

TECHNICAL MEMORANDUM

To: Nevada Environmental Response Trust

Cc: Nevada Division of Environmental Protection
United States Environmental Protection Agency

From: Katie Hendrickson

Date: November 19, 2020

Subject: Hydrogen-Based Gas Permeable Membrane Pilot Study Monthly Progress Report

At the direction of the Nevada Environmental Response Trust (NERT or Trust), Tetra Tech, Inc. (Tetra Tech) has prepared this memorandum that summarizes Tetra Tech's progress made during October 2020 toward successfully implementing the Hydrogen-Based Gas Permeable Membrane Pilot Study.

Task Progress Update: October 2020

Task M26 – Hydrogen-Based Gas Permeable Membrane Pilot Study

- Current Status
 - Test Scenario #1, which involves treatment of the existing FBR influent obtained from the FBR equalization tank, began on August 31, 2020. Weekly steady state performance sample collection, as outlined in the Hydrogen-Based Gas Permeable Membrane Pilot Study System Operation Manual, started on September 14, 2020.
 - Unvalidated operational samples continued to show the perchlorate concentrations in the system effluent was consistently below 18 µg/L from August 31, 2021 through October 6, 2021 while operating between 2 to 2.4 gallons per minute (gpm), so the flow rate was increased to 3.5 gpm on October 6, 2020 as part of evaluating the effects of various parameters on the performance of the system after four weeks of steady state operations (per the Work Plan). On October 14, 2020, after performance samples were collected, the flow rate was adjusted back to the design flow rate of 2 gpm and the sequence of reactors was switched to allow the system to rebalance. The system was operated at 2 gpm for the remainder of October.
 - The available performance assessment sample results, including analytical data and field parameters from the influent, effluent from each reactor, and final effluent are shown in Table 1. Results of performance sampling demonstrate the pilot unit is significantly reducing contaminant concentrations. While unvalidated operational samples (Figure 1) indicated perchlorate concentrations in the system effluent were consistently below laboratory detection limits through October 6, 2021 when the system flow rate was increased to 3.5 gpm, the performance samples from Week 4 (collected on October 6, 2020) showed detections of perchlorate in the lag reactor (200 µg/L) and final pilot unit effluent (73 µg/L). While the concentrations were above 18 µg/L, the

effluent concentrations still represented a significant reduction from influent perchlorate concentration of 73,000 µg/L. Similarly, performance results from Week 5 (collected on October 14, 2020) when the system was operating at an increased flow rate of 3.5 gpm, show a reduction in perchlorate concentration from 50,000 µg/L in the influent to 52 µg/L in the lag reactor. Chlorate and nitrate concentrations in the lag reactor and final effluent were below detection limits in both the Week 4 and Week 5 performance samples.

- A pilot study status meeting was conducted with NDEP on October 22, 2020. The available data was presented and NDEP requested the pilot study continue with an additional four weeks of operation under Scenario 1 at 2 gpm.
- Schedule and Progress Updates
 - Operation and optimization of the pilot unit will continue in November 2020. Analytical results for additional performance sampling events will be presented in future monthly progress reports when data are available.
- Health and Safety
 - There were no health and safety incidents related to Task M26 during October 2020. Safety measures continue to be implemented to minimize potential exposure to COVID-19, including the use of face coverings, gloves, and hand sanitizer, as well as protocols for monitoring temperatures, minimizing the number of people on site at one time, and evaluating tasks to increase physical distance between personnel.

CERTIFICATION

Hydrogen-Based Gas Permeable Membrane Pilot Study Monthly Progress Report

**Nevada Environmental Response Trust Site
(Former Tronox LLC Site)
Henderson, Nevada**

Nevada Environmental Response Trust (NERT) Representative Certification

I certify that this document and all attachments submitted to the Division were prepared at the request of, or under the direction or supervision of NERT. Based on my own involvement and/or my inquiry of the person or persons who manage the systems(s) or those directly responsible for gathering the information or preparing the document, or the immediate supervisor of such person(s), the information submitted and provided herein is, to the best of my knowledge and belief, true, accurate, and complete in all material respects.

Office of the Nevada Environmental Response Trust

Le Petomane XXVII, not individually, but solely in its representative capacity as the Nevada Environmental Response Trust Trustee

Signature: Jay A Steinberg Not Individually, but Solely as President of the Trustee, not individually, but solely in his representative capacity as President of the Nevada Environmental Response Trust Trustee

Name: Jay A. Steinberg, not individually, but solely in his representative capacity as President of the Nevada Environmental Response Trust Trustee

Title: Solely as President and not individually

Company: Le Petomane XXVII, Inc., not individually, but solely in its representative capacity as the Nevada Environmental Response Trust Trustee

Date: 11/19/2020

CERTIFICATION

I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been prepared in a manner consistent with the current standards of the profession, and to the best of my knowledge, comply with all applicable federal, state, and local statutes, regulations, and ordinances. I hereby certify that all laboratory analytical data was generated by a laboratory certified by the NDEP for each constituent and media presented herein.

Description of Services Provided: Prepared Hydrogen-Based Gas Permeable Pilot Study Monthly Progress Report.



Kyle Hansen, CEM
Field Operations Manager/Geologist
Tetra Tech, Inc.

November 19, 2020

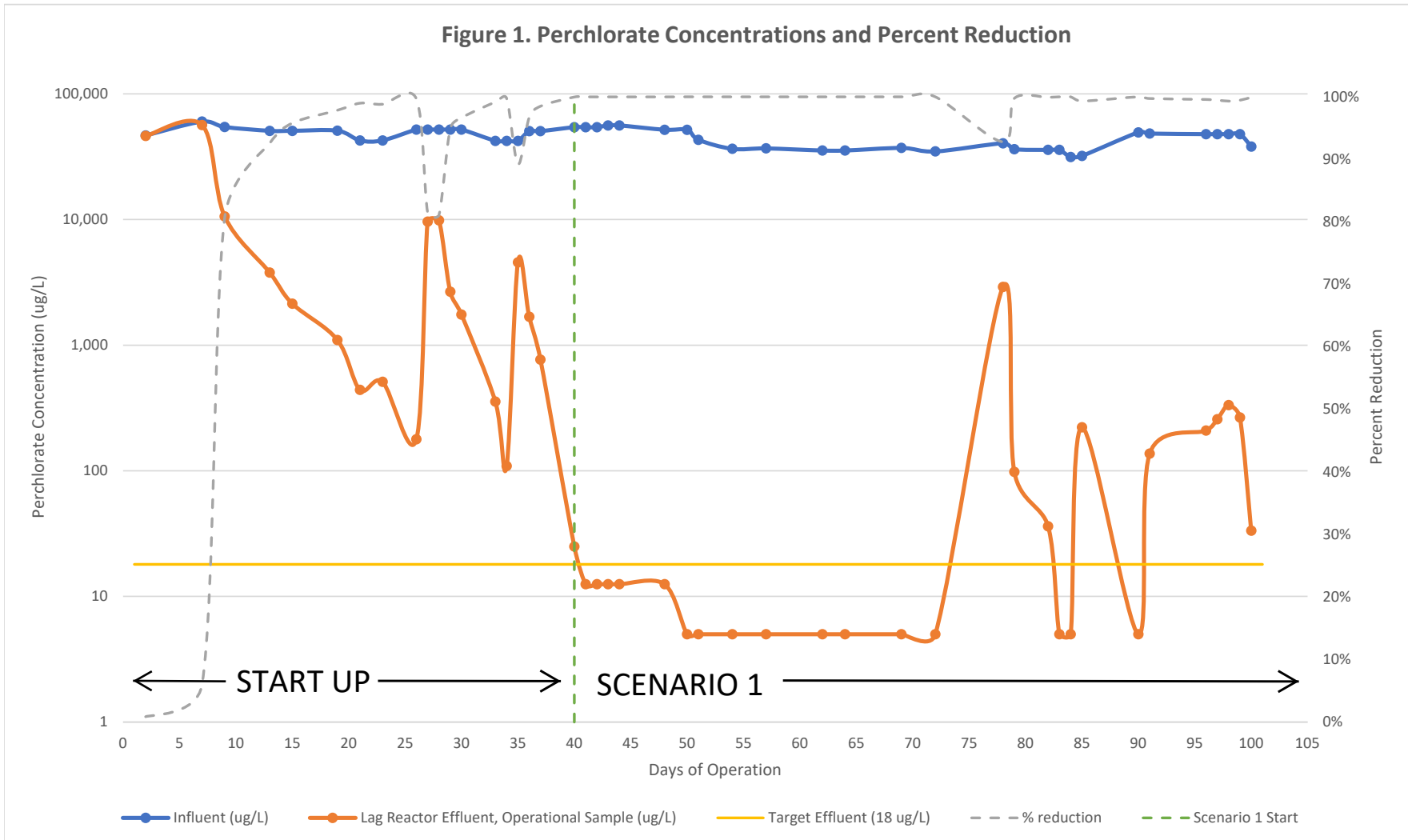
Date

Nevada CEM Certificate Number: 2167
Nevada CEM Expiration Date: September 18, 2022

Figures

DRAFT

Figure 1. Perchlorate Concentrations and Percent Reduction



Tables

Table 1
Scenario 1 Performance Monitoring Data
Hydrogen-Gas Based Permeable Membrane Pilot Study

Week and Date	Influent Water											Biological Reactors																								
	Flow	T	pH	Perchlorate	Chlorate	Nitrate -N	Total Cr ¹	Cr VI ¹	TDS	TSS	Perchlorate (ppb)			Chlorate (ppb)			Nitrate (ppm)			Total Cr (ppb) ¹		TSS (ppm)			pH			T (°C)			ORP			Pressure (psig)		
	gpm	°C	s.u.	ppb	ppb	ppm	ppb	ppb	ppm	ppm	Lead	Middle	Lag	Lead	Middle	Lag	Lead	Middle	Lag	Lag	Lag	Lead	Middle	Lag	Lead	Middle	Lag	Lead	Middle	Lag	Lead	Middle	Lag	Lead	Middle	Lag
1 (9/15/20)	2.0	28.1	7.67	58,000	97,000	8.4	NA	NA	5,800	17	34,000	340	4.2	31,000	<100	90	0.29	<0.014	0.13	NA	NA	12	39	15	7.79	7.78	7.65	29.5	30.6	30.4	-102	-397	-406	12.82	5.68	8.78
2 (9/21/20)	2.0	30.6	7.69	37,000	100,000	8.8	NA	NA	4,800	13	34,000	240	6.1	33,000	<100	<100	0.33	<0.014	<0.014	NA	NA	17	19	9.5	7.85	7.86	7.89	31.2	31.8	31.5	-80	-383	-373	13.32	5.79	8.1
3 (9/30/20)	2.4	30.2	7.69	60,000	99,000	9.2	NA	NA	5,500	14	40,000	10,000	54	49,000	7,000	<10	1.8	0.093	<0.014	NA	NA	14	5.5	<5	7.83	7.83	7.49	29.8	30.5	30.4	-162	-116	-327	13.64	6.66	8.14
4 (10/6/20)	2.4	27.7	7.60	73,000	120,000	9.9	NA	NA	5,000	<5	43,000	13,000	200	58,000	8,800	<100	2.0	0.078	<0.014	NA	NA	<5	6.6	6.6	7.80	7.81	7.44	28.5	29.6	29.6	-93	-119	-163	14.6	8.98	8.48
5 (10/14/20)	3.5	22.3	7.58	50,000	98,000	7.9	NA	NA	5,700	18	62,000	2,900	52	49,000	2,100	<10	0.059	1.3	<0.014	NA	NA	7.5	<5	6	7.80	7.81	7.80	20.9	22.2	20.8	-68	-471	-175	18.72	13.2	9.3

Week and Date	Post Reactor Tank Effluent						Treated Water Holding Tank						Cartridge Filter Effluent										
	Perchlorate	Chlorate	Nitrate - N	Total Cr ¹	Cr VI ¹	TSS	T	pH	Total Cr ¹	Cr VI ¹	TSS	T	pH	Turbidity	Perchlorate	Chlorate	Nitrate -N	Total Cr ¹	Cr VI ¹	TDS	TSS	T	pH
	ppb	ppb	ppm	ppb	ppb	ppm	°C	s.u.	ppb	ppb	ppm	°C	s.u.	NTU	ppb	ppb	ppm	ppb	ppb	ppm	ppm	°C	s.u.
1 (9/15/20)	4.7	70	<0.014	NA	NA	13	29.5	7.65	NA	NA	27	30.2	8.38	251	2.2	<100	<0.014	NA	NA	5,500	21	30.0	8.40
2 (9/21/20)	6.4	<100	<0.014	NA	NA	16	30.9	7.72	NA	NA	18	31.1	8.32	286	2.2	<40	<0.014	NA	NA	4,800	9.5	31.2	8.28
3 (9/30/20)	20	<10	<0.014	NA	NA	12	28.5	7.76	NA	NA	9.5	30.0	7.92	37.4	130	180	<0.014	NA	NA	5,200	5	30.2	7.83
4 (10/6/20)	89	<100	<0.014	NA	NA	6.1	27.7	7.55	NA	NA	12	28.7	7.76	42.1	73	<100	<0.014	NA	NA	4,700	<5	28.9	7.49
5 (10/14/20)	28	<10	<0.014	NA	NA	5	20.8	8.35	NA	NA	14	25.3	8.46	10.2	38	<10	<0.014	NA	NA	5,700	15	25.3	8.48

1 The chromium analysis will only be performed during Scenario #3.
NA = Not analyzed