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July 9, 2021

Kristine L. Wheeler, P.E., Director
Bureau of Water Supply Protection
NYS Department of Health
Empire State Plaza
Corning Tower
Albany, NY 12237

Re: Inc. Village of Hempstead - Progress Report
for 1,4 Dioxane MCL Deferral – Q2 2021
Public Water System ID# 2902827

Dear Director Wheeler:

We are the consulting engineer to the Village of Hempstead Water Department and we write on its behalf. This summary report of activities is submitted in compliance with the requirements listed in your letter dated January 8, 2021, which granted a deferral for enforcement of the 1,4 Dioxane Maximum Contaminant Level (MCL). Continuation of the Deferral was based on the Village meeting the conditions listed in your letter.

Condition 1
Condition 1 required that public notification be made within 30 days of your letter. The Village had the notice published in the Hempstead Beacon on January 22, 2021. The receipt and confirmation of publication was attached for your records with the Q1 report.

Condition 2
Condition 2 required preparation of this quarterly progress report and submission to NYSDOH by the 10th day of the month following each calendar quarter. This report is therefore due by July 10, 2021 for the second quarter.

Activities during the second quarter of 2021 included continued operation and sampling of the Purifics Water, Inc. Advanced Oxidation Process (AOP) pilot system. The Purifics pilot system uses titanium dioxide (TiO_2) activated with UV light to create high energy radicals to oxidize 1,4 Dioxane. The Village of Hempstead has an unusual problem compared to most other water suppliers on Long Island in that it is impacted by high VOCs, presumably contributed to by the Roosevelt Field groundwater plume, while also having high concentrations of iron. Iron concentrations tend to increase for wells located further south, while VOC contamination is much less common in the southern portion of the Magothy Aquifer. Other wells impacted with 1,4 Dioxane tend to have lower concentrations of iron.

The Purifics system was potentially less sensitive to iron as it operates with a “cuf” prefiltration system to remove most iron ahead of the AOP reactor. Pilot samples showed 1,4 Dioxane removal up to 97% but these results were not uniform or consistent. An interim report on these

pilot sample results is being prepared but one contributing factor seems to be calcium deposition within the AOP reactor reducing UV light intensity.
Consequently, the Village is ending the pilot with Purifics and will begin a new pilot study with Trojan UV. The Trojan system uses hydrogen peroxide (H_2O_2) activated with UV light.

The Village utilizes Air Stripping Towers (ASTs) to remove VOCs at both of the existing water plants and has an iron removal plant using green sand filters at the Laurel Avenue Plant. Historically the ASTs at Clinton Street have removed half or more of the iron and it was hoped that the "cuf" pretreatment would effectively remove most of the remainder without the need to install manganese greensand filters. The AOP pilot was placed at the Clinton Street plant and was piped to be able to feed raw water from the wells and well water after passing through the AST.

The Village initially planned to collect four rounds of samples with the Purifics AOP pilot. When the 1,4-Dioxane results for the first round of sampling came in above the new MCL the Village evaluated the pilot and made modifications they thought would resolve the issue. After several weeks of additional sampling and 14 more samples the Pilot was still not removing enough 1,4-Dioxane from the water to meet the MCL. Calcium deposition on the UV sleeves within the AOP reactor seemed to be a significant factor. A variety of cleaning and maintenance activities were also performed as part of the pilot verification process. CO_2 and acids were used to adjust pH prior to the AOP reactor to investigate the impact on AOP performance. Attached is a table with corresponding charts summarizing the sample results.

After the first round of sampling we suspected that the TiO_2 had been fouled with iron. An acid wash with sulfuric acid was attempted but was not effective. The TiO_2 media was replaced before the pilot effluent was sampled again. The possibility that the addition of CO_2 reduced the oxidation potential in the Photo Cat AOP reactor was also investigated and CO_2 addition was deleted during future pilot sample rounds. The results from April 1, 2021 were promising with 97% removal of 1,4-Dioxane.

Samples were taken on April 23, 2021 using water from well 3R, no AST, no CUF, and dissolved oxygen added with air feed at 5 LPM and 10 LMP. Prior to taking more samples the system was acid washed to try and remove any iron deposited in the pilot unit. Runs were made without use of the CUF in order to determine if the TiO_2 would become fouled. The results included 74% and 79% removal of 1,4-Dioxane, but these were not sufficient to meet the MCL requirement.

When the quartz sleeves in which the UV bulbs are installed were evaluated a thin film was noted and was suspected to be calcium. The pilot study was expanded to examine the effectiveness of future maintenance activities. About 3.5 gallons of CLR (Calcium-Lime-Rust) remover was circulated through the AOP for about an hour to remove the calcium deposit from the quartz sleeves. The CLR was flushed out of the system and the TiO_2 media was replaced again.

The next round of samples were taken from well 3R on May 13, 2021 without use of the AST or CUF. Air was added at 2 LPM to increase dissolved oxygen for all three effluent samples. A variety of flow rates through the AOP reactor were used with 84%, 95%, and 67% removal of 1,4-Dioxane. The only result to meet the MCL was the second sample with 95% removal.
It was desired to investigate if the system was still getting calcification on the bulbs and if it could be prevented with a low dose of acid during pilot operation. Before the next round of sampling began the TiO_2 was flushed out and CLR was added and circulated in the system. Then the AOP was run with 200mL/h sulfuric acid addition for 5 hours. Once it was confirmed that there was no calcification on the bulbs the pilot was run with a sulfuric acid addition of 200mL/h and an air feed of 2 LPM to increase dissolved oxygen concentrations with no AST or CUF pretreatment. These samples were taken on May 28, 2021 and 1,4-Dioxane reduction was poor. Purifics representatives suspected that the CLR used to remove the calcification from the bulbs may have encapsulated the TiO_2 media and rendered it inactive.

The last samples were taken on June 10, 2021, the water used was directly from well 3R with no use of the AST or CUF. Before these samples were taken the entire system was flushed for a few hours and the TiO_2 was removed and replaced. This round of samples included a sulfuric acid feed of 200 mL/h with two different water flow rates through the pilot. Unfortunately neither run produced results lower than the 1,4-Dioxane MCL.

Interim conclusions from these pilot sampling runs include that iron and calcium removal pretreatment is necessary for reliable AOP operation, and that further study of the impact of calcium, pH and dissolved oxygen concentrations is necessary prior to further consideration of the TiO_2 AOP system. In the meantime Tony Powell, the CTO and Applications Manager at Purifics is going to visit from Canada to spend time doing further testing of the Purifics AOP pilot system.

The Village is making arrangements to begin testing with the Trojan Technologies pilot system using UV/H_2O_2. It is possible that calcium deposition may adversely impact that system as well. Planning for design and installation of manganese greensand filters for Clinton Street has commenced.

It is evident based on these results that more extensive pretreatment is required for any AOP that is to be constructed at the treatment plant. This will ultimately delay completion of the full scale AOP implementation at the Clinton Street water Plant.

The Village was very active during the second quarter performing a water rate study and to implement new water rates configured to support the cost of the new AOP treatment systems and associated pretreatment. Capital and operating costs were projected over the next five years and specific rate proposals for the next two years were presented to the Village Mayor and Board of Trustees. On June 29, 2021 the board approved a water rate increases for the next two years to help pay for these improvements at the Water Treatment Plants. The rate increase becomes effective on August 1, 2021 with a further increase on August 1, 2022. The additional costs to the residents are necessary in order for the water treatment plant to provide the required funds for the construction and operation of the AOP treatment systems.

Condition 3

Condition 3 required documentation if exposure mitigation measures cannot be implemented. Currently the Village of Hempstead is in compliance with the exposure minimization measures stipulated in the deferral application. These include deferring use of wells having higher concentrations of 1,4 Dioxane and mixing the water from the wells with elevated levels of 1,4 Dioxane with wells that have lower levels of 1,4 Dioxane. Trace concentrations of 1,4 Dioxane are present in the water distributed to the residents since seven out of the nine wells have levels of 1,4 Dioxane above the MCL. It is impossible for the Village to distribute water to their residents below the MCL without at least one full scale AOP treatment unit in operation because the water demand is high and cannot be met with only two wells. The Village is working as quickly as they can to find the most suitable AOP treatment units to implement at the water treatment plants.

Please call me if you have any questions or comments.

Sincerely,
J. R. Holzmacher, P.E., LLC

J. Robert Holzmacher, P.E.
Principal

JRH/sc
Encl.
CC: Mike Taylor, Supervisor
Steve Giardino, Assistant Supervisor

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ATTACHMENT A

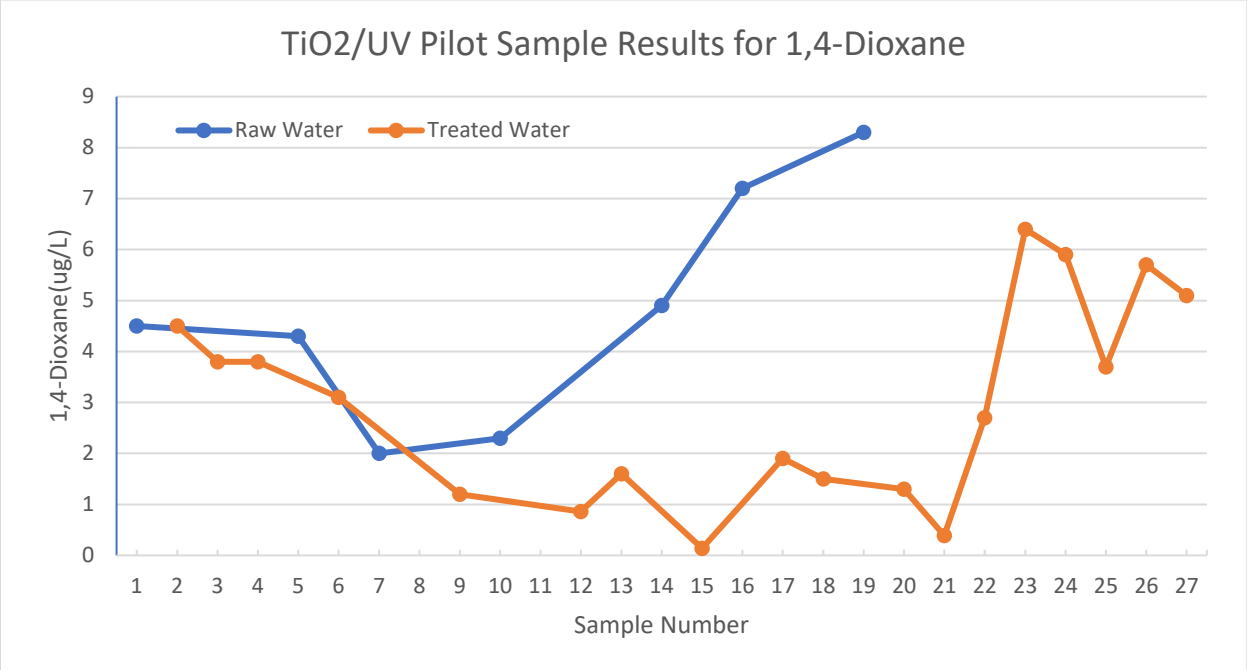
TiO_2/UV Pilot Sample Results

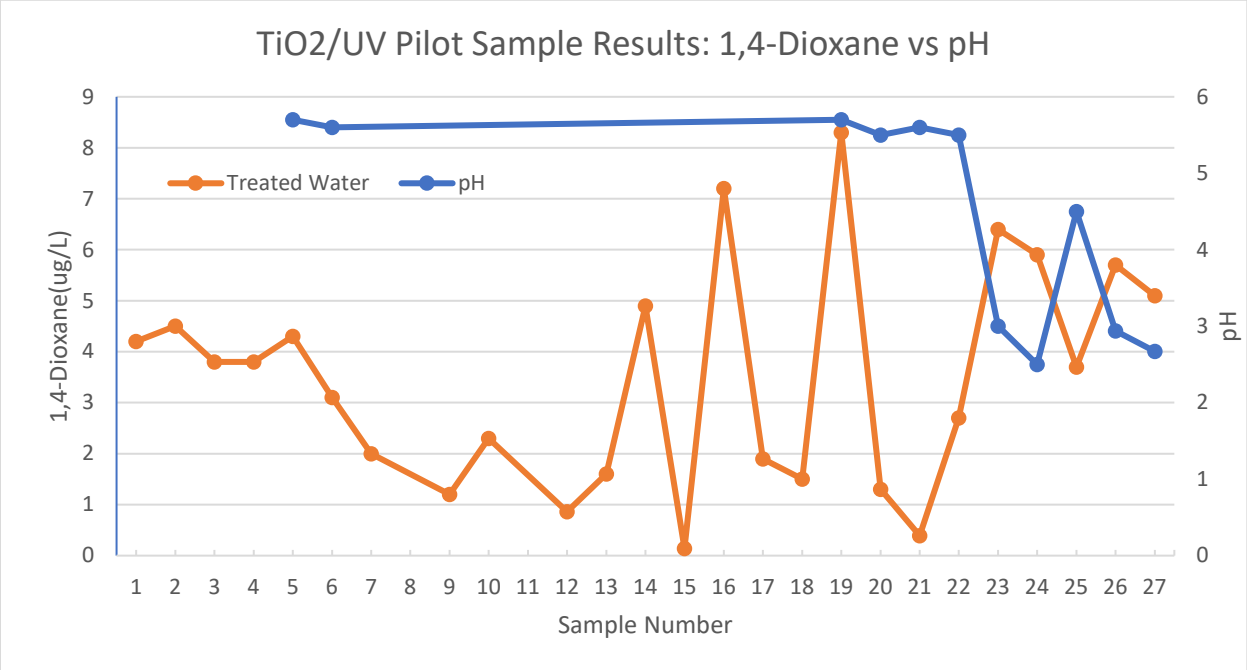
AOP Pilot Core Sample Results - Effluent to the Pilot Treatment Unit

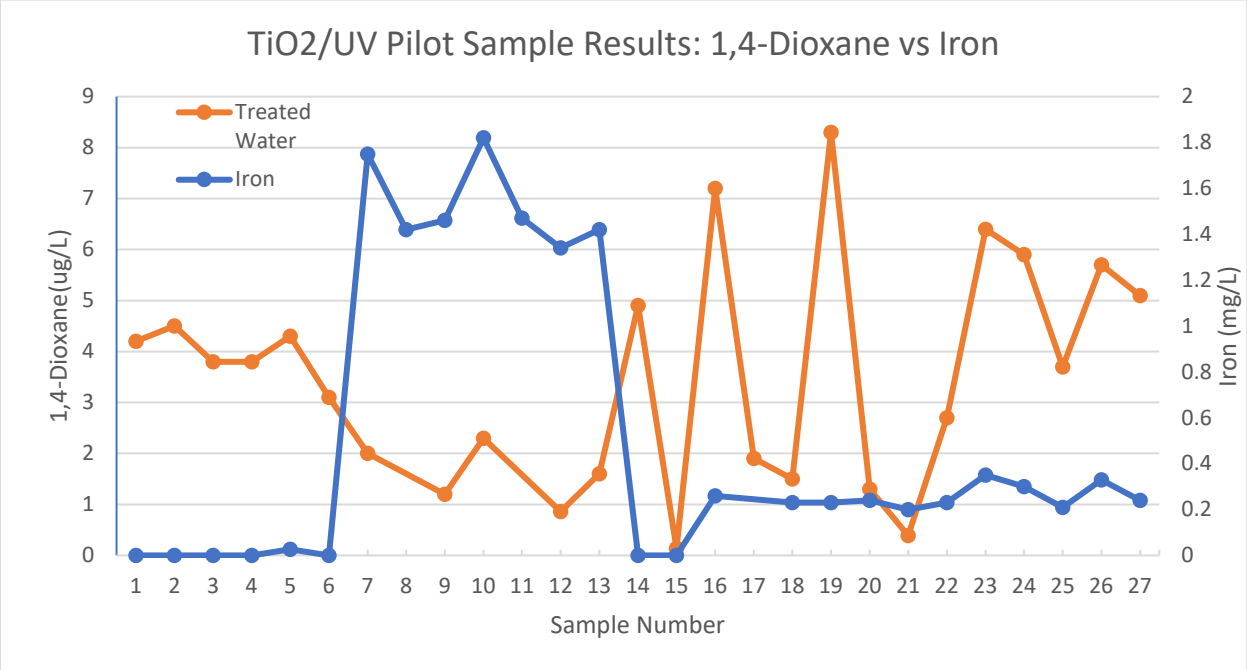
	Date	Run Number	Well No.	1,4-Dioxane (ug/L)	pH	Alkalinity (mg/L)	Fe (mg/L)	DO (mg/L)	Flow into AOP (GPM)	Slurry Flow into UV (GPM)	Notes
1	3/15/2021	control	5	4.2			0				AST
2	3/15/2021	control	5	4.5			0				No CUF, Pilot at 0% energy, addition of CO_2
3	3/15/2021	A1	5	3.8			0				No CUF, Pilot at 50% energy, addition of CO_2
4	3/15/2021	A2	5	3.8			0				No CUF, Pilot at 75% energy, additon of CO_2
5	3/15/2021	A3	5	4.3	5.7	3.2	0.026				AST
6	3/15/2021	A3	5	3.1	5.6	3.6	0				AST, No CUF, Pilot at 100% energy, addition of CO_2
7	3/15/2021	A4	4	2			1.75				AST
8	3/15/2021	A4	4				1.42				AST, CUF, Pilot at 50% energy, addition of CO_2
9	3/15/2021	A4	4	1.2			1.46				AST, CUF, Pilot at 50% energy, addition of CO_2
10	3/15/2021	A5	4	2.3			1.82				AST
11	3/15/2021	A5	4				1.47				AST, CUF, Pilot at 100% energy, addition of CO_2
12	3/15/2021	A5	4	0.86			1.34				AST, CUF, Pilot at 100% energy, addition of CO_2
13	3/15/2021	A6	4	1.6			1.42				AST, No CUF, Pilot at 100% energy, addition of CO_2
14	4/1/2021	n/a	5	4.9			0				AST
15	4/1/2021	n/a	5	0.14			0				AST, CUF, Pilot at 100% energy, TiO_2 replaced

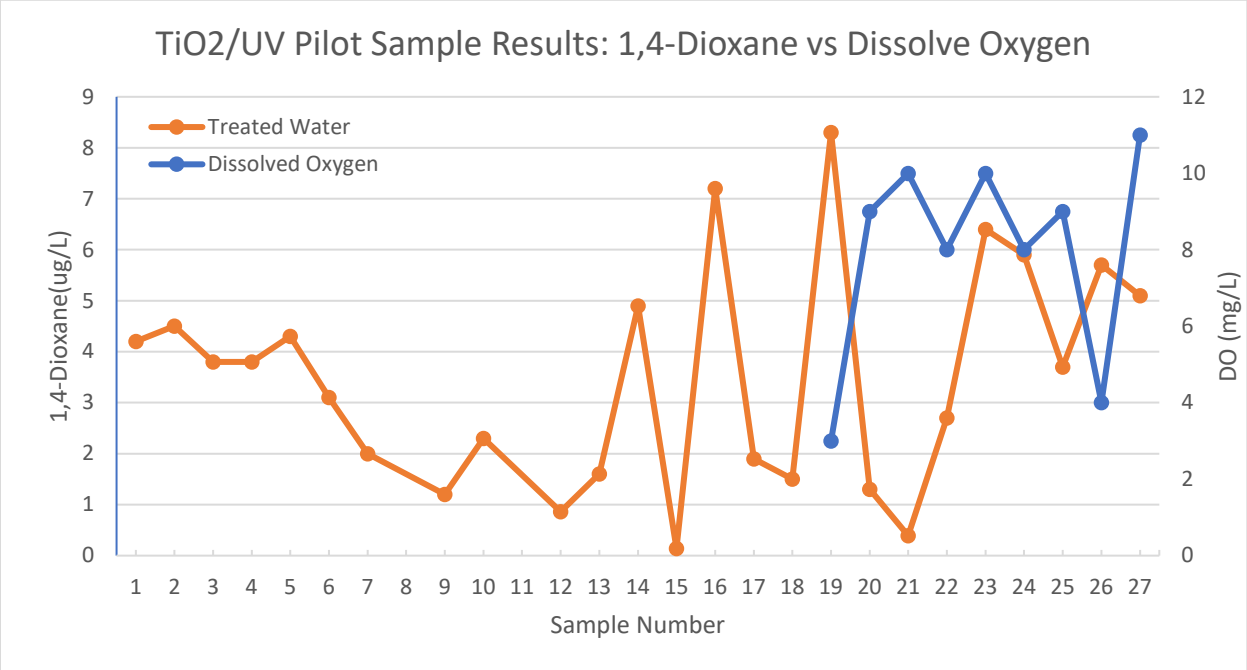
	Date	Run Number	Well No.	1,4-Dioxane (ug/L)	pH	Alkalinity (mg/L)	Fe (mg/L)	DO (mg/L)	Flow into AOP (GPM)	Slurry Flow into UV (GPM)	Notes
16	4/23/2021	n/a	3R	7.2			0.26				No AST
17	4/23/2021 2:30PM	n/a	3R	1.9							No AST, No CUF, acid washed the system, 5LPM DO
18	4/23/2021 3:20PM	n/a	3R	1.5			0.23				No AST, No CUF, acid washed the system, 10LPM DO
19	5/13/2021	n/a	3R	8.3	5.7	9	0.23	3			No AST
20	5/13/2021 2:05PM	n/a	3R	1.3	5.5	9	0.24	9	32.5	8	No AST, No CUF, TiO_2 replaced, 2LPM DO
21	5/13/2021 2:30PM	n/a	3R	0.39	5.6	10	0.2	10	17.4	6.4	No AST, No CUF, TiO_2 replaced, 2LPM DO
22	5/13/2021 3:00PM	n/a	3R	2.7	5.5	10	0.23	8	32.5	6.5	No AST, No CUF, TiO_2 replaced, 2LPM DO
23	5/28/2021 11:40AM	n/a	3R	6.4	3	0	0.35	10	30	20	No AST, No CUF, Acid addition of 200ml/hr, DO addition of 2LPM
24	5/28/2021 12:00PM	n/a	3R	5.9	2.5	0	0.3	8	17	6	No AST, No CUF, Acid addition of 200ml/hr, DO addition of 2LPM
25	5/28/2021 12:40PM	n/a	3R	3.7	4.5	5	0.21	9	30	20	No AST, No CUF, DO addition of 2LPM. Removal of some TiO_2
26	6/10/2021 12:45PM	n/a	3R	5.7	2.94	0	0.33	4	37	21	No AST, No CUF, TiO_2 replaced, Acid addition 200ml/hr
27	6/10/2021 1:50PM	n/a	3R	5.1	2.67	0	0.24	11	15	16	No AST, No CUF, TiO_2 replaced, Acid addition 200ml/hr

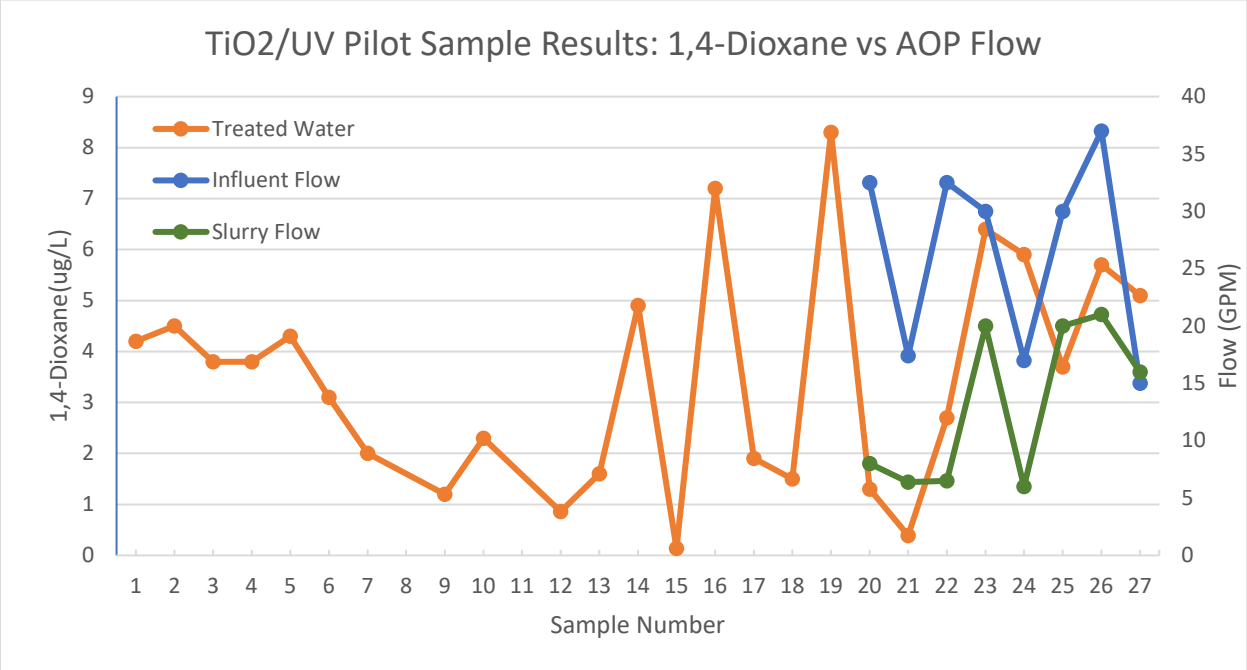
= Raw Water
= Post CUF
= AOP Effluent


TiO2/UV Pilot Sample Results for 1,4-Dioxane
Raw Water
Treated Water
1,4-Dioxane(ug/L)
Sample Number


TiO2/UV Pilot Sample Results: 1,4-Dioxane vs pH
Treated Water
pH
1,4-Dioxane(ug/L)
pH
Sample Number


TiO2/UV Pilot Sample Results: 1,4-Dioxane vs Iron
Treated Water
Iron
1,4-Dioxane(ug/L)
Iron (mg/L)
Sample Number


TiO2/UV Pilot Sample Results: 1,4-Dioxane vs Dissolve Oxygen
Treated Water
Dissolved Oxygen
1,4-Dioxane(ug/L)
DO (mg/L)
Sample Number


TiO2/UV Pilot Sample Results: 1,4-Dioxane vs AOP Flow
Treated Water
Influent Flow
Slurry Flow
1,4-Dioxane(ug/L)
Flow (GPM)
Sample Number
0
1
2
3
4
5
6
7
8
9
0
5
10
15
20
25
30
35
40
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27