

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: August 29, 2018

Subject: Unit 4 Source Area In-Situ Bioremediation Treatability 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 July 2018 toward successfully implementing the Unit 4 Source Area In-Situ Bioremediation Treatability Study. The location of the treatability study is depicted on Figure 1 and the location of the borings and wells are depicted on Figure 2.

Task Progress Update: July 2018

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

- Task Leader – Arul Ayyaswami
- Current Status
 - 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. No additional sample results are currently available to report for these microcosms.
 - Treatability Study Modification No. 1 for the Unit 4 Source Area In-Situ Bioremediation Bench-Scale Work Plan was submitted to NDEP on June 29, 2018 and approved by NDEP in a letter dated July 10, 2018. The approved modification includes additional bench-scale testing to:
 - Examine the impact of nano-scale zero-valent iron (ZVI) on the reduction of hexavalent chromium and other chemicals of potential concern (COPCs) as part of bench-scale testing and evaluate the degradation kinetics of a selected organic carbon source with and without the addition of ZVI to determine if the addition of ZVI influences biological reduction of COPCs.
 - Determine if chloroform is degraded along with other COPCs, estimate chloroform degradation rates, evaluate potential chloroform toxicity to microorganisms, and identify intermediate and final degradation products associated with biodegradation of chloroform as part of bench-scale testing.

- Evaluate the effectiveness of citric acid as a carbon source for ISB in the source area relative to molasses or emulsified vegetable oil (EVO) as part of bench-scale testing.
- The following pre-implementation field activities were performed during the reporting period to collect critical data required to finalize the treatability study design:
 - Extraction well U4-E-02I was re-developed on June 27, 2018 to remove residual grout in the well and re-sampled on July 5, 2018. The analytical results from the latest groundwater sample analysis are currently being validated and will be summarized in the next progress report.
 - Step-drawdown tests were performed on four wells, U4-E-01I, U4-E-02I, U4-E-05D, and U4-E-01D by pumping at three rates for approximately 2 hours each. During each step-drawdown test, pressure transducers were placed in the test well and nearby wells to monitor the amount of drawdown. The results of the step-drawdown tests are summarized below:
 - U4-E-01I was tested on July 16, 2018 and extraction rates of 1.25 gallons per minute (gpm) (step 1) and 2.75 gpm (step 2) were achieved. An extraction rate of 3.4 gpm was used for step 3; however, stabilization did not occur.
 - U4E-02I was tested on July 17, 2018 and extraction rates of 1.5 gpm (step 1), 3.45 gpm (step 2), and 6.1 gpm (step 3) were achieved. An additional step was conducted with an extraction rate of 7.75 gpm; however, stabilization did not occur.
 - U4-E-05D was tested on July 18, 2018 and extraction rates of 0.75 gpm (step 1), 1.5 gpm (step 2), and 2.25 gpm (step 3) were achieved. The water level in U4-E-05D stabilized at approximately 102 ft below top of casing (btoc) while pumping at 2.25 gpm during step 3. As this water level was near the pump inlet, another step was not attempted.
 - U4-E-01D was tested on July 19, 2018 and an extraction rate of 0.33 gpm (step 1) was achieved. The second step was planned for 0.5 gpm; however, the maximum flow rate achieved was approximately 0.33 gpm. A third step was attempted at a higher flow rate, but stabilization did not occur before the water level reached the pump inlet and the test was stopped after approximately 42 minutes.
 - A constant-rate test was performed on intermediate well U4-E-02I between July 24 and July 26, 2018. The well was pumped for a total of 48 hours at an average extraction rate of 6.2 gpm. The constant-rate test was stopped after verifying the stabilization criteria of less than 0.03 ft change in water levels over 15 minutes was achieved at the closest monitoring well, U4-IS-MW-02I. Recovery monitoring of groundwater levels was conducted after the conclusion of the intermediate well constant-rate test from July 26 to 27, 2018 and concluded after confirming the groundwater levels had recovered to baseline level. Groundwater samples were collected every 12 hours during the test and submitted to TestAmerica Laboratories, Inc., (TAL) for the following analyses:
 - Pechlorate by Method 314.0
 - Hexavalent chromium by Method 218.6
 - Chloroform by Method 8260B
 - Nitrate by Method 300.0
 - Sulfate by Method 300.0
 - Ammonium by Method 350.1

- A constant-rate test was performed on deep well U4-E-01D between July 30 and August 1, 2018. The well was pumped for a total of 60 hours at an average extraction rate of 0.36 gpm. The constant-rate test was stopped after verifying the stabilization criteria of less than 0.03 ft change in water levels over 15 minutes was achieved at the closest monitoring well, U4-IS-MW-02D. Recovery monitoring of groundwater levels was conducted after the conclusion of the test from August 2 to 3, 2018 and concluded after confirming the groundwater levels had recovered to baseline level. Groundwater samples were collected every 10 hours during the test and submitted to TAL for the following analyses:
 - Pechlorate by Method 314.0
 - Hexavalent chromium by Method 218.6
 - Chloroform by Method 8260B
 - Nitrate by Method 300.0
 - Sulfate by Method 300.0
 - Ammonium by Method 350.1
- A technical memorandum discussing the groundwater fluctuations observed during background water level monitoring was submitted to NDEP on July 30, 2018. In an e-mail dated July 31, 2018, NDEP approved modification of the aquifer testing stabilization criteria from less than 0.01 ft change in water levels over 30 minutes as stated in the Work Plan to less than 0.03 ft change over 15 minutes.
- Schedule and Progress Updates
 - The following activities are scheduled to be conducted in August 2018:
 - Continued UNLV microcosm testing in accordance with the Unit 4 Source Area In-Situ Bioremediation Treatability Study Bench-Scale Work Plan and Treatability / Pilot Study Modification No. 1.
 - Groundwater modeling using data obtained during pre-implementation field activities.
 - Begin developing the final injection and extraction system design including well design, injection and extraction rates, cycling frequency, performance monitoring program, and conveyence pipeline.
 - The Trust is planning to submit a Treatability / Pilot Study Modification for the Unit 4 Source Area In-Situ Bioremediation Treatability Study Work Plan in August 2018. This modification will propose the following:
 - Perform a groundwater extraction test to determine if short-term groundwater extraction (up to 3 months) will reduce TDS and COPCs in groundwater to concentrations that have been successfully bioremediated in the bench-scale tests.
- Health and Safety
 - There were no health and safety incidents related to Task M21 during July 2018.

CERTIFICATION

Unit 4 Source Area Bioremediation Treatability 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

not individually, but solely as President
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: 8/29/18

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 Monthly Progress Report, Nevada Environmental Response Trust Site, Henderson, Nevada.



August 29, 2018

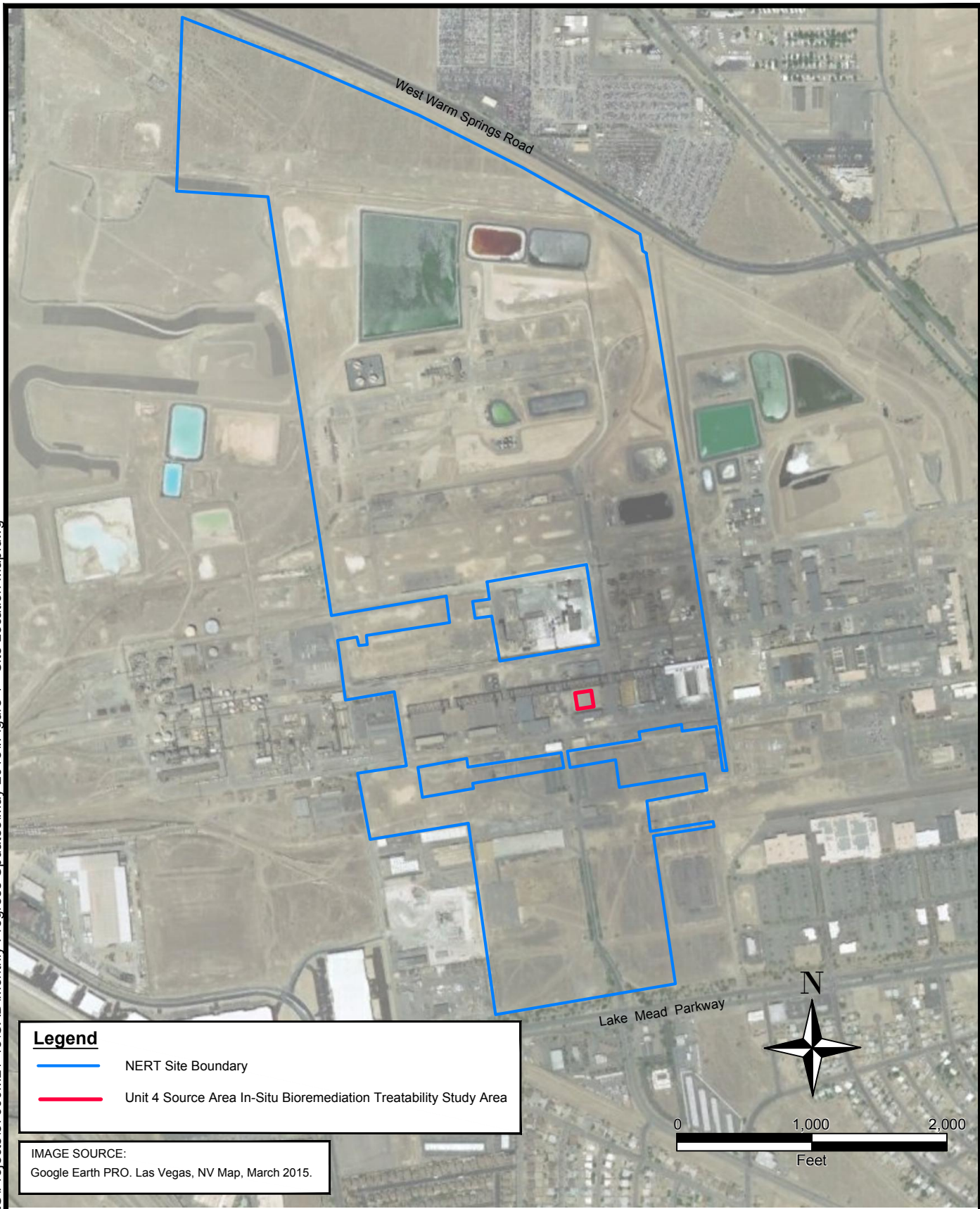
Kyle Hansen, CEM
Field Operations Manager/Geologist
Tetra Tech, Inc.

Date

Nevada CEM Certificate Number: 2167
Nevada CEM Expiration Date: September 18, 2020

Figures

tts318fs3.tt.local\CES\Projects\87600M21-18\CAD\Monthly Progress Updates\May 2018\Figure 1 - Site Location Map.dwg





Legend	
	NERT Site Boundary
	Unit 4 Source Area In-Situ Bioremediation Treatability Study Area

IMAGE SOURCE:
Google Earth PRO. Las Vegas, NV Map, March 2015.

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NEVADA ENVIRONMENTAL RESPONSE TRUST SITE
UNIT 4 SOURCE AREA IN-SITU BIOREMEDIATION TREATABILITY STUDY
SITE LOCATION MAP

Project No:	117-7502018
Date:	JUNE 13, 2018
Designed By:	PK
Figure No.	1

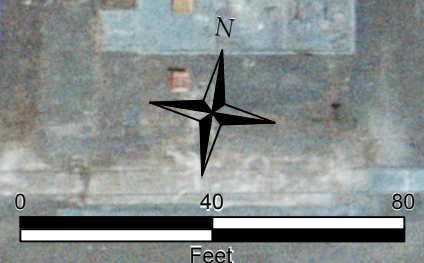


Legend

- Geotechnical Soil Boring Location
- ⊕ Existing Third Mobilization Monitoring Well
- ⊕ Nested Monitoring Well (I - Intermediate; D - Deep)
- ⊕ UMCf Injection/Extraction Well Cluster (2 Screen Intervals; I - Intermediate; D - Deep)
- Unit 4 Treatability Study Area
- Department of Homeland Security Restricted Area
- Existing Unit 4 Building

Notes:

1. All locations are approximate.
2. Imagery Source: Aerotech Mapping, August 2016.
3. Well location source: Unit 4 Source Area In-Situ Bioremediation Treatability Study Work Plan, Tetra Tech, 2017.




TETRA TECH

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NEVADA ENVIRONMENTAL RESPONSE TRUST SITE
 UNIT 4 SOURCE AREA IN-SITU BIOREMEDIATION TREATABILITY STUDY

BORING AND WELL LOCATIONS

Project No:	117-7502018
Date:	JULY 10, 2018
Designed By:	CL
Figure No.	2