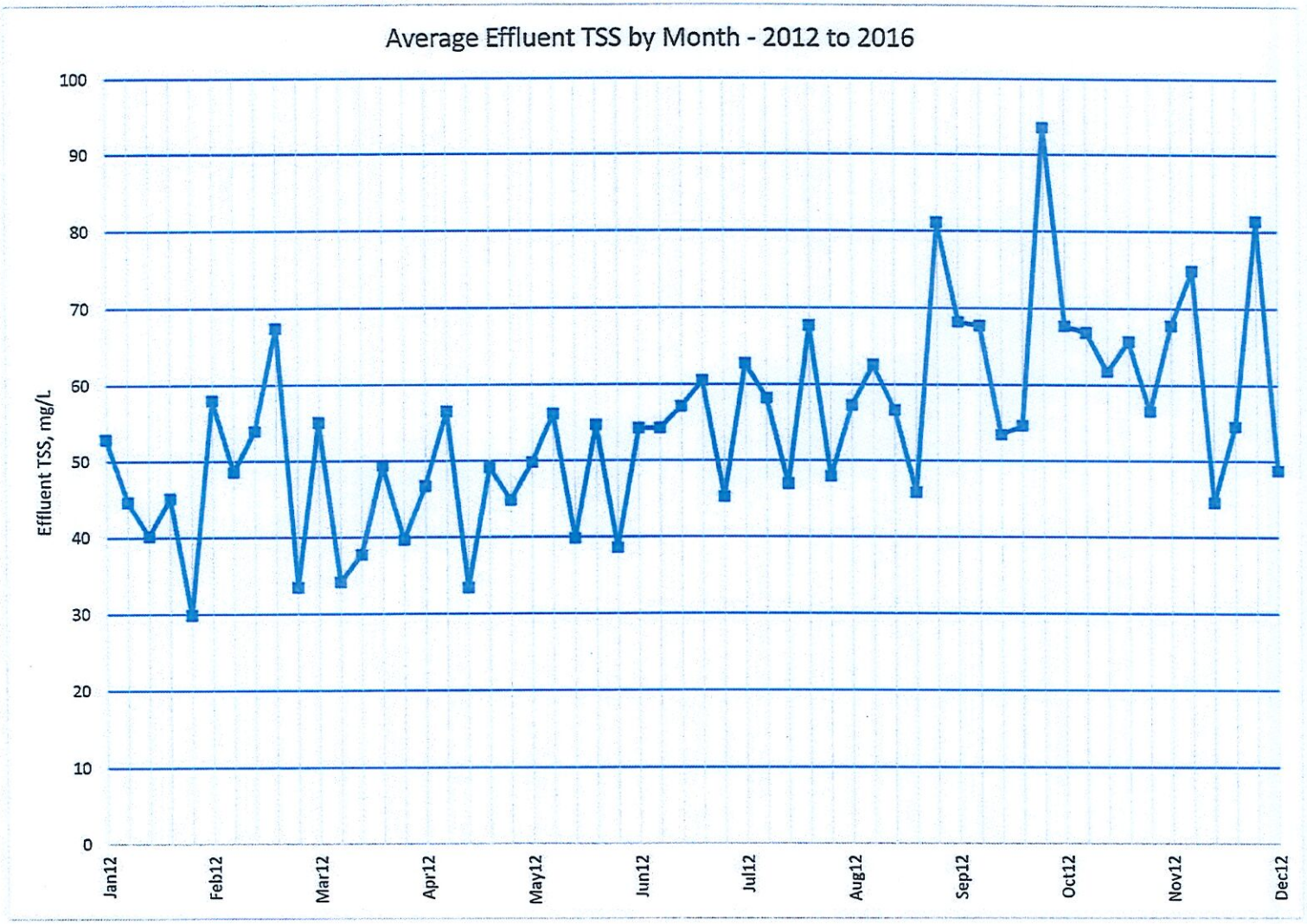
Avg TSS by Month(B)

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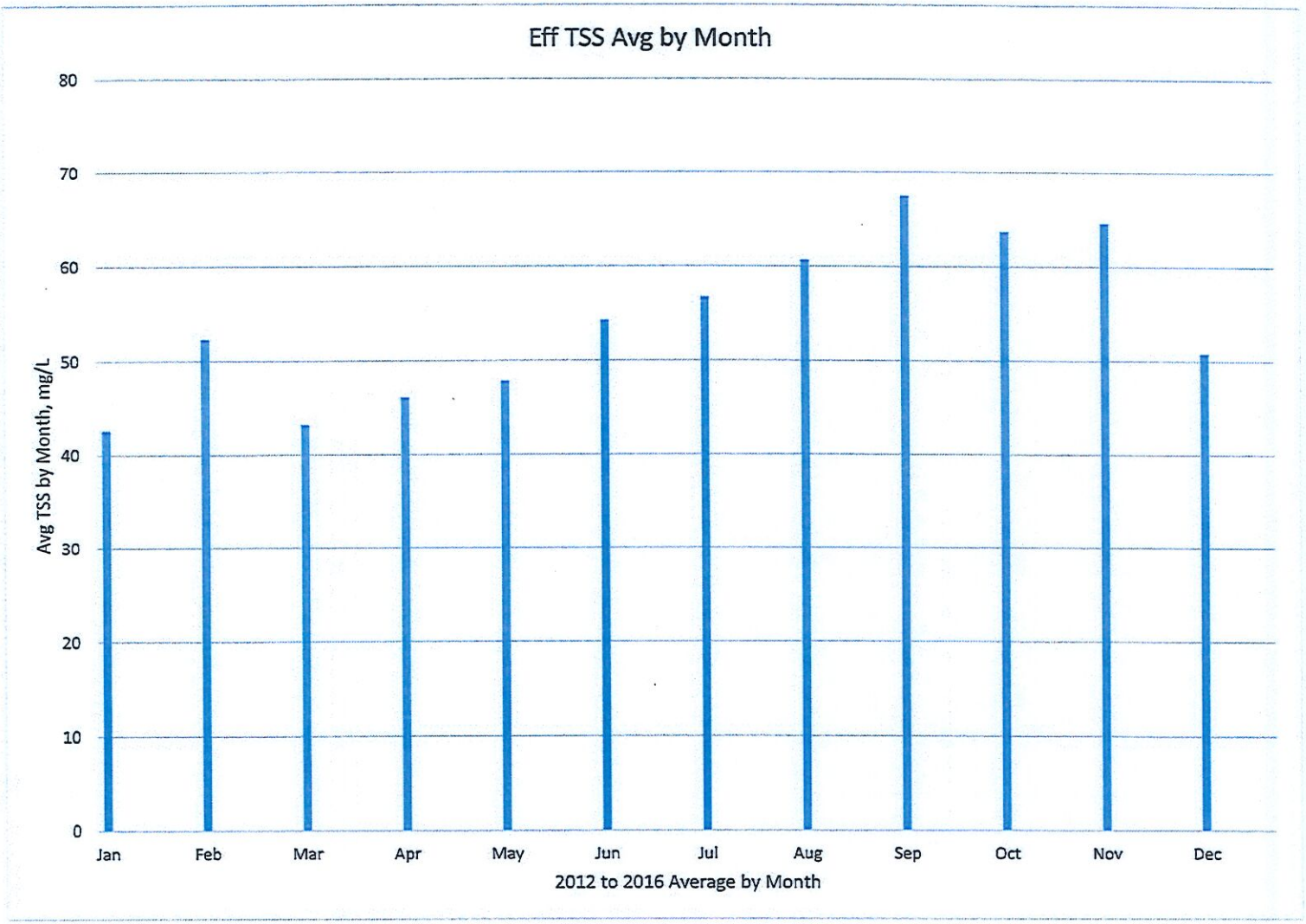
Avg TSS by Month to Dec 2016

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| Row Labels | Average of Inf_Flow_M.G.D. | Average of Inf_tss_mg/L_comp-24 | Average of eff_tss_mg/L_comp-24 | Average of tss_%_rem_mg_L_CAL | Average of Inf_tss_lbs_CAL | Average of eff_tss_lbs_CAL | Average of Inf_BOD_mg/L_comp-24 |
|---|---|---|---|---|---|---|---|
| 2012 | | | | | | | |
| Jan12 | 5.35 | 183 | 53 | 70.5 | 7,321 | 2,147 | 205 |
| Feb12 | 4.50 | 217 | 58 | 72.4 | 7,789 | 2,088 | 251 |
| Mar12 | 5.40 | 159 | 55 | 62.5 | 6,747 | 2,324 | 196 |
| Apr12 | 4.39 | 189 | 47 | 74.9 | 6,649 | 1,644 | 217 |
| May12 | 5.19 | 205 | 50 | 75.7 | 9,005 | 2,278 | 195 |
| Jun12 | 6.11 | 237 | 54 | 75.1 | 12,335 | 2,934 | 204 |
| Jul12 | 3.90 | 349 | 63 | 80.3 | 11,530 | 2,092 | 303 |
| Aug12 | 3.85 | 344 | 57 | 82.7 | 10,928 | 1,829 | 317 |
| Sep12 | 3.39 | 318 | 68 | 77.3 | 9,323 | 2,022 | 323 |
| Oct12 | 3.81 | 275 | 68 | 73.2 | 8,805 | 2,194 | 292 |
| Nov12 | 3.49 | 284 | 68 | 73.7 | 8,265 | 1,940 | 288 |
| Dec12 | 5.37 | 174 | 49 | 70.2 | 6,655 | 2,171 | 210 |
| 2012 Total | 4.57 | 245 | 57 | 74.4 | 8,801 | 2,136 | 250 |
| 2013 | | | | | | | |
| Jan13 | 4.48 | 161 | 45 | 72.3 | 5,995 | 1,681 | 211 |
| Feb13 | 5.02 | 160 | 49 | 69.1 | 6,978 | 2,141 | 213 |
| Mar13 | 7.26 | 124 | 34 | 71.7 | 7,759 | 2,045 | 138 |
| Apr13 | 5.01 | 186 | 57 | 67.3 | 7,911 | 2,402 | 211 |
| May13 | 4.59 | 208 | 56 | 71.7 | 7,391 | 2,051 | 244 |
| Jun13 | 6.30 | 169 | 54 | 68.1 | 9,154 | 2,943 | 175 |
| Jul13 | 4.30 | 219 | 58 | 72.7 | 8,410 | 2,240 | 241 |
| Aug13 | 3.41 | 252 | 63 | 75.2 | 6,979 | 1,732 | 358 |
| Sep13 | 3.79 | 244 | 68 | 72.2 | 5,478 | 1,519 | 335 |
| Oct13 | 2.82 | 279 | 67 | 75.6 | 6,655 | 1,611 | 327 |
| Nov13 | 2.86 | 361 | 75 | 77.3 | 7,409 | 1,569 | 424 |
| Dec13 | 3.67 | 322 | 64 | 79.9 | 10,942 | 2,172 | 344 |
| 2013 Total | 4.43 | 223 | 57 | 72.8 | 7,584 | 2,008 | 268 |
| 2014 | | | | | | | |
| Jan14 | 5.12 | 226 | 40 | 82.4 | 10,349 | 1,697 | 233 |
| Feb14 | 2.79 | 297 | 54 | 81.9 | 6,024 | 1,083 | 339 |
| Mar14 | 4.19 | 261 | 38 | 85.4 | 8,671 | 955 | 252 |
| Apr14 | 4.52 | 217 | 33 | 83.3 | 8,327 | 1,363 | 182 |
| May14 | 3.25 | 291 | 40 | 85.9 | 8,170 | 1,125 | 258 |
| Jun14 | 2.50 | 399 | 57 | 85.3 | 7,742 | 1,113 | 337 |
| Jul14 | 2.01 | 372 | 47 | 86.1 | 5,786 | 1,133 | 326 |
| Aug14 | 3.30 | 424 | 57 | 86.8 | 13,874 | 2,034 | 329 |
| Sep14 | 2.62 | 475 | 53 | 88.7 | 11,080 | 1,245 | 389 |
| Oct14 | 3.11 | 438 | 62 | 84.9 | 10,379 | 1,443 | 387 |
| Nov14 | 3.44 | 296 | 45 | 85.1 | 8,625 | 1,293 | 301 |
| Dec14 | 6.37 | 218 | 40 | 80.3 | 11,097 | 2,222 | 178 |
| 2014 Total | 3.70 | 327 | 47 | 84.7 | 9,252 | 1,389 | 290 |
| 2015 | | | | | | | |
| Jan15 | 3.79 | 241 | 45 | 83.1 | 6,520 | 1,216 | 224 |
| Feb15 | 3.86 | 291 | 67 | 76.4 | 9,223 | 2,141 | 284 |
| Mar15 | 4.70 | 277 | 49 | 80.7 | 8,244 | 1,421 | 229 |
| Apr15 | 6.65 | 166 | 49 | 68.1 | 9,214 | 3,145 | 140 |
| May15 | 2.33 | 507 | 55 | 89.2 | 13,827 | 1,477 | 421 |
| Jun15 | 4.12 | 409 | 61 | 84.0 | 13,253 | 2,063 | 287 |
| Jul15 | 3.25 | 376 | 68 | 78.1 | 11,407 | 1,863 | 317 |
| Aug15 | 2.89 | 279 | 46 | 82.2 | 7,581 | 1,177 | 300 |
| Sep15 | 2.82 | 277 | 55 | 80.7 | 5,963 | 1,184 | 317 |
| Oct15 | 2.93 | 310 | 66 | 76.7 | 7,098 | 1,508 | 283 |
| Nov15 | 3.20 | 340 | 55 | 83.6 | 8,968 | 1,445 | 334 |
| Dec15 | 3.15 | | | | | | |
| 2015 Total | 3.75 | 313 | 56 | 79.8 | 9,159 | 1,713 | 284 |
| 2016 | | | | | | | |
| Jan16 | 4.60 | 228 | 30 | 86.8 | 8,430 | 1,126 | 221 |
| Feb16 | 4.90 | 255 | 33 | 86.7 | 10,617 | 1,422 | 236 |
| Mar16 | 5.49 | 285 | 40 | 79.7 | 10,322 | 1,834 | 182 |
| Apr16 | 4.26 | 201 | 45 | 76.5 | 7,012 | 1,577 | 201 |
| May16 | 3.31 | 224 | 39 | 82.1 | 6,065 | 1,072 | 249 |
| Jun16 | 2.94 | 325 | 45 | 85.7 | 7,973 | 1,116 | 378 |
| Jul16 | 2.74 | 266 | 48 | 81.3 | 5,798 | 1,045 | 285 |
| Aug16 | 2.55 | 308 | 81 | 73.0 | 6,481 | 1,701 | 271 |
| Sep16 | 2.38 | 284 | 94 | 65.2 | 5,606 | 1,866 | 275 |
| Oct16 | 3.13 | 341 | 57 | 83.4 | 7,228 | 1,195 | 331 |
| Nov16 | 3.34 | 347 | 81 | 75.2 | 11,061 | 2,537 | 310 |
| Dec16 | 4.09 | 354 | 51 | 85.5 | 10,724 | 1,543 | 341 |
| 2016 Total | 3.64 | 278 | 54 | 79.9 | 8,348 | 1,527 | 279 |

| Average of eff_BOD_mg/L_Comp-24 | Average of Inf_BOD_LBS_CAL | Average of eff_BOD_lbs_CAL | Average of BOD_% Removal_CAL | Average of Temp_inf_grab | Average of pH_inf_grab | Average of eff_pH_grab | Average of primary_sludge_flow_gal |
|---|---|---|---|---|---|---|---|
| 132 | 8,240 | 5,262 | 35 | 11.6 | 6.9 | 6.6 | 492,218 |
| 148 | 9,042 | 5,372 | 40 | 11.3 | 6.7 | 6.5 | 530,336 |
| 136 | 8,187 | 5,829 | 29 | 12.4 | 6.8 | 6.5 | 495,681 |
| 161 | 7,487 | 5,458 | 27 | 14.5 | 6.9 | 6.5 | 687,603 |
| 132 | 8,426 | 5,644 | 32 | 16.1 | 6.7 | 6.3 | 539,314 |
| 114 | 10,350 | 5,859 | 42 | 18.1 | 6.8 | 6.4 | 578,215 |
| 158 | 10,069 | 5,228 | 48 | 20.5 | 6.5 | 6.4 | 644,873 |
| 173 | 9,722 | 5,310 | 45 | 21.6 | 6.4 | 6.3 | 698,281 |
| 203 | 9,559 | 5,900 | 38 | 20.8 | 6.4 | 6.3 | 661,596 |
| 172 | 9,290 | 5,645 | 39 | 19.0 | 6.6 | 6.4 | 694,363 |
| 144 | 8,503 | 4,227 | 50 | 16.0 | 6.7 | 6.5 | 742,339 |
| 110 | 7,088 | 3,824 | 46 | 14.5 | 6.7 | 6.4 | 901,385 |
| 149 | 8,833 | 5,319 | 39 | 16.4 | 6.7 | 6.4 | 639,131 |
| | | | | | | | |
| 112 | 7,859 | 4,199 | 46 | 12.3 | 7.0 | 6.6 | 669,720 |
| 108 | 8,707 | 4,392 | 49 | 12.5 | 6.7 | 6.5 | 615,305 |
| 74 | 8,428 | 4,360 | 48 | 11.9 | 6.7 | 6.5 | 686,034 |
| 103 | 8,971 | 4,329 | 51 | 12.8 | 6.7 | 6.5 | 686,051 |
| 134 | 8,787 | 4,812 | 45 | 15.6 | 6.7 | 6.4 | 690,206 |
| 93 | 7,229 | 3,657 | 49 | 18.0 | 6.5 | 6.3 | 715,173 |
| 129 | 8,689 | 4,717 | 46 | 20.1 | 6.5 | 6.4 | 1 |
| 185 | 9,823 | 5,094 | 48 | 20.7 | 6.3 | 6.3 | 1 |
| 187 | 7,191 | 3,880 | 45 | 20.3 | 6.4 | 6.3 | 1 |
| 180 | 8,544 | 4,687 | 45 | 18.7 | 6.5 | 6.5 | 1 |
| 242 | 8,780 | 5,022 | 42 | 16.2 | 6.3 | 6.5 | 1 |
| 166 | 11,275 | 5,386 | 53 | 14.2 | 6.5 | 6.5 | 1 |
| 140 | 8,717 | 4,551 | 47 | 16.1 | 6.6 | 6.4 | 331,938 |
| | | | | | | | |
| 115 | 9,929 | 4,699 | 52 | 12.2 | 6.7 | 6.6 | 1 |
| 145 | 5,383 | 2,446 | 54 | 11.7 | 6.8 | 6.6 | 1 |
| 101 | 4,554 | 1,801 | 61 | 11.0 | 6.7 | 6.6 | 1 |
| 76 | 7,103 | 2,982 | 58 | 12.8 | 6.9 | 6.5 | 1 |
| 95 | 7,166 | 2,699 | 62 | 15.0 | 7.0 | 6.6 | 1 |
| 112 | 6,549 | 2,163 | 67 | 17.8 | 7.1 | 6.7 | 1 |
| 110 | 6,078 | 2,074 | 66 | 19.9 | 6.9 | 6.7 | 1 |
| 120 | 10,447 | 3,783 | 63 | 20.9 | 6.7 | 6.7 | 1 |
| 142 | 8,912 | 3,227 | 63 | 21.0 | 6.8 | 6.6 | 1 |
| 148 | 9,103 | 3,445 | 61 | 19.2 | 6.7 | 6.6 | 1 |
| 116 | 8,783 | 3,361 | 62 | 16.2 | 6.8 | 6.6 | 1 |
| 73 | 8,839 | 3,643 | 58 | 13.2 | 6.9 | 6.7 | 1 |
| 112 | 7,686 | 3,005 | 61 | 15.9 | 6.8 | 6.6 | 1 |
| | | | | | | | |
| 107 | 5,365 | 2,901 | 51 | 11.8 | 6.9 | 6.7 | 1 |
| 149 | 8,960 | 4,895 | 48 | 11.1 | 6.8 | 6.7 | 1 |
| 95 | 6,656 | 2,657 | 59 | 10.9 | 6.9 | 6.6 | 0 |
| 70 | 7,593 | 4,068 | 47 | 11.5 | 6.9 | 6.5 | 0 |
| 128 | 5,446 | 2,792 | 69 | 15.5 | 6.8 | 6.5 | 0 |
| 127 | 8,011 | 3,802 | 52 | 17.7 | 6.9 | 6.5 | 0 |
| 101 | 8,009 | 2,456 | 67 | 20.1 | 6.7 | 6.6 | 1 |
| 128 | 7,679 | 3,176 | 56 | 21.4 | 6.7 | 6.6 | 1 |
| 145 | 6,796 | 3,100 | 54 | 21.7 | 6.7 | 6.6 | 1 |
| 113 | 6,213 | 2,495 | 59 | 19.0 | 6.8 | 6.6 | 1 |
| 115 | 8,763 | 2,968 | 64 | 17.0 | 6.7 | 6.6 | 1 |
| | | | | 15.8 | 6.9 | 6.6 | |
| 115 | 7,568 | 3,240 | 57 | 16.2 | 6.8 | 6.6 | 0 |
| | | | | | | | |
| 78 | 8,030 | 2,817 | 64 | | | | |
| 80 | 9,625 | 3,273 | 66 | | | | |
| 70 | 8,868 | 3,427 | 58 | | | | |
| 79 | 6,915 | 2,739 | 60 | | | | |
| 86 | 6,717 | 2,335 | 65 | | | | |
| 131 | 9,304 | 2,666 | 66 | | | | |
| 132 | 6,186 | 2,435 | 59 | | | | |
| 132 | 5,687 | 2,765 | 51 | | | | |
| 137 | 5,430 | 2,714 | 51 | | | | |
| 115 | 7,207 | 2,424 | 65 | | | | |
| 114 | 5,607 | 1,488 | 63 | | | | |
| 99 | 10,297 | 2,950 | 71 | | | | |
| 101 | 7,822 | 2,853 | 61 | | | | |

2120-02

PEIRCE ISLAND WWTF CEPT PILOT
PORTSMOUTH, NH

**Pilot Test 7 Meeting NOTES**
**August 8, 2017 at 9:00 AM**

**ATTENDEES (By Conference Call):**

| | |
|---|---|
| • Terry Desmarais | City of Portsmouth |
| • Don Song | City of Portsmouth |
| • Timothy Babkirk | City of Portsmouth |
| • Steve Clifton | Underwood Engineers |
| • David Mercier | Underwood Engineers |
| • Daniel Jacobson | Underwood Engineers |

Work Completed Since Last Meeting:

- Based on purely comparing one pilot to another, the performance of each pilot appears to have gotten progressively worse from 1 to 2 to 3/3A (see attached graph). Tim noted last meeting that this is something he sees year to year based on seasonal variation.
- To address this issue, additional statistical analysis was performed on the historical monthly performance data to see how each pilot performed compared to the historical chemical during the same time of year.

Discussion of Statistical Analysis Results:

- Seasonal variation of effluent quality is clearly present when comparing historical monthly average data.
    - Effluent quality is better in colder months than warmer months, with an approximate TSS effluent of 55-65 mg/L in warmer months (see attached graph).
- According to the statistical analysis performed on the pilots versus historical data from the same time of year (a summary table is provided at the end of the document):
    - Pilot 1 influent proved to be statistically different (lower) than historical data and Pilot 1 effluent proved to be *not* statistically different than historical data.
    - Pilot 2 influent proved to be *not* statistically different than historical data and Pilot 2 effluent proved to be statistically different than historical data (higher). The average Pilot 2 effluent TSS was 55.7 mg/L, and the average historical effluent TSS was 43.1 mg/L.
    - Pilot 3 influent proved to be *not* statistically different than historical data and Pilot 3 effluent proved to be statistically different than historical data (higher). The average Pilot 3 effluent TSS was 70.3 mg/L, and the average historical effluent TSS was 50.9 mg/L.
    - So far, Underwood has obtained 10 TSS effluent data points for Pilot 3A. Pilot 3A influent and effluent has so far proved to be both statistically different than

historical data. The average Pilot 3A influent has been higher. The average Pilot 3A effluent TSS was 66.7 mg/L, and the average historical effluent TSS was 52.9 mg/L.

- The analysis concludes that there is no justification to switch chemicals.
- Underwood will construct three summary graphs to show the comparison of Pilots and Historical Data performance during the same time of year. **Follow-up:** Graphs have been created; see attached.

Additional Discussion:

- The average effluent TSS using the 10 data points obtained for Pilot 3A was 66.7 mg/L. The average effluent so far is not much different than the average effluent for Pilot 3, which was 70.3 mg/L TSS.
- Tim will continue tweaking doses, which has recently gotten the effluent TSS to around 50 mg/L.
    - 24-hour sampling will continue 5 days a week to see if the 50 mg/L TSS effluent can be achieved consistently.
- In response to the EPA potentially asking for a reasoning behind comparing Pilots to Historical Data rather than comparing Pilot to Pilot:
    - Each of the three Pilots proved to be statistically different to each other. The average effluent TSS was lowest with Pilot 1 (ran March-April) and highest with Pilot 3 (ran June-July).
    - This is similar to what the plant has seen year to year when looking at monthly averages instead of annual averages. Therefore, seasonal variations should be taken into account.
    - The PAC product Pilot's (1&2) effluent TSS was equal to or greater than historical effluent.
- The City asked if a reduction in effluent quality based on temperature is normal or unique to the Portsmouth CEPT plant.
    - Underwood stated that warmer months produce more colloidal TSS in sewer systems which is harder to settle.
    - Underwood will give the Gloucester WWTF a call to obtain past readings to see if this is normal for CEPT plants. **Follow-up:** Underwood pulled Gloucester data off EPA ECHO website and it looks very similar to Portsmouth's, see attached graph.
- Aries 252 could be piloted again in late August/early September.
    - The City is not interested, but will do if EPA finds there is merit.
    - In early September construction changes will need piloting to stop.

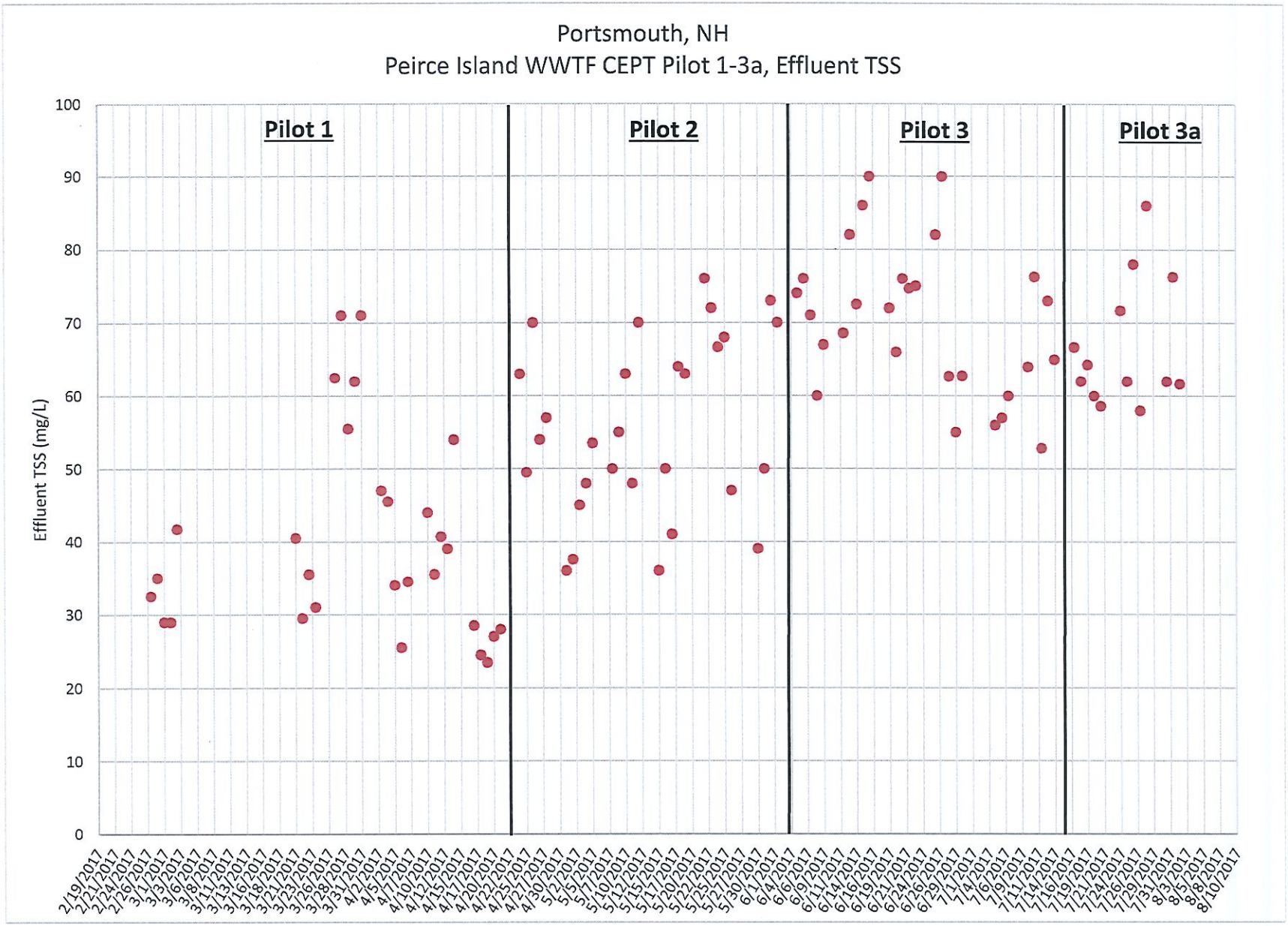
Planned:

- Underwood will provide the City with three summary graphs for the comparison between Pilots and Historical Data.
    - To be sent to the EPA early next week for their input.
- Underwood to call Gloucester WWTF to obtain past effluent data.

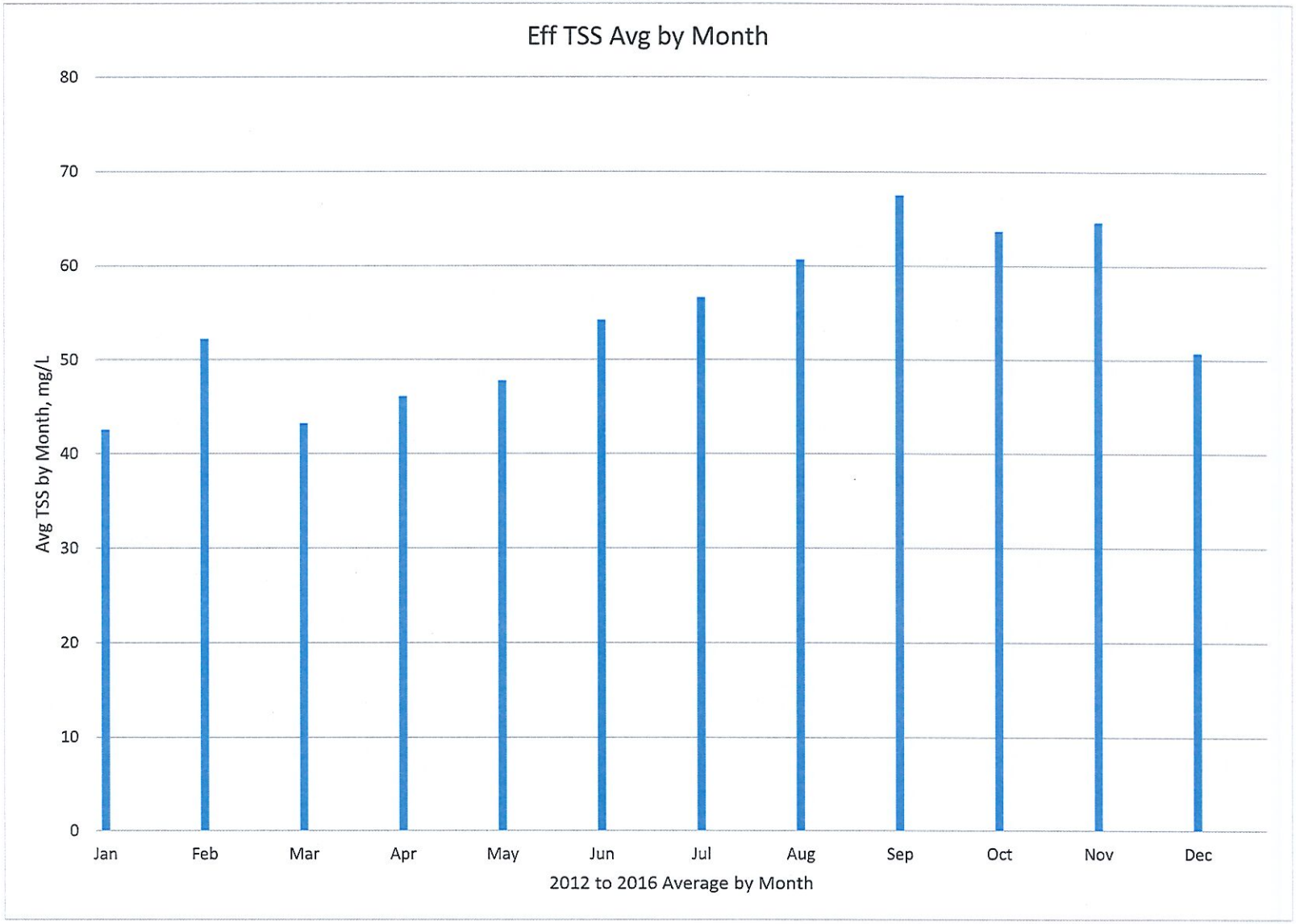
**Portsmouth, NH CEPT** **Project #2120**

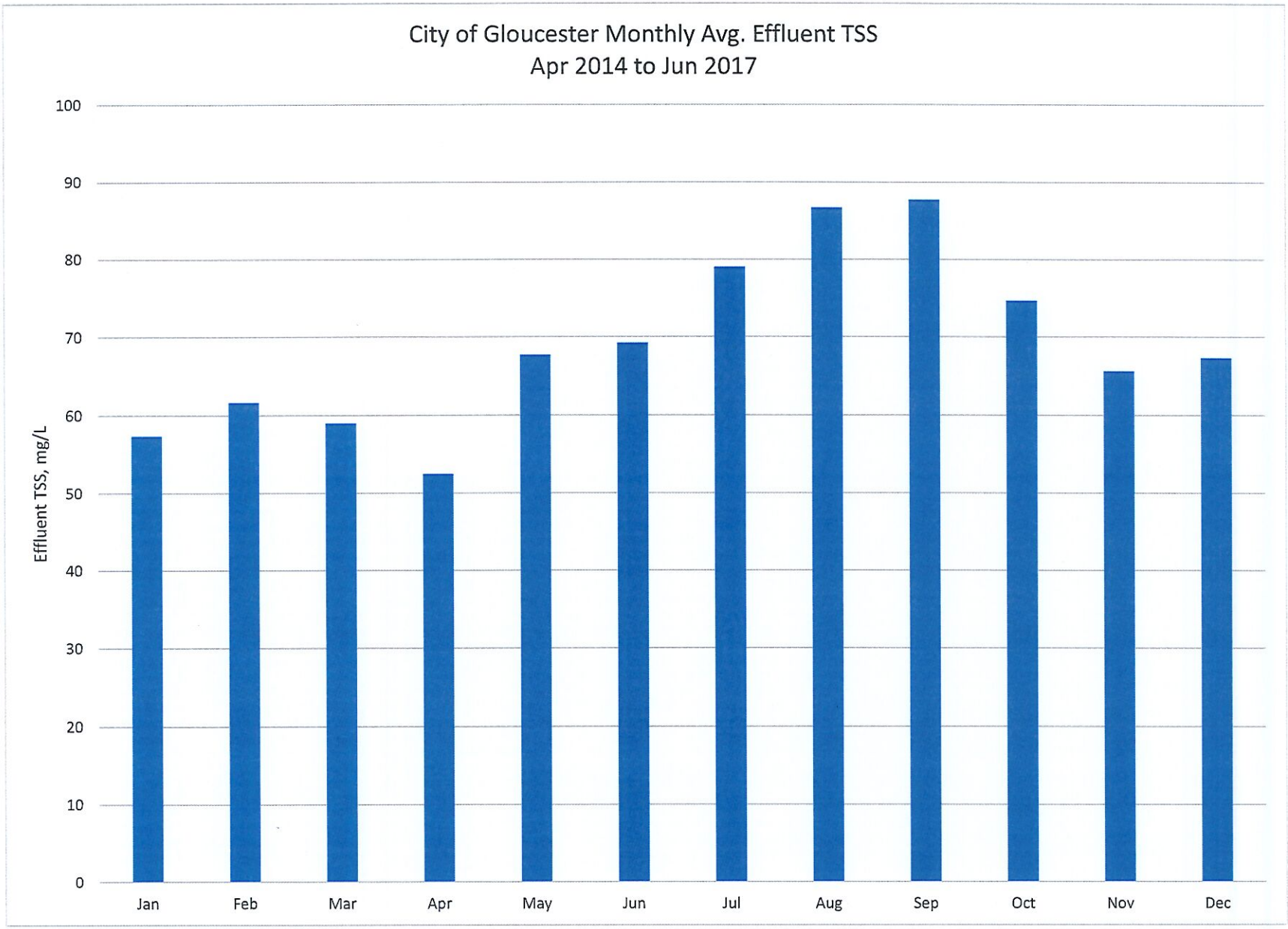
## Historical Comparison Summary Table

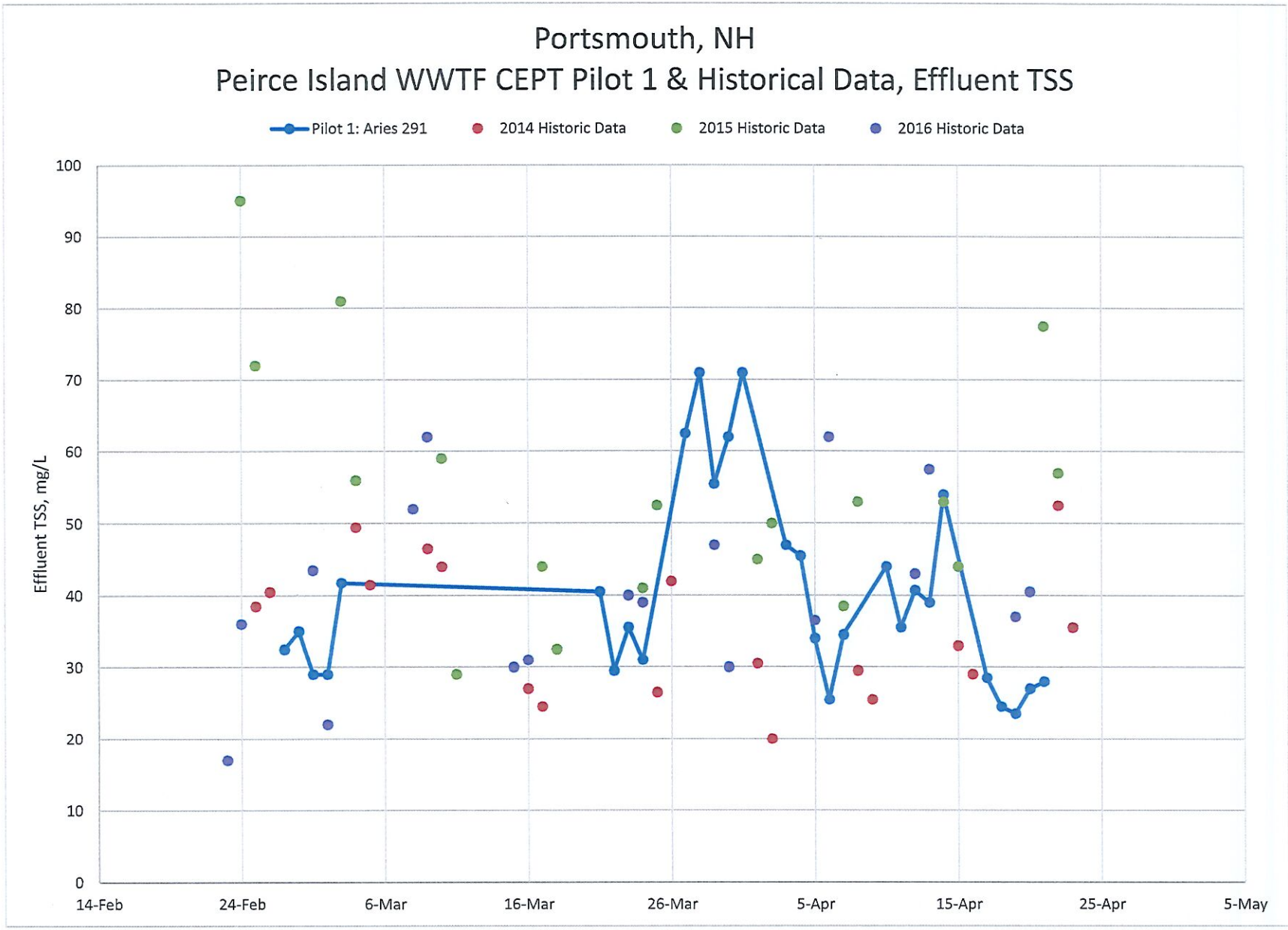
| | | Average TSS (mg/L) | |
|---|---|---|---|
| **Pilot 1** | *Aries 291* | Aries 291 | Historical |
| Influent: | Statistically different than Historical data | 233 | 181.9 |
| Effluent: | Proved to be **not different** than Historical data | 39.9 | 42.2 |
| | | | |
| **Pilot 2** | *Aries 252* | Aries 252 | Historical |
| Influent: | Proved to be **not different** than Historical data | 318.1 | 327.6 |
| Effluent: | Statistically different than Historical data | 55.7 | 43.1 |
| | | | |
| **Pilot 3** | *Aries 2076* | Aries 2076 | Historical |
| Influent: | Proved to be **not different** than Historical data | 358.6 | 400.4 |
| Effluent: | Statistically different than Historical data | 70.3 | 50.9 |
| | | | |
| **Pilot 3A** | *Aries 2076 A* | Aries 2076A | Historical |
| Influent: | Statistically different than Historical data | 361.4 | 281.9 |
| Effluent: | Statistically different than Historical data | 66.7 | 52.9 |

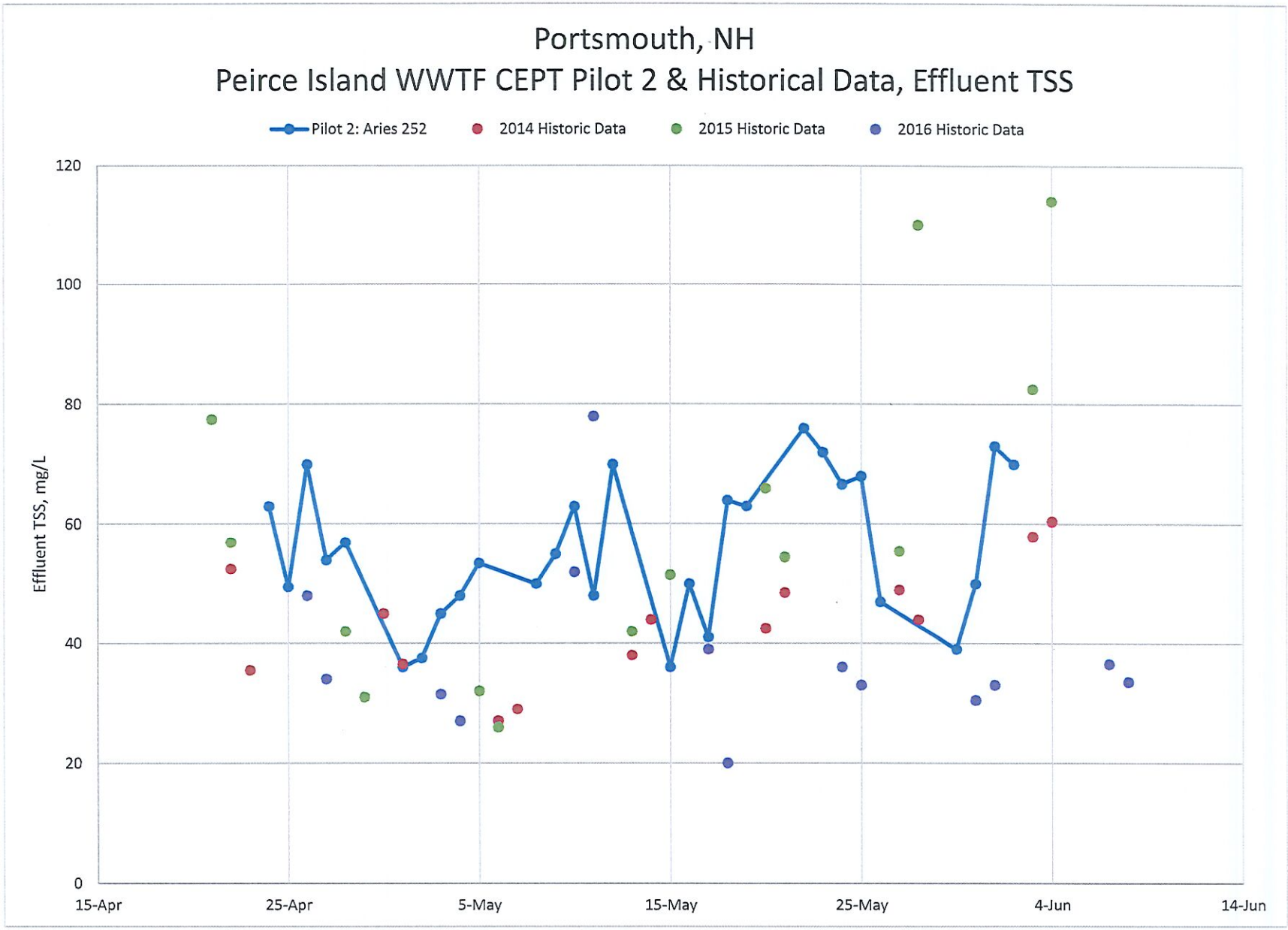


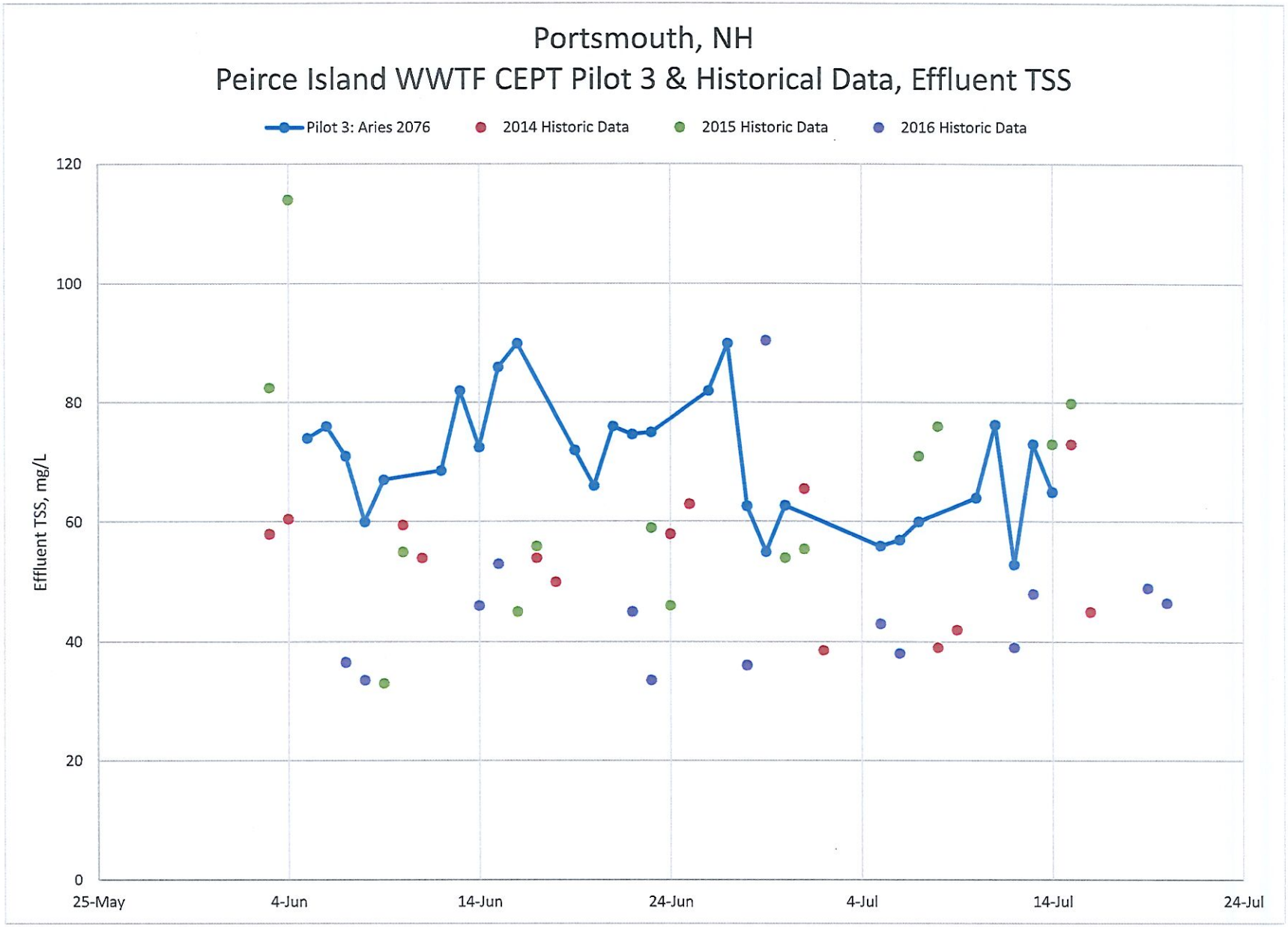

N:\PROJECTS\PORTSMOUTH, NH\REALNUM\2120 Peirce Island WWTF CEPT Pilot\08_Comp\2120 Portsmouth CEPT Pilot Startup Dosing Flows


Eff TSS Avg by Month
80
70
60
50
40
30
20
10
0
Avg TSS by Month, mg/L
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2012 to 2016 Average by Month


City of Gloucester Monthly Avg. Effluent TSS
Apr 2014 to Jun 2017
Effluent TSS, mg/L
100
90
80
70
60
50
40
30
20
10
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 1 & Historical Data, Effluent TSS
Pilot 1: Aries 291
2014 Historic Data
2015 Historic Data
2016 Historic Data
Effluent TSS, mg/L
100
90
80
70
60
50
40
30
20
10
0
14-Feb
24-Feb
6-Mar
16-Mar
26-Mar
5-Apr
15-Apr
25-Apr
5-May


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 2 & Historical Data, Effluent TSS
Pilot 2: Aries 252
2014 Historic Data
2015 Historic Data
2016 Historic Data
Effluent TSS, mg/L
120
100
80
60
40
20
0
15-Apr
25-Apr
5-May
15-May
25-May
4-Jun
14-Jun


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 3 & Historical Data, Effluent TSS
Pilot 3: Aries 2076
2014 Historic Data
2015 Historic Data
2016 Historic Data
Effluent TSS, mg/L
120
100
80
60
40
20
0
25-May
4-Jun
14-Jun
24-Jun
4-Jul
14-Jul
24-Jul

2120-02

PEIRCE ISLAND WWTF CEPT PILOT
PORTSMOUTH, NH

**Pilot Test 8 Meeting NOTES**
**August 21, 2017 at 11:00 AM**

**ATTENDEES (By Conference Call):**

| | |
|---|---|
| • Terry Desmarais | City of Portsmouth |
| • Timothy Babkirk | City of Portsmouth |
| • Steve Clifton | Underwood Engineers |
| • David Mercier | Underwood Engineers |

Work Completed Since Last Meeting:

- The City spoke with the EPA on Friday, 8/18, regarding the CEPT study.
    - The EPA requested an analysis on whether flows have impacted the performance of the pilot studies. They suggested graphs containing effluent flow vs effluent TSS, and looking at periods of wet vs dry weather for each pilot.
- The EPA would like the City to re-run Aries 252.

Discussion of Aries 252:

- While the primary sludge pumps are being moved, the sludge storage tanks and one clarifier will be lost for a period of time.
- The City expressed concerns about using Aries 252 during tough operational periods.
- The EPA still wants to see the performance of Aries 252 in warmer conditions.
- The City currently has two totes of Aries 252, which will last approximately 5-6 days. Therefore they will need more.
    - EPA would like this Aries 252 pilot to run for 4 weeks.
    - Lead time is 9 business days on the 252 chemical.
- The second Aries 252 pilot will begin on Wednesday, 8/23, starting at a low dose of 8.6ppm of Aries 252 and a poly dose of 0.19ppm.
- Dave M. to let Eastern Analytical know the new/extended dates for testing.

Additional Discussion:

- Underwood is to generate graphs/statistics relative to effluent flow vs. effluent TSS.
- Tim is to continue doing gravity thickener overflow and underflow.
- The average effluent TSS since 8/4 is approximately 65 mg/L.

Planned:

- Underwood is to provide the City with the requested graphs and statistics.
- Next conference call on 9/6/17 at 10:00 AM.
    - Dave is to send out invite.

2120-02

PEIRCE ISLAND WWTF CEPT PILOT
PORTSMOUTH, NH

**Pilot Test 9 Meeting NOTES**
**September 6, 2017 at 11:30 AM**

**ATTENDEES (By Conference Call):**

| | |
|---|---|
| • Terry Desmarais | City of Portsmouth |
| • Timothy Babkirk | City of Portsmouth |
| • Steve Clifton | Underwood Engineers |
| • David Mercier | Underwood Engineers |
| • Daniel Jacobson | Underwood Engineers |

Work Completed Since Last Meeting:

- Pilot 3A using Aries 2076 and operator optimized doses concluded on 8/22/17.
    - As requested by the EPA, the City began Pilot 2A using Aries 252 on 8/23/17 to test the chemical's performance in warmer temperatures.
    - Pilot 2A began with a low dose of 8.6ppm of Aries 252 and a poly dose of 0.19ppm.
- Underwood generated graphs showing effluent TSS quality vs. influent flow as requested by the City.

Discussion of Aries 252:

- So far, Pilot 2A using Aries 252 has considerably higher effluent TSS values when compared with Pilots 1-3A.
    - The first two weeks of Pilot 2A has resulted in an average effluent TSS of 88 mg/L. Pilot 1, Pilot 2, Pilot 3, and Pilot 3A have resulted in average effluent TSS values of 40, 56, 70, and 70 mg/L, respectively.
- Tim mentioned that Pilot 2A has caused some operational issues including a scum mat on the thickener and thinner sludge and less inventory than usual.
- The average influent TSS has decreased for Pilot 2A when compared to the previous pilots (see attached table).
- The City will increase the Aries 252 dose to 27.0ppm on Thursday, 9/7, to see whether the chemical's performance does better at higher doses.
    - Pilot 2A is to continue with a high dose until it concludes on Friday, 9/22.

Discussion of Effluent Quality vs. Influent Flow Graphs:

- Underwood generated graphs using influent flow data for the first three pilots (see attached graphs).
    - Tim sent the most recent flow data during call for Underwood to create graphs for the final two pilots.

    - Underwood is to send those graphs, along with text edits discussed during the call, to the City so they can relay them to the EPA.
- The graphs show that there is no correlation between effluent TSS performance and flow.
    - The R-squared value produced for each graph is insignificant.
- Dave told the City that he can provide similar graphs showing historic effluent TSS quality vs. flow data.
- The City told Underwood that the average influent daily flow is measured at Mechanic Street and this is used for effluent flow at the Peirce Island plant.

Additional Discussion:

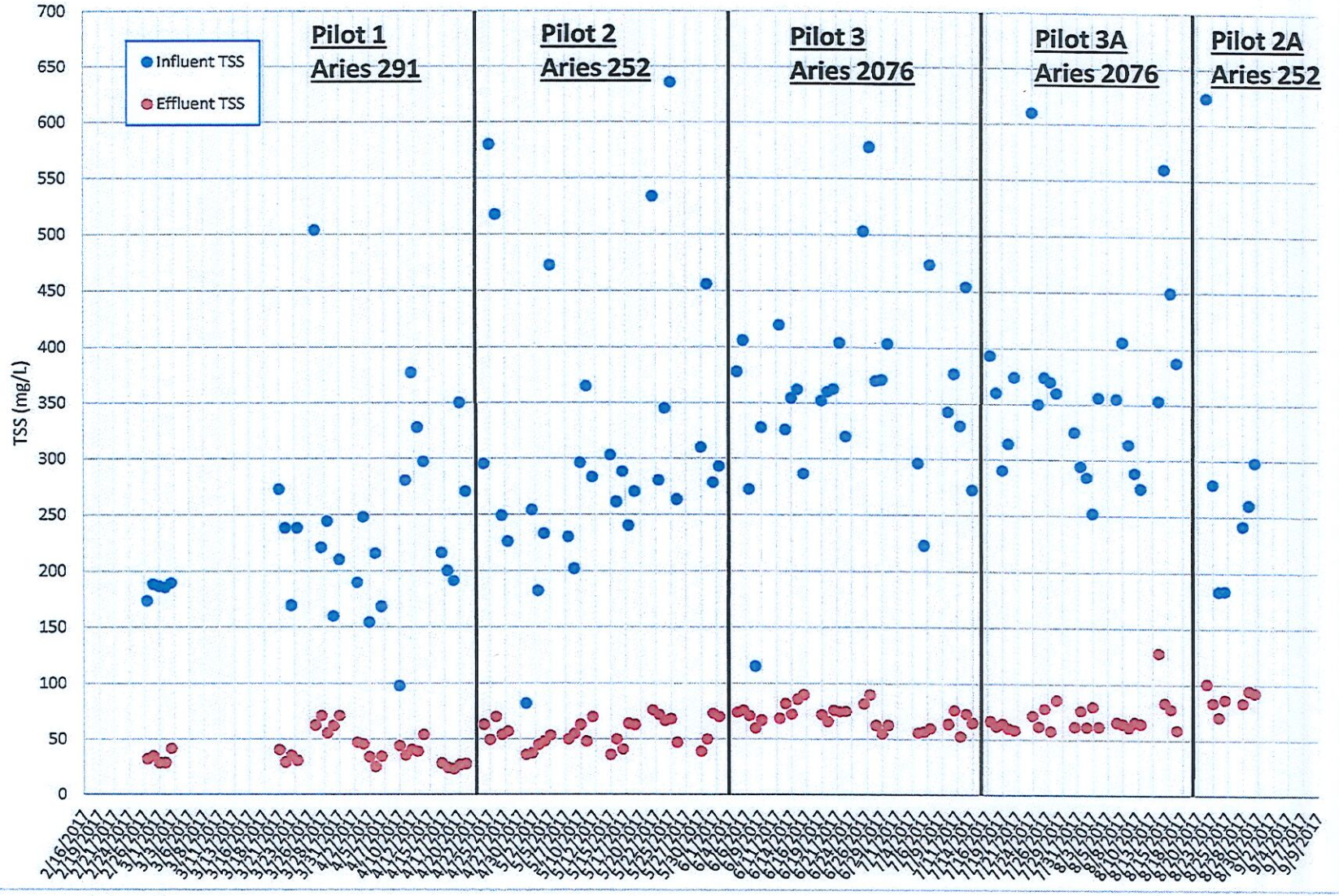
- The last time the chlorine contact tanks were cleaned was just before Pilot 2A began.
    - Tim is to clean them again this Friday, 9/8 and will make observations.

Planned:

- Underwood is to provide the City with the additional graphs.
- Tim is to send Underwood the most recent flow data and thickener overflow TSS values.
- Next conference call on 9/19/17 at 11:30 AM.
    - Dave is to send out invite.

Portsmouth, NH

Peirce Island WWTF CEPT Pilot 1-3A, Influent and Effluent TSS

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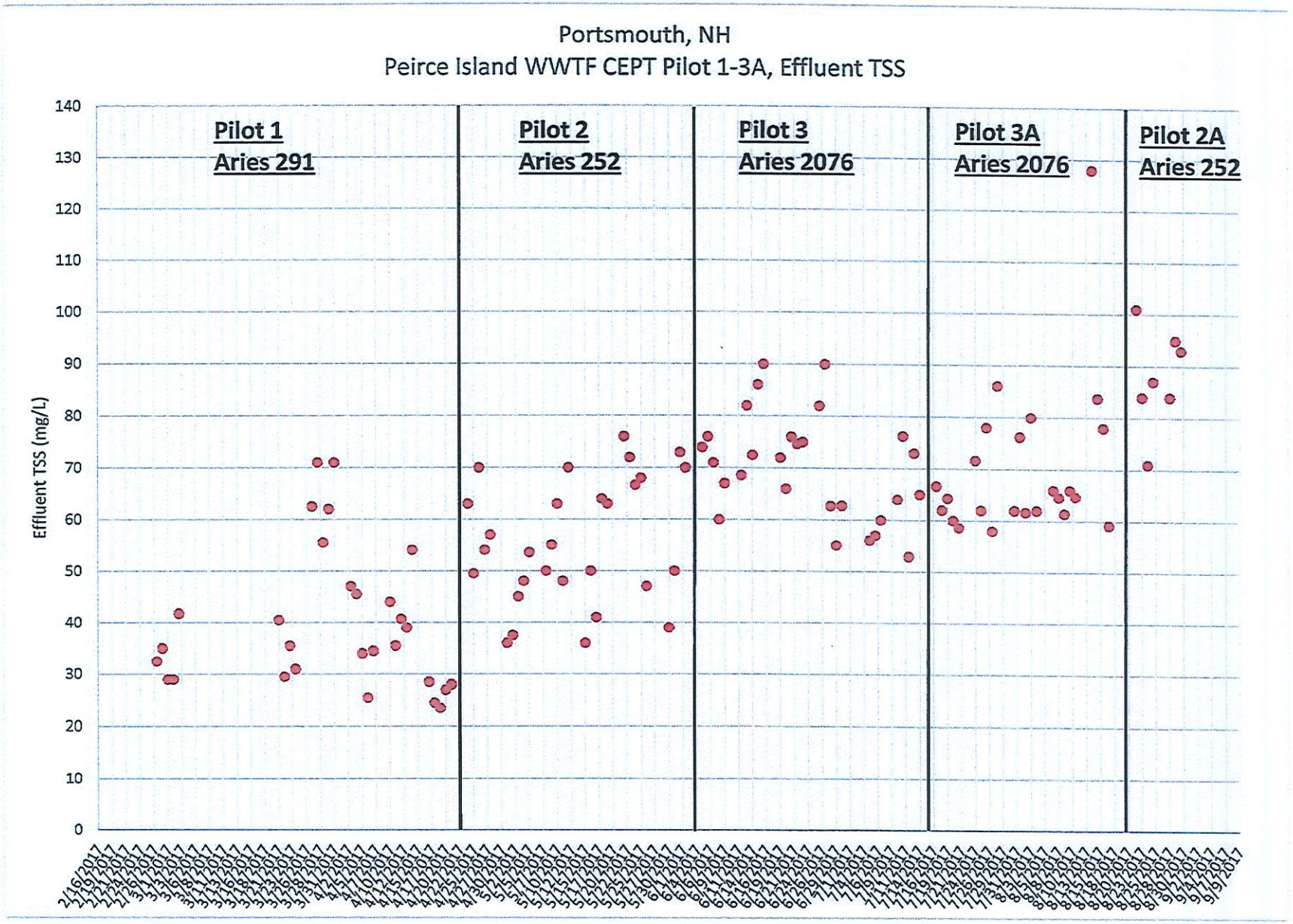


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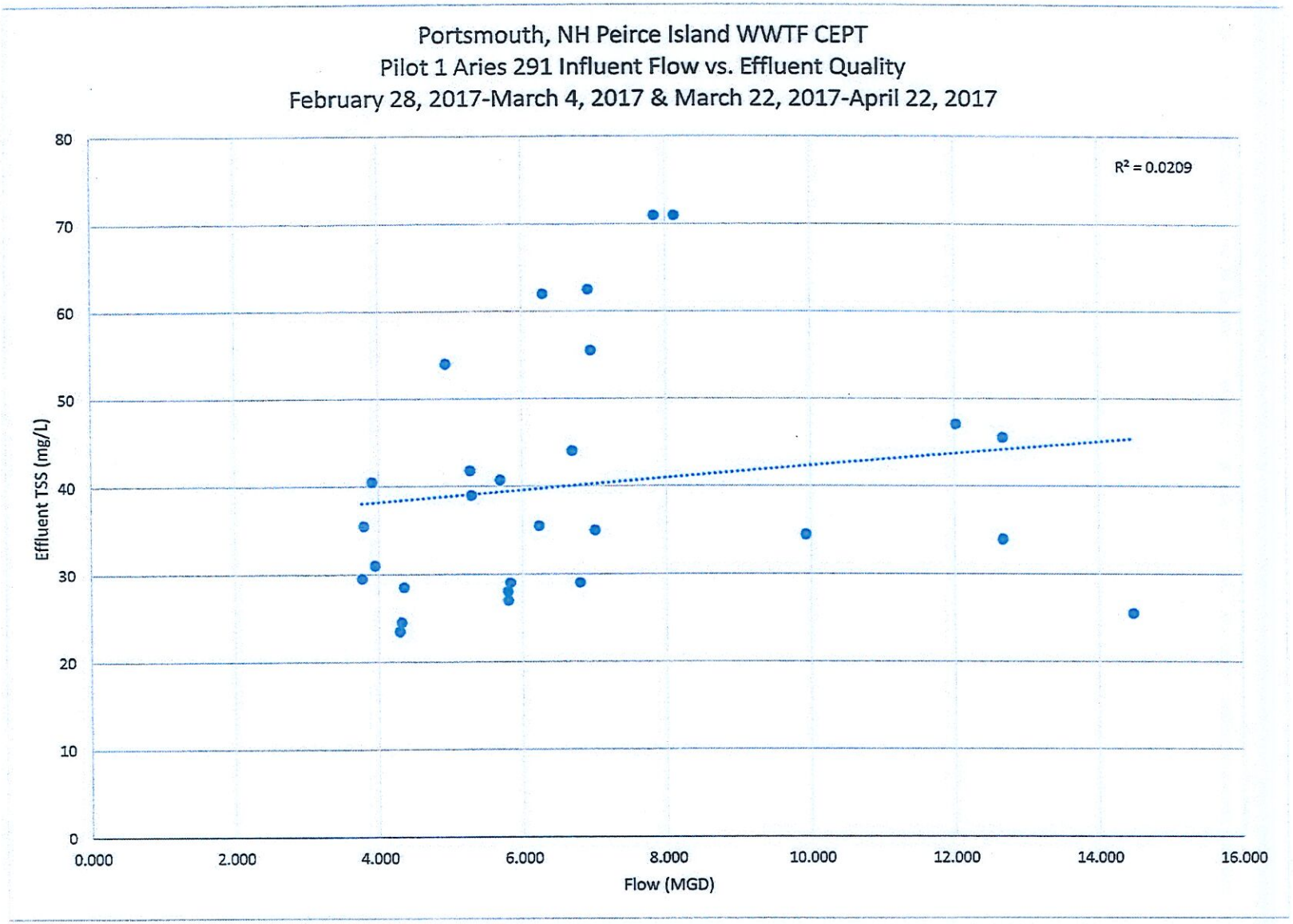
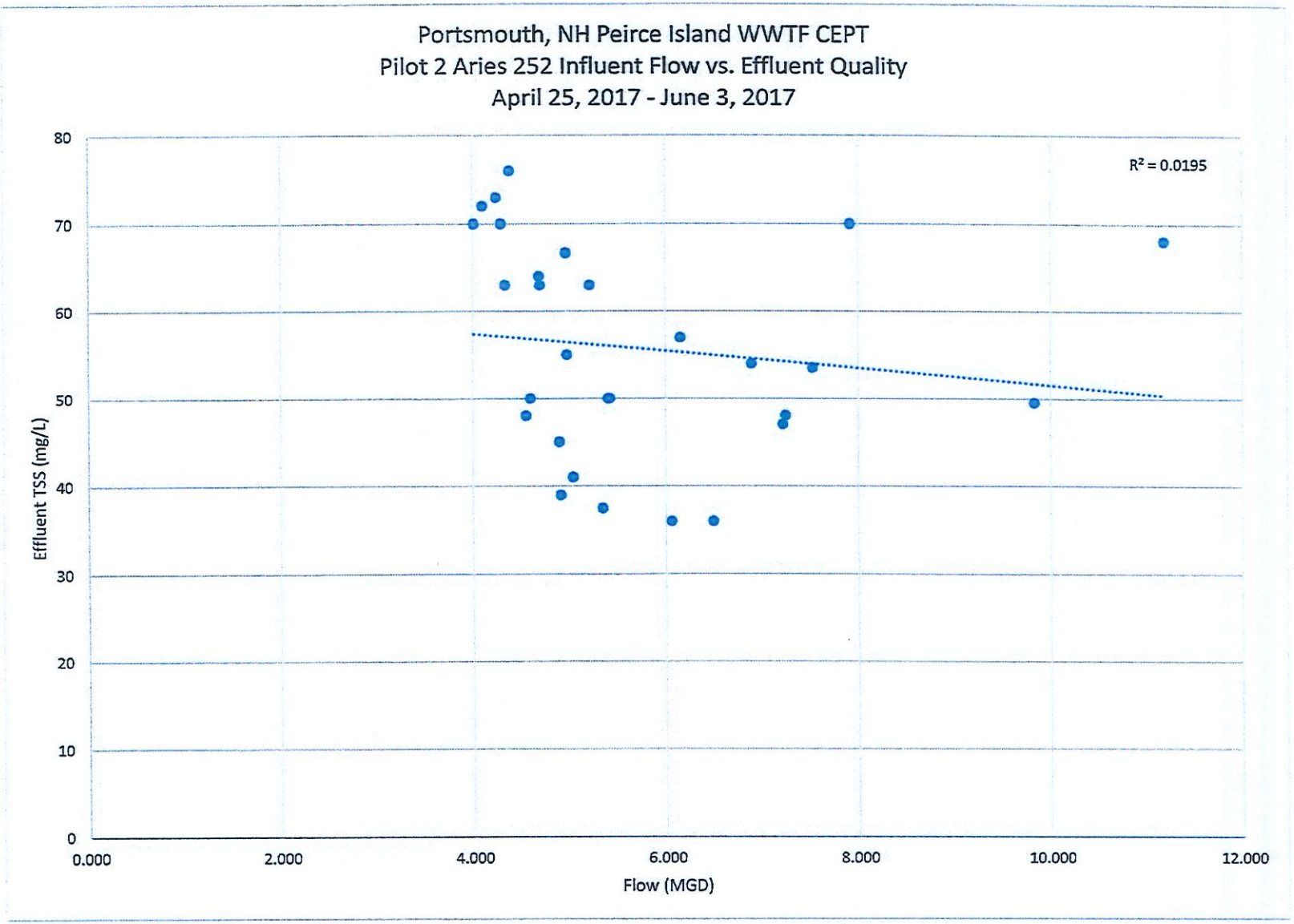
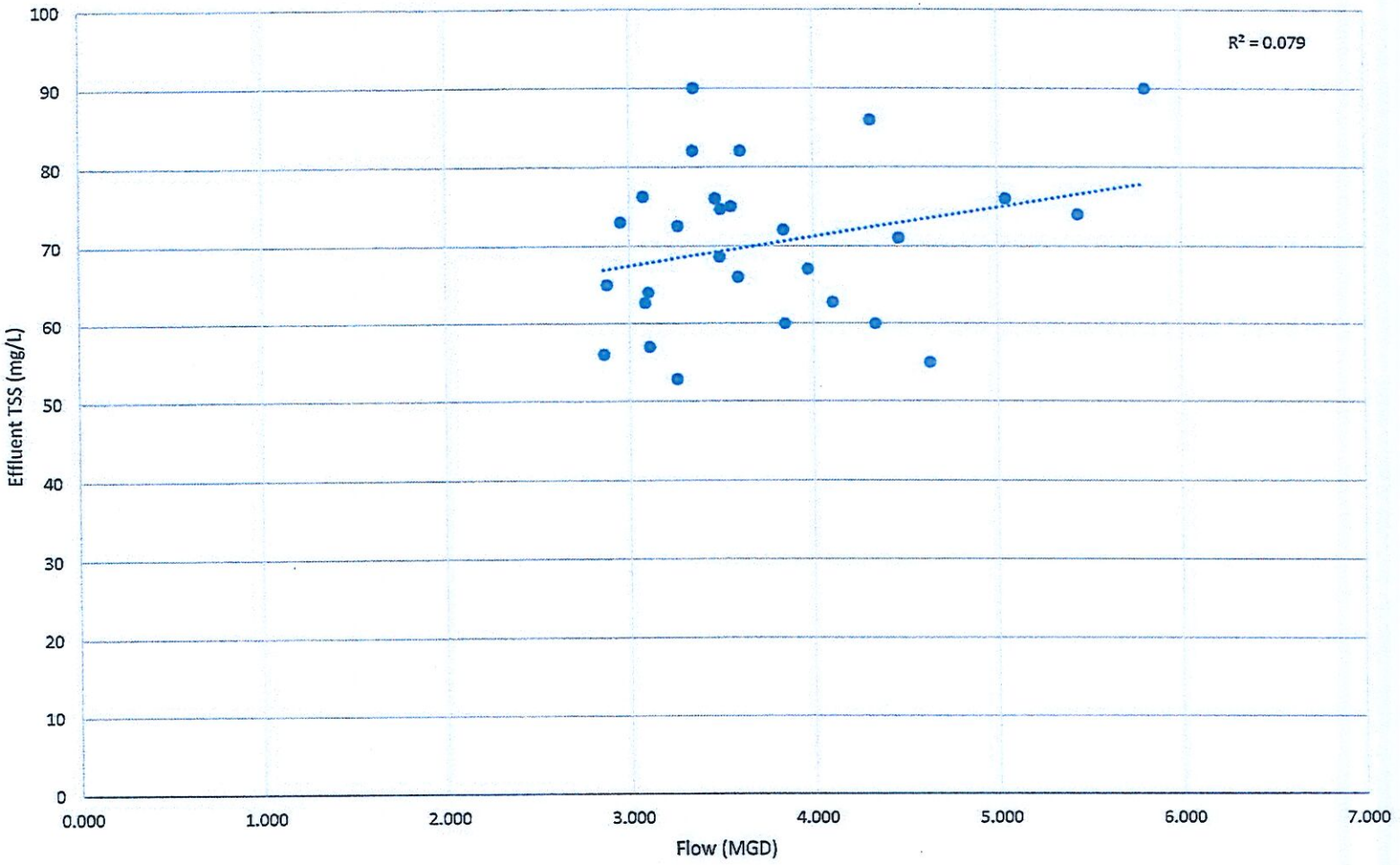
| Pilot | Row Labels | Average of Influent TSS (mg/L) | Average of Effluent TSS (mg/L) | Average of % Removal |
|---|---|---|---|---|
| Pilot 3 | Aries 2076 | 358.56 | 70.26 | 79.03% |
| Pilot 3A | Aries 2076 A | 362.27 | 70.04 | 79.95% |
| Pilot 2 | Aries 252 | 318.09 | 55.70 | 80.32% |
| Pilot 2A | Aries 252 A | 295.30 | 87.86 | 66.38% |
| Pilot 1 | Aries 291 | 233.01 | 39.90 | 81.24% |
| | **Grand Total** | **314.389** | **60.130** | **0.793** |

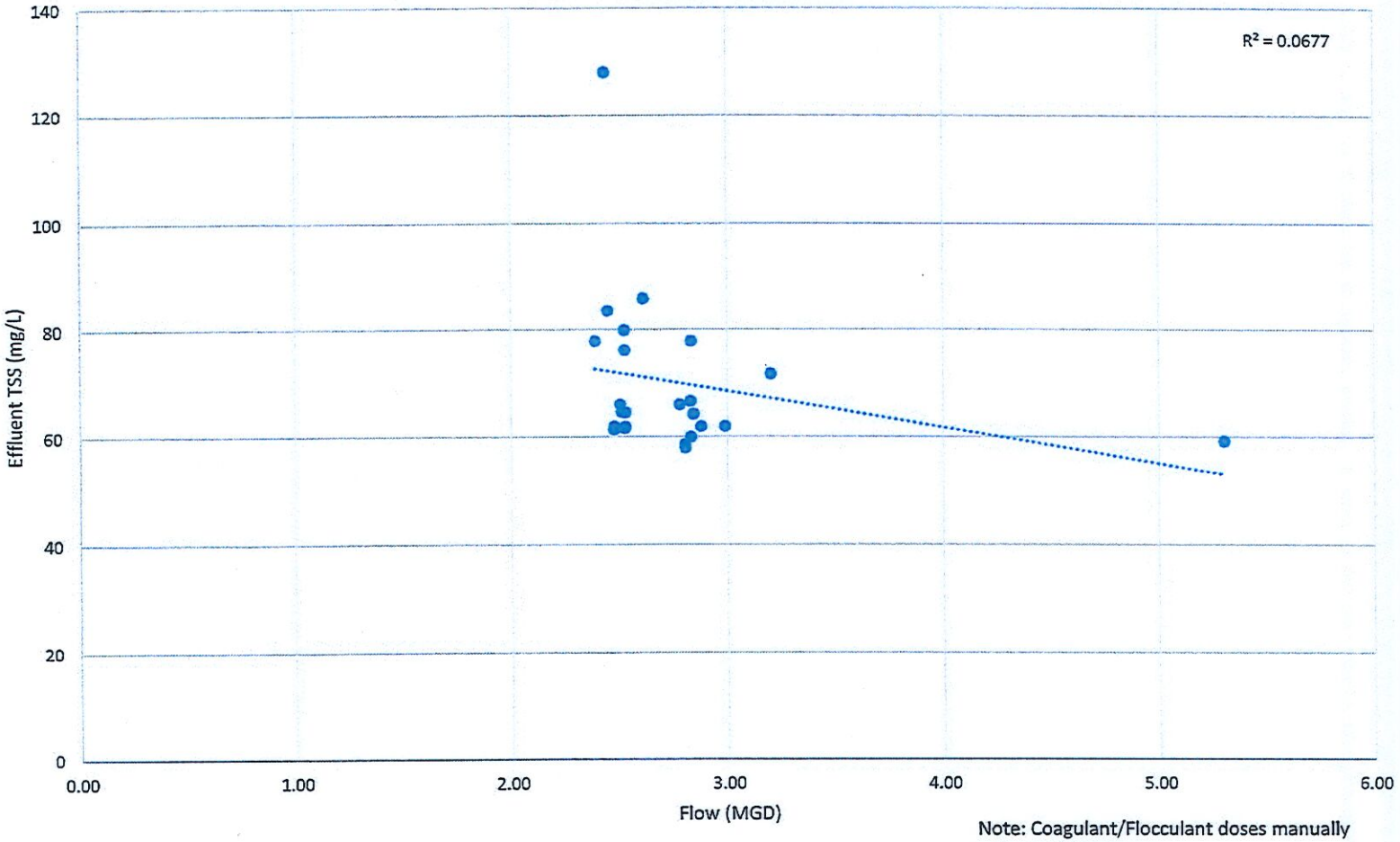

Portsmouth, NH Peirce Island WWTF CEPT
Pilot 1 Aries 291 Influent Flow vs. Effluent Quality
February 28, 2017-March 4, 2017 & March 22, 2017-April 22, 2017
R² = 0.0209
Effluent TSS (mg/L)
Flow (MGD)
0
10
20
30
40
50
60
70
80
0.000
2.000
4.000
6.000
8.000
10.000
12.000
14.000
16.000


Portsmouth, NH Peirce Island WWTF CEPT
Pilot 2 Aries 252 Influent Flow vs. Effluent Quality
April 25, 2017 - June 3, 2017
R² = 0.0195
Effluent TSS (mg/L)
Flow (MGD)
0
10
20
30
40
50
60
70
80
0.000
2.000
4.000
6.000
8.000
10.000
12.000

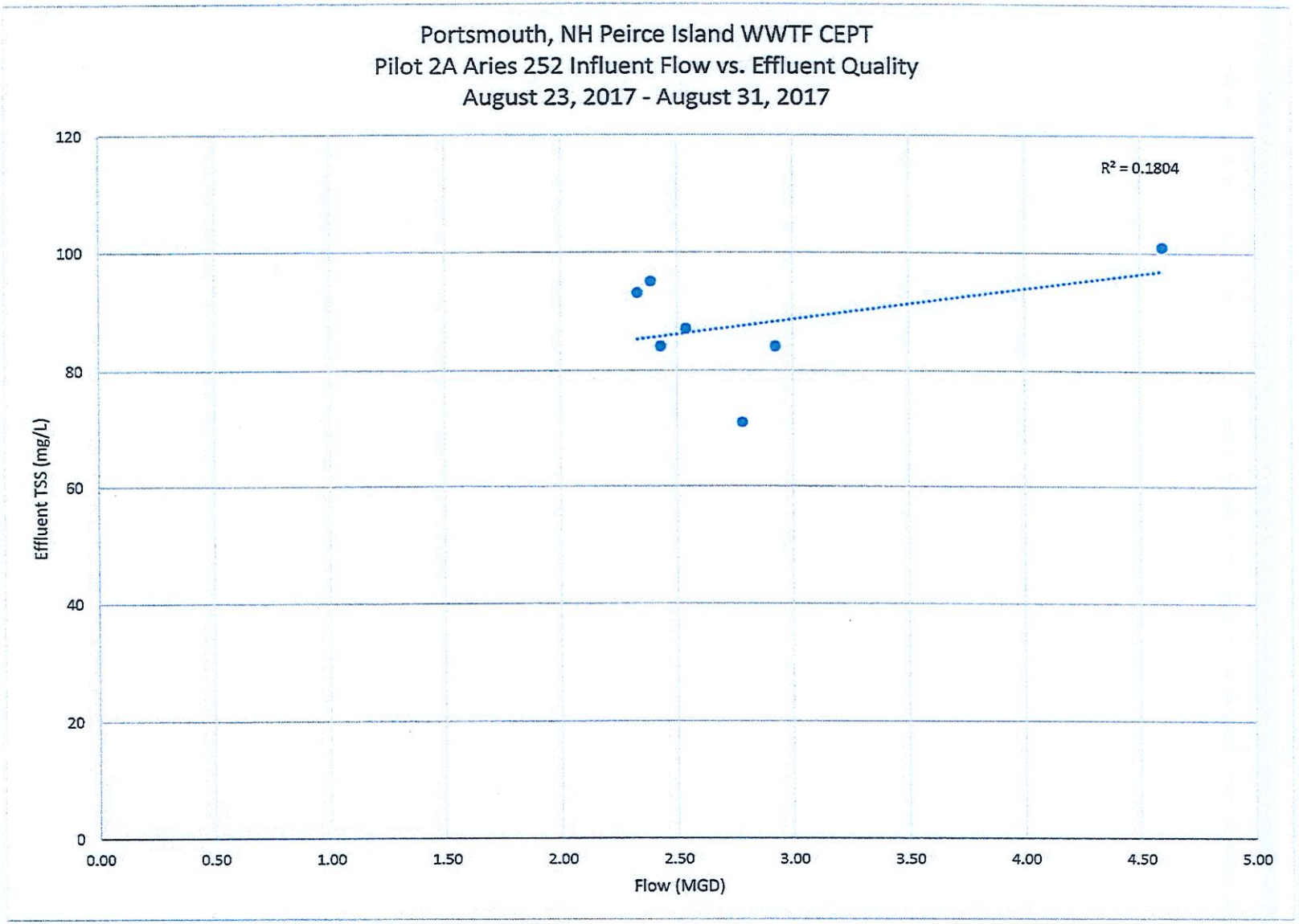
Portsmouth, NH Peirce Island WWTF CEPT
Pilot 3 Aries 2076 Influent Flow vs. Effluent Quality
June 6, 2017 - July 15, 2017



Portsmouth, NH Peirce Island WWTF CEPT
Pilot 3A Aries 2076 Influent Flow vs. Effluent Quality
July 18, 2017 - August 22, 2017




Note: Coagulant/Flocculant doses manually adjusted by operator.


Portsmouth, NH Peirce Island WWTF CEPT
Pilot 2A Aries 252 Influent Flow vs. Effluent Quality
August 23, 2017 - August 31, 2017
R² = 0.1804
Effluent TSS (mg/L)
120
100
80
60
40
20
0
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
5.00
Flow (MGD)

2120-02

PEIRCE ISLAND WWTF CEPT PILOT
PORTSMOUTH, NH

**Pilot Test 10 Meeting NOTES**
**September 19, 2017 at 11:30 AM**

**ATTENDEES (By Conference Call):**

| | |
|---|---|
| • Terry Desmarais | City of Portsmouth |
| • Timothy Babkirk | City of Portsmouth |
| • Steve Clifton | Underwood Engineers |
| • David Mercier | Underwood Engineers |
| • Daniel Jacobson | Underwood Engineers |

Work Completed Since Last Meeting:

- Pilot 2A using Aries 252 increased to a high dose of 27.0ppm of Aries 252 and continued at a poly dose of 0.19ppm on 9/7.
    - Pilot 2A was run at a low dose from 8/23 to 9/6.
    - The high dose will continue until Pilot 2A's conclusion on 9/22.
- The City spoke with the EPA regarding the charts produced showing Flow vs Effluent TSS.
- Tim cleaned the chlorine contact tank on 9/8.

Discussion of Aries 252:

- Pilot 2A switched to a high dose of Aries 252 on 9/7.
    - As of 9/19, only a few days of results at the high dose has been obtained from Eastern Analytical.
    - Some readings were taken from Tim's data, which is labeled on the attached graphs.
- So far, Pilot 2A continues to have considerably higher effluent TSS values when compared with Pilots 1, 2, 3, and 3A.
    - The first three weeks of Pilot 2A has resulted in an average effluent TSS of 87.1 mg/L, and an average influent TSS of 263.74 mg/L.
- Tim mentioned that the sludge being produced is very thin and watery.
- Tim mentioned that the plant was running on just clarifier #2 starting on 9/11.
    - The other clarifier was back online Thursday, 9/14.

Discussion of Effluent Quality vs. Influent Flow Graphs:

- The EPA did not see much of a correlation between Flow vs Effluent TSS, and does not see a need for further analysis on it for now.
    - The EPA is still working to gather their thoughts.

- Terry spoke with the EPA about a conference call meeting to be schedule the week of 10/9.
    - The City does not need a report for the conference call meeting, but mentioned to UE that a final report shall be planned for the end of October.
    - The City asked UE for the updated tables and figures showing all results of the Pilots for the conference call meeting.
    - UE will provide the City with the updated results by 10/6.

Additional Discussion:

- Tim cleaned the chlorine contact tank on 9/8.
    - He mentioned that there was a lot more settled material with Aries 252.
    - There was about 9 to 10 inches of settled material at the bottom of the tank.
    - Tim says that there is typically only 1 to 2 inches of settled material with bad conditions getting to be around 4 inches, depending on how often the tank is cleaned.
- Steve asked how long it takes for the plant to get back to normal looking conditions after switching chemicals.
    - Tim says it takes about 24 hours.

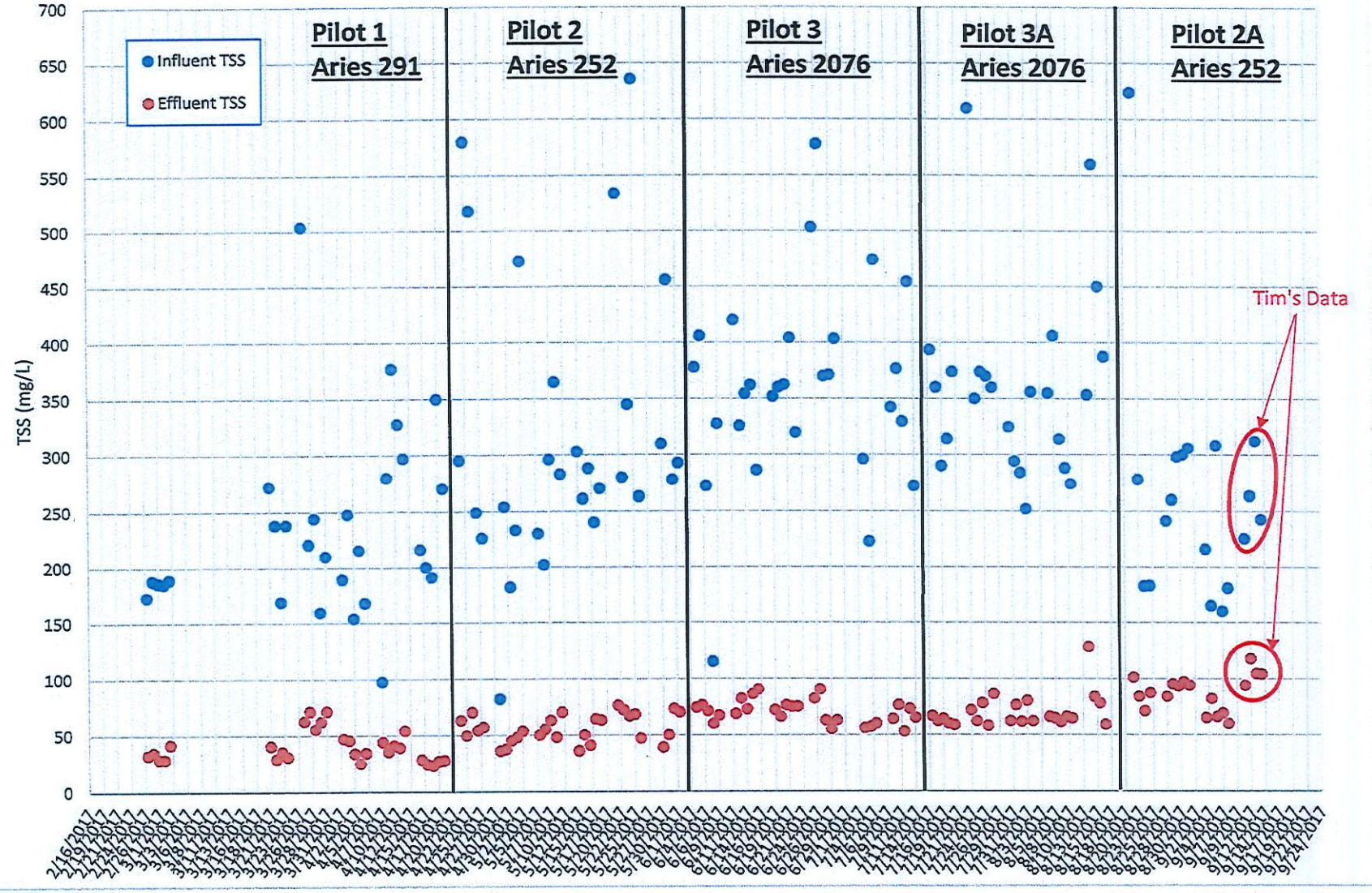
Planned:

- The City is to schedule a conference call meeting with the EPA on the week of 10/9.
- UE is to provide the City with the updated data for all Pilots by 10/6.
- UE is to provide the City with a final report by the end of October.

| Pilot | Row Labels | Average of Influent TSS (mg/L) | Average of Effluent TSS (mg/L) | Average of % Removal |
|---|---|---|---|---|
| Pilot 3 | Aries 2076 | 358.56 | 70.26 | 79.03% |
| Pilot 3A | Aries 2076 A | 362.27 | 70.04 | 79.95% |
| Pilot 2 | Aries 252 | 318.09 | 55.70 | 80.32% |
| Pilot 2A | Aries 252 A | 263.74 | 87.12 | 64.52% |
| Pilot 1 | Aries 291 | 233.01 | 39.90 | 81.24% |
| | **Grand Total** | **308.31** | **62.41** | **77.96%** |

Portsmouth, NH

Peirce Island WWTF CEPT Pilot 1-3A, Influent and Effluent TSS

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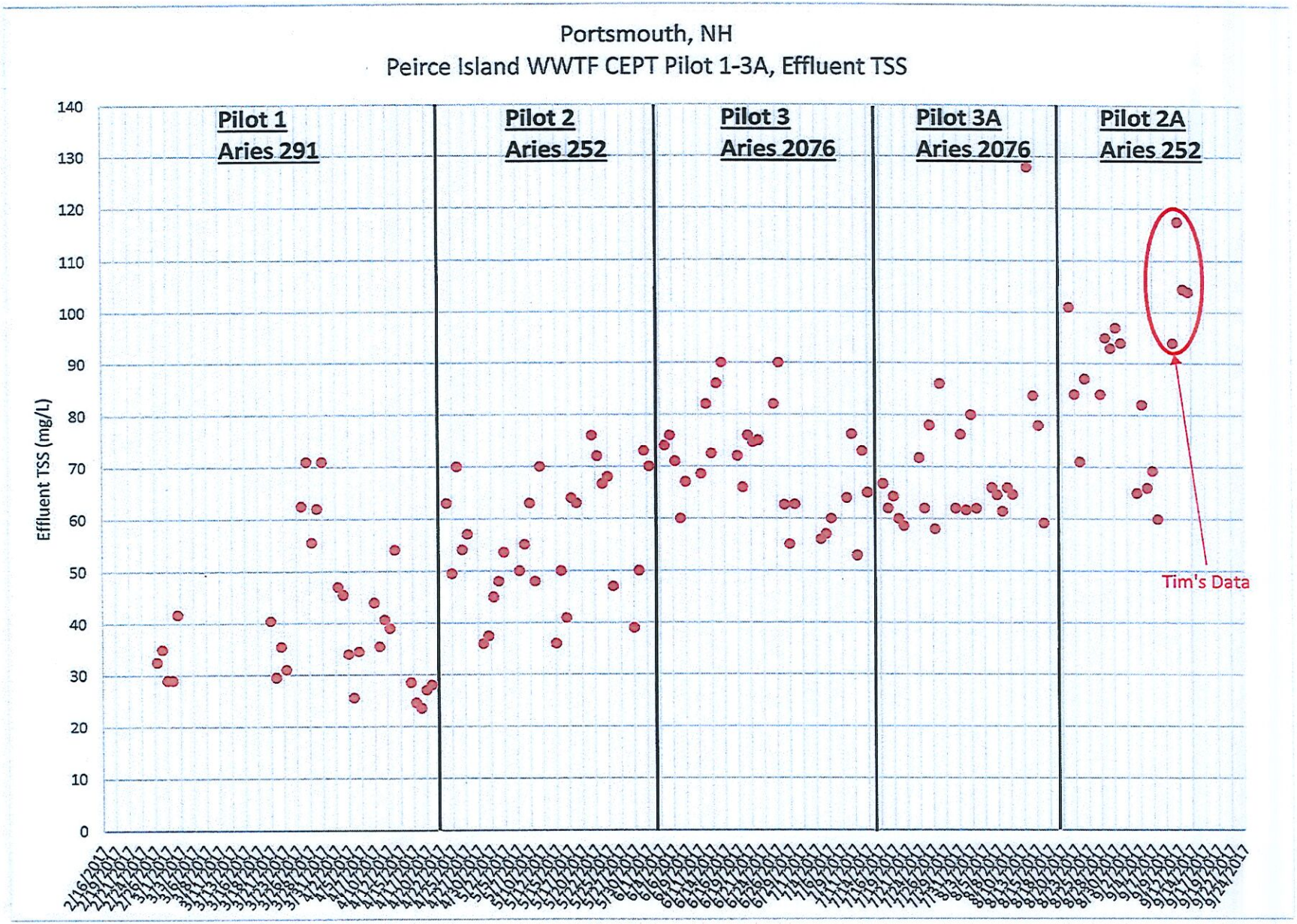
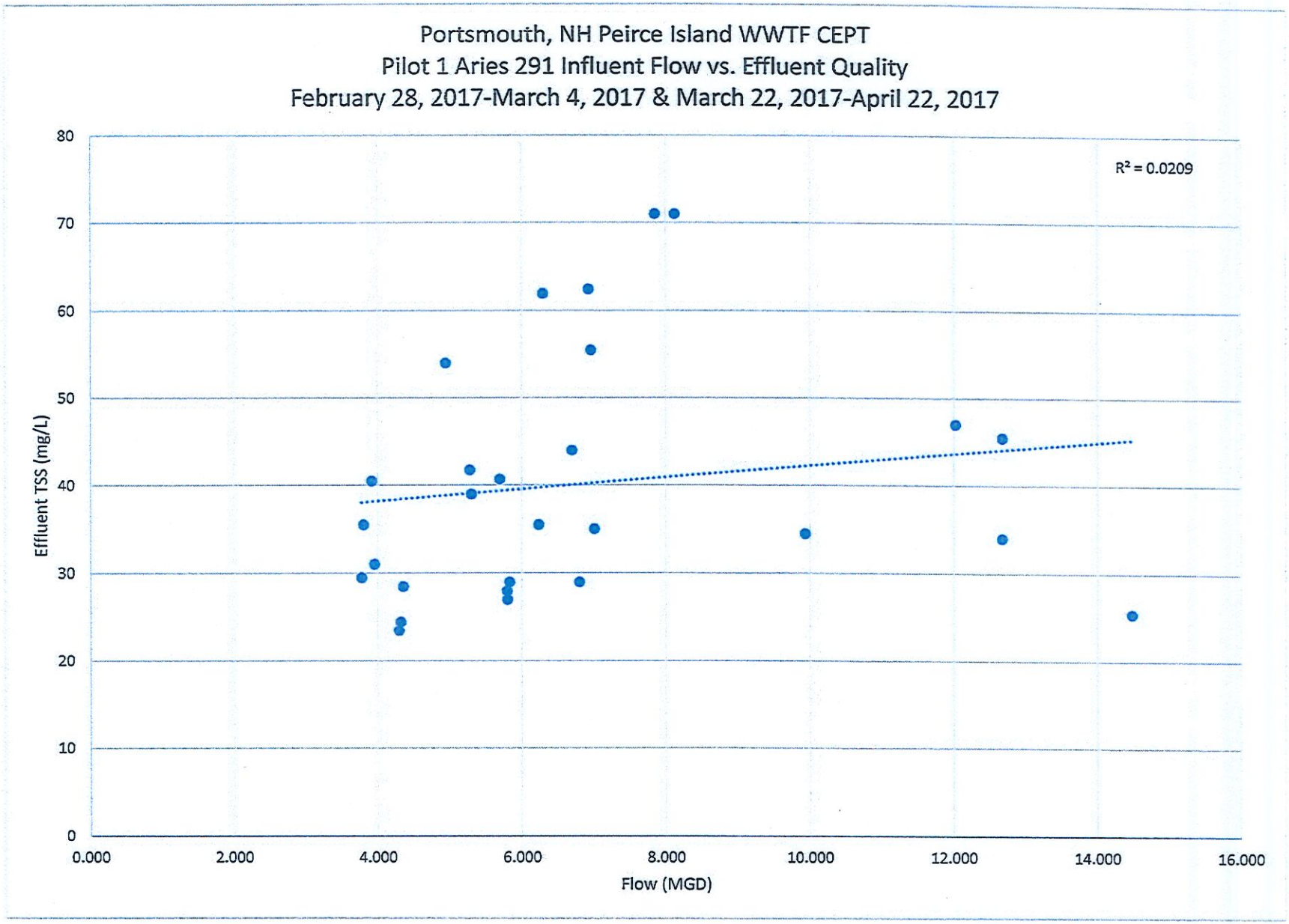
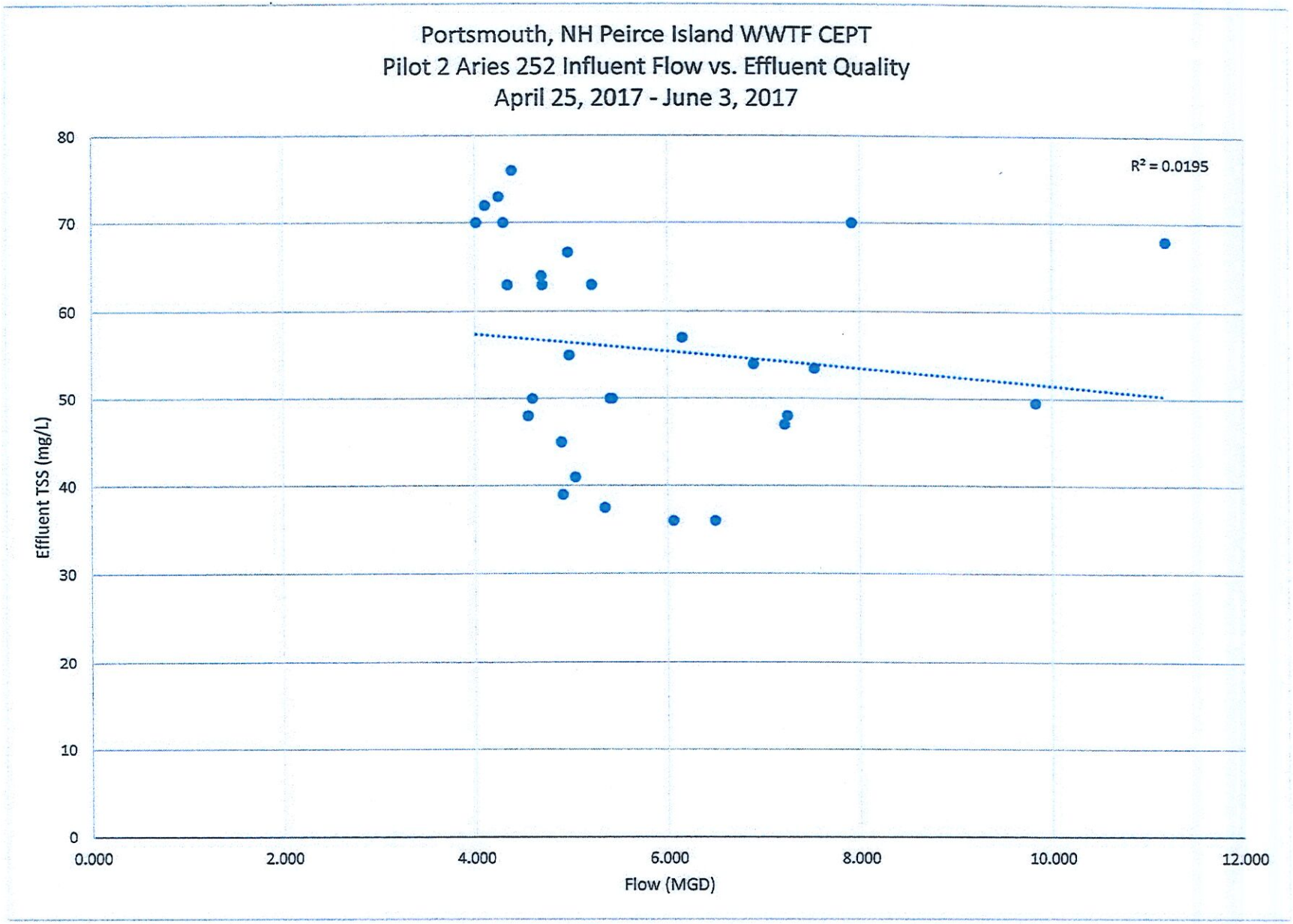
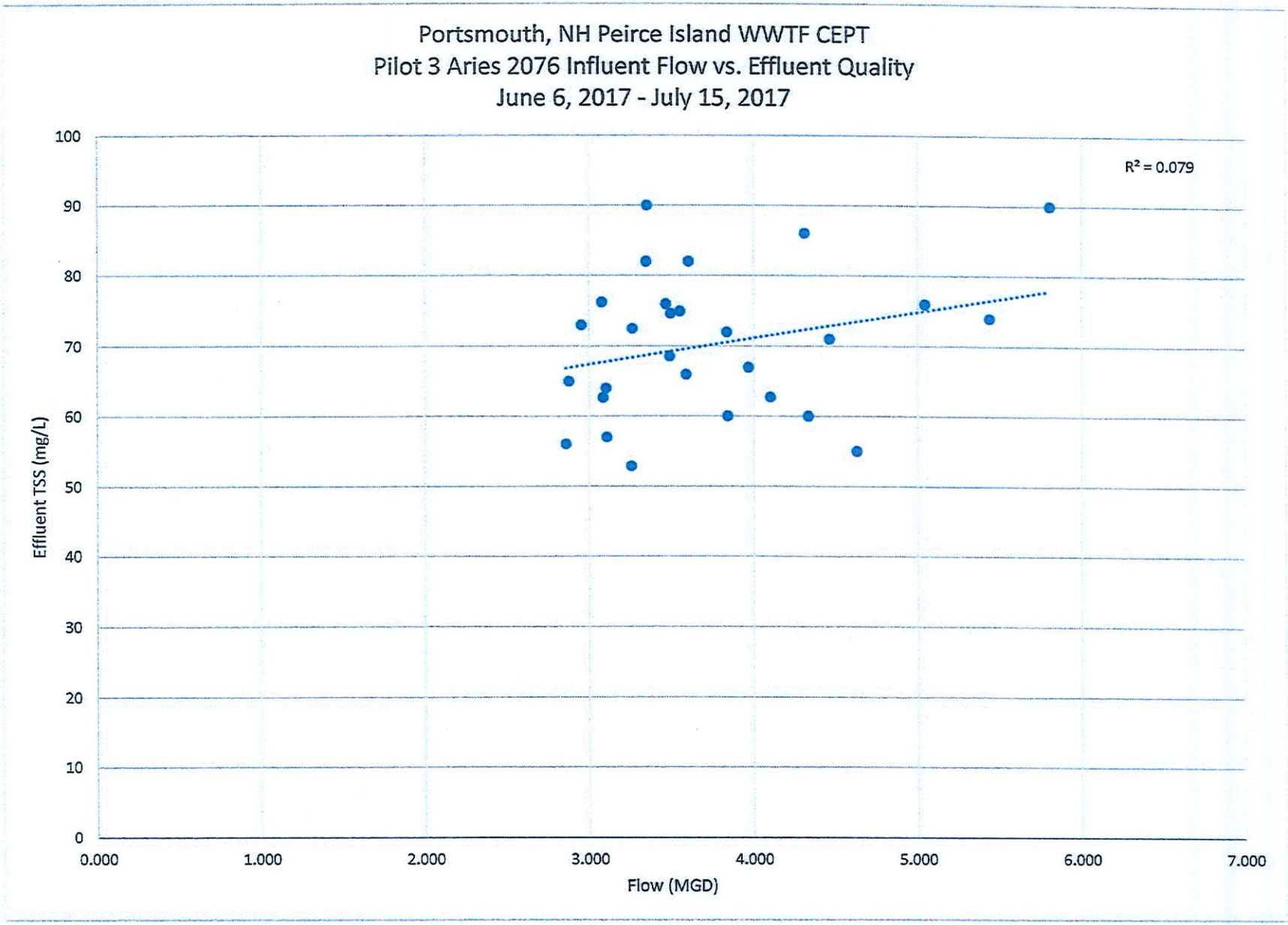


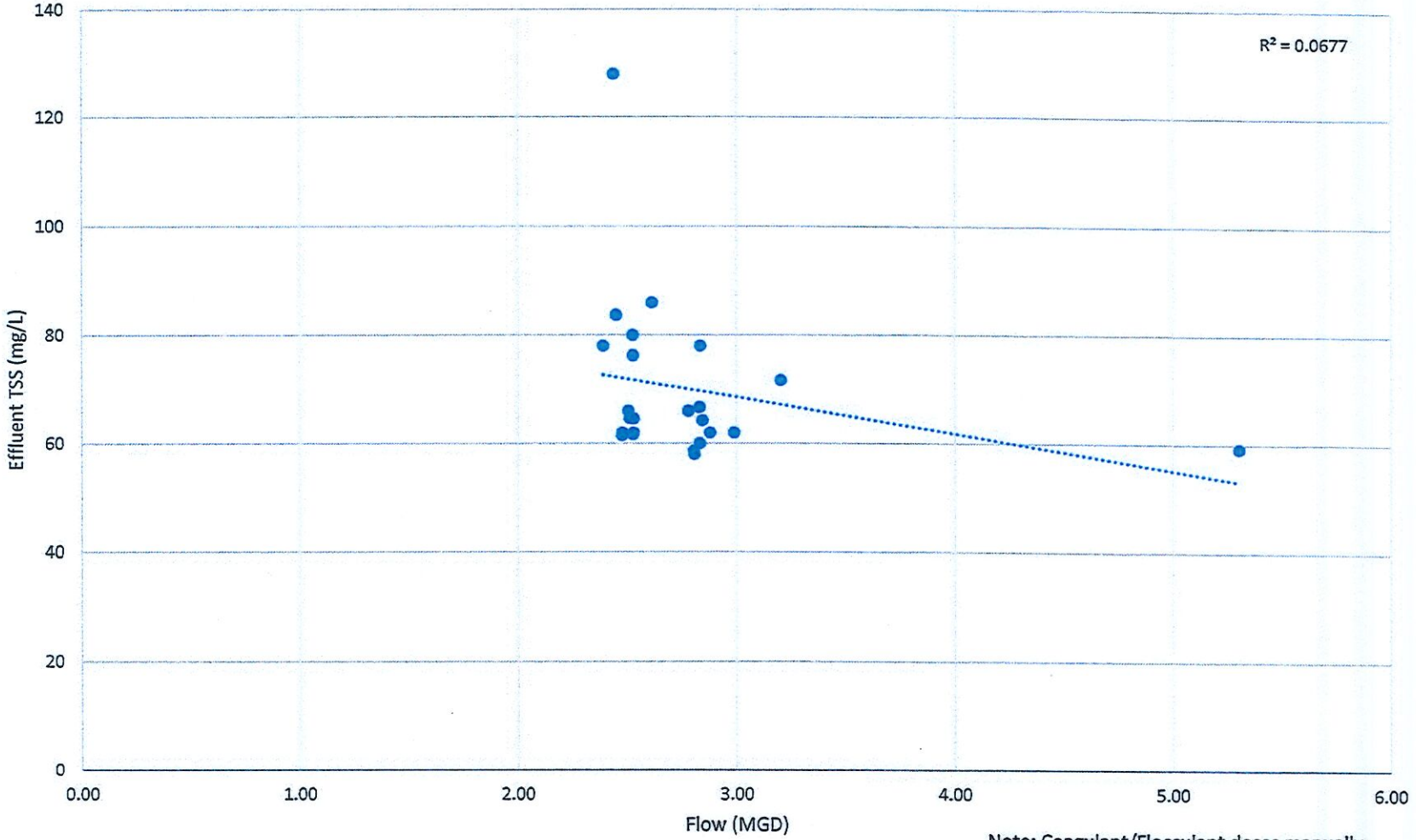

N:\PROJECTS\PORTSMOUTH, NH\REALNUM\2120 Peirce Island WWTF CEPT Pilot\08_Comp\2120 Portsmouth CEPT Pilot Startup Dosing Flows


Portsmouth, NH Peirce Island WWTF CEPT
Pilot 1 Aries 291 Influent Flow vs. Effluent Quality
February 28, 2017-March 4, 2017 & March 22, 2017-April 22, 2017
R² = 0.0209
Effluent TSS (mg/L)
Flow (MGD)
0
10
20
30
40
50
60
70
80
0.000
2.000
4.000
6.000
8.000
10.000
12.000
14.000
16.000

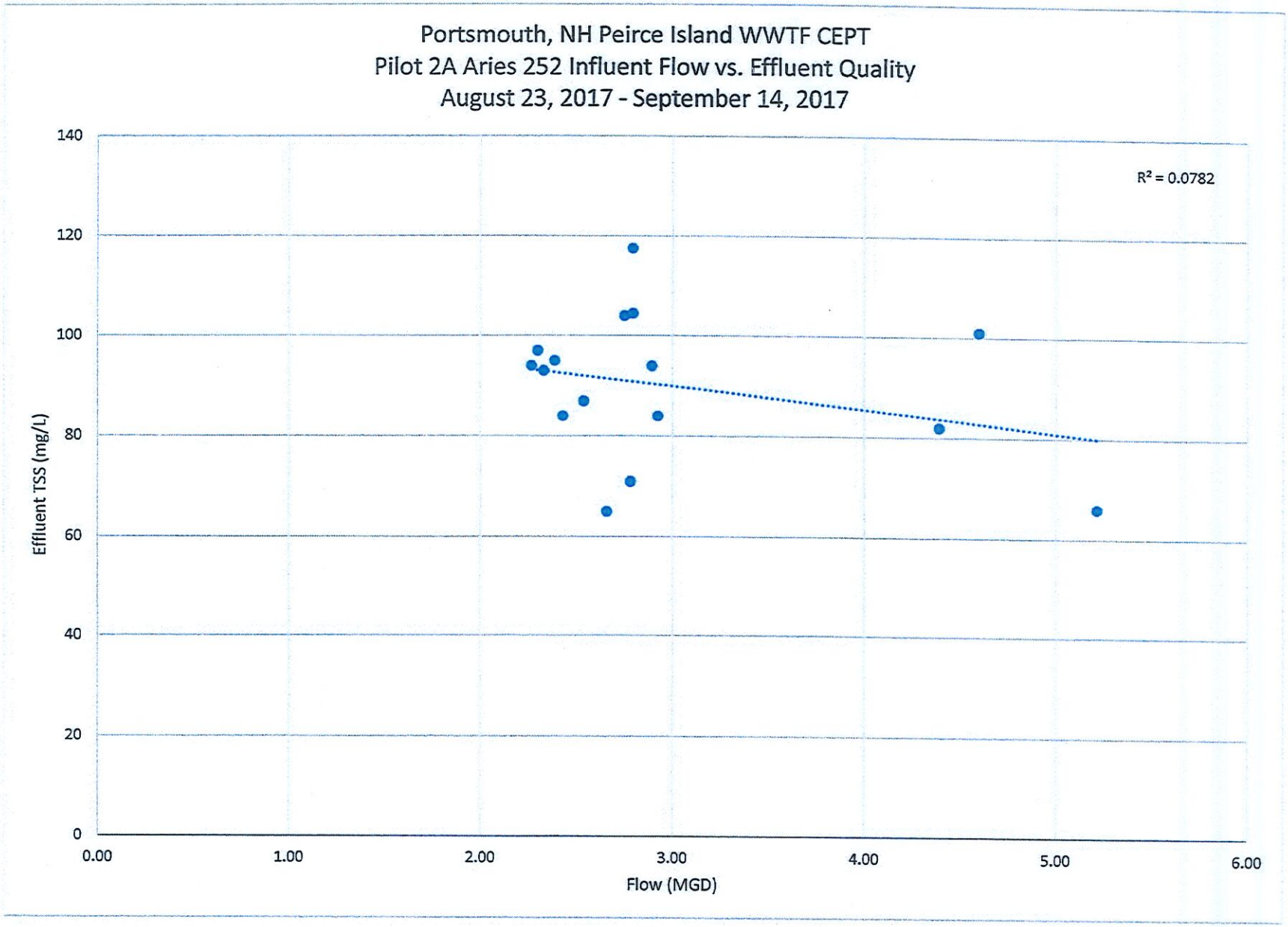

Portsmouth, NH Peirce Island WWTF CEPT
Pilot 2 Aries 252 Influent Flow vs. Effluent Quality
April 25, 2017 - June 3, 2017
R² = 0.0195
Effluent TSS (mg/L)
Flow (MGD)
0
10
20
30
40
50
60
70
80
0.000
2.000
4.000
6.000
8.000
10.000
12.000


Portsmouth, NH Peirce Island WWTF CEPT
Pilot 3 Aries 2076 Influent Flow vs. Effluent Quality
June 6, 2017 - July 15, 2017
R² = 0.079
Effluent TSS (mg/L)
Flow (MGD)
100
90
80
70
60
50
40
30
20
10
0
0.000
1.000
2.000
3.000
4.000
5.000
6.000
7.000

Portsmouth, NH Peirce Island WWTF CEPT
Pilot 3A Aries 2076 Influent Flow vs. Effluent Quality
July 18, 2017 - August 22, 2017




Note: Coagulant/Flocculant doses manually adjusted by operator.


Portsmouth, NH Peirce Island WWTF CEPT
Pilot 2A Aries 252 Influent Flow vs. Effluent Quality
August 23, 2017 - September 14, 2017
R² = 0.0782
Effluent TSS (mg/L)
Flow (MGD)
0
20
40
60
80
100
120
140
0.00
1.00
2.00
3.00
4.00
5.00
6.00

Portsmouth, NH
Peirce Island WWTF
Pilot Testing Chemical dosing Results

Bold indicates a change in dose

| | | SCADA Set Doses | | PAC Pump Measured flow/dose | | | Poly Pump Measured flow/dose | | EAI Lab TSS Values | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | D-Box Flow (MGD) | PAC Setpoint (mg/L) | Poly Setpoint (mg/L) | PAC pump RPM | PAC pump flow rate (GPH) | PAC Dose (mg/L) | Poly Pump Flowrate (ml/min) | Poly Dose (mg/L) | Influent (mg/L) | Effluent (mg/L) | Removal (%) | Notes |
| 2/27/2017 7:50 | 9.6 | 30 | | 26.1 | 5.33 | 13.33 | | | | | | Pilot started with ARIES 291 PAC. Setpoints of 30ppm and 0.5ppm chosen for pilot startup. Poly SCADA changes had not been implemented. Coag SCADA not done correctly. |
| 2/27/2017 9:00 | 9.7 | 30 | 0.49 | 52.2 | 10.66 | 26.39 | | | | | | SCADA changes implemented for Poly and Coag. Setpoints set for both chemicals. |
| 2/27/2017 9:30 | 10.1 | 19.94 | 0.25 | | | | | | | | | Poor settling in clarifiers, poor quality effluent (visual) Doses were both reduced per operator judgement. |
| 2/27/2017 9:55 | 10.6 | 19.94 | 0.25 | 34.2 | 6.99 | 15.82 | | | | | | Check of coagulant pump dose showed somewhat lower than SCADA dose. |
| 2/27/2017 11:00 | 11.8 | 19.94 | 0.25 | 39.9 | 8.15 | 16.58 | | | | | | Clarifiers look better, floc is sinking well. Check of coagulant pump again showed dose to be low. |
| 2/27/2017 11:20 | 11.8 | 19.94 | 0.19 | | | | | | | | | Floc still looks good, but some of it is floating. Operator reduced poly dose. |
| 2/27/2017 13:00 | 9.2 | 16.17 | 0.19 | 22 | 4.49 | 11.73 | | | | | | Operator dropped PAC dose to 16ppm. Check of pump shows it is still low. |
| 2/27/2017 13:10 | 9.8 | 16.17 | 0.19 | | | | 6.74 | 0.26 | | | | Flow test for poly pump is slightly high. |
| 2/27/2017 13:20 | 10.2 | 16.17 | 0.19 | | | | 5.88 | 0.22 | | | | Flow test for poly pump is slightly high. |
| 2/27/2017 14:00 | 10.2 | 16.17 | 0.19 | 22.5 | 4.60 | 10.82 | | | | | | Check of coagulant pump shows flows still too low. |
| 2/28/2017 8:00 | 7.5 | 16.17 | 0.19 | 9.3 | 1.90 | 6.08 | | | | | | Determined that SCADA programming was not quite right up till this point. |
| 2/28/2017 8:45 | 8.4 | 16.17 | 0.19 | 13.6 | 2.78 | 7.94 | | | | | | RHR troubleshot SCADA with Mike, determined problem. Mike made changes 2/28/17 afternoon. Need to verify that changes were correct |
| 2/28/2017 9:00 | | 16.17 | 0.19 | | | | | | 173 | 32.5 | 81.21 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/1/2017 8:00 | 8.5 | 20 | 0.29 | | | | | | | | | Doses at SCADA had been adjusted since day before - Verify when changes were made |
| 3/1/2017 8:10 | 8.5 | 40.43 | 0.29 | | | | | | | | | Poor clarifier performance (visual). It was decided to turn dose up to 40 ppm to see if performance improved. |
| 3/1/2017 8:30 | 8.3 | 40.43 | 0.29 | 77.2 | 15.77 | 45.61 | | | | | | Flow test for PAC slightly high. |
| 3/1/2017 9:00 | | 40.43 | 0.29 | | | | | | 188 | 35.0 | 81.38 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/1/2017 17:00 | | 30 | 2 | | | | | | | | | Doses reset to jar test optimal levels of 30ppm and 2ppm and hold for 24 hrs. |
| 3/2/2017 8:30 | 8.1 | 30 | 2 | 58.8 | 12.01 | 35.59 | 46.3 | 2.17 | | | | Clarifiers had lots of solids on top |
| 3/2/2017 9:00 | 7.9 | 30 | 2 | 55.1 | 11.26 | 34.20 | | | | | | Flow test for PAC slightly high. |
| 3/2/2017 9:00 | | 30 | 2 | | | | | | 186 | 29.0 | 84.41 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/3/2017 8:00 | | 5.39 | 0.12 | | | | | | | | | Frozen solids on top of tank caused skimmer arm to bind up. City backed dose off drastically. |
| 3/3/2017 9:00 | | 30 | 2 | | | | | | 185 | 29.0 | 84.32 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/3/2017 11:00 | | 5.39 | 0.12 | | | | | | | | | Lower doses have resulted in significant improvement to clarifier performance (visual). City notes they can only process 30 gpm of sludge vs 50 gpm with ferric. |
| 3/4/2017 9:00 | | 5.39 | 0.12 | | | | | | 189 | 41.8 | 77.88 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/7/2017 7:30 | PILOT TESTING WITH ARIES 291 STOPPED DUE TO CONSTRUCTION ISSUES AT WWTF. | | | | | | | | | | | Plant staff need to catch up on sludge dewatering which has been adversely affected by change to PAC coagulant. |
| 3/21/2017 7:00 | PILOT TESTING WITH ARIES 291 RESTARTED. | | | | | | | | | | | |
| 3/21/2017 9:00 | | 26.95 | 0.10 | | | | | | | | | City restarted pilot with coagulant dose similar to jar testing doses. |
| 3/22/2017 9:15 | | 26.95 | 0.19 | | | | | | 272 | 40.5 | 85.11 | Small Floc spreading over surface of Clarifiers, Not settling well, Still having Problems running PAC sludge through Fouriner Press. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/23/2017 9:00 | | 26.95 | 0.29 | | | | | | 238 | 29.5 | 87.61 | Small Floc spreading over surface of Clarifiers, Not settling well, Still having Problems running PAC sludge through Fouriner Press. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/24/2017 8:45 | | 26.95 | 0.29 | | | | | | 169 | 35.5 | 78.99 | Light gray floc observed in Gravity Thickener, not settling well. Only about 6" of sludge in thickener. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/25/2017 7:30 | | 24.26 | 0.29 | | | | | | 238 | 31.0 | 86.97 | Sample collected at 9:00 AM represents previous 24 hour period. PAC dose decreased per Operator's judgement. |
| 3/25/2017 10:15 | | 29 | 0.29 | | | | | | | | | PAC dose was increased per Opertor's judgement |
| 3/25/2017 16:45 | | 16.17 | 0.16 | | | | | | | | | Both chemical doses were reduced per Opertor's judgement |
| 3/26/2017 10:30 | | 8.09 | 0.16 | | | | | | | | | PAC dose was reduced per Opertor's judgement |
| 3/27/2017 9:30 | | 8.09 | 0.16 | | | | | | | | | Over the weekend the Thickener was all light gray suspended Floc top to bottom no separation showing in Sludge Judge |
| 3/28/2017 8:45 | | 6.47 | 0.12 | | | | | | 504 | 62.5 | 87.60 | Poor settling, very thin sludge, not pressing well, lots of Pin Floc in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |

**Portsmouth, NH**
**Peirce Island WWTF**
**Pilot Testing Chemical dosing Results**

**Bold indicates a change in dose**

| | | *SCADA Set Doses* | | *PAC Pump Measured flow/dose* | | | *Poly Pump Measured flow/dose* | | *EAI Lab TSS Values* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | D-Box Flow (MGD) | PAC Setpoint (mg/L) | Poly Setpoint (mg/L) | PAC pump RPM | PAC pump flow rate (GPH) | PAC Dose (mg/L) | Poly Pump Flowrate (ml/min) | Poly Dose (mg/L) | Influent (mg/L) | Effluent (mg/L) | Removal (%) | Notes |
| 3/29/2017 9:00 | | 6.47 | 0.12 | | | | | | 221 | 71.0 | 67.84 | Poor settling, very thin sludge, not pressing well, lots of Pin Floc in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/30/2017 8:30 | | 6.47 | 0.12 | | | | | | 244 | 55.5 | 77.25 | Poor settling, very thin sludge, not pressing well, lots of Pin Floc in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |
| 3/31/2017 9:00 | | 6.47 | 0.12 | | | | | | 160 | 62.0 | 61.13 | Poor settling, very thin sludge, not pressing well, lots of Pin Floc in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/1/2017 9:00 | | 6.47 | 0.12 | | | | | | 210 | 71.0 | 66.19 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/3/2017 9:00 | | 6.47 | 0.12 | | | | | | | | | High flows from snow melt, small Pin Floc. Very thin gray Sludge |
| 4/4/2017 9:00 | | 2.7 | 0.08 | | | | | | 189 | 47.0 | 75.17 | **Heavy Rain, high flows, no settling, not much sludge. Doses for PAC and polymer reduced per Operator's judgement.** Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/5/2017 9:00 | | 1.6 | 0.06 | | | | | | 248 | 45.5 | 81.63 | **Flows over 10 MGD, Smaller Floc in the Clarifiers. Doses for PAC and polymer reduced again per Operator's judgement.** Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/6/2017 9:00 | | 4.3 | 0.1 | | | | | | 154 | 34.0 | 77.92 | **Heavy Rain, high flows, no settling. City ran out of sludge around 11:00AM had to shut down process. Chemical doses both increased.** Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/7/2017 9:00 | | 5.4 | 0.19 | | | | | | 215.5 | 25.5 | 88.17 | **Flows still over 10 MGD, seeing some brown clumps floating on surface of both Clarifiers, only pressed 28 tons of Sludge all week. Doses for PAC and polymer reduced per Operator's judgement.** Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/8/2017 9:00 | | 5.4 | 0.19 | | | | | | 168 | 34.5 | 79.46 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/10/2017 9:00 | | 6.5 | 0.23 | | | | | | | | | **Flows around 8 MGD. Medium sized Floc in the Clarifier. Doses for PAC and polymer increased per Operator's judgement.** |
| 4/11/2017 9:00 | | 8.1 | 0.29 | | | | | | 98 | 44.0 | 54.92 | **Large floc on surface on Clarifiers are not settling. Doses for PAC and polymer increased per Operator's judgement.** Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/12/2017 9:00 | | 8.1 | 0.19 | | | | | | 280 | 35.5 | 87.32 | **Much larger Floc, Flows are down around 6.5MGD. Staff left PAC dose the same but reduced Polymer dose. Sample collected at 9:00 AM represents previous 24 hour period.** |
| 4/13/2017 9:00 | | 8.1 | 0.19 | | | | | | 377 | 40.7 | 89.20 | Still a very large Floc flows are down around 5 MGD, Floc is still staying on surface of Clarifiers and being pushed into the Scum. Tanks, PAC and poly reacting much different as the flows come down. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/14/2017 9:00 | | 8.1 | 0.19 | | | | | | 328 | 39.0 | 88.11 | Flows Around 5 MGD, Floc is now smaller. City ran out of Sludge on 4/13/17 and still not much Sludge today. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/15/2017 9:00 | | 8.1 | 0.19 | | | | | | 297 | 54.0 | 81.82 | Weekend Flows around 4 MGD, Clarifiers look ok but large clumps of Sludge forming in the Thickener. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/18/2017 9:00 | | 27 | 0.23 | | | | | | 216 | 28.5 | 86.81 | **PAC and Polymer doses increased for final week of Pilot 1 per UEI recommendation.** Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/19/2017 9:00 | | 27 | 0.23 | | | | | | 200 | 24.5 | 87.75 | 4 FT of Black watery Sludge in Thickener, Not as many large clumps floating on surface. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/20/2017 9:00 | | 27 | 0.31 | | | | | | 191 | 23.5 | 87.70 | Light Grey Floc in Thickener, not really settling. Sample collected at 9:00 AM represents previous 24 hour period. **Polymer dose increase per Operator's judgement.** |
| 4/21/2017 9:00 | | 27 | 0.19 | | | | | | 350 | 27.0 | 92.29 | **Polymer dose decrease per Operator's judgement.** Light Grey Floc in Thickener, not really settling. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/22/2017 9:00 | | 27 | 0.19 | | | | | | 270 | 28.0 | 89.63 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/23/2017 9:00 | | 27 | 0.19 | | | | | | 270 | 28.0 | 89.63 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/24/2017 7:00 | **PILOT 2 BEGUN WITH ARIES 252** | | | | | | | | | | | |
| 4/24/2017 7:00 | | 8.6 | 0.19 | | | | | | | | | **Pilot 2 begun with Aries 252. Pilot started with doses similar to "low doses" used in Pilot 1.** Sludge is still like black water it Pressing but very wet, Clarifiers look about the same Small pin Floc. |
| 4/25/2017 9:00 | | 8.6 | 0.19 | | | | | | 295 | 63.0 | 78.64 | Rain all day Flows between 8-16 MGD, Sludge became extremely thick which it usually does with high flows. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/26/2017 9:00 | | 8.6 | 0.19 | | | | | | 580 | 49.5 | 91.47 | Flows Around 7 MGD, Sludge is still very thick, Hard to tell how the 252 is working because of the rain and High Flows. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/27/2017 9:00 | | 8.6 | 0.19 | | | | | | 518 | 70.0 | 86.49 | Sample collected at 9:00 AM represents previous 24 hour period. Flows Around 7 MGD, Sludge is still very thick, Hard to tell how the 252 is working because of the rain and High Flows. Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/28/2017 9:00 | | 8.6 | 0.19 | | | | | | 249 | 54.0 | 78.31 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 4/29/2017 9:00 | | 8.6 | 0.19 | | | | | | 226 | 57.0 | 74.78 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/2/2017 9:00 | | 8.6 | 0.19 | | | | | | 82 | 36.0 | 56.10 | Flows around 5 MGD, Clarifiers are cloudy light grey, Sludge is still very thick. Sample collected at 9:00 AM represents previous 24 hour period. |

**Portsmouth, NH**
**Peirce Island WWTF**
**Pilot Testing Chemical dosing Results**

**Bold** indicates a change in dose

| | | *SCADA Set Doses* | | *PAC Pump Measured flow/dose* | | | *Poly Pump Measured flow/dose* | | *EAI Lab TSS Values* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | D-Box Flow (MGD) | PAC Setpoint (mg/L) | Poly Setpoint (mg/L) | PAC pump RPM | PAC pump flow rate (GPH) | PAC Dose (mg/L) | Poly Pump Flowrate (ml/min) | Poly Dose (mg/L) | Influent (mg/L) | Effluent (mg/L) | Removal (%) | Notes |
| 5/3/2017 9:00 | | 8.6 | 0.19 | | | | | | 254 | 37.5 | 85.24 | Flows around 5 MGD, Clarifiers are cloudy light grey, Sludge is still very thick. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/4/2017 9:00 | | 8.6 | 0.19 | | | | | | 182 | 45.0 | 75.27 | Flows around 5 MGD, Clarifiers are cloudy light grey, Sludge is still very thick. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/5/2017 9:00 | | 8.6 | 0.19 | | | | | | 233 | 48.0 | 79.40 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/6/2017 9:00 | | 8.6 | 0.19 | | | | | | 473 | 53.5 | 88.69 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/9/2017 9:00 | | 8.6 | 0.19 | | | | | | 230 | 50.0 | 78.26 | Flows around 5 MGD, Clarifiers are cloudy light grey, Sludge has thined out but still able to be pressed. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/10/2017 9:00 | | 8.6 | 0.19 | | | | | | 202 | 55.0 | 72.77 | Flows around 5 MGD, Clarifiers are cloudy light grey, Sludge has thined out but still able to be pressed. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/11/2017 9:00 | | 8.6 | 0.19 | | | | | | 296 | 63.0 | 78.72 | Cleaned Chlorine Contacts, Sludge on bottom was normal around 4", Sludge still very thin. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/12/2017 9:00 | | 8.6 | 0.19 | | | | | | 365 | 48.0 | 86.85 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/13/2017 9:00 | | 8.6 | 0.19 | | | | | | 283 | 70.0 | 75.27 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/16/2017 9:00 | | 8.6 | 0.19 | | | | | | 303 | 36.0 | 88.12 | Flows around 5.5 MGD, Thick Sludge, Clarifiers have a lot floating on surface. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/17/2017 9:00 | | 8.6 | 0.19 | | | | | | 261 | 50.0 | 80.84 | Flows around 5.5 MGD, Thick Sludge, Clarifiers have a lot floating on surface. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/18/2017 9:00 | | 8.6 | 0.19 | | | | | | 288 | 41.0 | 85.76 | Flows around 5 MGD, Sludge Thinned out, Some pin floc in Contacts. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/19/2017 9:00 | | 8.6 | 0.19 | | | | | | 240 | 64.0 | 73.33 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/20/2017 9:00 | | 8.6 | 0.19 | | | | | | 270 | 63.0 | 76.67 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/23/2017 9:00 | | 27 | 0.19 | | | | | | 534 | 76.0 | 85.77 | Went up on Pac Dose to 27mg/L, Floe around 4.5 MGD, Sludge thinned out. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/24/2017 9:00 | | 27 | 0.19 | | | | | | 280 | 72.0 | 74.29 | Went up on Pac Dose to 27mg/L, Floe around 4.5 MGD, Sludge thinned out. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/25/2017 9:00 | | 27 | 0.19 | | | | | | 345 | 66.7 | 80.68 | Floc in Clarifiers staying on top not settling well, Thin Sludge. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/26/2017 9:00 | | 27 | 0.19 | | | | | | 636 | 68.0 | 89.31 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/27/2017 9:00 | | 27 | 0.19 | | | | | | 263 | 47.0 | 82.13 | Weekend High flows due to Rain Pac and Poly in Manual Pace lots of sludge floating in Clarifiers. Sample collected at 9:00 AM represents previous 24 hour period. |
| 5/31/2017 9:00 | | 27 | 0.19 | | | | | | 310 | 39.0 | 87.42 | Thickener is now starting to show the grey Floc across the top and not settling well. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/1/2017 9:00 | | 27 | 0.19 | | | | | | 456 | 50.0 | 89.04 | Thickener showing more suspended solids, Sludge is getting thin, Flows around 4.5 MGD. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/2/2017 9:00 | | 27 | 0.19 | | | | | | 278 | 73.0 | 73.74 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/3/2017 9:00 | | 27 | 0.19 | | | | | | 292.7 | 70.0 | 76.08 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/5/2017 9:00 | PILOT 3 BEGUN WITH ARIES 2076 | | | | | | | | | | | Started using Ferric at 8.6 mg\L Poly at 0.19 mg\L. |
| 6/6/2017 9:00 | | 8.6 | 0.19 | | | | | | 378 | 74.0 | 80.42 | Flows around 4.9 MGD, Large Floc in Clarifiers but still settling ok. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/7/2017 9:00 | | 8.6 | 0.19 | | | | | | 406 | 76.0 | 81.28 | Flows around 4.9 MGD, Large Floc in Clarifiers but still settling ok. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/8/2017 9:00 | | 8.6 | 0.19 | | | | | | 272 | 71.0 | 73.90 | Not Sure what happened on this day numbers are way off. EA determined two bottle values were swapped due to mis-labeling. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/9/2017 9:00 | | 8.6 | 0.19 | | | | | | 115 | 60.0 | 47.83 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/10/2017 9:00 | | 8.6 | 0.19 | | | | | | 328 | 67.0 | 79.57 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/13/2017 9:00 | | 8.6 | 0.19 | | | | | | 420 | 68.6 | 83.67 | Flows are down around 3 MGD, Seeing the Influent solids Concentration going up. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/14/2017 9:00 | | 8.6 | 0.19 | | | | | | 326 | 82.0 | 74.85 | Flows are down around 3 MGD, Seeing the Influent solids Concentration going up, Lots of solids floating on Clarifiers. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/15/2017 9:00 | | 8.6 | 0.19 | | | | | | 354 | 72.5 | 79.54 | Flows are down around 3 MGD, Seeing the Influent solids Concentration going up, Lots of solids floating on Clarifiers. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/16/2017 9:00 | | 8.6 | 0.19 | | | | | | 362 | 86.0 | 76.24 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/17/2017 9:00 | | 8.6 | 0.19 | | | | | | 286 | 90.0 | 68.53 | Sample collected at 9:00 AM represents previous 24 hour period. |

**Portsmouth, NH**
**Peirce Island WWTF**
**Pilot Testing Chemical dosing Results**

**Bold** indicates a change in dose

| | | *SCADA Set Doses* | | *PAC Pump Measured flow/dose* | | | *Poly Pump Measured flow/dose* | | *EAI Lab TSS Values* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | D-Box Flow (MGD) | PAC Setpoint (mg/L) | Poly Setpoint (mg/L) | PAC pump RPM | PAC pump flow rate (GPH) | PAC Dose (mg/L) | Poly Pump Flowrate (ml/min) | Poly Dose (mg/L) | Influent (mg/L) | Effluent (mg/L) | Removal (%) | Notes |
| 6/20/2017 9:00 | | 8.6 | 0.19 | | | | | | 352 | 72.0 | 79.55 | Flows around 3.5 MGD, Not settling well in Clarifiers, Under normal operation I would make Poly adjustments to dial it in. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/21/2017 9:00 | | 8.6 | 0.19 | | | | | | 360 | 66.0 | 81.67 | Flows around 3.5 MGD, Not settling well in Clarifiers, Under normal operation I would make Poly adjustments to dial it in. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/22/2017 9:00 | | 8.6 | 0.19 | | | | | | 362.5 | 76.0 | 79.03 | More consistent sludge back on Ferric, Pressing much better on Ferric. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/23/2017 9:00 | | 8.6 | 0.19 | | | | | | 404 | 74.7 | 81.52 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/24/2017 9:00 | | 8.6 | 0.19 | | | | | | 320 | 75.0 | 76.56 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/27/2017 9:00 | | 8.6 | 0.19 | | | | | | 503 | 82.0 | 83.71 | Flows around 2.8 MGD, Mechanic ST has been switching between Main and By-Pass Pumps leaving lots of rags and floating solids in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/28/2017 9:00 | | 8.6 | 0.19 | | | | | | 578 | 90.0 | 84.43 | Flows around 2.8 MGD, Mechanic ST has been switching between Main and By-Pass Pumps leaving lots of rags and floating solids in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/29/2017 9:00 | | 8.6 | 0.19 | | | | | | 370 | 62.7 | 83.06 | Flows around 2.8 MGD, Mechanic ST has been switching between Main and By-Pass Pumps leaving lots of rags and floating solids in Clarifier. Sample collected at 9:00 AM represents previous 24 hour period. |
| 6/30/2017 9:00 | | 8.6 | 0.19 | | | | | | 371 | 55.0 | 85.18 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/1/2017 9:00 | | 8.6 | 0.19 | | | | | | 403 | 62.7 | 84.45 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/6/2017 9:00 | | 27.0 | 0.19 | | | | | | 296 | 56.0 | 81.08 | Flows around 2.8 MGD, Thick Sludge, Clarifiers have more on surface due to Mech. ST running BY-Pass Pump. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/7/2017 9:00 | | 27.0 | 0.19 | | | | | | 223 | 57.0 | 74.42 | Flows around 2.8 MGD, Thick Sludge, Clarifiers have more on surface due to Mech. ST running BY-Pass Pump. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/8/2017 9:00 | | 27.0 | 0.19 | | | | | | 474 | 60.0 | 87.34 | Flows around 2.8 MGD, Thick Sludge, Clarifiers have more on surface due to Mech. ST running BY-Pass Pump. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/11/2017 9:00 | | 27.0 | 0.19 | | | | | | 343 | 64.0 | 81.31 | Flows around 2.8 MGD, Thick Sludge, Clarifiers have more on surface due to Mech. ST running BY-Pass Pump. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/12/2017 9:00 | | 27.0 | 0.19 | | | | | | 377 | 76.3 | 79.76 | Flows around 2.8 MGD, Thick Sludge, Clarifiers have more on surface due to Mech. ST running BY-Pass Pump. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/13/2017 9:00 | | 27.0 | 0.19 | | | | | | 330 | 52.9 | 83.98 | Flows around 2.8 MGD, Thick Sludge, Clarifiers have more on surface due to Mech. ST running BY-Pass Pump. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/14/2017 9:00 | | 27.0 | 0.19 | | | | | | 454 | 73.0 | 83.93 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/15/2017 9:00 | | 27.0 | 0.19 | | | | | | 272 | 65.0 | 76.10 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/17/2017 9:00 | **Aries 2076 Operator Optimized started** | | | | | | | | | | | Started making adjustments to Ferric and Poly trying to fine tune it, Flows around 2.8 MGD, Still lots of thick sludge |
| 7/18/2017 9:00 | | 32.0 | 0.29 | | | | | | 393 | 66.7 | 83.05 | Started making adjustments to Ferric and Poly trying to fine tune it, Flows around 2.8 MGD, Still lots of thick sludge. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/19/2017 9:00 | | 37.0 | 0.39 | | | | | | 360 | 62.0 | 82.78 | Clarifiers are black till afternoon hard to see what Floc looks like, still have thick sludge pressing very well. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/20/2017 9:00 | | 40.0 | 0.49 | | | | | | 290 | 64.3 | 77.83 | Clarifiers are black till afternoon hard to see what Floc looks like, still have thick sludge pressing very well. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/21/2017 9:00 | | 42.0 | 0.58 | | | | | | 314 | 60.0 | 80.91 | Flows still low around 2.8 MGD, Mech st by pass pump on, lot's of rags and floating solids in Clarifiers, Thick sludge. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/22/2017 9:00 | | 42.0 | 0.58 | | | | | | 374 | 58.6 | 84.33 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/25/2017 9:00 | | 32.0 | 0.48 | | | | | | 610 | 71.7 | 88.25 | Rain Flows around 5 MGD, High Influent and Effluent #s due to rain but % removal was still good. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/26/2017 9:00 | | 32.0 | 0.29 | | | | | | 350 | 62.0 | 82.29 | Construction Problems with Ferric Tanks and pumps clogging all day never got the correct dose. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/27/2017 9:00 | | 45.0 | 0.58 | | | | | | 374 | 78.0 | 79.14 | Flows around 2.8 MGD, Black Clarifiers till afternoon, Thick Sludge Pressing very well. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/28/2017 9:00 | | 45.0 | 0.58 | | | | | | 370 | 58.0 | 84.32 | Flows around 2.8 MGD, Black Clarifiers till afternoon, Thick Sludge Pressing very well. Sample collected at 9:00 AM represents previous 24 hour period. |
| 7/29/2017 9:00 | | 45.0 | 0.58 | | | | | | 360 | 86.0 | 76.11 | Flows around 2.8 MGD, Black Clarifiers till afternoon, Thick Sludge Pressing very well. Sample collected at 9:00 AM represents previous 24 hour period. |

Portsmouth, NH
Peirce Island WWTF
Pilot Testing Chemical dosing Results

Bold indicates a change in dose

| | | SCADA Set Doses | | PAC Pump Measured flow/dose | | | Poly Pump Measured flow/dose | | EAI Lab TSS Values | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | D-Box Flow (MGD) | PAC Setpoint (mg/L) | Poly Setpoint (mg/L) | PAC pump RPM | PAC pump flow rate (GPH) | PAC Dose (mg/L) | Poly Pump Flowrate (ml/min) | Poly Dose (mg/L) | Influent (mg/L) | Effluent (mg/L) | Removal (%) | Notes |
| 8/1/2017 9:00 | | 43.0 | 0.68 | | | | | | 325 | 62.0 | 80.92 | Problems with Ferric system getting plugged again, Not sure how many hours it was plugged Happened overnight. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/2/2017 9:00 | | 43.0 | 0.58 | | | | | | 294 | 76.3 | 74.06 | Still having problems with Ferric strainer plugging, Ordered larger mesh strainer to help with the problem, Thick Sludge. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/3/2017 9:00 | | 43.0 | 0.58 | | | | | | 284 | 61.7 | 78.29 | Still having problems with Ferric strainer plugging, Ordered larger mesh strainer to help with the problem, Thick Sludge. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/4/2017 9:00 | | 43.0 | 0.58 | | | | | | 252 | 80.0 | 68.25 | collected at 9:00 AM represents previous 24 hour period. |
| 8/5/2017 9:00 | | 43.0 | 0.58 | | | | | | 356 | 62.0 | 82.58 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/8/2017 9:00 | | 43.0 | 0.58 | | | | | | 355 | 66.0 | 81.41 | Had to clean remainder of Ferric from Bulk Tank into grit chambers so tank could be removed, May have messed with the numbers. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/9/2017 9:00 | | 43.0 | 0.58 | | | | | | 406 | 64.6 | 84.09 | Had to clean remainder of Ferric from Bulk Tank into grit chambers so tank could be removed, May have messed with the numbers. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/10/2017 9:00 | | 52.0 | 0.58 | | | | | | 314 | 61.5 | 80.43 | Increased Ferric and Poly trying to back on track after all the problems with the Ferric Tanks. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/11/2017 9:00 | | 52.0 | 0.58 | | | | | | 288 | 66.0 | 77.08 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/12/2017 9:00 | | 52.0 | 0.58 | | | | | | 274 | 64.7 | 76.38 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/15/2017 9:00 | | 43.0 | 0.58 | | | | | | 353 | 128.0 | 63.77 | Construction Problems with Ferric Tanks and pumps clogging all day never got the correct dose. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/16/2017 9:00 | | 43.0 | 0.68 | | | | | | 560 | 83.8 | 85.04 | Construction Problems with Ferric Tanks and pumps clogging all day never got the correct dose. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/17/2017 9:00 | | 0.0 | 0.00 | | | | | | 450 | 78.0 | 82.67 | Rain Flows around 5 MGD, High Influent and Effluent #s due to rain but % removal was still good. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/18/2017 9:00 | | 0.0 | 0.00 | | | | | | 388 | 59.2 | 84.72 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/19/2017 9:00 | | 0.0 | 0.00 | | | | | | 0 | 0.0 | #DIV/0! | Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/23/2017 9:00 | Pilot 2A BEGAN WITH ARIES 252 | | | | | | | | | | | Heavy Rain overnight made for high Influent and Effluent TSS, Thick Sludge. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/23/2017 9:00 | | 8.6 | 0.19 | | | | | | 624 | 101.0 | 83.81 | Flows around 4 MGD due to rain the night before, First full 24 hours of PAC 252, Clarifiers still black till afternoon. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/24/2017 9:00 | | 8.6 | 0.19 | | | | | | 278 | 84.0 | 69.78 | Flows around 2.9 MGD Influent has cleared up after the rain not coming in black right now, Sludge is ok just a little thin. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/25/2017 9:00 | | 8.6 | 0.19 | | | | | | 183 | 71.0 | 61.14 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/26/2017 9:00 | | 8.6 | 0.19 | | | | | | 183.1 | 87.0 | 52.48 | Thick Foam and Sludge floating on surface of thickener not sure why, Sludge starting to get thin. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/29/2017 9:00 | | 8.6 | 0.19 | | | | | | 241.3 | 84.0 | 65.19 | Flows around 2.8 MGD, Very thin Sludge and not much of it Thickener only at 1.5 FT. |
| 8/30/2017 9:00 | | 8.6 | 0.19 | | | | | | 260.0 | 95.0 | 63.46 | Sludge is very watery Thickener showing less than a foot, Yesterdays sludge can was only 5 ton. Sample collected at 9:00 AM represents previous 24 hour period. |
| 8/31/2017 9:00 | | 8.6 | 0.19 | | | | | | 298.0 | 93.0 | 68.79 | Ran out of sludge, Coming into the holding tanks like Gray Water. Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/1/2017 9:00 | | 8.6 | 0.19 | | | | | | 300.0 | 97.0 | 67.67 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/2/2017 9:00 | | 8.6 | 0.19 | | | | | | 306.0 | 94.0 | 69.28 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/5/2017 9:00 | | 8.6 | 0.19 | | | | | | 216.0 | 65.0 | 69.91 | Sludge thickened up over the weekend, TSS still high with low % removal. Flows around 2.6 MGD, Not settling well only 43% removal. Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/6/2017 9:00 | | 8.6 | 0.19 | | | | | | 165.0 | 82.0 | 50.30 | Heavy Rain on and off, Sludge looks ok about 2' in Thickener. Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/7/2017 9:00 | | 27.0 | 0.19 | | | | | | 308.3 | 66.0 | 78.59 | Day after some rain, Sludge thickened up a little bit, The Fournier Press hasn't been running great the pressure keeps jumping around. Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/8/2017 9:00 | | 27.0 | 0.19 | | | | | | 160.0 | 69.2 | 56.73 | Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/9/2017 9:00 | | 27.0 | 0.19 | | | | | | 181.0 | 80.0 | 56.85 | Sample collected at 9:00 AM represents previous 24 hour period. |

Portsmouth, NH
Peirce Island WWTF
Pilot Testing Chemical dosing Results

Bold indicates a change in dose

| | | SCADA Set Doses | | PAC Pump Measured flow/dose | | | Poly Pump Measured flow/dose | | EAI Lab TSS Values | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Time | D-Box Flow (MGD) | PAC Setpoint (mg/L) | Poly Setpoint (mg/L) | PAC pump RPM | PAC pump flow rate (GPH) | PAC Dose (mg/L) | Poly Pump Flowrate (ml/min) | Poly Dose (mg/L) | Influent (mg/L) | Effluent (mg/L) | Removal (%) | Notes |
| 9/11/2017 9:00 | | 27.0 | 0.19 | | | | | | 225.5 | 94.0 | 58.31 | Running on one Clarifier, Sludge is thin and watery. Flows around 2.7 MGD, Sludge is very thin having a hard time getting enough Sludge to press before it turns into water. Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/12/2017 9:00 | | 27.0 | 0.19 | | | | | | 263.5 | 117.5 | 55.41 | Flows around 2.7 MGD, Sludge is very thin having a hard time getting enough Sludge to press before it turns into water. Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/13/2017 9:00 | | 27.0 | 0.19 | | | | | | 312.5 | 104.5 | 66.56 | Flows around 2.7 MGD, Sludge is very thin having a hard time getting enough Sludge to press before it turns into water. Sample collected at 9:00 AM represents previous 24 hour period. |
| 9/14/2017 9:00 | | 27.0 | 0.19 | | | | | | 242.5 | 104.0 | 57.11 | Sludge is very thin, Ran out of Sludge Thursday around noon had to shut down the press and wait till Friday AM to fill sludge can. Sample collected at 9:00 AM represents previous 24 hour period. |

2120-02

PEIRCE ISLAND WWTF CEPT PILOT
PORTSMOUTH, NH

**Pilot Test 11 Meeting NOTES**
**November 17, 2017 at 2:30 PM**

**ATTENDEES (By Conference Call):**

| | |
|---|---|
| • Terry Desmarais | City of Portsmouth |
| • Timothy Babkirk | City of Portsmouth |
| • David Mercier | Underwood Engineers |
| • Daniel Jacobson | Underwood Engineers |
| • Joy Hilton | Environmental Protection Agency |
| • Mark Klingenstein | Environmental Protection Agency |

Discussion of Pilot 2A using Aries 252:

- Pilot 2A with Aries 252 coagulant was the last pilot conducted, running from August 23 – September 23. As requested by EPA, the chemical combination was run a second time to see its performance in warmer temperatures.
- The effluent TSS values achieved in Pilot 2A are considerably higher than values achieved in Pilots 1, 2, 3, and 3A.
    - Pilot 2A resulted in an average effluent TSS of 79.4 mg/L and an average influent TSS of 263.9 mg/L.
- Pilot 2A also resulted in poor operating conditions, producing very thin and watery sludge.

Discussion of Pilot Testing:

- The pilot's effluent TSS quality each got progressively worse from Pilot 1.
- A strong correlation was found between effluent TSS quality and the time of year.
    - Historical data shows that effluent TSS quality is better is colder weather than in warmer weather.
- Statistical analyses show that when comparing effluent TSS between each pilot, all were found to be significantly different from each other except for Pilot 3 and Pilot 3A, both using Aries 2076. Influent TSS was found to be significantly different between several of the pilots, but not significantly different for others.
- There was not a strong correlation between influent and effluent TSS.
    - Results show that the effluent TSS quality achieved was approximately equal whether influent TSS values were high and low.
- Pilot 1 with Aries 291 and Pilot 2A with Aries 252 presented the poorest operating conditions at the plant.

- Operator observations included significant coloration changes in the clarifier and thickener, cloudy effluent, fluffy floc not settling, low sludge inventory with thin and watery sludge.

Discussion of Conclusions:

- Each Pilot was compared to historical TSS data from the same time of year using the ANOVA and t-Test statistical analyses.
  - Pilot 1 with Aries 291 was the only pilot that resulted in an average effluent TSS that was not significantly different than historic values at the same time of year. However, the effluent TSS produced was not 10% better than the average historic value, and this chemical combination resulted in poor operating conditions.
  - The other four pilots proved to be significantly different and produced a poorer effluent quality than historic values.
- Underwood feels that because the historic chemical combination worked as well or better than the piloted chemical combinations there is no justification to switch chemicals.

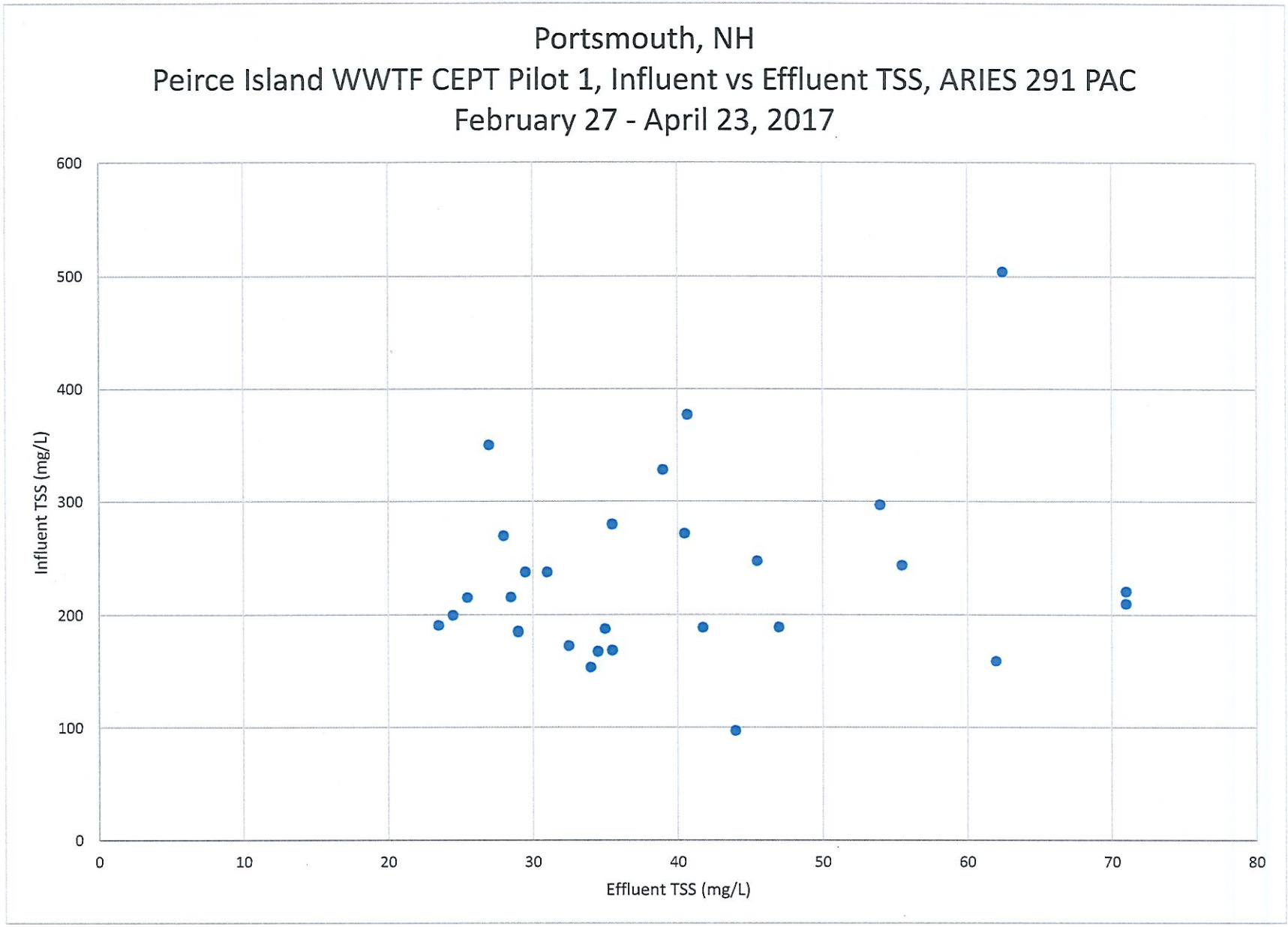
Additional Discussion:

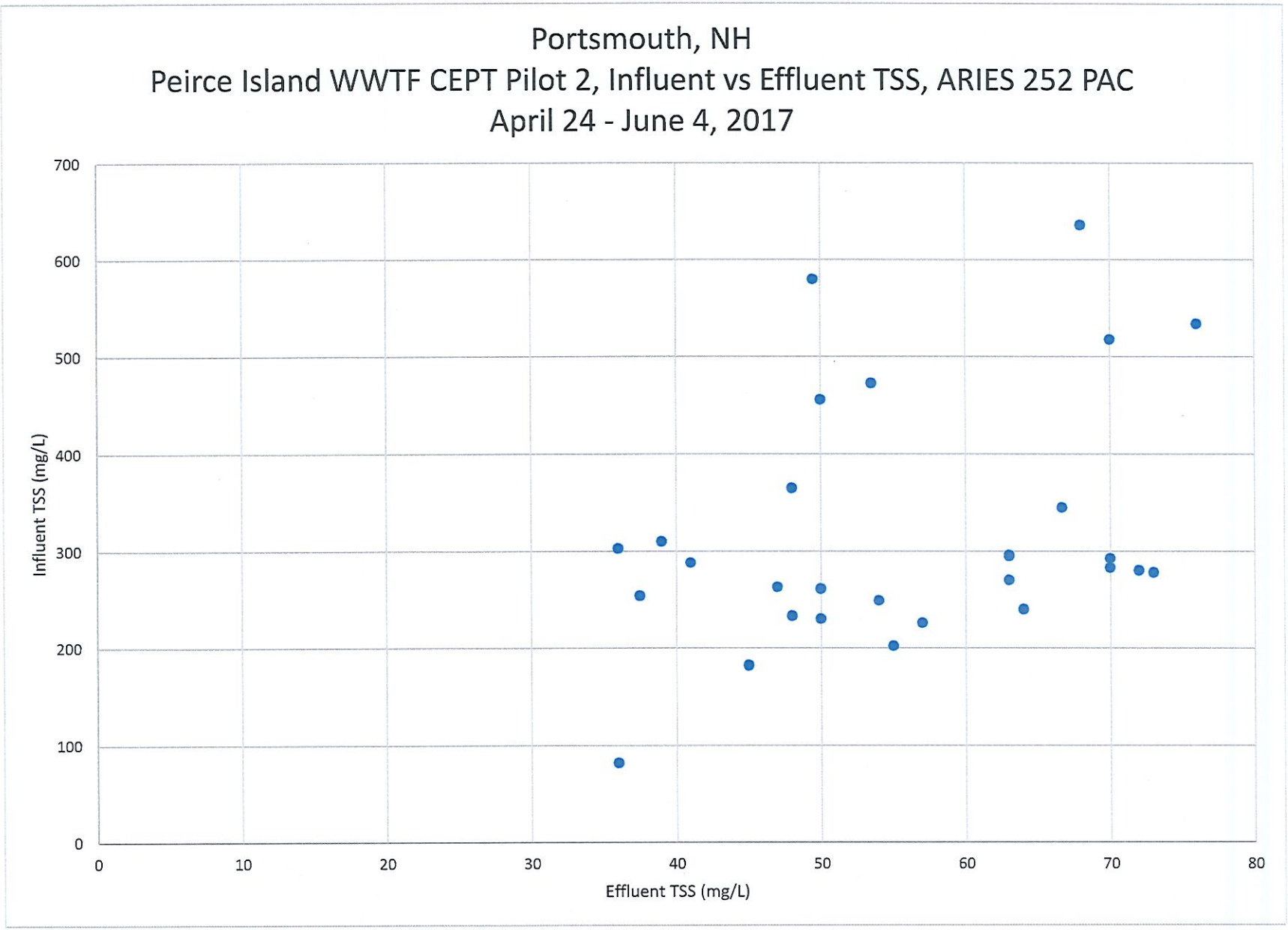
- The City is to review the final report before submitting to the EPA.
- The EPA will review and respond with comments.

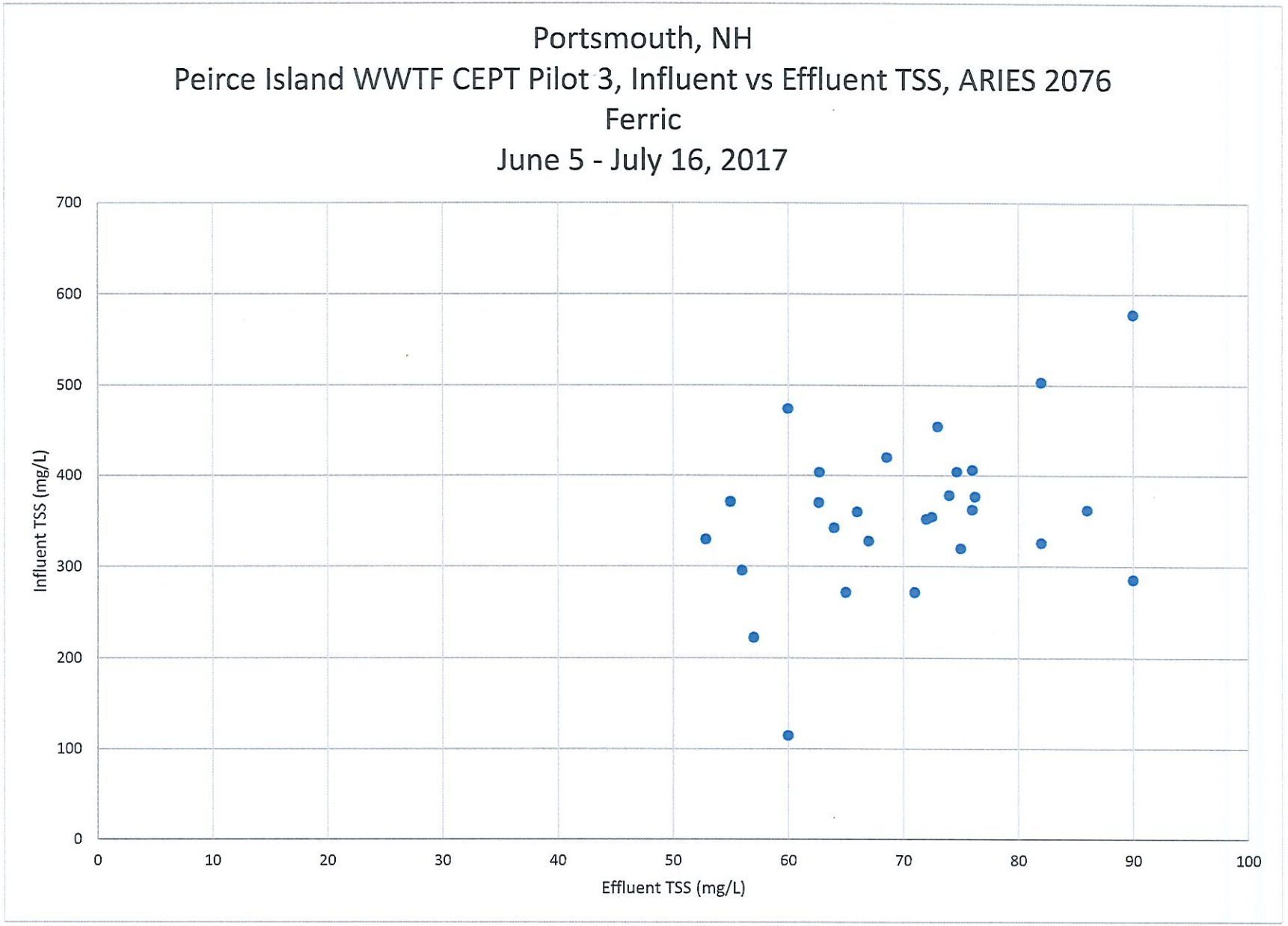
Planned:

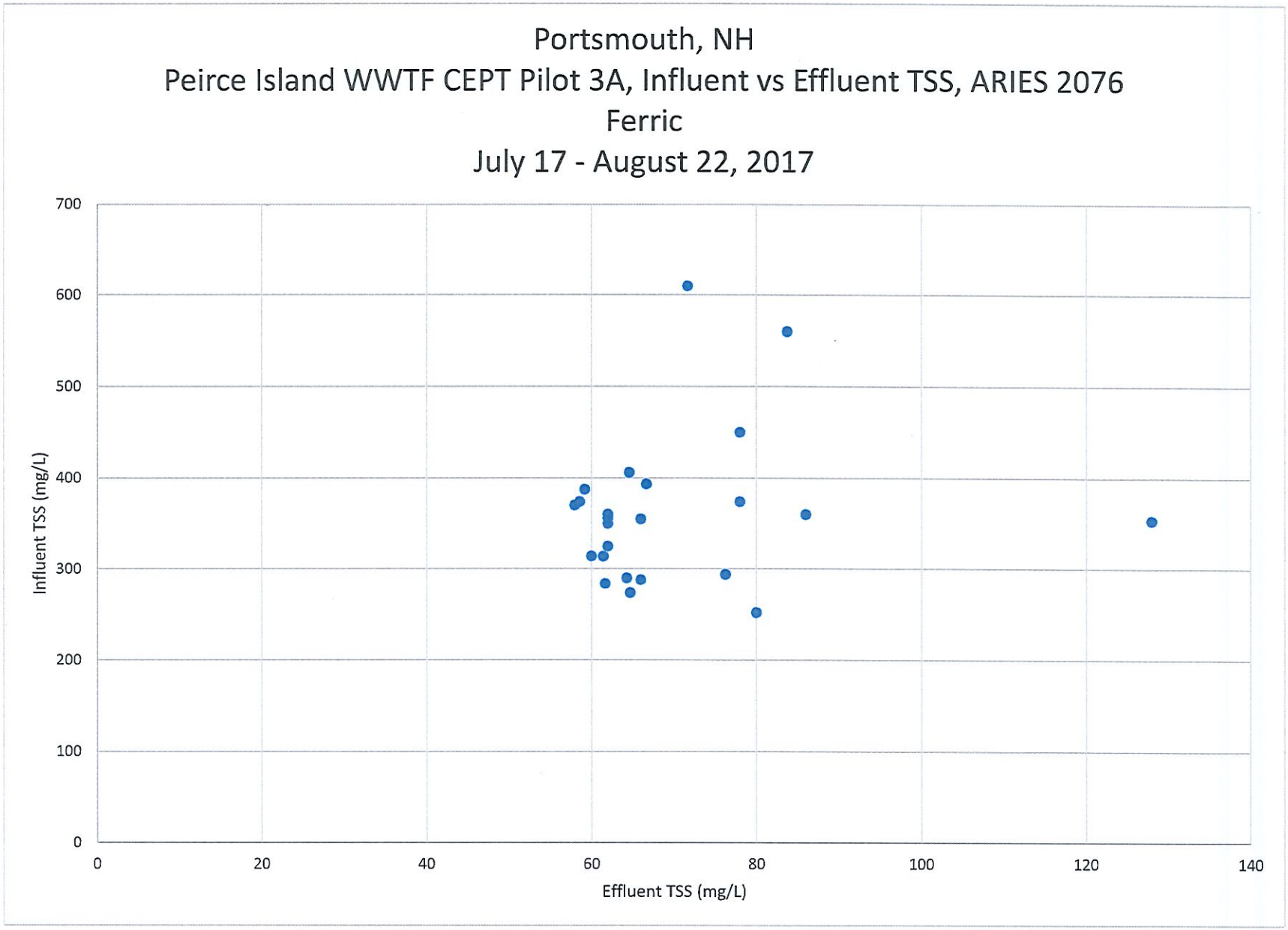
- Underwood is to prepare the final report for the City by 11/29.
- The City is to respond with comments before submitting to the EPA by the week of 12/12.

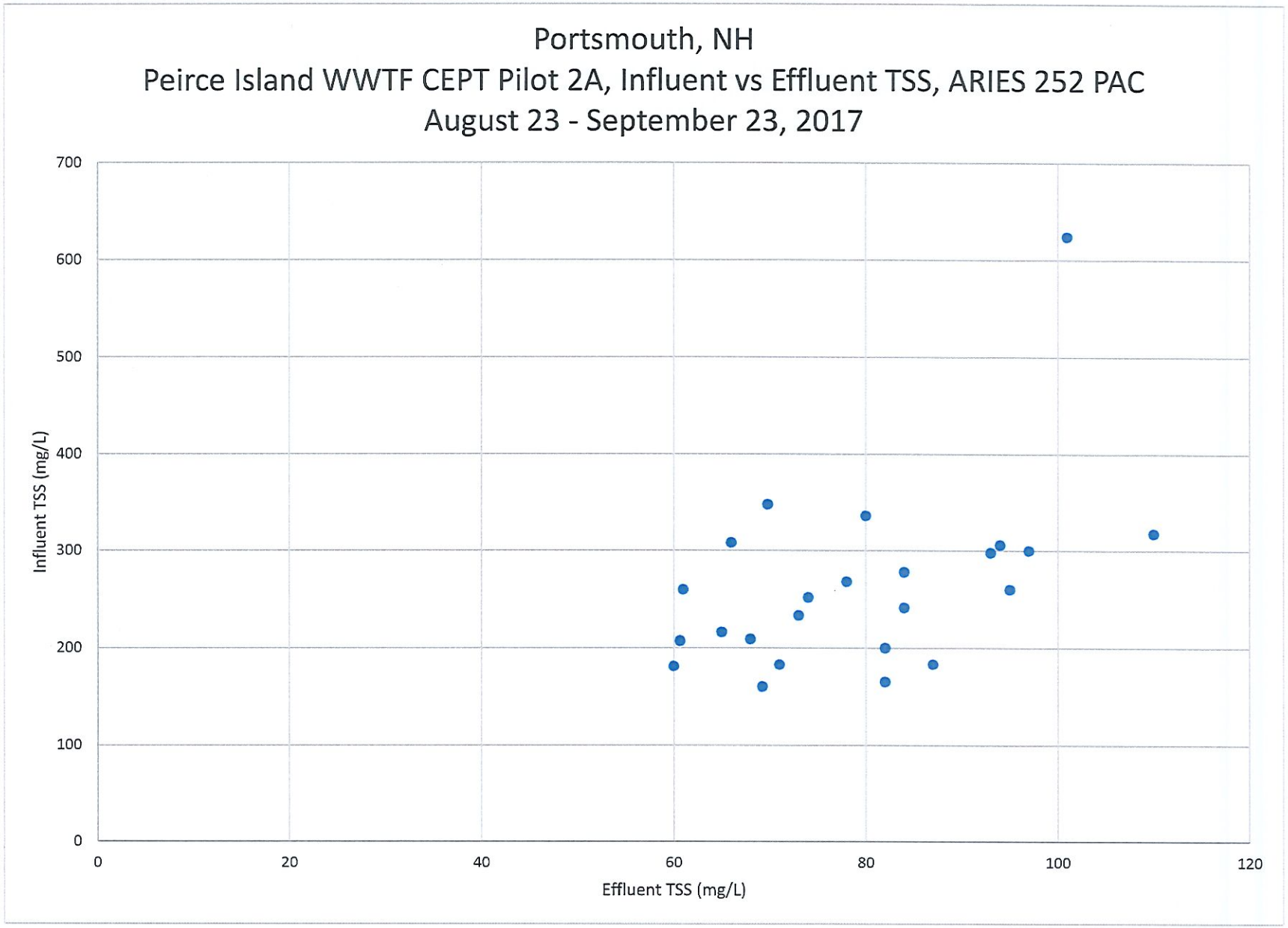
# APPENDIX E


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 1, Influent vs Effluent TSS, ARIES 291 PAC
February 27 - April 23, 2017
Influent TSS (mg/L)
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
Effluent TSS (mg/L)


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 2, Influent vs Effluent TSS, ARIES 252 PAC
April 24 - June 4, 2017
Influent TSS (mg/L)
Effluent TSS (mg/L)
0
100
200
300
400
500
600
700
0
10
20
30
40
50
60
70
80


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 3, Influent vs Effluent TSS, ARIES 2076
Ferric
June 5 - July 16, 2017
Influent TSS (mg/L)
Effluent TSS (mg/L)
0
100
200
300
400
500
600
700
0
10
20
30
40
50
60
70
80
90
100


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 3A, Influent vs Effluent TSS, ARIES 2076
Ferric
July 17 - August 22, 2017
Influent TSS (mg/L)
700
600
500
400
300
200
100
0
0
20
40
60
80
100
120
140
Effluent TSS (mg/L)


Portsmouth, NH
Peirce Island WWTF CEPT Pilot 2A, Influent vs Effluent TSS, ARIES 252 PAC
August 23 - September 23, 2017
Influent TSS (mg/L)
700
600
500
400
300
200
100
0
0
20
40
60
80
100
120
Effluent TSS (mg/L)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