

TECHNICAL MEMORANDUM

To: Nevada Environmental Response Trust

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

From: Arul Ayyaswami and Dan Pastor

Date: April 20, 2018

Subject: Unit 4 Source Area In-Situ Bioremediation Treatability Study 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 March 2018 toward successfully implementing the Unit 4 Source Area In-Situ Bioremediation Treatability Study.

Task Progress Update: March 2018

Task M21 – Unit 4 Source Area In-situ Bioremediation Treatability Study

- Task Leader – Arul Ayyaswami
- Current Status

Bench-Scale Studies

- The University of Nevada – Las Vegas (UNLV) continues microcosm testing with a combination of carbon substrates, mixed microbial cultures, and soil and groundwater collected from boring locations in the vicinity of the Unit 4 Building. Evaluation of the microcosm results are ongoing. Initial results include:
 - Hexavalent chromium concentrations decreased from 106 milligrams per liter (mg/L) to 11.5 mg/L after 70 days in microcosms containing molasses, groundwater, and a mixed bacterial culture. Hexavalent chromium concentrations decreased from 60 mg/L to less than 0.2 mg/L within 21 days in microcosms containing molasses, groundwater diluted at a 1:1 ratio, and a mixed bacterial culture. Limited hexavalent chromium reduction was observed in microcosms containing EOS Pro and EOS Pro with acetate.
 - Nitrate concentration reduced from 334 mg/L to less than 10 mg/L within 49 days in microcosms containing molasses, groundwater diluted at a 1:1 ratio, and a mixed bacterial culture. Nitrate analyses are still being performed for the other microcosms, including microcosms containing undiluted water.
 - Chlorate concentrations reduced from approximately 13,000 mg/L to 3,600 mg/L after 63 days in microcosms containing molasses, groundwater diluted at a 1:1 ratio, and a mixed

bacterial culture. Chlorate analyses are still being performed for the other microcosms, including microcosms containing undiluted water.

- Perchlorate concentrations reduced from approximately 1,800 mg/L to 570 mg/L after approximately 63 days in microcosms containing molasses, groundwater diluted at a 1:1 ratio, and a mixed bacterial culture. Perchlorate analyses are still being performed for the other microcosms, including microcosms containing undiluted water.

Pre-Field Activities

- The Underground Injection Control (UIC) permit application is under development and will be submitted to the Nevada Department of Environmental Protection Bureau of Water Pollution Control in early April.
- On March 29, 2018, the State of Nevada Department of Conservation and Natural Resources, Division of Water Resources, granted permission for the installation of 42 wells as specified in the NDEP-approved work plan.
- **Schedule and Progress Updates**
 - UNLV microcosm testing will continue in April 2018. Additional bench-scale testing is under consideration to evaluate:
 - The use of citric acid as a carbon source for the in-situ bioremediation of the chemicals of potential concern (COPCs) and the associated degradation kinetics;
 - The use of nano-scale zero valent iron for the reduction of hexavalent chromium and degradation kinetics for the COPCs; and
 - Whether chloroform is potentially toxic to native microorganisms and if it can be biologically degraded along with the other COPCs. If so, additional evaluation will be performed to determine chloroform degradation rates and intermediate and final degradation products associated with the biodegradation of chloroform.
 - Coordination with Tronox and preparation of additional Tronox ground breaking permit applications are in progress.
- **Health and Safety**
 - There were no health and safety incidents related to Task M21 during March 2018.

CERTIFICATION

Unit 4 Source Area Bioremediation 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 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

not individually, but solely as
Per AS
Signature: Jay A Steinberg, 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: 4/16/18

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 Unit 4 Source Area Bioremediation Treatability Study Progress Update, Nevada Environmental Response Trust Site, Henderson, Nevada



April 20, 2018

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

Date

Nevada CEM Certificate Number: 2167
Nevada CEM Expiration Date: September 18, 2018