

# MEMO

Date **October 28, 2019**  
To **Nevada Environmental Response Trust**  
From **John Pekala, Scott Warner, and Chris Ritchie**  
Copy to **Nevada Division of Environmental Protection  
United States Environmental Protection Agency**  
Subject **In-Situ Bioelectrochemical Laboratory-Scale  
Treatability Study Monthly Progress Report**

## **TASK PROGRESS UPDATE: SEPTEMBER 2019**

At the direction of the Nevada Environmental Response Trust (NERT or Trust), Ramboll US Corporation (Ramboll) has prepared this memorandum that summarizes Ramboll's progress during September 2019 toward successfully implementing the In-Situ Bioelectrochemical Laboratory-Scale Treatability Study for the remediation of perchlorate in water. Treatability study laboratory testing is performed at Colorado State University (CSU) via subcontract with Ramboll on behalf of NERT.

## **TASK M24 – IN-SITU BIOELECTROCHEMICAL LABORATORY-SCALE TREATABILITY STUDY**

- Task Leaders – Scott Warner / Chris Ritchie
- Current Status
  - Batch Testing: Microcosm sampling was completed in August 2019. The batch testing demonstrated that electrochemical groundwater treatment can consistently generate electron donors and stimulate biological reduction of perchlorate, chlorate, and nitrate. Not unexpectedly, lag-phases in perchlorate reduction may be on the order of several months depending on the soil matrix and microbial community. The complete results of the microcosm samples and associated data will be provided in a laboratory-scale testing results report as described in more detail under the heading "Schedule and Progress Updates".
  - Column Testing: The second stage of column testing, as outlined in the April 2019 progress update, was completed on September 6, 2019. The soil columns, which were supplemented with vitamin B12 on May 15, 2019 and molybdate on June 11, 2019, continued to be monitored into the first week of September. Since the addition of the vitamin B12 and molybdate, results from the analysis of column effluent indicate relatively low and inconsistent reduction in perchlorate effluent concentrations in each of three columns. We interpret these results as an indication of the difficulty in establishing the appropriate biological community and achieving uniform flow in the columns (as opposed to the sand tank testing observations discussed in the following paragraph). Perchlorate reduction appeared to be more prominent in specific areas along the flow paths of the columns, however, indicating the presence of intermittent and localized perchlorate reduction zones that were likely influenced by preferential flow paths. The

complete results of the column testing will be provided in the laboratory-scale testing results report.

- Sand Tank Testing: The sand tank continued to operate as a flow-through system in September with final samples collected on September 12, 2019. In continuation of conditions implemented on August 12, 2019, the sand tank was operated in September at a water flow velocity of approximately 0.9 feet per day (ft/day, or 26 centimeters/day) or a residence time (i.e., time that influent water remains in the sand tank) of approximately 7 days within the tank; the target influent concentrations of the electron acceptors during this assessment period were 5 milligrams per liter (mg/L) for nitrate, 4 mg/L for nitrite, 9 mg/L for perchlorate, and 6 mg/L for chlorate. As shown on Figure 1, the analytical results of water samples collected under these conditions indicated net downward trends in perchlorate, chlorate, and nitrate concentrations across the sand tank flow path regardless of depth. While the average perchlorate effluent concentration was  $1.2 \pm 0.9$  mg/L, perchlorate was not detected in the effluent at concentrations below 12.5 micrograms per liter ( $\mu\text{g/L}$ ) for two of the six sampling events. The slight variability in perchlorate effluent concentrations likely is a function of transient conditions within the sand tank during the assessment period; the results remain within the expected range of concentration values indicative of effective treatment. Monitoring results also indicated that dissolved hydrogen was readily consumed in the sand tank, illustrating its value as a reliable electrochemically-generated electron donor. Final conclusions regarding the sand tank testing will be included in the laboratory-scale testing results report.
- Schedule and Progress Updates
  - If the Trust believes that further evaluation of this technology is warranted, a modification to the treatability study work plan (Treatability/Pilot Study Modification No. 11) will be submitted in December 2019 to (1) obtain site-specific design parameters through a focused assessment of site microbial conditions and (2) implement a small-scale bioelectrochemical field test. This modification will contain the laboratory-scale testing results report, which will present a summary of bench-scale testing completed to-date to support an incremental stage small-scale field test.
  - Bench-scale testing was completed on September 12, 2019. A report summarizing the results of the laboratory testing program (batch microcosms, column tests, and the sand tank testing) is anticipated to be submitted to NDEP as an attachment to the treatability study modification described above. If the Trust elects not to proceed with the treatability study modification, the final laboratory-scale testing results report will be submitted as a standalone document.
- Health and Safety
  - There were no safety incidents during September 2019.

## ATTACHMENT

Figure 1: Sand Tank Flow Path Sampling Results for Perchlorate, Chlorate, and Nitrate During a 7-Day Residence Time

## **In-Situ Bioelectrochemical Laboratory-Scale Treatability Study Progress Update**

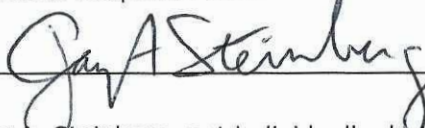
### **Nevada Environmental Response Trust Site (Former Tronox LLC Site) Henderson, Nevada**

#### **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 system(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, Inc., not individually, but solely in its representative capacity as the Nevada Environmental Response Trust Trustee

**Signature:**  **Not Individually, but Solely  
as President of the 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:** 10/24/19

## **In-Situ Bioelectrochemical Laboratory-Scale Treatability Study Progress Update**

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

### **Responsible Certified Environmental Manager (CEM) for this project**

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 provided 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.



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**John M. Pekala, PG**  
**Principal**

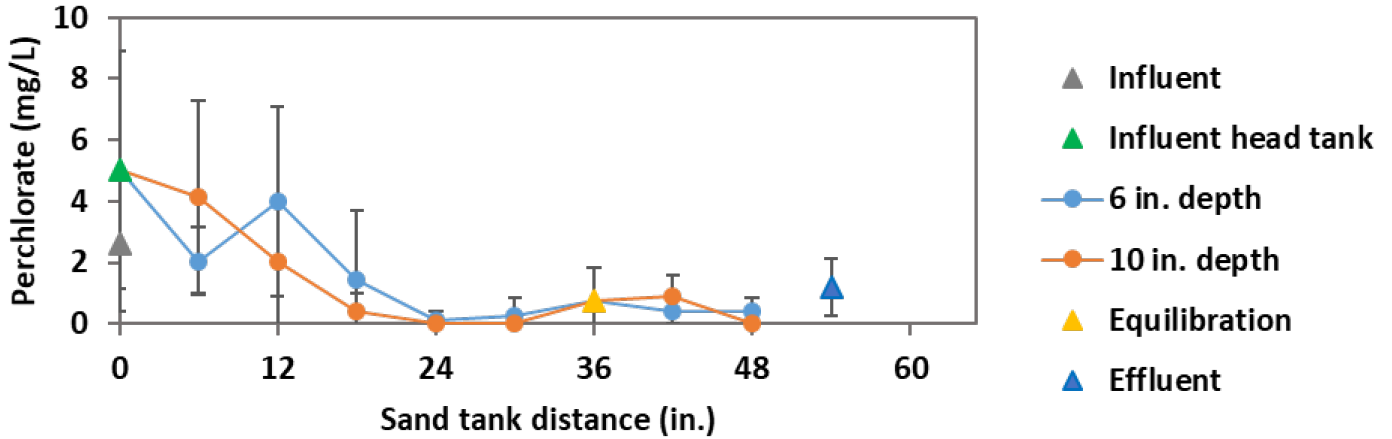
October 28, 2019

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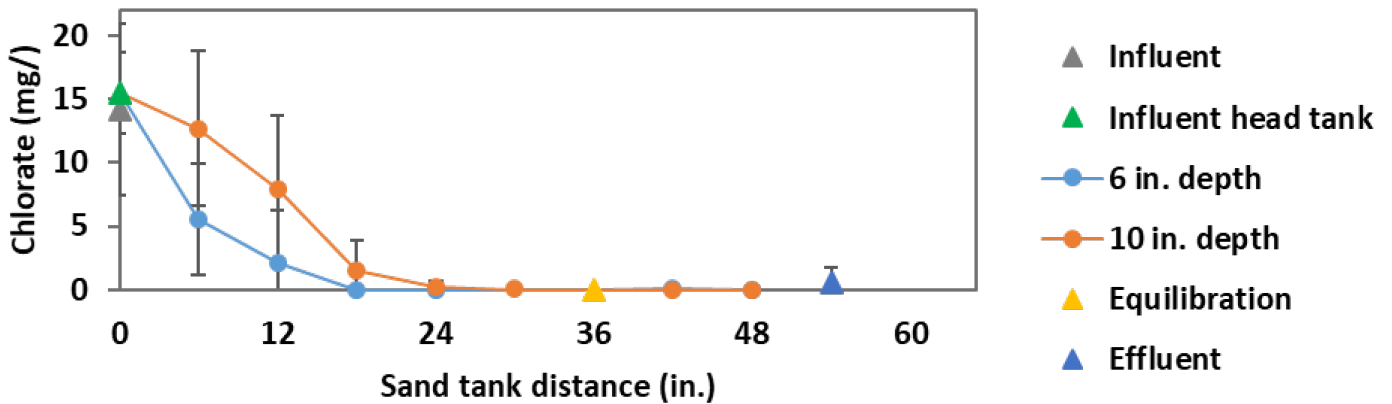
**Date**

Certified Environmental Manager  
Ramboll US Corporation  
CEM Certificate Number: 2347  
CEM Expiration Date: September 20, 2020

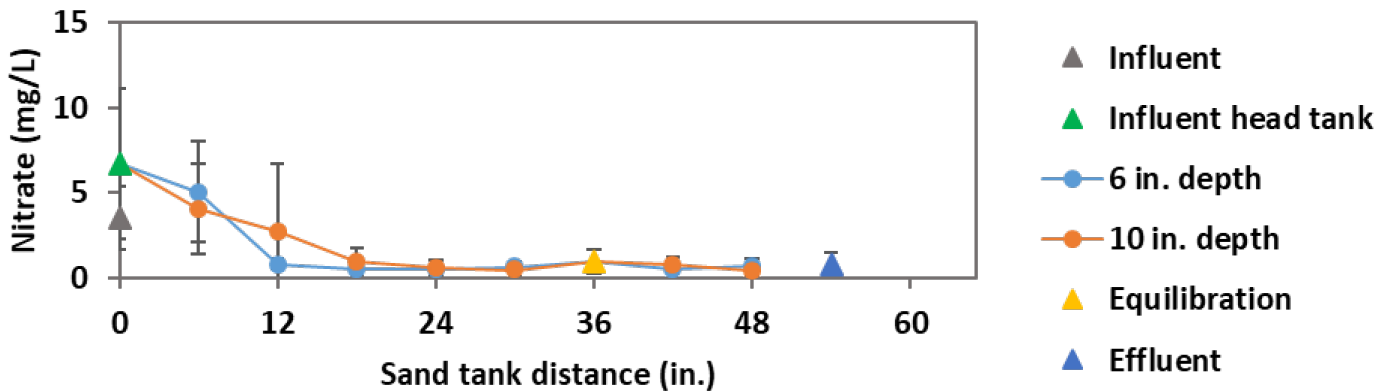
### Perchlorate consumption



### Chlorate consumption



### Nitrate consumption



Note: Each panel shows concentrations in the influent, influent head tank, and along the sand tank flow path at depths of 6 inches (in.) and 10 in.



**Sand Tank Flow Path Sampling Results for Perchlorate, Chlorate, and Nitrate During a 7-Day Residence Time**  
 Nevada Environmental Response Trust  
 Henderson, Nevada

Figure

**1**