MEMO

Date	**May 4, 2020**
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	**Las Vegas Wash ZVI-Enhanced Bioremediation Treatability Study Monthly Progress Report**

TASK PROGRESS UPDATE: MARCH 2020

At the direction of the Nevada Environmental Response Trust (NERT or Trust), Ramboll US Corporation (Ramboll) has prepared this memorandum which summarizes Ramboll's progress during March 2020 toward successfully implementing the Las Vegas Wash Zero-Valent Iron (ZVI)-Enhanced Bioremediation Treatability Study, formerly known as the Galleria Drive ZVI-Enhanced Bioremediation Treatability Study. Treatability laboratory testing is currently being performed by PRIMA Environmental via subcontract with Ramboll on behalf of NERT.

TASK M18 – LAS VEGAS WASH ZVI-ENHANCED BIOREMEDIATION TREATABILITY STUDY

- Task Leaders – Scott Warner / Chris Ritchie
- Current Status
  - As previously reported, Phase 1 of the treatability study was completed in June 2019. Phase 2 (design and implementation of a field test) is planned to be completed in the vicinity of Las Vegas Wash Transect 1A (Transect 1A) pending completion of a data gap evaluation initiated in November 2019 consistent with Treatability/Pilot Study Modification No. 9, which was submitted to Nevada Division of Environmental Protection (NDEP) on October 8, 2019 and approved by NDEP on October 14, 2019.
  - Transect 1A field activities associated with the implementation of Treatability/Pilot Study Modification No. 9 were completed in January 2020.
  - Streamlined bench-scale testing associated with the implementation of Treatability/Pilot Study Modification No. 9 is being conducted to evaluate the performance of ZVI under conditions present in Transect 1A. Transect 1A bench-scale testing continued during March 2020 and included ongoing soil microcosm testing using Transect 1A soil and groundwater. Transect 1A bench-scale tests are being conducted for two different microcosm groups defined by test objectives. Details on the main objectives, initiation dates, and sampling dates for each soil microcosm group are provided in the following table. Multiple microcosms were inoculated with sludge from the on-site fluidized bed reactors (FBRs) to prevent potential lags in microbial stimulation that can result from

disturbance of the samples during sampling, transportation, and microcosm preparation activities.

Microcosm Group Number	Main Objective	Testing Initiation Date	March Sampling Dates
Group 1	Evaluate ZVI's ability to reduce perchlorate, chlorate, and nitrate under Transect 1A conditions	1/25/2020	Week 8 – 3/23/2020
Group 2	Evaluate the effects of carrier agents, additives, and nutrient/carbon amendments on ZVI's performance in reducing perchlorate, chlorate, and nitrate[1]	1/16/2020	Week 8 – 3/12/2020
Note: 1. Carrier agents include guar powder, additives include cross-linker and enzyme breaker, nutrients include vitamin B12 and diammonium phosphate, and carbon includes Emulsified Oil Substrate (EOS) 100.			

- Microcosm Test Results:
    - **Group 1**: Cumulative results from the first eight weeks (including the March samples) of soil microcosm testing for Group 1, which includes application of varying doses of ZVI to Transect 1A alluvium soil and Transect 1A Upper Muddy Creek formation (UMCf) soil, are presented on Figures 1 through 3. Group 1 microcosm data collected during the reporting period continue to show the following trends, as presented in the February progress report:
        - Nearly complete reduction of perchlorate, chlorate, and nitrate was achieved in both alluvium and UMCf microcosms for all ZVI dose levels after four weeks. Perchlorate, chlorate, and nitrate concentrations remained relatively unchanged at Week 8 compared to the Week 4 results presented in the February progress report.
        - Insignificant correlation between reaction rates and ZVI dose was exhibited during the testing conducted through Week 8.
        - More rapid reduction of perchlorate and chlorate was observed in the UMCf microcosms in the first two weeks compared to the alluvium microcosms with concentrations becoming negligible starting at Week 4 and continuing into Week 8.

      Group 1 microcosms with remaining detections of perchlorate will continue to be sampled in April, and associated data will be provided in the April progress report.
    - **Group 2**: Cumulative results from the first eight weeks (including the March samples) of soil microcosm testing for Group 2, which includes application of ZVI, carrier agent, additives, and/or nutrient/carbon amendments to mixed Transect 1A alluvium and UMCf soil, are presented on Figures 4 through 6. Group 2 microcosm data collected during the reporting period show the following trends:

  - Nearly complete reduction of chlorate and nitrate was achieved under all tested conditions except for the control (i.e., no treatment) microcosm by Week 8 with only low-level detections of chlorate remaining.
  - Complete reduction of perchlorate was achieved within the first four weeks for all conditions in which inoculum was provided to the microcosms and within eight weeks for the microcosm in which no inoculum was added, indicating a lag in biological perchlorate reduction in the non-inoculated microcosm compared to the inoculated microcosms.

  The Group 2 microcosm without inoculum will be sampled in April to confirm that perchlorate has been completely reduced, and associated data will be provided in the April progress report.

- Schedule and Progress Updates
  - Streamlined bench-scale testing associated with the implementation of Treatability/Pilot Study Modification No. 9 is anticipated to be completed in April 2020. Data from bench-scale testing activities will continue to be summarized in the April progress report. Furthermore, the bench-scale testing data collected to date support the suitability of Transect 1A as a field test location and will be used to inform the Phase 2 field test design.
  - A Stakeholder Roundtable is anticipated to be held during third quarter 2020 to present Phase 1 field and laboratory/bench-scale data and Phase 2 details of the treatability study.
- Health and Safety
  - No safety incidents occurred during March 2020.

Attachments

Figure 1: Perchlorate Concentrations in Transect 1A Microcosms (Group 1 – Alluvium and UMCf Soil)

Figure 2: Chlorate Concentrations in Transect 1A Microcosms (Group 1 – Alluvium and UMCf Soil)

Figure 3: Nitrate Concentrations in Transect 1A Microcosms (Group 1 – Alluvium and UMCf Soil)

Figure 4: Perchlorate Concentrations in Transect 1A Microcosms (Group 2 – Mixed Soil)

Figure 5: Chlorate Concentrations in Transect 1A Microcosms (Group 2 – Mixed Soil)

Figure 6: Nitrate Concentrations in Transect 1A Microcosms (Group 2 – Mixed Soil)

Las Vegas Wash ZVI-Enhanced 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 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: Jay A Steinberg 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: 5/1/2020

Las Vegas Wash ZVI-Enhanced Bioremediation Treatability Study Progress Update

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

Responsible Certified Environmental Manager (CEM) for this project

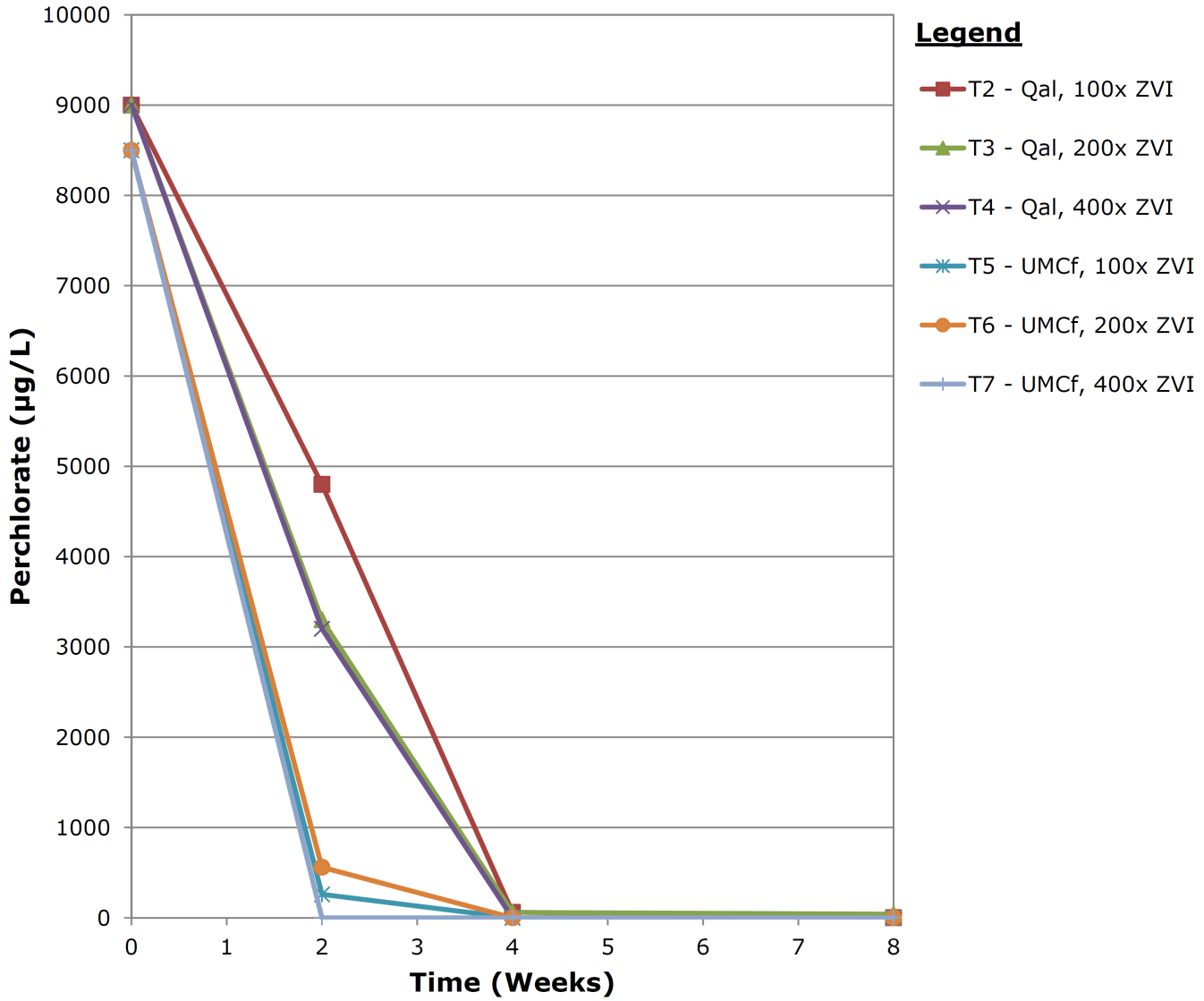
I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and, to the best of my knowledge, comply with all applicable federal, state and local statutes, regulations and ordinances.

May 4, 2020

John M. Pekala, PG
Principal

Date

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



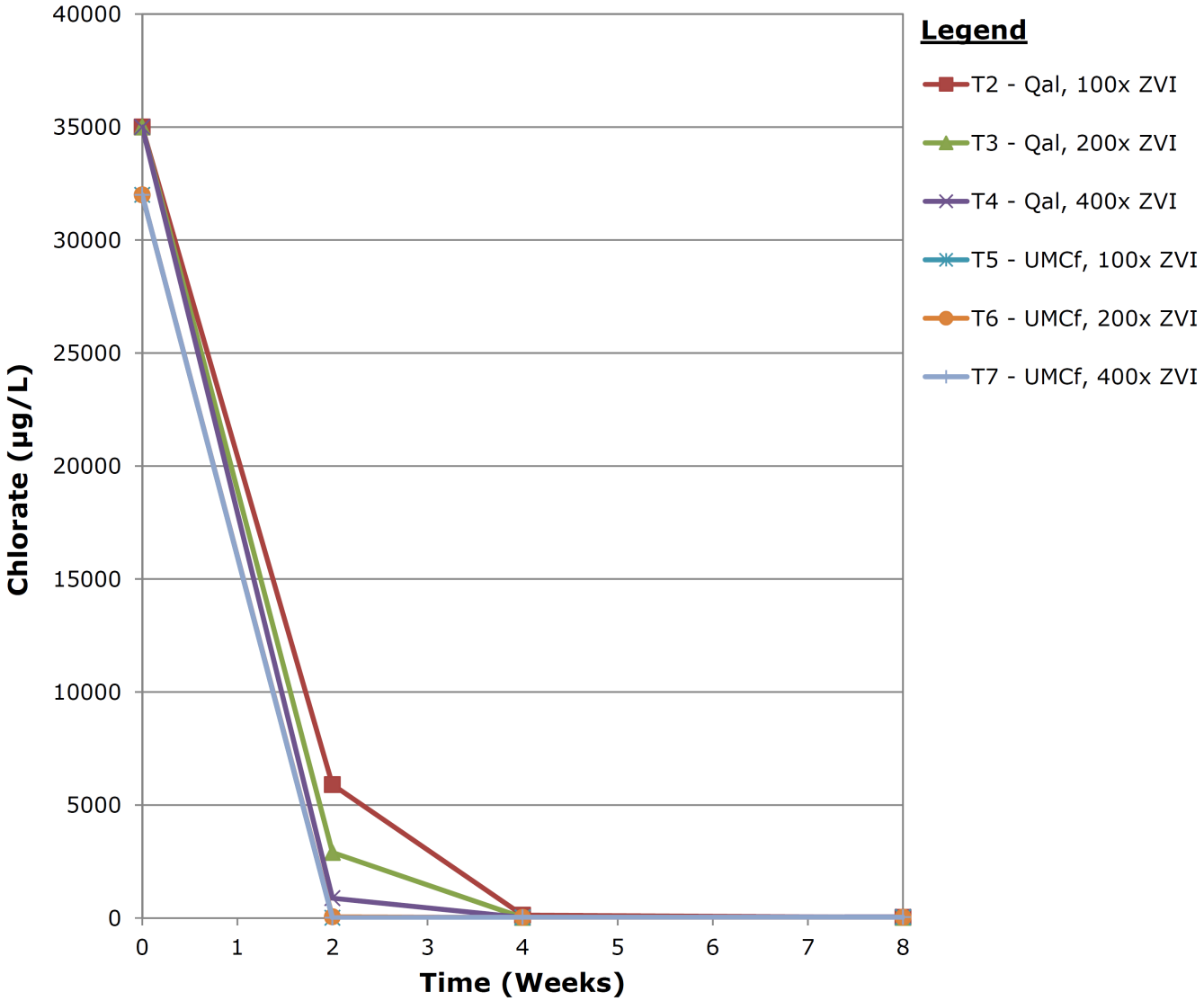
Notes:
1. Tests T2 through T7 were inoculated upon test initiation.
µg/L = micrograms per liter; Qal = Alluvium; UMCf = Upper Muddy Creek formation

RAMBOLL

Perchlorate Concentrations in Transect 1A Microcosms (Group 1 - Alluvium and UMCf Soil)
Nevada Environmental Response Trust Site
Henderson, Nevada

Figure
1

Drafter: UP	Date: 04/08/20	Contract Number: 1690016064	Approved:	Revised:



Notes:
1. Tests T2 through T7 were inoculated upon test initiation.
µg/L = micrograms per liter; Qal = Alluvium; UMCf = Upper Muddy Creek formation

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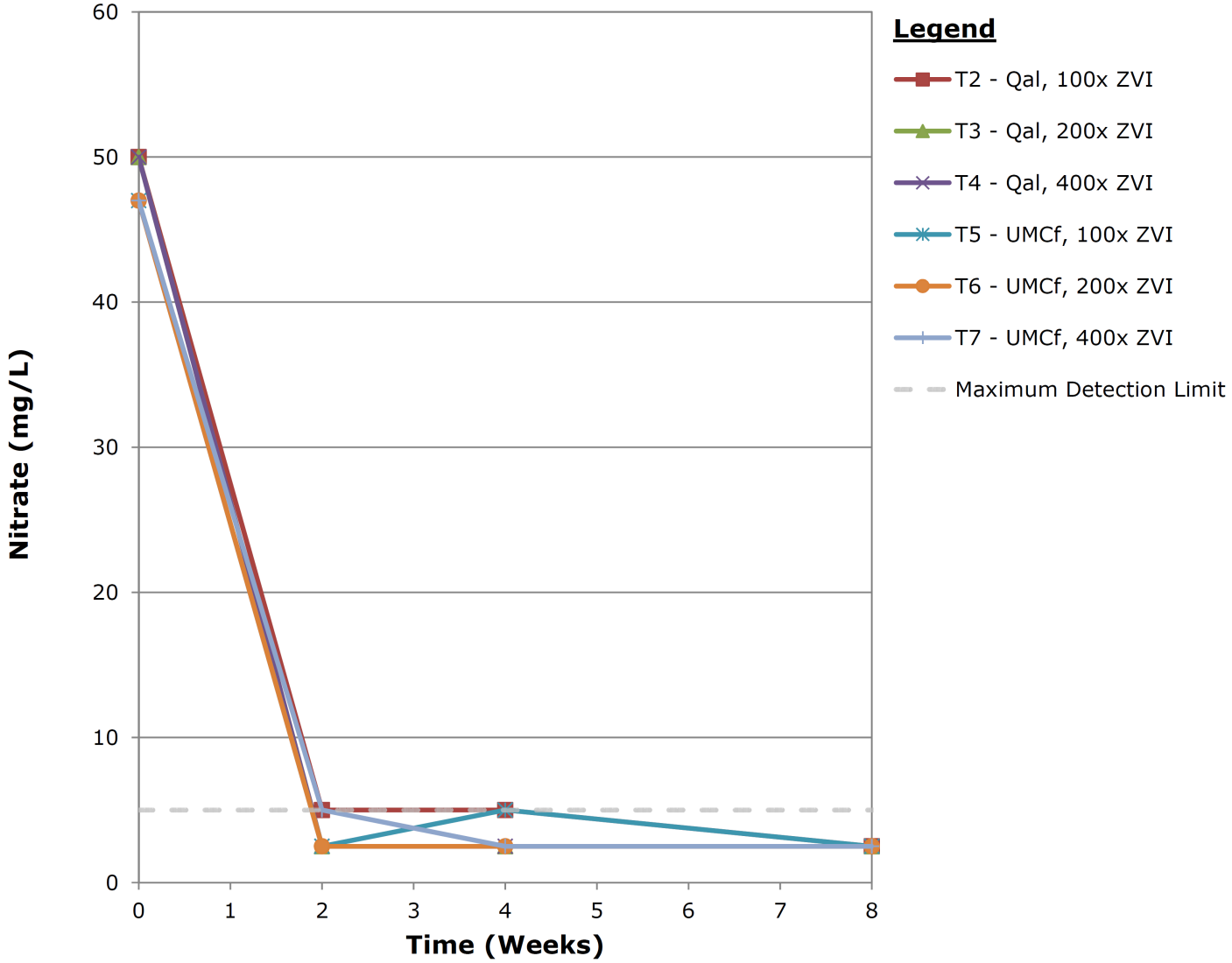
Chlorate Concentrations in Transect 1A Microcosms (Group 1 - Alluvium and UMCf Soil)
Nevada Environmental Response Trust Site
Henderson, Nevada

Figure
2

Drafter: UP	Date: 04/08/20	Contract Number: 1690016064	Approved:	Revised:



Notes:
1. Tests T2 through T7 were inoculated upon test initiation.
2. Non-detect nitrate concentrations are plotted at or below the maximum detection limit of 5 mg/L.
mg/L = milligrams per liter; Qal = Alluvium; UMCf = Upper Muddy Creek formation

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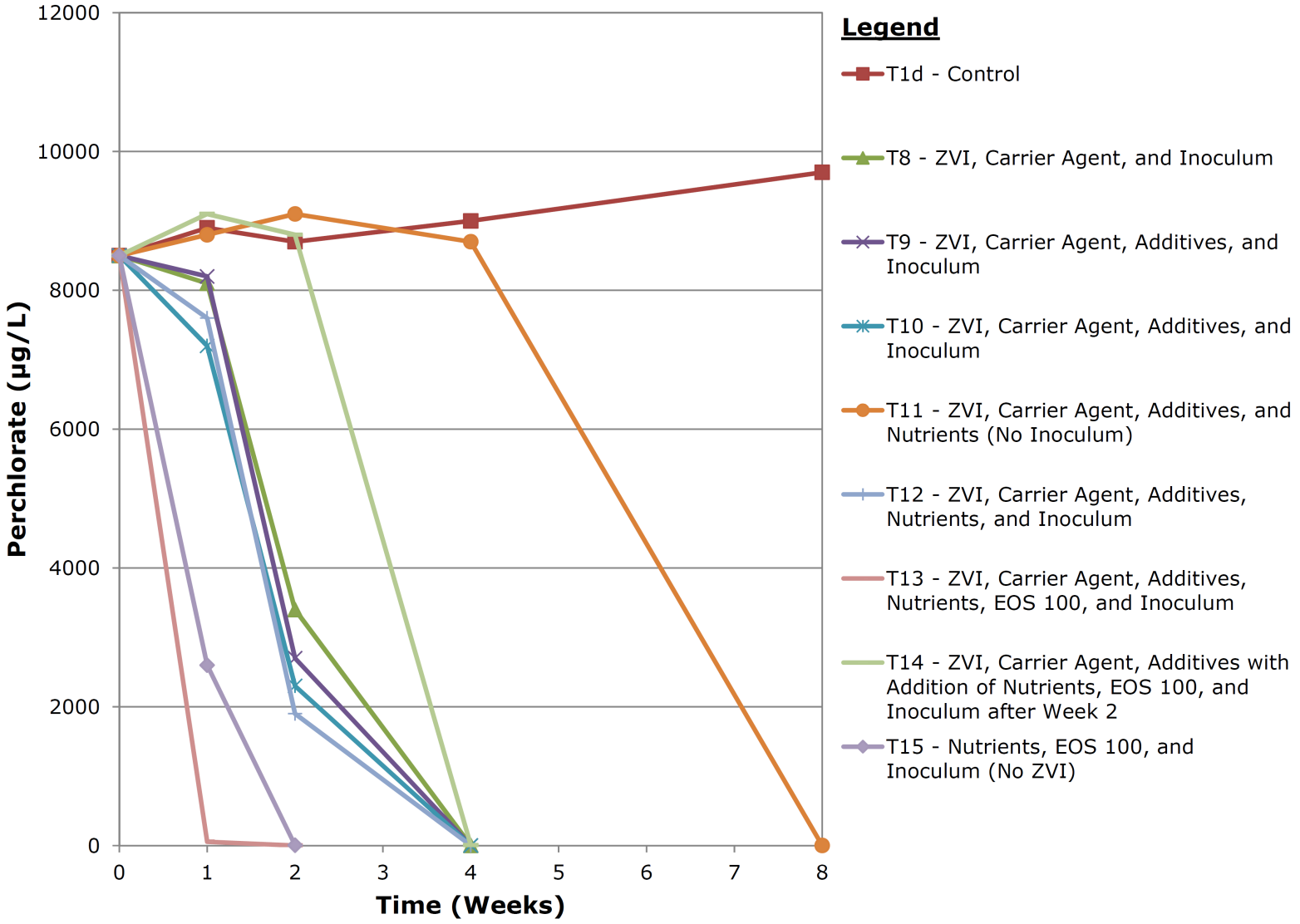
Nitrate Concentrations in Transect 1A Microcosms (Group 1- Alluvium and UMCf Soil)
Nevada Environmental Response Trust Site
Henderson, Nevada

Figure
3

Drafter: UP	Date: 04/08/20	Contract Number: 1690016064	Approved:	Revised:



Note:
µg/L = micrograms per liter

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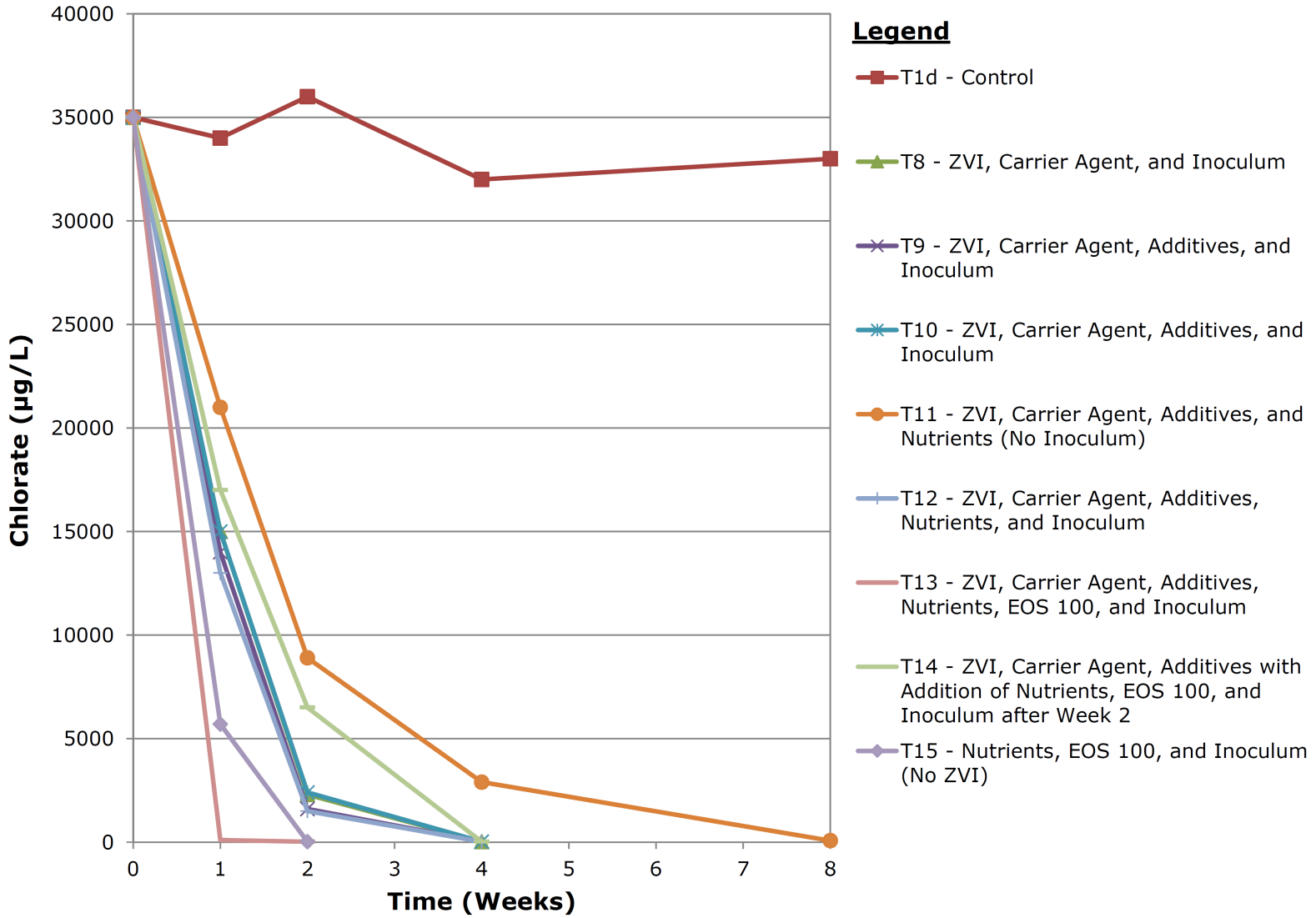
Perchlorate Concentrations in Transect 1A Microcosms (Group 2 - Mixed Soil)
Nevada Environmental Response Trust Site
Henderson, Nevada

Figure
4

Drafter: UP	Date: 04/08/20	Contract Number: 1690016064	Approved:	Revised:



Note:
µg/L = micrograms per liter

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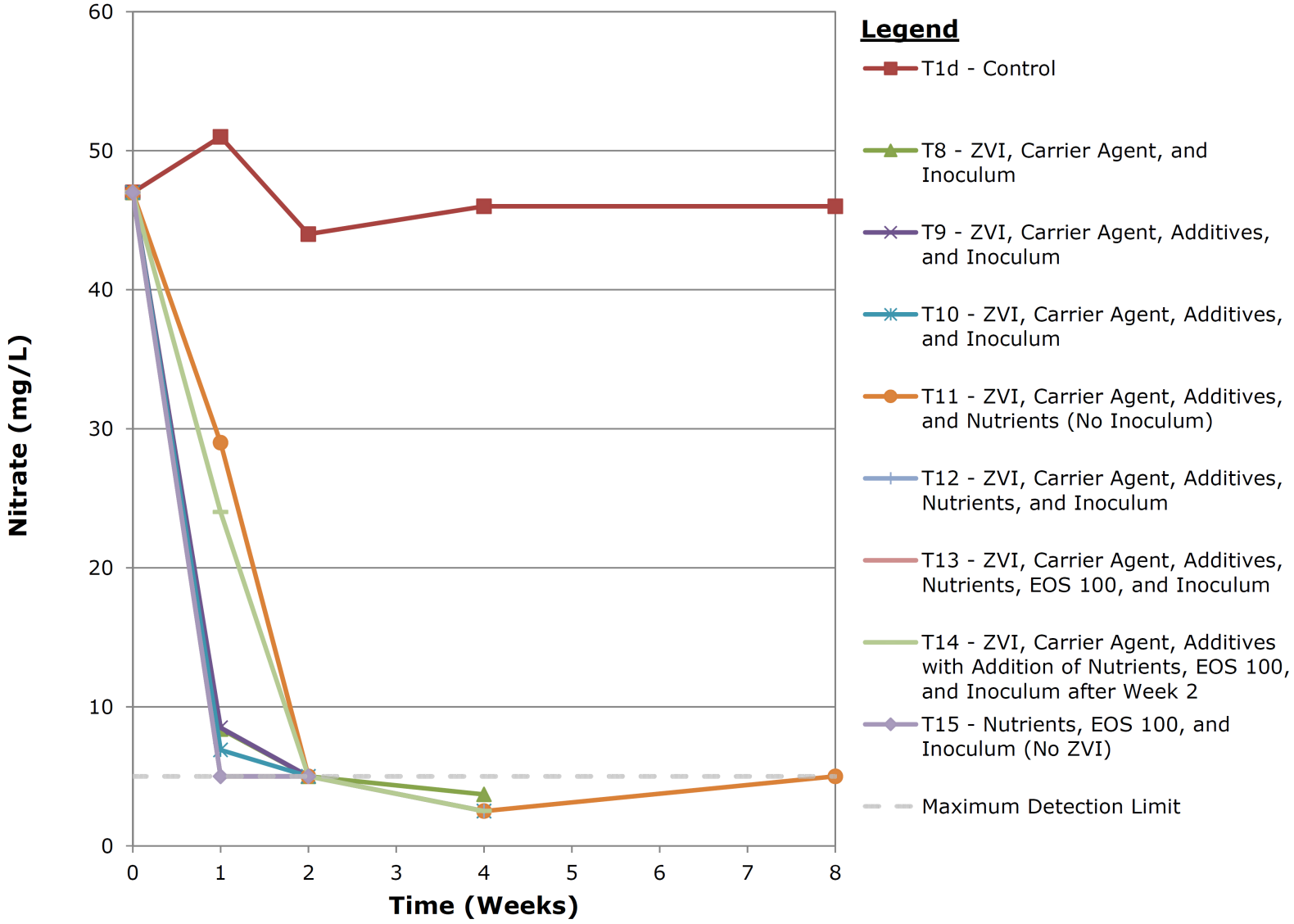
Chlorate Concentrations in Transect 1A Microcosms (Group 2 - Mixed Soil)
Nevada Environmental Response Trust Site
Henderson, Nevada

Figure
5

Drafter: UP	Date: 04/08/20	Contract Number: 1690016064	Approved:	Revised:



Notes:
1. Non-detect nitrate concentrations are plotted at or below the maximum detection limit of 5 mg/L.
mg/L = milligrams per liter

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Nitrate Concentrations in Transect 1A Microcosms (Group 2 - Mixed Soil)
Nevada Environmental Response Trust Site
Henderson, Nevada

Figure
6

Drafter: UP	Date: 04/08/20	Contract Number: 1690016064	Approved:	Revised: