

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: June 3, 2019

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 April 2019 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 well locations are depicted on Figure 2.

Task Progress Update: April 2019

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) continued microcosm and column testing in accordance with the Unit 4 Source Area In-Situ Bioremediation Treatability Study Bench-Scale Work Plan and Treatability Study Modification No. 1. The following is a brief summary of results of the microcosm and column testing through April 2019:
 - UNLV performed microcosm tests with a combination of molasses, molasses with acetate, mixed microbial cultures, and soil and groundwater collected from boring and well locations near the Unit 4 Building. The next microcosm sampling event is planned for mid-May 2019 based on the current degradation rates. It is anticipated that this will be the final microcosm sampling event based on the limited volume of material that remains available for sampling. The analytical results from the sampling event will be summarized in future progress reports.
 - UNLV performed microcosm testing using nano-scale zero valence iron (nZVI). The microcosm tests evaluated the effectiveness of nZVI to treat groundwater collected from the Unit 4 area and in various combinations with mixed microbial cultures, molasses, nutrients, groundwater, and soil. Within these microcosms, hexavalent chromium concentrations reduced from approximately 22 mg/L to less than 1 mg/L within 4 hours using the stoichiometric requirement of nZVI. After 46 days, nitrate concentrations reduced from approximately 87 mg/L to less than 16 mg/L and chloroform concentrations reduced

from approximately 1,300 µg/L to 600 µg/L in all of the microcosms. Limited chlorate and perchlorate reductions were observed after 46 days in the microcosms. Additional microcosm testing is being performed using a larger dosing of nZVI. Analytical results for the additional microcosm testing with nZVI are not yet available and will be discussed in future progress reports.

- UNLV continued column testing with two intermediate columns (columns packed with a mixture of sand and soil collected from 75 to 85 feet bgs) and two deep columns (columns packed with a mixture of sand and soil collected from 95 to 105 feet bgs). The columns used a continuous feed solution of molasses, diluted groundwater from wells U4-E-021 and U4-E-05D, sodium bicarbonate, mixed microbial cultures, and nutrients. Hexavalent chromium concentrations at the effluent of the columns have reduced from approximately 10 mg/L to less than 0.05 mg/L. The pH of the effluent from the columns remains between 7 and 8. Analytical results for nitrate, chloroform, chlorate, and perchlorate are not yet available.
- Schedule and Progress Updates
 - The following activities are scheduled to be conducted in May 2019:
 - Continued UNLV microcosm and column testing in accordance with the Unit 4 Source Area In-Situ Bioremediation Treatability Study Bench-Scale Work Plan and Treatability Study Modification No. 1.
 - A Unit 4 Source Area In-Situ Bioremediation Treatability Study Work Plan Addendum for Phase 2 will be prepared at the completion of laboratory testing provided the data support moving forward with a field test. The actual submittal timeline of the Addendum will be dependant on the duration of the microcosm and column studies.
- Health and Safety
 - There were no health and safety incidents related to Task M21 during April 2019.

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

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: 6/3/19

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.



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

June 3, 2019

Date

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

Figures

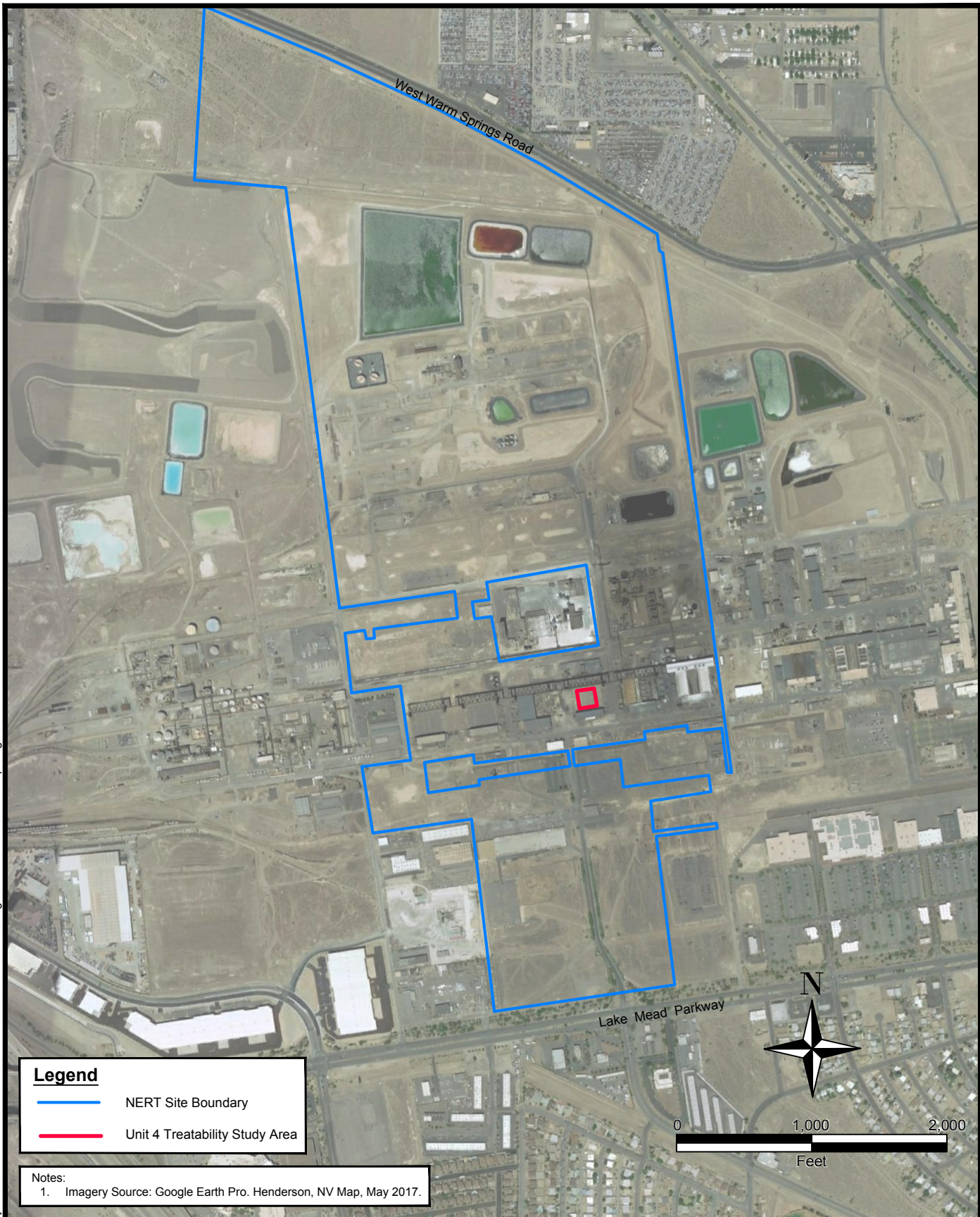


Figure 1 - Site Location Map.dwg

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Legend

- NERT Site Boundary
- Unit 4 Treatability Study Area

Notes:
 1. Imagery Source: Google Earth Pro. Henderson, NV Map, May 2017.



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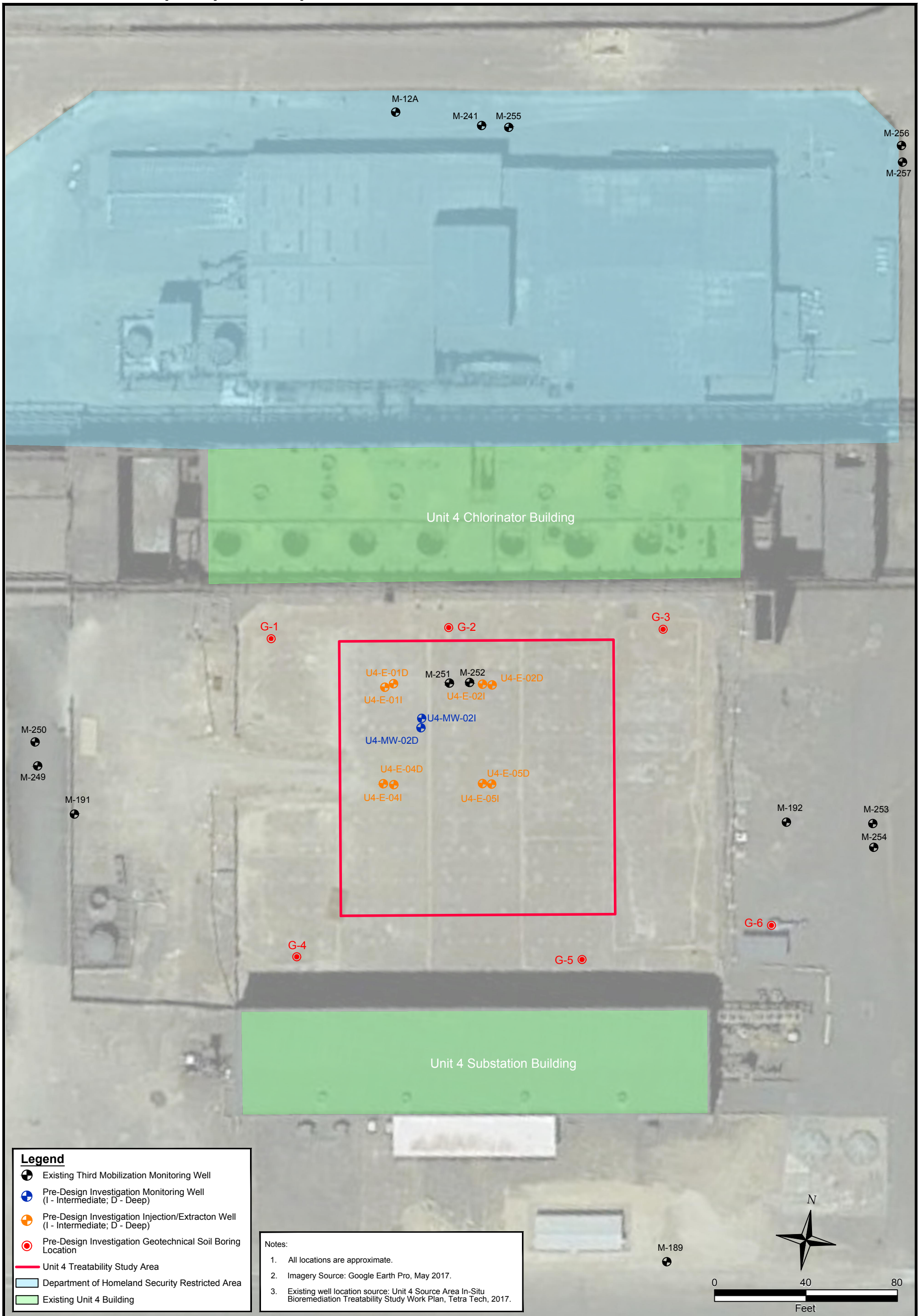
NEVADA ENVIRONMENTAL RESPONSE TRUST SITE

UNIT 4 SOURCE AREA IN-SITU BIOREMEDIATION TREATABILITY STUDY

SITE LOCATION MAP

Project No: 117-7502019
 Date: MARCH 5, 2019
 Designed By: KB

Figure No.
1



Legend

- Existing Third Mobilization Monitoring Well
- Pre-Design Investigation Monitoring Well (I - Intermediate; D - Deep)
- Pre-Design Investigation Injection/Extracton Well (I - Intermediate; D - Deep)
- Pre-Design Investigation Geotechnical Soil Boring Location
- Unit 4 Treatability Study Area
- Department of Homeland Security Restricted Area
- Existing Unit 4 Building

Notes:

1. All locations are approximate.
2. Imagery Source: Google Earth Pro, May 2017.
3. Existing well location source: Unit 4 Source Area In-Situ Bioremediation Treatability Study Work Plan, Tetra Tech, 2017.

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Feet

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

BORING AND WELL LOCATIONS

| | |
|--------------|---------------|
| Project No: | 117-7502019 |
| Date: | APRIL 5, 2019 |
| Designed By: | KB |
| Figure No. | 2 |