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National Nuclear Security Administration
Sandia Field Office
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JUL 2 2 2020

Mr. Kevin Pierard
Chief, Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Bldg. 1
Santa Fe, New Mexico 87505

Subject: July 2020 Environmental Restoration Operations Consolidated Quarterly Report, Sandia National Laboratories, New Mexico (SNL/NM)

Dear Mr. Pierard:

Enclosed is the July Environmental Restoration Operations Consolidated Quarterly Report for SNL/NM, Environmental Protection Agency identification number NM5890110518. This report addresses all quarterly reporting (January through March 2020) set forth in the Compliance Order in Consent, for SNL/NM.

If you have questions, please contact David Rast of our staff at (505) 845-5349, or David.Rast@nnsa.doe.gov

Sincerely,

Jeffrey P. Harrell
Manager

Enclosure

cc: See Page 2

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NNSA-2020-003385

Sandia National Laboratories, New Mexico

Environmental Restoration Operations

A U.S. Department of Energy Environmental Cleanup Program

Consolidated Quarterly Report

January – March 2020

July 2020

United States Department of Energy
Sandia Field Office

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CONSOLIDATED QUARTERLY REPORT

July 2020

SANDIA NATIONAL LABORATORIES, NEW MEXICO

ENVIRONMENTAL RESTORATION OPERATIONS

U.S. DEPARTMENT OF ENERGY:	SANDIA FIELD OFFICE
CONTRACTOR:	NATIONAL TECHNOLOGY AND ENGINEERING SOLUTIONS OF SANDIA
PROJECT MANAGER:	Christi D. Leigh

NUMBER OF POTENTIAL RELEASE SITES SUBJECT TO CORRECTIVE ACTION: 6

SUSPECT WASTE: Radionuclides, metals, organic compounds, and explosives

REPORTING PERIOD: January – March 2020

OVERVIEW

This Sandia National Laboratories, New Mexico Environmental Restoration Operations (ER) Consolidated Quarterly Report (ER Quarterly Report) fulfills all quarterly reporting requirements set forth in the Compliance Order on Consent. Table I-1 lists the six sites remaining in the corrective action process. This ER Quarterly Report presents activities and data as follows:

SECTION I: Environmental Restoration Operations Consolidated Quarterly Report, January – March 2020

SECTION II: Perchlorate Screening Quarterly Groundwater Monitoring Report, January – March 2020

SECTION III: Technical Area-V In-Situ Bioremediation Treatability Study Phase I Full Scale Operation, January – March 2020

ABBREVIATIONS AND ACRONYMS

µg/L	microgram(s) per liter
µS/cm	microsiemen(s) per centimeter
AGMR	Annual Groundwater Monitoring Report
AOC	Area of Concern
BSG	Burn Site Groundwater
CME	Corrective Measures Evaluation
COC	constituent of concern
Consent Order	Compliance Order on Consent
CY	Calendar Year
CYN	Canyons (acronym used for well identification only)
Dhc	*Dehalococcoides*
DO	dissolved oxygen
DOE	U.S. Department of Energy
DP	Discharge Permit
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration Operations
ER Quarterly Report	Environmental Restoration Operations Consolidated Quarterly Report
FOP	Field Operating Procedure
GWQB	Ground Water Quality Bureau
HWB	Hazardous Waste Bureau
INJ	injection (acronym used for well identification only)
ISB	in-situ bioremediation
LTS	Long-Term Stewardship
LWDS	liquid waste disposal system (acronym used for well identification only)
MCL	maximum contaminant level
MDL	method detection limit
mg/L	milligrams per liter
MW	monitoring well (acronym used for well identification)
ND	non-detect
NMED	New Mexico Environment Department
NNSA	National Nuclear Security Administration
NPN	nitrate plus nitrite
ORP	oxidation reduction potential
pH	potential of hydrogen (negative logarithm of the hydrogen ion concentration)
SAP	Sampling and Analysis Plan
SC	specific conductivity
SNL/NM	Sandia National Laboratories, New Mexico
SSO	Sandia Site Office

SWMU	Solid Waste Management Unit
TA2-W	Technical Area-II (Well) (acronym used for well identification only)
TA2-SW	Technical Area-II (Southwest) (acronym used for well identification only)
TAG	Tijeras Arroyo Groundwater
TAV	Technical Area-V (acronym used for well identification only)
TA-V	Technical Area-V
TAVG	Technical Area-V Groundwater
TCE	trichloroethene
TJA	Tijeras Arroyo (acronym used for well identification only)
TOC	total organic carbon
TSWP	Treatability Study Work Plan
VOC	volatile organic compound
WYO	Wyoming (acronym used for well identification numbers in tables only)

SECTION I
TABLE OF CONTENTS

LIST OF TABLES

SECTION I
ENVIRONMENTAL RESTORATION OPERATIONS CONSOLIDATED QUARTERLY REPORT, January – March 2020

1.0 Introduction

This Environmental Restoration Operations (ER) Consolidated Quarterly Report (ER Quarterly Report) provides the status of ongoing corrective action activities being implemented at Sandia National Laboratories, New Mexico (SNL/NM) during the January – March 2020 reporting period.

Table I-1 lists the Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) currently identified for corrective action at SNL/NM. This section of the ER Quarterly Report summarizes the work completed during this reporting period at sites undergoing corrective action. Corrective action activities were conducted during this reporting period at the three groundwater AOCs:

- Burn Site Groundwater (BSG) AOC,
- Technical Area-V (TA-V) Groundwater (TAVG) AOC, and
- Tijeras Arroyo Groundwater (TAG) AOC.

Corrective action activities are deferred at the Long Sled Track (SWMU 83), the Gun Facilities (SWMU 84), and the Short Sled Track (SWMU 240) because these three sites are active mission facilities. These three active mission sites are located in Technical Area-III.

There were no SWMUs or AOCs in the corrective action complete regulatory process during this reporting period. Corrective action complete status has been approved for all SWMUs within the surface boundaries of each of the three groundwater AOCs.

2.0 Environmental Restoration Operations Work Completed

The following subsections identify the constituents of concern (COCs), summarize the corrective action milestones, and describe the ER work completed during the January – March 2020 reporting period at the three groundwater AOCs.

2.1 Sites Undergoing Corrective Action

In a letter dated April 14, 2016, the New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB) defined the scope and milestones for corrective action at three groundwater AOCs (BSG AOC, TAVG AOC, and TAG AOC) (NMED April 2016). Sections I.2.1.1 through I.2.1.3 discuss the specific milestones from this letter.

2.1.1 Burn Site Groundwater Area of Concern

Nitrate has been identified as a COC in groundwater at the BSG AOC based on detections above the U.S. Environmental Protection Agency (EPA) maximum contaminant level (MCL) in samples collected from monitoring wells. The EPA MCL and State of New Mexico groundwater standard for nitrate (as nitrogen) is 10 milligrams per liter (mg/L). The groundwater sampling and analysis program for the BSG AOC currently includes perchlorate analyses of water from five groundwater monitoring wells (CYN-MW15, sampled semiannually; and CYN-MW16 through CYN-MW19, sampled quarterly).

The U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA) and SNL/NM personnel met with the NMED HWB on July 20, 2015 to discuss the status of sites currently undergoing corrective action. For the BSG AOC, all parties agreed to a weight-of-evidence characterization program: (1) to conduct additional isotopic analyses/nitrate fingerprinting and age-dating of the groundwater; (2) to conduct a transducer study using existing wells to determine whether the groundwater is unconfined, semi-confined, or confined; and (3) to conduct an aquifer pumping test to help determine the origin of the elevated nitrates in the groundwater.

In January 2019, a Monitoring Well Installation Work Plan for the BSG AOC was submitted to NMED HWB (SNL/NM January 2019a) and subsequently approved by NMED HWB (NMED February 2019). The work plan proposed a minimum of four wells (CYN-MW16 through CYN-MW19) that will help define the extent of nitrate contamination in groundwater and refine the potentiometric surface in the BSG AOC. Long-term sampling from these new well locations, along with other BSG monitoring wells, will provide data to characterize the AOC and assist in evaluating potential remedial actions.

The following activities occurred at the BSG AOC during the January – March 2020 reporting period:

- Groundwater sampling was conducted in January 2020. Table I-3 presents the identification and the sampling frequency for these monitoring wells. The complete analytical results for Calendar Year (CY) 2020 groundwater monitoring will be presented in the SNL/NM CY 2020 Annual Groundwater Monitoring Report (AGMR), which is anticipated to be submitted to the NMED in the summer of 2021.

- Perchlorate analysis of groundwater samples from the BSG AOC is discussed in Section II of this ER Quarterly Report.

- Continued preparing a well installation report for CYN-MW16, CYN-MW17, CYN-MW18, and CYN-MW19; this report will be submitted to NMED in May 2020.

- A second sampling event was performed at groundwater monitoring wells CYN-MW16, CYN-MW17, CYN-MW18, and CYN-MW19. The concentration of nitrate plus nitrite in January in well CYN-MW16 was 11.7 mg/L, exceeding the EPA MCL of 10 mg/L for the second consecutive quarter.

2.1.2 Technical Area-V Groundwater Area of Concern

Trichloroethene (TCE) and nitrate have been identified as COCs in groundwater at the TAVG AOC based on detections above the EPA MCLs in samples collected from monitoring wells. The EPA MCLs and the State of New Mexico groundwater standards for TCE and nitrate (as nitrogen) are 5 micrograms per liter (µg/L) and 10 mg/L, respectively.

Personnel from the DOE/NNSA, DOE Headquarters Office of Environmental Management, SNL/NM, and NMED HWB worked together to address the groundwater contamination at the TAVG AOC. A meeting was held with the NMED HWB on July 20, 2015, and all parties agreed on a phased Treatability Study to evaluate the effectiveness of in-situ bioremediation (ISB) as a potential technology to treat the groundwater contamination at the TAVG AOC.

To implement the ISB Treatability Study, SNL/NM personnel planned to install up to three injection wells (TAV-INJ1, TAV-INJ2, and TAV-INJ3) at TA-V near the highest contaminant concentrations in groundwater detected in monitoring wells TAV-MW6, TAV-MW10, and LWDS-MW1, respectively. The substrate solution containing essential

food and nutrients for biostimulation was prepared in aboveground tanks. This substrate solution, along with the biodegradation bacteria, was gravity-injected to groundwater via injection well.

The NMED HWB approved the Revised Treatability Study Work Plan (TSWP) (SNL/NM March 2016) on May 10, 2016 (NMED May 2016). In accordance with the Revised TSWP, the ISB Treatability Study is being conducted in two phases. Phase I included a pilot test followed by full-scale operation at the first injection well (TAV-INJ1). Phase II of the ISB Treatability Study will include well installation and full-scale operation at the second and third injection wells (TAV-INJ2 and TAV-INJ3). The decision to install the Phase II injection wells will be dependent upon the findings of the Phase I full-scale operation.

The NMED Ground Water Quality Bureau (GWQB) required a groundwater Discharge Permit (DP) for operation of the injection wells. NMED GWQB issued DP-1845 to DOE/NNSA for the SNL/NM ISB Treatability Study injection wells on May 26, 2017 (NMED May 2017a). The DP-1845 term started on May 30, 2017 and will end on May 30, 2022. As required by DP-1845, DOE/NNSA and SNL/NM personnel submit separate quarterly reports to the NMED GWQB.

SNL/NM personnel have completed the Phase I pilot test at injection well TAV-INJ1. The operation and results of the pilot test were presented in Section III of the October 2018 ER Quarterly Report (SNL/NM October 2018). Based on the results of the pilot test, DOE/NNSA and SNL/NM personnel proposed eight modifications for the full-scale operation at well TAV-INJ1 (DOE July 2018). The NMED HWB subsequently approved the modifications on August 13, 2018 (NMED August 2018). Therefore, the implementation of the full-scale operation at well TAV-INJ1 is governed by the Revised TSWP and where applicable, the approved modifications for full-scale operation.

SNL/NM personnel started the Phase I full-scale operation at well TAV-INJ1 in October 2018 and completed the six-month injection period in April 2019. Details on the six-month injection activities were presented in Section III of the October 2019 ER Quarterly Report (SNL/NM October 2019). The injection period is followed by two years of groundwater monitoring for the performance of the ISB. The two-year performance monitoring includes three monthly sampling events followed by quarterly sampling events for the remainder of the two-year period, as planned in the Revised TSWP (SNL/NM March 2016). The three monthly sampling events occurred in June (first and last week) and July 2019. The Phase I

ISB Treatability Study performance monitoring is currently on a quarterly schedule until May 2021.

The following activities occurred at TAVG AOC during the January – March 2020 reporting period:

- For the performance monitoring of the Phase I ISB Treatability Study, groundwater sampling was conducted at the treatment zone (i.e., in the proximity of injection well TAV-INJ1) as well as outside the treatment zone during this reporting period. Section III presents the groundwater monitoring results for the ISB Treatability Study for this quarter. Analytical results for DP-specific requirements are presented in DP quarterly reports that are submitted separately to the NMED GWQB.

- The TA-V groundwater monitoring network currently comprises 18 active monitoring wells. Of these 18 wells, well TAV-MW6 is designated as an ISB Treatability Study performance monitoring well and follows the sampling frequency and analytes specified for the ISB Treatability Study (see Section III). Well TAV-MW7, because of its proximity to the injection well TAV-INJ1, continues to serve as a monitoring well for the ISB Treatability Study, although no impact from the substrate solution injections has been observed at this deep well. Programmatically it belongs to the TA-V groundwater monitoring network (SNL/NM January 2019b). Groundwater monitoring results at wells TAV-MW6 and TAV-MW7 will continue to be reported in Section III of the ER Quarterly Reports for the duration of the ISB Treatability Study.

- Table I-2 presents the CY 2020 sampling frequency for the monitoring wells at TAVG AOC for the 17 wells in the TA-V groundwater monitoring network (18 wells minus well TAV-MW6). Groundwater sampling was conducted in February 2020. The SNL/NM CY 2020 AGMR will present the analytical results for CY 2020 groundwater monitoring, which is scheduled for submittal to the NMED HWB in the summer of 2021.

- The concentration of TCE at well TAV-MW4 exceeded the EPA MCL of 5 µg/L for the first time in May 2019 (5.44 µg/L). In subsequent quarterly sampling, TCE concentrations were:
    - 5.09 µg/L in August 2019,
    - 5.40 µg/L in November 2019, and
    - 4.99 µg/L in the environmental sample and 5.03 µg/L in the environmental duplicate sample in February 2020.

An evaluation of the TCE exceedances at well TAV-MW4 was provided in Appendix A of Section III of the January 2020 ER Quarterly Report (SNL/NM January 2020). This well is one of the eight monitoring wells outside the ISB Treatability Study treatment area that are sampled quarterly, and its analytical results are presented in Section III of this quarterly report.

2.1.3 Tijeras Arroyo Groundwater Area of Concern

Nitrate has been identified as a COC in groundwater for the TAG AOC based on exceedances of the EPA MCL in samples collected from monitoring wells completed in the Perched Groundwater System and in the merging zone above the Regional Aquifer. TCE has been identified as a COC for the Perched Groundwater System (NMED April 2004). No TCE concentrations in Regional Aquifer samples have exceeded the EPA MCL. The EPA MCLs and State of New Mexico groundwater standards for TCE and nitrate (as nitrogen) are 5 µg/L and 10 mg/L, respectively.

In May 2017, NMED HWB completed its review of the Current Conceptual Model and Corrective Measures Evaluation Report for the TAG AOC (SNL/NM December 2016), which was submitted to the NMED HWB on November 23, 2016 (DOE November 2016). This report was submitted in accordance with NMED's "Summary of Agreements and Proposed Milestones…" letter of April 14, 2016 (NMED April 2016). The subsequent disapproval letter issued by the NMED HWB (NMED May 2017b) requested the inclusion of additional information in a revised report. The Revised TAG Current Conceptual Model and Corrective Measures Evaluation Report was then submitted to the NMED HWB on February 13, 2018 (SNL/NM February 2018). The review cycle for NMED HWB is ongoing.

During January – March 2020, groundwater samples were collected from 11 monitoring wells (TA1-W-06, TA2-W-01, TA2-W-19, TA2-W-26, TA2-W-27, TA2-W-28, TJA-2, TJA-3, TJA-4, TJA-6, and TJA-7) scheduled for quarterly and semiannual sampling. Table I-2 presents the CY 2020 sampling frequency for the TAG monitoring wells. The analytical results for the TAG AOC CY 2020 groundwater monitoring will be included in the SNL/NM CY 2020 AGMR, which is scheduled for submittal to the NMED HWB in the summer of 2021.

2.2 Sites in Corrective Action Complete Regulatory Process

There are currently no SWMUs or AOCs in the corrective action complete regulatory process.

3.0 References

DOE, see U.S. Department of Energy.

New Mexico Environment Department (NMED), April 2004. "Compliance Order on Consent Pursuant to the New Mexico Hazardous Waste Act § 74-4-10: Sandia National Laboratories Consent Order," New Mexico Environment Department, Santa Fe, New Mexico. April 29, 2004.

New Mexico Environment Department (NMED), April 2016. Letter to J.P. Harrell (U.S. Department of Energy, NNSA/Sandia Field Office) and M. W. Hazen (Sandia National Laboratories, New Mexico), "Summary of Agreements and Proposed Milestones Pursuant to the Meeting of July 20, 2015, March 30, 2016, Sandia National Laboratories, EPA ID# NM5890110518, HWB-SNL-16-MISC," NMED, Hazardous Waste Bureau, Santa Fe, New Mexico. April 14, 2016.

New Mexico Environment Department (NMED), May 2016. Letter to J. Harrell (U.S. Department of Energy NNSA/Sandia Field Office) and P. Davies (Sandia National Laboratories, New Mexico), "Approval Revised Treatability Study Work Plan for In-Situ Bioremediation at the Technical Area-V Groundwater Area of Concern, Sandia National Laboratories, EPA ID# NM5890110518, HWB-SNL-15-020," NMED, Hazardous Waste Bureau, Santa Fe, New Mexico. May 10, 2016.

New Mexico Environment Department (NMED), May 2017a. Ground Water Discharge Permit, Sandia National Laboratories/New Mexico, Discharge Permit-1845, NMED, Ground Water Quality Bureau, Santa Fe, New Mexico. May 26, 2017.

New Mexico Environment Department (NMED), May 2017b. Letter to J.P. Harrell (U.S. Department of Energy NNSA/Sandia Field Office) and Carol Adkins (Sandia National Laboratories), "Disapproval Tijeras Arroyo Groundwater Current Conceptual Model and Corrective Measures Evaluation Report, December 2016, Sandia National Laboratories [*sic*] New Mexico, EPA ID# NM5890110518, HWB-SNL-16-020," May 18, 2017.

New Mexico Environment Department (NMED), August 2018. Letter to J.P. Harrell (U.S. Department of Energy NNSA/Sandia Field Office) and R.O. Griffith (Sandia National Laboratories), "Approval: Technical Area-V (TA-V) Treatability Study Notification of Full-Scale Operation at Well TAV-INJ1, Sandia National Laboratory, EPA ID# NM5890110518, HWB-SNL-15-020," August 13, 2018.

New Mexico Environment Department (NMED), February 2019. Letter to J.P. Harrell (U.S. Department of Energy NNSA/Sandia Field Office) and P. Shoemaker (Sandia National Laboratories), "Approval: Monitoring Well Installation Work Plan, Burn Site Groundwater Monitoring Wells CYN-MW16 Through CYN-MW23, Sandia National Laboratories, EPA ID# NM5890110518, HWB-SNL-19-003," February 12, 2019.

NMED, see New Mexico Environment Department.

Sandia National Laboratories, New Mexico (SNL/NM), March 2016. *Revised Treatability Study Work Plan for In-Situ Bioremediation at the Technical Area-V Groundwater Area of Concern, Sandia National Laboratories, Albuquerque, New Mexico,* Environmental Restoration Operations, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories, New Mexico (SNL/NM), December 2016. *Tijeras Arroyo Groundwater Current Conceptual Model and Corrective Measures Evaluation Report*, Environmental Restoration Operations, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories, New Mexico (SNL/NM), February 2018. *Revised Tijeras Arroyo Groundwater Current Conceptual Model and Corrective Measures Evaluation Report*, Environmental Restoration Operations, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories, New Mexico (SNL/NM), October 2018. *Environmental Restoration Operations Consolidated Quarterly Report April – June 2018*, Environmental Restoration Operations, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories, New Mexico (SNL/NM), January 2019a. *Monitoring Well Installation Work Plan, Burn Site Groundwater Monitoring Wells CYN-MW16 through CYN-MW23, Sandia National Laboratories, Albuquerque, New Mexico,* Environmental Restoration Operations, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories, New Mexico (SNL/NM), January 2019b. *Environmental Restoration Operations Consolidated Quarterly Report July – September 2018, Sandia National Laboratories, Albuquerque, New Mexico,* Environmental Restoration Operations, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories, New Mexico (SNL/NM), October 2019. *Environmental Restoration Operations Consolidated Quarterly Report April – June 2019, Sandia National Laboratories, Albuquerque, New Mexico,* Environmental Restoration Operations, Sandia National Laboratories, Albuquerque, New Mexico.

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SNL/NM, see Sandia National Laboratories, New Mexico.

U.S. Department of Energy (DOE), November 2016. Letter to J.E. Kieling (New Mexico Environment Department), "Tijeras Arroyo Groundwater Current Conceptual Model and Corrective Measures Evaluation Report, December 2016," November 23, 2016.

U.S. Department of Energy (DOE), July 2018. Letter to J. E. Kieling (New Mexico Environment Department), "Technical Area-V (TA-V) Treatability Study Notification of Full-Scale Operation at Well TAV-INJ1", July 20, 2018.

Tables

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Table I-1
Solid Waste Management Units and Areas of Concern
Where Corrective Action is Not Complete

Solid Waste Management Units and Areas of Concern	
Site Number	**Site Description**
83	Long Sled Track
84	Gun Facilities
240	Short Sled Track
NA	Tijeras Arroyo Groundwater Investigation (TAG AOC)
NA	TA-V Groundwater Investigation (TAVG AOC)
NA	Burn Site Groundwater Investigation (BSG AOC)

Notes:

AOC = Area of Concern.
BSG = Burn Site Groundwater.
NA = Not applicable. A site number was not assigned.
TAG = Tijeras Arroyo Groundwater.
TA-V = Technical Area-V.
TAVG = Technical Area-V Groundwater.

Table I-2
Groundwater Sampling and Analysis

Investigation Site	Sampling Frequency in CY 2020	Quarter of Sampling in CY 2020	Location of Analytical Results	Location of Perchlorate Analytical Results	Monitoring Wells in Network
TAVG AOC [a]	Quarterly	1,2,3,4	AGMR	NA	LWDS-MW1, TAV-MW2, TAV-MW4, TAV-MW7, TAV-MW8, TAV-MW10, TAV-MW11, TAV-MW12, TAV-MW14, TAV-MW15, TAV-MW16
	Annually	2	AGMR	NA	AVN-1, LWDS-MW2, TAV-MW3, TAV-MW5, TAV-MW9, TAV-MW13
BSG AOC	Semiannually	2,4	AGMR	NA	CYN-MW4, CYN-MW7, CYN-MW8, CYN-MW9, CYN-MW10, CYN-MW11, CYN-MW12, CYN-MW13, CYN-MW14A, CYN-MW15
	Quarterly	1,2,3,4	AGMR	Section II of ER Consolidated Quarterly Report	CYN-MW16, CYN-MW17, CYN-MW18, CYN-MW19
TAG AOC [b]	Quarterly	1,2,3,4	AGMR	NA	TA2-W-19, TA2-W-26, TA2-W-28, TJA-2, TJA-3, TJA-4, TJA-7
	Semiannually	1,3	AGMR	NA	TA1-W-06, TA2-W-01, TA2-W-27, TJA-6
	Annually	3	AGMR	NA	PGS-2, TA1-W-01, TA1-W-02, TA1-W-03, TA1-W-04, TA1-W-05, TA1-W-08, TA2-NW1-595, WYO-3

Notes:

[a]TAVG AOC monitoring network comprises 18 active wells: 17 wells are listed here; well TAV-MW6 currently is part of the ISB Treatability Study and follows a separate monitoring plan (see Section I.2.1.2).
[b] Monitoring well WYO-4 was removed from the TAG sampling schedule in response to the August 2017 meeting with NMED HWB personnel.

AGMR = Annual Groundwater Monitoring Report.
AOC = Area of Concern.
AVN = Area-V (North) (acronym used for well identification only).
BSG = Burn Site Groundwater (Area of Concern).
CY = Calendar Year.
CYN = Canyons (Burn Site Groundwater Area of Concern; acronym used for well identification only).
ER = Environmental Restoration.
HWB = Hazardous Waste Bureau.
ISB = In-situ bioremediation.
LWDS = Liquid waste disposal system (acronym used for well identification only).
MW = Monitoring well (acronym used for well identification only).
NA = Not applicable. No wells in the site network are currently being sampled and analyzed for perchlorate, or were not sampled during this reporting period.
NMED = New Mexico Environment Department.
PGS = Parade Ground South (acronym used for well identification only).
TA1-W = Technical Area-I (Well) (acronym used for well identification only).
TA2-NW = Technical Area-II (Northwest) (acronym used for well identification only).
TA2-W = Technical Area-II (Well) (acronym used for well identification only).
TAG = Tijeras Arroyo Groundwater (Area of Concern).
TAV = Technical Area-V (acronym used for well identification only).
TAVG = Technical Area-V Groundwater (Area of Concern).
TJA = Tijeras Arroyo (acronym used for well identification only).
WYO = Wyoming (acronym used for well identification only).

SECTION II
TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES (concluded)

APPENDICES

SECTION II
PERCHLORATE SCREENING QUARTERLY GROUNDWATER MONITORING REPORT, January – March 2020

1.0 Introduction

Section IV.B of the Compliance Order on Consent (the Consent Order), between the New Mexico Environment Department (NMED), the U.S. Department of Energy (DOE), and Sandia National Laboratories, New Mexico (SNL/NM), effective on April 29, 2004, stipulates that a select group of groundwater monitoring wells at SNL/NM be sampled for perchlorate (NMED April 2004). This section of the Environmental Restoration Operations (ER) Consolidated Quarterly Report (ER Quarterly Report) summarizes the perchlorate screening groundwater monitoring completed during the January – March 2020 reporting period in response to the requirements of the Consent Order. The outline of this report is based on the required elements of a "Periodic Monitoring Report" described in Section X.D. of the Consent Order (NMED April 2004).

In November 2005, DOE/National Nuclear Security Administration (NNSA) and SNL/NM personnel submitted a letter report on the status of perchlorate screening in groundwater at SNL/NM monitoring wells (SNL/NM November 2005). The letter report summarized previous correspondence and sampling results and outlined proposed future work to comply with NMED Hazardous Waste Bureau (HWB) requirements for perchlorate screening of groundwater. As specified in the letter report, quarterly reports are submitted for wells active in the perchlorate screening monitoring well network.

Based on the NMED HWB response (NMED January 2006), DOE/NNSA and SNL/NM personnel submit each quarterly report within 90 days following the quarter that the data represent. In November 2008, DOE/NNSA and SNL/NM personnel received approval from the NMED HWB to proceed to semiannual reporting (NMED November 2008); however, upon further consideration, the NMED HWB once more required quarterly reporting (NMED April 2009). This did not alter the previously negotiated frequency for monitoring well CYN-MW6, an existing Burn Site Groundwater (BSG) Area of Concern (AOC) monitoring well that has been under the sampling and reporting requirements of the Consent Order since the well was installed, which remains at a semiannual frequency for sampling and reporting. Due to declining water levels, CYN-MW6 has insufficient water to routinely sample and the replacement monitoring well (CYN-MW15) was installed in December 2014; the negotiated semiannual sampling frequency transferred to the replacement well.

In September 2011, DOE/NNSA and SNL/NM personnel requested an extension of the submittal dates by one month for ER Quarterly Reports (SNL/NM September 2011). The NMED HWB approved the request (NMED September 2011), which allows DOE/NNSA and SNL/NM personnel to submit perchlorate quarterly reports within 120 days following the quarter that the data represent.

This report is the fiftieth perchlorate screening quarterly report submitted since the November 2005 letter report (SNL/NM February 2006).

Groundwater at BSG AOC monitoring wells CYN-MW16, CYN-MW17, CYN-MW18, and CYN-MW19 were sampled for the second time during this reporting period (Table II-1). The corresponding reporting will continue for as long as a well remains active in the perchlorate screening monitoring well network, or unless otherwise negotiated with the NMED.

2.0 Scope of Activities

This report provides January – March 2020 perchlorate screening groundwater monitoring analytical results for wells CYN-MW16 through CYN-MW19 (Figure II-1, Table II-1). In accordance with the requirements of Table XI-1 of the Consent Order, a well with four consecutive quarters of non-detects (NDs) for perchlorate at the screening level/method detection limit (MDL) of 4 micrograms per liter (µg/L) is removed from the requirement of continued monitoring for perchlorate. Data for numerous wells identified in the Consent Order have satisfied this requirement; these wells have been removed from the perchlorate screening program. Perchlorate results for these wells are not discussed in this current report. Table II-2 lists the wells discussed in previous perchlorate screening reports.

SNL/NM personnel performed groundwater sampling for perchlorate at monitoring wells CYN-MW16 through CYN-MW19 in January 2020 (Table II-1). Groundwater sampling activities were conducted in accordance with procedures outlined in the *Burn Site Groundwater Monitoring, Mini-SAP for Second Quarter, Fiscal Year 2020—ER Wells* (SNL/NM January 2020).

As described in the Mini-Sampling and Analysis Plans (SAP), groundwater sampling was performed in accordance with current SNL/NM Long-Term Stewardship Project Field Operating Procedures (FOPs). A portable Bennett™ groundwater sampling system was used to collect the groundwater samples. The sampling pump and tubing bundle were decontaminated prior to placement into each monitoring well in accordance with procedures described in FOP 05-03, “Groundwater Monitoring Equipment Decontamination” (SNL/NM

January 2018a). Wells were purged a minimum of one saturated screen volume before sampling in accordance with FOP 05-01, "Groundwater Monitoring Well Sampling and Field Analytical Measurements" (SNL/NM January 2018b). Field water quality measurements for turbidity, potential of hydrogen (pH), temperature, specific conductivity (SC), oxidation-reduction potential (ORP), and dissolved oxygen (DO) were obtained from the well prior to collecting the groundwater sample. Groundwater temperature, SC, ORP, DO, and pH were measured with an In-Situ Incorporated Aqua TROLL® 600 Multiparameter water quality meter. Turbidity was measured with a HACH™ Model 2100Q turbidity meter. Purging continued until four stable measurements for turbidity, pH, temperature, and SC were obtained. Groundwater stability is considered acceptable when the following parameters are achieved:

- Turbidity measurements are less than 5 nephelometric turbidity units, or within 10 percent for turbidity values greater than 5 nephelometric turbidity units.
- pH is within 0.1 units.
- Temperature is within 1.0 degree Celsius.
- SC is within 5 percent.

Field measurement logs documenting details of well purging and water quality measurements have been submitted to the SNL/NM Customer Funded Record Center.

Groundwater samples were submitted to GEL Laboratories, LLC for chemical analysis of perchlorate using U.S. Environmental Protection Agency (EPA) Method 314.0 (EPA November 1999). Table II-3 provides the sample identification, Analysis Request/Chain-of-Custody form number, and the associated groundwater investigation area. The analytical report from GEL Laboratories, LLC, including certificates of analysis (Appendix A), analytical methods, MDLs, practical quantitation limits, dates of analyses, results of quality control analyses, and data validation findings (Appendix B), have been submitted to the SNL/NM Customer Funded Record Center.

3.0 Regulatory Criteria

For a given monitoring well, four consecutive ND results using the screening level/MDL of 4 µg/L are considered by the NMED HWB as evidence of the absence of perchlorate, such that additional monitoring for perchlorate in that well is not required. If perchlorate is detected using the screening level/MDL of 4 µg/L in a specific well, then monitoring will

continue at that well at a frequency negotiated with the NMED. The Consent Order (NMED April 2004) also requires that detections equal to or greater than 4 µg/L be evaluated by DOE/NNSA and SNL/NM personnel to determine the nature and extent of perchlorate contamination and incorporate the results of this evaluation into a Corrective Measures Evaluation (CME), based on a screening level/MDL of 4 µg/L. The Consent Order, Section VII.C, clarifies that the CME process will be initiated where there is a documented release to the environment, and where corrective measures are necessary to protect human health and the environment.

3.1 Burn Site Groundwater Area of Concern

In March 2007, NMED HWB sent a letter of approval, which required DOE/NNSA and SNL/NM personnel to "determine the nature and extent of the contamination and complete a CME for the perchlorate-impacted groundwater in the vicinity of CYN-MW6" (NMED March 2007). As this was based solely on four quarters of monitoring results, DOE and SNL/NM personnel submitted a letter to the NMED HWB in April 2007 (SNL/NM April 2007) recommending further characterization through continued quarterly monitoring of monitoring well CYN-MW6 for an additional four quarters, ending in December 2007, to ensure appropriate characterization of this well. In January 2008, DOE/NNSA and SNL/NM personnel requested a meeting with the NMED HWB to discuss the need for continued monitoring or additional characterization work and, potentially, a CME.

In preparation for discussing the perchlorate-impacted groundwater in the vicinity of monitoring well CYN-MW6, and to show that the requirement "to determine the nature and extent of contamination" (NMED March 2007) had been met, DOE/NNSA and SNL/NM personnel provided supporting information to the NMED HWB (SNL/NM March 2008). Perchlorate in surface soil has been characterized at several Solid Waste Management Units in the study area (SNL/NM June 2006 and March 2008–Appendix C). Based on these data, DOE/NNSA and SNL/NM personnel consider the nature and extent of perchlorate in groundwater at the BSG AOC to be sufficiently characterized. Since 2004, groundwater samples from four other monitoring wells in the vicinity of the BSG AOC have been analyzed for perchlorate, including monitoring wells CYN-MW1D, CYN-MW5, CYN-MW7, and CYN-MW8. All wells were sampled for four quarters and all results were ND for perchlorate (SNL/NM March 2008–Appendix D).

In accordance with the requirements of Section VI.K.1.b of the Consent Order (NMED April 2004), a human health risk assessment has been performed to evaluate the potential for adverse health effects from the concentrations of perchlorate detected in monitoring well CYN-MW6 groundwater samples. The maximum perchlorate concentration to date of 8.93 µg/L was used in the risk assessment. The calculated hazard

quotient of 0.35 is less than the NMED HWB target level of a hazard index (the sum of all hazard quotients) of 1.0 (NMED June 2006, SNL/NM March 2008–Appendix E). For another point of comparison, NMED HWB risk assessment guidance lists a tap water standard of 13.8 µg/L for perchlorate (NMED February 2019a); therefore, the historical maximum concentration detected is 35 percent less than the NMED HWB tap water standard.

Because perchlorate concentrations in samples from monitoring well CYN-MW6 have exceeded the screening level, DOE/NNSA and SNL/NM personnel initiated a negotiation process with the NMED HWB (SNL/NM March 2007) to determine the frequency of continued monitoring. In November 2008, DOE/NNSA and SNL/NM personnel received approval from the NMED HWB to proceed with semiannual monitoring of perchlorate in monitoring well CYN-MW6 and proceed with semiannual reporting of all perchlorate results (NMED November 2008). Upon further consideration, the NMED HWB once more required that DOE/NNSA and SNL/NM personnel resume quarterly monitoring and reporting of perchlorate results with the exception of monitoring well CYN-MW6 (NMED April 2009). Due to declining water levels, CYN-MW6 has insufficient water to routinely sample and was replaced; the last sample collected at CYN-MW6 was on October 15, 2012. The replacement monitoring well (CYN-MW15) was installed in December 2014 and assumed the negotiated semiannual monitoring frequency. Monitoring well CYN-MW14A was also installed in December 2014; this well was considered a new monitoring well that requires quarterly sampling due to its deep screen interval.

In April 2009, NMED HWB sent a letter that required DOE/NNSA and SNL/NM personnel to characterize the nature and extent of the perchlorate contamination in soil and groundwater in the BSG AOC (NMED April 2009). A characterization work plan was prepared and submitted to the NMED HWB (SNL/NM November 2009), approved by the NMED HWB (NMED February 2010), and implemented in July 2010.

In January 2019, a Monitoring Well Installation Work Plan for the BSG AOC was submitted to NMED HWB (SNL/NM January 2019) and subsequently approved by NMED HWB (NMED February 2019b). The work plan proposed a minimum of four wells (CYN-MW16 through CYN-MW19) that will help define the extent of nitrate contamination in groundwater and refine the potentiometric surface in the BSG AOC. These four new wells were sampled for the second time during this reporting period and will be sampled for perchlorate for a minimum of four quarters.

3.2 Tijeras Arroyo Groundwater and Technical Area-V Groundwater Areas of Concern

The April 2009 letter from the NMED HWB to DOE/NNSA and SNL/NM personnel was not limited to the BSG AOC (NMED April 2009). The NMED HWB had also requested that DOE/NNSA and SNL/NM personnel monitor perchlorate concentrations for a minimum of four quarters at five monitoring wells in the Tijeras Arroyo Groundwater (TAG) AOC and at four monitoring wells in the Technical Area-V Groundwater AOC. All nine wells from these two AOCs have been sampled for four consecutive monitoring events with no perchlorate detections being reported; therefore, these nine wells have been removed from the perchlorate monitoring well network. A TAG monitoring well (TA2-SW1-320) was damaged and was replaced by well TA2-W-28 in December 2014. The replacement well was installed for monitoring the same depth interval as damaged well TA2-SW1-320. Because well TA2-SW1-320 was not one of the four TAG wells selected for perchlorate sampling, replacement well TA2-W-28 does not require perchlorate sampling.

4.0 Monitoring Results

Table II-3 summarizes the details of samples collected from the four monitoring wells in the January - March 2020 reporting period. Table II-4 summarizes the current and historical perchlorate results for these wells. Appendix A provides the analytical laboratory certificates of analysis for the January – March 2020 perchlorate data. Perchlorate was ND in the January 2020 environmental groundwater samples collected from wells CYN-MW16 through CYN-MW19.

Table II-5 summarizes the stabilized water quality values measured immediately before the groundwater samples were collected. The field water quality measurements include turbidity, pH, temperature, SC, ORP, and DO.

The analytical data were reviewed and validated in accordance with Administrative Operating Procedure 00-03, “Data Validation Procedure for Chemical and Radiochemical Data,” (SNL/NM June 2017). No problems were identified with the analytical data that resulted in qualification of the data as unusable. The data are acceptable and reported quality control measures are adequate. Appendix B provides the data validation sample findings summary sheets for the perchlorate data.

No variances or nonconformances in perchlorate sampling field activities, or field conditions from requirements in the groundwater monitoring Mini-SAP (SNL/NM January 2020), were identified during the January - March 2020 sampling activities.

5.0 Summary and Conclusions

Based on analytical data presented in Table II-4 and in previous reports, the following statements can be made:

- The perchlorate concentrations for the groundwater samples from the four new monitoring wells (CYN-MW16 through CYN-MW19) were all ND.

- Since June 2004 (the start of sampling as required by the Consent Order), perchlorate was detected above the screening level/MDL (4 µg/L) in groundwater samples collected from only one well (CYN-MW6) and its replacement well (CYN-MW15) in the perchlorate monitoring well network.

- DOE/NNSA and SNL/NM personnel will continue semiannual monitoring of perchlorate at monitoring well CYN-MW15 and quarterly monitoring of perchlorate at monitoring wells CYN-MW16 through CYN-MW19.

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Figures

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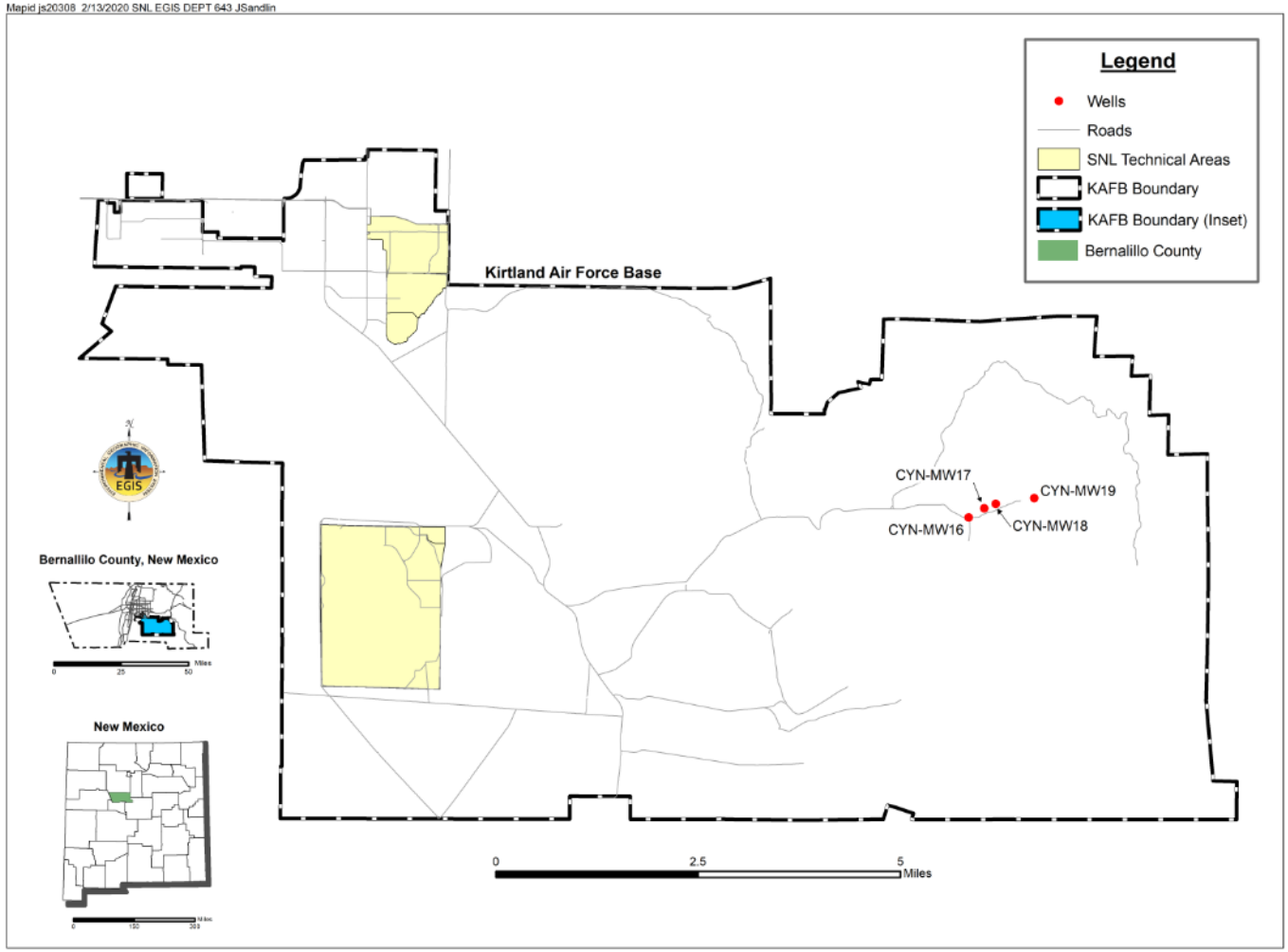

Figure II-1
Sandia National Laboratories, New Mexico
Current Perchlorate Screening Monitoring Well Network, January – March 2020

Tables

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Table II-1
Current Perchlorate Screening Monitoring Well Network
January - March 2020

Well	Date Sampled	Number of Consecutive Sampling Events[a]	Remaining Number of Sampling Events	Sampling Equipment
CYN-MW16	16-Jan-20	2	2	Bennett™ Pump
CYN-MW17	14-Jan-20	2	2	Bennett™ Pump
CYN-MW18	15-Jan-20	2	2	Bennett™ Pump
CYN-MW19	13-Jan-20	2	2	Bennett™ Pump

Notes

[a]Includes this sampling event.

CYN = Canyons (Burn Site Groundwater Area of Concern).
MW = Monitoring well.

Table II-2
Monitoring Wells Discussed in Previous Perchlorate Screening Reports

Well	Date of Last Perchlorate Sampling Event
CCBA-MW1	Oct 2014
CCBA-MW2	Oct 2014
CTF-MW1	Jan 2014
CTF-MW2	Sep 2014
CTF-MW3	Sep 2014
CYN-MW1D	Sep 2006
CYN-MW5	Jan 2014
CYN-MW6	Oct 2012
CYN-MW7	Dec 2006
CYN-MW8	Dec 2006
CYN-MW9	May 2011
CYN-MW10	May 2011
CYN-MW11	May 2011
CYN-MW12	May 2011
CYN-MW14A	Sep 2015
CYN-MW15	Oct 2019*
LWDS-MW1	Feb 2010
MRN-2	Sep 2006
MRN-3D	Sep 2006
MWL-BW1	Apr 2005
MWL-BW2	Jan 2009

Well	Date of Last Perchlorate Sampling Event
MWL-MW1	Apr 2005
MWL-MW7	Apr 2009
MWL-MW8	Apr 2009
MWL-MW9	Apr 2009
NWTA3-MW2	Jun 2006
OBS-MW1	Oct 2014
OBS-MW2	Oct 2014
OBS-MW3	Oct 2014
SWTA3-MW4	Dec 2006
TA1-W-03	Nov 2010
TA1-W-06	May 2010
TA1-W-08	May 2010
TA2-W-01	May 2010
TA2-W-27	May 2010
TAV-MW11	Nov 2011
TAV-MW12	Nov 2011
TAV-MW13	Nov 2011
TAV-MW14	Nov 2011
TAV-MW15	Oct 2017
TAV-MW16	Nov 2017

Notes

* = Monitoring well CYN-MW15 is sampled semiannually.
BW = Background well.
CCBA = Coyote Canyon Blast Area.
CTF = Coyote Test Field.
CYN = Canyons (Burn Site Groundwater Area of Concern).
LWDS = Liquid waste disposal system.
MRN = Magazine Road North.
MW = Monitoring well.
MWL = Mixed Waste Landfill.
NWTA3 = Northwest Technical Area (-III).
OBS = Old Burn Site.
SWTA3 = Southwest Technical Area (-III).
TA1-W = Technical Area-I (Well).
TA2-W = Technical Area-II (Well).
TAV = Technical Area-V.

Table II-3
Sample Details for January - March 2020 Perchlorate Sampling

Well	Sample Identification	AR/COC Number	Associated Groundwater Investigation
CYN-MW16	112105-007	620724	BSG AOC
CYN-MW17	112094-007	620721	BSG AOC
CYN-MW18	112101-007 112102-007	620723	BSG AOC
CYN-MW19	112090-007	620719	BSG AOC

Notes

AOC = Area of Concern.
AR/COC = Analysis Request/Chain-of-Custody.
BSG = Burn Site Groundwater.
CYN = Canyons (Burn Site Groundwater Area of Concern).
MW = Monitoring well.

Table II-4
Summary of Perchlorate Screening Analytical Results for the Current Monitoring Well Network, January - March 2020

Well	Sample Date	AR/COC Number	Sample Number	Result (µg/L)	MDL (µg/L)	PQL (µg/L)	MCL (µg/L)	Laboratory Qualifier[a]	Validation Qualifier[b]	Analytical Method[c]	Comments
Burn Site Groundwater Area of Concern											
CYN-MW16	20-Nov-19	620651	111922-007	ND	4.0	12	NE	U		EPA 314.0	
			111923-004	ND	4.0	12	NE	U		EPA 314.0	Duplicate sample
	16-Jan-20	620724	112105-007	ND	4.0	12	NE	U		EPA 314.0	
CYN-MW17	19-Nov-19	620652	111926-007	ND	4.0	12	NE	U		EPA 314.0	
	14-Jan-20	620721	112094-007	ND	4.0	12	NE	U		EPA 314.0	
CYN-MW18	19-Nov-19	620653	111929-007	ND	4.0	12	NE	U		EPA 314.0	
	15-Jan-20	620723	112101-007	ND	4.0	12	NE	U		EPA 314.0	
			112102-007	ND	4.0	12	NE	U		EPA 314.0	Duplicate sample
CYN-MW19	18-Nov-19	620654	111932-007	ND	4.0	12	NE	U		EPA 314.0	
	13-Jan-20	620719	112090-007	ND	4.0	12	NE	U		EPA 314.0	

Notes

[a]Laboratory Qualifier
U = Analyte is absent or below the MDL.

[b]Validation Qualifier
If cell is blank, then all quality control samples meet acceptance criteria with respect to submitted samples.

[c]Analytical Method
EPA 314.0: EPA, November 1999, "Perchlorate in Drinking Water Using Ion Chromatography," EPA 815/R-00-014 .

% = Percent.
µg/L = Micrograms per liter.
AR/COC = Analysis Request/Chain-of-Custody.
CFR = Code of Federal Regulations.
CYN = Canyons (Burn Site Groundwater Area of Concern).
EPA = U.S. Environmental Protection Agency.
MCL = Maximum contaminant level. Established by the EPA Primary Water Regulations (40 CFR 141.11, Subpart B) and subsequent amendments or Title 20, Chapter 7, Part 1 of the New Mexico Administrative Code, incorporating 40 CFR 141.
MDL = Method detection limit. The minimum concentration that can be measured and reported with 99% confidence that the analyte is greater than zero; analyte is matrix-specific.
MW = Monitoring well.
ND = Non-detect (at MDL).
NE = Not established.
PQL = Practical quantitation limit. The lowest concentration of analytes in a sample that can be reliably determined within specified limits of precision and accuracy by the indicated method under routine laboratory operating conditions.

Table II-5
Perchlorate Screening Groundwater Monitoring
Field Water Quality Measurements[a], January - March 2020

Well	Sample Date	Temperature (°C)	Specific Conductivity (µmho/cm)	Oxidation-Reduction Potential (mV)	pH	Turbidity (NTU)	Dissolved Oxygen (% Sat)	Dissolved Oxygen (mg/L)
Burn Site Groundwater Area of Concern								
CYN-MW16	16-Jan-20	16.06	716.2	-27.7	7.37	0.32	9.70	0.82
CYN-MW17	14-Jan-20	18.25	599.1	-40.5	7.15	0.48	20.5	1.63
CYN-MW18	15-Jan-20	17.49	819.5	141.6	6.89	0.75	7.60	0.61
CYN-MW19	13-Jan-20	14.58	631.8	-95.5	7.62	0.18	65.3	5.53

Notes

[a]Field measurements obtained immediately before the groundwater sample was collected.

°C = Degrees Celsius.
% Sat = Percent saturation.
µmho/cm = Micromho(s) per centimeter.
CYN = Canyons (Burn Site Groundwater Area of Concern).
mg/L = Milligrams per liter.
mV = Millivolt(s).
MW = Monitoring well.
NTU = Nephelometric turbidity unit.
pH = Potential of hydrogen (negative logarithm of the hydrogen ion concentration).

Appendix A
Analytical Laboratory Certificates of Analysis for the Perchlorate Data

SMO 2012-ARCOC (4-2012)

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY

AOP 95-16

501457

Internal Lab

Batch No. N/A

SMO Use

AR/COC 620724

Project Name:	ER BURN SITE	Date Samples Shipped:	1/16/2020
Project/Task Manager:	Michael Skelly	Carrier/Waybill No.	309042
Project/Task Number:	176092.01.06	Lab Contact:	Edie Kent/843-769-7385
Service Order:	CF671-20	Lab Destination:	GEL
Tech Area:		Contract No.:	1983530
Building:	Room:	Operational Site:	

SMO Authorization:

SMO Contact Phone: Wendy Palencia/505-844-3132

Send Report to SMO: Stephanie Montaño/505-284-2553

☐ Waste Characterization
☐ RMA
☐ Released by COC No.
☑ 4° Celsius

Bill to: Sandia National Laboratories (Accounts Payable), P.O. Box 5800, MS-0154 Albuquerque, NM 87185-0154

Sample No.	Fraction	Sample Location Detail	Depth (ft)	Date/Time Collected	Sample Matrix	Container Type	Container Volume	Preservative	Collection Method	Sample Type	Parameter & Method Requested	Lab Sample ID
112104	001	ER Burn Site-FB 1	NA	1/16/20 10:24	DIW	G	3x40 ml	HCl	G	FB	VOC, TCL PRESERVED (SW846-8260B)	001
112104	002	ER Burn Site-FB 2	NA	1/16/20 10:25	DIW	AG	3x40 ml	NONE	G	FB	TPH-GRO (SW846-8015)	002
112105	001	CYN-MW16	399	1/16/20 10:41	GW	G	3x40 ml	HCl	G	SA	VOC, TCL PRESERVED (SW846-8260B)	003
112105	002	CYN-MW16	399	1/16/20 10:42	GW	AG	3x40 ml	NONE	G	SA	TPH-GRO (SW846-8015)	004
112105	003	CYN-MW16	399	1/16/20 10:43	GW	AG	4x1 L	NONE	G	SA	TPH-DRO (SW846-8015)	005
112105	004	CYN-MW16	399	1/16/20 10:44	GW	AG	4x1 L	None	G	SA	HE (SW846-8330B LC/MS/MS)	006
112105	005	CYN-MW16	399	1/16/20 10:45	GW	P	125 ml	H2SO4	G	SA	NPN (EPA 353.2)	007
112105	006	CYN-MW16	399	1/16/20 10:46	GW	P	125 ml	None	G	SA	ANIONS-Br,Cl,F,SO4 (SW846-9056)	008
112105	007	CYN-MW16	399	1/16/20 10:47	GW	P	250 ml	None	G	SA	PERCHLORATE (EPA 314.0)	009
112105	008	CYN-MW16	399	1/16/20 10:48	GW	P	500 ml	HNO3	G	SA	METALS, TAL + Mo (SW846-6020/7470)	010

Last Chain: ☑ Yes
Validation Req'd: ☑ Yes
Background: ☐ Yes
Confirmatory: ☐ Yes

Sample Tracking — SMO Use
Date Entered:
Entered by:
QC inits.:

Special Instructions/QC Requirements:
EDD ☑ Yes
Turnaround Time ☐ 7-Day* ☐ 15-Day* ☑ 30-Day
Negotiated TAT ☐
Sample Disposal ☐ Return to Client ☑ Disposal by Lab
Return Samples By:
Comments: If perchlorate detected, then request verification analysis using method SW846-6850. Received trip blanks from lab with head space. Filtered sample collected in field using 0.45 micron filter.

Conditions on Receipt

Sample Team Members	Name	Signature	Init.	Company/Organization/Phone/Cell
	Robert Lynch		RL	SNL/08888/505-844-4013/505-250-7090
	Zachary Tenorio		ZT	SNL/08888/505-845-8636/505-259-5765
	Denisha Sanchez		DS	SNL/08888/505-845-7829/505-208-1375
	William Gibson		WG	SNL/08888/505-284-3307/505-239-7367

Relinquished by		Org. 08888	Date 1/16/2020	Time 1705	Relinquished by	Org. Date Time
Received by		Org. 00628	Date 1/16/2020	Time 1705	Received by	Org. Date Time
Relinquished by		Org. 00628	Date 1/16/20	Time 1940	Relinquished by	Org. Date Time
Received by		Org.	Date 1-17-20	Time 7:20	Received by	Org. Date Time

Lab Use

*Prior confirmation with SMO required for 7 and 15 day TAT

SMO 2012-ARCOC (4-2012)

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY (Continuation)

AOP 95-16

AR/COC 620724

Project Name:	ER BURN SITE	Project/Task Manager:	Michael Skelly	Project/Task No.:	176092.01.06
Tech Area:					
Building:	Room:				

Sample No.	Fraction	Sample Location Detail	Depth (ft)	Date/Time Collected	Sample Matrix	Container Type	Container Volume	Preserv-ative	Collection Method	Sample Type	Parameter & Method Requested	Lab use Lab Sample ID
112105	009	CYN-MW16	399	1/16/20 10:49	FGW	P	500 ml	HNO3	G	SA	METALS, TAL + Mo (SW846-6020/7470)	011
112105	010	CYN-MW16	399	1/16/20 10:50	GW	P	1 L	HNO3	G	SA	GAMMA SPEC, SHORT LIST (EPA 901)	012
112105	011	CYN-MW16	399	1/16/20 10:51	GW	P	1 L	HNO3	G	SA	GROSS-ALPHA/BETA (EPA 900)	013
112105	012	CYN-MW16	399	1/16/20 10:52	GW	P	1 L	HNO3	G	SA	ISO U (HASL-300)	014
112105	013	CYN-MW16	399	1/16/20 10:53	GW	AG	250 ml	NONE	G	SA	TRITIUM (EPA 906)	015
112106	001	ER Burn Site-TB 11	NA	1/16/20 10:24	DIW	G	3x40 ml	HCl	G	TB	VOC, TCL PRESERVED (SW846-8260B)	016
112106	002	ER Burn Site-TB 12	NA	1/16/20 10:25	DIW	AG	3x40 ml	None	G	TB	TPH-GRO (SW846-8015)	017

Recipient Initials_____

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: February 13, 2020

Company :	Sandia National Laboratories
Address :	1515 Eubank SE,ORG 4142 BLDG. 1090/120, MS 1103 Albuquerque, New Mexico 87123
Contact:	Ms. Wendy Palencia
Project:	Groundwater, Level C Package

Client Sample ID:	112105-007	Project:	SNLSGWtr
Sample ID:	501457009	Client ID:	SNLS005
Matrix:	AQUEOUS		
Collect Date:	16-JAN-20 10:47		
Receive Date:	17-JAN-20	Client Desc.:	CYN-MW16
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Ion Chromatography												
EPA 314.0 Perchlorate by IC "As Received"												
Perchlorate	U	ND	0.00400	0.0120	mg/L		1	LXA2	02/04/20	2009	1965256	1

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	EPA 314.0 DOE-AL	

Notes:

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

SMO 2012-ARCOC (4-2012)

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY

AOP 95-16

Internal Lab

Batch No.

SMO Use

AR/COC 620721

Project Name: ER BURN SITE	Date Samples Shipped: 1/15/2020	SMO Authorization:	☐ Waste Characterization
Project/Task Manager: Michael Skelly	Carrier/Waybill No. 308957	SMO Contact Phone: Wendy Palencia/505-844-3132	☐ RMA
Project/Task Number: 176092.01.06	Lab Contact: Edie Kent/843-769-7385		☐ Released by COC No.
Service Order: CF671-20	Lab Destination: GEL	Send Report to SMO: Stephanie Montaño/505-284-2553	☑ 4° Celsius
	Contract No.: 1983530		Bill to: Sandia National Laboratories (Accounts Payable), P.O. Box 5800, MS-0154 Albuquerque, NM 87185-0154
Tech Area:			
Building: Room:	Operational Site:		

Sample No.	Fraction	Sample Location Detail	Depth (ft)	Date/Time Collected	Sample Matrix	Container Type	Container Volume	Preservative	Collection Method	Sample Type	Parameter & Method Requested	Lab Sample ID
112094	001	CYN-MW17	394	1/14/20 10:47	GW	G	3x40 ml	HCl	G	SA	VOC, TCL PRESERVED (SW846-8260B)	035
112094	002	CYN-MW17	394	1/14/20 10:48	GW	AG	3x40 ml	NONE	G	SA	TPH-GRO (SW846-8015)	036
112094	003	CYN-MW17	394	1/14/20 10:49	GW	AG	4x1 L	NONE	G	SA	TPH-DRO (SW846-8015)	037
112094	004	CYN-MW17	394	1/14/20 10:50	GW	AG	4x1 L	None	G	SA	HE (SW846-8330B LC/MS/MS)	038
112094	005	CYN-MW17	394	1/14/20 10:51	GW	P	125 ml	H2SO4	G	SA	NPN (EPA 353.2)	039
112094	006	CYN-MW17	394	1/14/20 10:52	GW	P	125 ml	None	G	SA	ANIONS-Br,Cl,F,SO4 (SW846-9056)	040
112094	007	CYN-MW17	394	1/14/20 10:53	GW	P	250 ml	None	G	SA	PERCHLORATE (EPA 314.0)	041
112094	008	CYN-MW17	394	1/14/20 10:54	GW	P	500 ml	HNO3	G	SA	METALS, TAL + Mo (SW846-6020/7470)	042
112094	009	CYN-MW17	394	1/14/20 10:55	FGW	P	500 ml	HNO3	G	SA	METALS, TAL + Mo (SW846-6020/7470)	043
112094	010	CYN-MW17	394	1/14/20 10:56	GW	P	1 L	HNO3	G	SA	GAMMA SPEC, SHORT LIST (EPA 901)	044

Last Chain: ☐ Yes	Sample Tracking	SMO Use	Special Instructions/QC Requirements:
Validation Req'd: ☑ Yes	Date Entered:		EDD ☑ Yes
Background: ☐ Yes	Entered by:		Turnaround Time ☐ 7-Day* ☐ 15-Day* ☑ 30-Day
Confirmatory: ☐ Yes	QC inits.		Negotiated TAT ☐
			Sample Disposal ☐ Return to Client ☑ Disposal by Lab
			Return Samples By:
			Comments: If perchlorate detected, then request verification analysis using method SW846-6850. Received trip blanks from lab with head space and broken seal. used 0.45 micron filter in the field on filtered fraction 009. WJG 1-14-20

Conditions on Receipt

Sample Team Members	Name	Signature	Init.	Company/Organization/Phone/Cell
	Robert Lynch		RL	SNL/08888/505-844-4013/505-250-7090
	Zachary Tenorio		ZT	SNL/08888/505-845-8636/505-259-5765
	Denisha Sanchez		DS	SNL/08888/505-845-7829/505-208-1375
	William Gibson		WJG	SNL/08888/505-284-3307/505-239-7367

						Lab Use
Relinquished by	Org. 8888	Date 1/14/20	Time 1139	Relinquished by	Org.	Date	Time
Received by	Org. 0628	Date 1/14/20	Time 1139	Received by	Org.	Date	Time
Relinquished by	Org. 00628	Date 1/15/20	Time 0900	Relinquished by	Org.	Date	Time
Received by	Org.	Date 1/16/20	Time 720	Received by	Org.	Date	Time

*Prior confirmation with SMO required for 7 and 15 day TAT

SMO 2012-ARCOC (4-2012)

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY (Continuation)

AOP 95-16

AR/COC 620721

Project Name:	ER BURN SITE	Project/Task Manager:	Michael Skelly	Project/Task No.:	176092.01.06
Tech Area:					
Building:	Room:				

Sample No.	Fraction	Sample Location Detail	Depth (ft)	Date/Time Collected	Sample Matrix	Container Type	Container Volume	Preserv-ative	Collection Method	Sample Type	Parameter & Method Requested	Lab use Lab Sample ID
112094	011	CYN-MW17	394	1/14/20 10:57	GW	P	1 L	HNO3	G	SA	GROSS-ALPHA/BETA (EPA 900)	045
112094	012	CYN-MW17	394	1/14/20 10:58	GW	P	1 L	HNO3	G	SA	ISO U (HASL-300)	046
112094	013	CYN-MW17	394	1/14/20 10:59	GW	AG	250 ml	NONE	G	SA	TRITIUM (EPA 906)	047
112095	001	ER BSG-TB 5	NA	1/14/20 10:47	DIW	G	3x40 ml	HCl	G	TB	VOC, TCL PRESERVED (SW846-8260B)	048
112095	002	ER BSG-TB 6	NA	1/14/20 10:48	DIW	AG	3x40 ml	None	G	TB	TPH-GRO (SW846-8015)	049

Recipient Initials TC

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: February 13, 2020

Company :	Sandia National Laboratories
Address :	1515 Eubank SE,ORG 4142 BLDG. 1090/120, MS 1103 Albuquerque, New Mexico 87123
Contact:	Ms. Wendy Palencia
Project:	Groundwater, Level C Package

Client Sample ID:	112094-007	Project:	SNLSGWtr
Sample ID:	501283041	Client ID:	SNLS005
Matrix:	AQUEOUS		
Collect Date:	14-JAN-20 10:53		
Receive Date:	16-JAN-20	Client Desc.:	CYN-MW17
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
:on Chromatography												
EPA 314.0 Perchlorate by IC "As Received"												
Perchlorate	U	ND	0.00400	0.0120	mg/L		1	LXA2	02/04/20	1907	1965256	1

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	EPA 314.0 DOE-AL	

Notes:

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

SMO 2012-ARCOC (4-2012)

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY

AOP 95-16

501283

Internal Lab

Page 1 of 8 Multiple

Batch No. N/A

SMO Use

AR/COC 620723

Project Name:	ER BURN SITE	Date Samples Shipped:	1/15/2020	SMO Authorization:	☐ Waste Characterization
Project/Task Manager:	Michael Skelly	Carrier/Waybill No.	308957	SMO Contact Phone: Gmail	☐ RMA
Project/Task Number:	176092.01.06	Lab Contact:	Edie Kent/843-769-7385	Wendy Palencia/505-844-3132	☐ Released by COC No.
Service Order:	CF671-20	Lab Destination:	GEL	Send Report to SMO:	☑ 4° Celsius
		Contract No.:	1983530	Stephanie Montaño/505-284-2553	Bill to: Sandia National Laboratories (Accounts Payable), P.O. Box 5800, MS-0154 Albuquerque, NM 87185-0154
Tech Area:					
Building:	Room:	Operational Site:			

Sample No.	Fraction	Sample Location Detail	Depth (ft)	Date/Time Collected	Sample Matrix	Container Type	Container Volume	Preservative	Collection Method	Sample Type	Parameter & Method Requested	Lab Sample ID
112101	001	CYN-MW18	294	1/15/20 10:43	GW	G	3x40 ml	HCl	G	SA	VOC, TCL PRESERVED (SW846-8260B)	001
112101	002	CYN-MW18	294	1/15/20 10:44	GW	AG	3x40 ml	NONE	G	SA	TPH-GRO (SW846-8015)	002
112101	003	CYN-MW18	294	1/15/20 10:45	GW	AG	4x1 L	NONE	G	SA	TPH-DRO (SW846-8015)	003
112101	004	CYN-MW18	294	1/15/20 10:46	GW	AG	4x1 L	None	G	SA	HE (SW846-8330B LC/MS/MS)	004
112101	005	CYN-MW18	294	1/15/20 10:47	GW	P	125 ml	H2SO4	G	SA	NPN (EPA 353.2)	005
112101	006	CYN-MW18	294	1/15/20 10:48	GW	P	125 ml	None	G	SA	ANIONS-Br,Cl,F,SO4 (SW846-9056)	006
112101	007	CYN-MW18	294	1/15/20 10:49	GW	P	250 ml	None	G	SA	PERCHLORATE (EPA 314.0)	007
112101	008	CYN-MW18	294	1/15/20 10:50	GW	P	500 ml	HNO3	G	SA	METALS, TAL + Mo (SW846-6020/7470)	008
112101	009	CYN-MW18	294	1/15/20 10:51	FGW	P	500 ml	HNO3	G	SA	METALS, TAL + Mo (SW846-6020/7470)	009
112101	010	CYN-MW18	294	1/15/20 10:52	GW	P	1 L	HNO3	G	SA	GAMMA SPEC, SHORT LIST (EPA 901)	010

Last Chain:	☐ Yes	Sample Tracking	SMO Use
Validation Req'd:	☑ Yes	Date Entered:	
Background:	☐ Yes	Entered by:	
Confirmatory:	☐ Yes	QC inits.:	

Sample Team Members	Name	Signature	Init.	Company/Organization/Phone/Cell
	Robert Lynch		RL	SNL/08888/505-844-4013/505-250-7090
	Zachary Tenorio		ZT	SNL/08888/505-845-8636/505-259-5765
	Denisha Sanchez		DS	SNL/08888/505-845-7829/505-208-1375
	William Gibson		WG	SNL/08888/505-284-3307/505-239-7367

Special Instructions/QC Requirements:

EDD ☑ Yes

Turnaround Time ☐ 7-Day* ☐ 15-Day* ☑ 30-Day

Negotiated TAT ☐

Sample Disposal ☐ Return to Client ☑ Disposal by Lab

Return Samples By:

Comments: If perchlorate detected, then request verification analysis using method SW846-6850. Received trip blanks from lab with head space. Filtered metal samples in field using 0.45 micron filter.

Conditions on Receipt

Lab Use

Relinquished by		Org. 8888	Date 1/15/20	Time 1135	Relinquished by	Org.	Date	Time
Received by		Org. 6628	Date 1/15/20	Time 1135	Received by	Org.	Date	Time
Relinquished by		Org. 6628	Date 1/15/20	Time 1205	Relinquished by	Org.	Date	Time
Received by		Org.	Date 1/16/20	Time 720	Received by	Org.	Date	Time

*Prior confirmation with SMO required for 7 and 15 day TAT

SMO 2012-ARCOC (4-2012)

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY (Continuation)

AOP 95-16

AR/COC 620723

Project Name:	ER BURN SITE	Project/Task Manager:	Michael Skelly	Project/Task No.:	176092.01.06
Tech Area:					
Building:	Room:				

Sample No.	Fraction	Sample Location Detail	Depth (ft)	Date/Time Collected	Sample Matrix	Container Type	Container Volume	Preservative	Collection Method	Sample Type	Parameter & Method Requested	Lab use Lab Sample ID
112101	011	CYN-MW18	294	1/15/20 10:53	GW	P	1 L	HNO3	G	SA	GROSS-ALPHA/BETA (EPA 900)	011
112101	012	CYN-MW18	294	1/15/20 10:54	GW	P	1 L	HNO3	G	SA	ISO U (HASL-300)	012
112101	013	CYN-MW18	294	1/15/20 10:55	GW	AG	250 ml	NONE	G	SA	TRITIUM (EPA 906)	013
112102	002	CYN-MW18	294	1/15/20 10:44	GW	AG	3x40 ml	NONE	G	DU	TPH-GRO (SW846-8015)	014
112102	003	CYN-MW18	294	1/15/20 10:45	GW	AG	4x1 L	NONE	G	DU	TPH-DRO (SW846-8015)	015
112102	005	CYN-MW18	294	1/15/20 10:47	GW	P	125 ml	H2SO4	G	DU	NPN (EPA 353.2)	016
112102	007	CYN-MW18	294	1/15/20 10:49	GW	P	250 ml	None	G	DU	PERCHLORATE (EPA 314.0)	017
112103	001	ER Burn Site-TB 9	NA	1/15/20 10:43	DIW	G	3x40 ml	HCl	G	TB	VOC, TCL PRESERVED (SW846-8260B)	018
112103	002	ER Burn Site-TB 10	NA	1/15/20 10:44	DIW	AG	3x40 ml	None	G	TB	TPH-GRO (SW846-8015)	019

Recipient Initials TL

Certificate of Analysis

Report Date: February 13, 2020

Company :	Sandia National Laboratories
Address :	1515 Eubank SE,ORG 4142 BLDG. 1090/120, MS 1103 Albuquerque, New Mexico 87123
Contact:	Ms. Wendy Palencia
Project:	Groundwater, Level C Package

Client Sample ID:	112101-007	Project:	SNLSGWtr
Sample ID:	501283007	Client ID:	SNLS005
Matrix:	AQUEOUS		
Collect Date:	15-JAN-20 10:49		
Receive Date:	16-JAN-20	Client Desc.:	CYN-MW18
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Ion Chromatography												
EPA 314.0 Perchlorate by IC "As Received"												
Perchlorate	U	ND	0.00400	0.0120	mg/L		1	LXA2	02/04/20	1804	1965256	1

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	EPA 314.0 DOE-AL	

Notes:

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: February 13, 2020

Company :	Sandia National Laboratories
Address :	1515 Eubank SE,ORG 4142 BLDG. 1090/120, MS 1103 Albuquerque, New Mexico 87123
Contact:	Ms. Wendy Palencia
Project:	Groundwater, Level C Package

Client Sample ID:	112102-007	Project:	SNLSGWtr
Sample ID:	501283017	Client ID:	SNLS005
Matrix:	AQUEOUS		
Collect Date:	15-JAN-20 10:49		
Receive Date:	16-JAN-20	Client Desc.:	CYN-MW18
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Ion Chromatography												
EPA 314.0 Perchlorate by IC "As Received"												
Perchlorate	U	ND	0.00400	0.0120	mg/L	1	1	LXA2	02/04/20	1825	1965256	1

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	EPA 314.0 DOE-AL	

Notes:

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

SDG: 500942

SMO 2012-ARCOC (4-2012)

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY

AOP 95-16

500942

Internal Lab

Batch No.

SMO Use

AR/COC 620719

Project Name:	ER BURN SITE	Date Samples Shipped:	1/13/20	SMO Authorization:	☐ Waste Characterization
Project/Task Manager:	Michael Skelly	Carrier/Waybill No.	308833	SMO Contact Phone:	☐ RMA
Project/Task Number:	176092.01.06	Lab Contact:	Edie Kent/843-769-7385	Wendy Palencia/505-844-3132	☐ Released by COC No.
Service Order:	CF671-20	Lab Destination:	GEL	Send Report to SMO:	☑ 4° Celsius
		Contract No.:	1983530	Stephanie Montaño/505-284-2553	Bill to: Sandia National Laboratories (Accounts Payable), P.O. Box 5800, MS-0154 Albuquerque, NM 87185-0154
Tech Area:					
Building:	Room:	Operational Site:			

Sample No.	Fraction	Sample Location Detail	Depth (ft)	Date/Time Collected	Sample Matrix	Container Type	Container Volume	Preservative	Collection Method	Sample Type	Parameter & Method Requested	Lab Sample ID
112090	001	CYN-MW19	84	1/13/20 10:23	GW	G	3x40 ml	HCl	G	SA	VOC, TCL PRESERVED (SW846-8260B)	001
112090	002	CYN-MW19	84	1/13/20 10:24	GW	AG	3x40 ml	NONE	G	SA	TPH-GRO (SW846-8015)	002
112090	003	CYN-MW19	84	1/13/20 10:25	GW	AG	4x1 L	NONE	G	SA	TPH-DRO (SW846-8015)	003
112090	004	CYN-MW19	84	1/13/20 10:26	GW	AG	4x1 L	None	G	SA	HE (SW846-8330B LC/MS/MS)	004
112090	005	CYN-MW19	84	1/13/20 10:28	GW	P	125 ml	H2SO4	G	SA	NPN (EPA 353.2)	005
112090	006	CYN-MW19	84	1/13/20 10:30	GW	P	125 ml	None	G	SA	ANIONS-Br,Cl,F,SO4 (SW846-9056)	006
112090	007	CYN-MW19	84	1/13/20 10:31	GW	P	250 ml	None	G	SA	PERCHLORATE (EPA 314.0)	007
112090	008	CYN-MW19	84	1/13/20 10:32	GW	P	500 ml	HNO3	G	SA	METALS, TAL + Mo (SW846-6020/7470)	008
112090	009	CYN-MW19	84	1/13/20 10:33	FGW	P	500 ml	HNO3	G	SA	METALS, TAL + Mo (SW846-6020/7470)	009
112090	010	CYN-MW19	84	1/13/20 10:34	GW	P	1 L	HNO3	G	SA	GAMMA SPEC, SHORT LIST (EPA 901)	010

Last Chain:	☐ Yes	Sample Tracking	SMO Use
Validation Req'd:	☑ Yes	Date Entered:	
Background:	☐ Yes	Entered by:	
Confirmatory:	☐ Yes	QC inits.:	

Sample Team Members	Name	Signature	Init.	Company/Organization/Phone/Cell
	Robert Lynch			SNL/08888/505-844-4013/505-250-7090
	Zachary Tenorio			SNL/08888/505-845-8636/505-259-5765
	Denisha Sanchez			SNL/08888/505-845-7829/505-208-1375
	William Gibson			SNL/08888/505-284-3307/505-239-7367

Special Instructions/QC Requirements:

EDD ☑ Yes

Turnaround Time ☐ 7-Day* ☐ 15-Day* ☑ 30-Day

Negotiated TAT ☐

Sample Disposal ☐ Return to Client ☑ Disposal by Lab

Return Samples By:

Comments: If perchlorate detected, then request verification analysis using method SW846-6850. Received trip blanks from lab with head space. Received Trip Blanks with Broken Custody Tape.

Conditions on Receipt

Lab Use

Relinquished by		Org. 5888	Date 1/13/20	Time 1:30	Relinquished by	Org.	Date	Time
Received by		Org. 0625	Date 1/13/20	Time 1130	Received by	Org.	Date	Time
Relinquished by	TG	Org. 0628	Date 1/13/20	Time 1205	Relinquished by	Org.	Date	Time
Received by		Org.	Date 1-14-20	Time 815	Received by	Org.	Date	Time

*Prior confirmation with SMO required for 7 and 15 day TAT

SDG: 500942

SMO 2012-ARCOC (4-2012)

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY (Continuation)

AOP 95-16

AR/COC 620719

Project Name:	ER BURN SITE	Project/Task Manager:	Michael Skelly	Project/Task No.:	176092.01.06
Tech Area:					
Building:	Room:				

Sample No.	Fraction	Sample Location Detail	Depth (ft)	Date/Time Collected	Sample Matrix	Container Type	Container Volume	Preserv-ative	Collection Method	Sample Type	Parameter & Method Requested	Lab use Lab Sample ID
112090	011	CYN-MW19	84	1/13/20 10:35	GW	P	1 L	HNO3	G	SA	GROSS-ALPHA/BETA (EPA 900)	011
112090	012	CYN-MW19	84	1/13/20 10:36	GW	P	1 L	HNO3	G	SA	ISO U (HASL-300)	012
112090	013	CYN-MW19	84	1/13/20 10:37	GW	AG	250 ml	NONE	G	SA	TRITIUM (EPA 906)	013
112091	001	ER Burn Site-TB 1	NA	1/13/20 10:23	DIW	G	3x40 ml	HCl	G	TB	VOC, TCL PRESERVED (SW846-8260B)	014
112091	002	ER Burn Site-TB 2	NA	1/13/20 10:24	DIW	AG	3x40 ml	None	G	TB	TPH-GRO (SW846-8015)	015

Recipient Initials TG

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: February 11, 2020

Company :	Sandia National Laboratories
Address :	1515 Eubank SE,ORG 4142 BLDG. 1090/120, MS 1103 Albuquerque, New Mexico 87123
Contact:	Ms. Wendy Palencia
Project:	Groundwater, Level C Package

Client Sample ID:	112090-007	Project:	SNLSGWtr
Sample ID:	500942007	Client ID:	SNLS005
Matrix:	AQUEOUS		
Collect Date:	13-JAN-20 10:31		
Receive Date:	14-JAN-20	Client Desc.:	CYN-MW19
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Ion Chromatography												
EPA 314.0 Perchlorate by IC "As Received"												
Perchlorate	U	ND	0.00400	0.0120	mg/L		1	LXA2	02/04/20	1641	1965256	1

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	EPA 314.0 DOE-AL	

Notes:

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

Appendix B
Data Validation Sample Findings
Summary Sheets for the Perchlorate Data

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Memorandum

Date: February 24, 2020

To: File

From: Linda Thal

Subject: Inorganic Data Review and Validation – SNL
Site: ER Burn Site
ARCOC: 620719 and 620720
SDG: 500942
Laboratory: GEL
Project/Task: 176092.01.06
Analysis: General Chemistry

See the attached Data Validation Worksheets for supporting documentation on the data review and validation. This validation was performed according to SNL/NM SMO Procedure AOP 00-03 Rev 5.

Summary

Two samples were prepared and analyzed with accepted procedures using methods EPA 9056A (anions by IC), EPA 353.2 (nitrate/nitrite) and EPA 314.0 (perchlorate). Data were reported for all required analytes. Problems were identified with the data package that resulted in the qualification of data.

Anions:

1. The initial calibration intercept was > the MDL and positive for chloride. The associated result for sample 500942021 was a detect <3X the value of the intercept and will be **qualified J+,I5**.

2. The MS and duplicate analyses were performed on sample -006 and were diluted 10X for chloride and sulfate. Sample -021 (DIW QC) was analyzed undiluted. The associated result for chloride was a detect and will be **qualified J,RP1**; the associated result for sulfate was non-detect and will be **qualified UJ,RP1** due to lack of matrix-specific precision data.

Data are acceptable and reported QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times and Preservation

The samples were prepared and analyzed within the prescribed holding times and were properly preserved.

Calibration

All initial and continuing calibration met QC acceptance criteria except as noted above in the Summary section and as follows. The initial calibration intercept was > the MDL and positive for chloride. The associated result for sample -006 was a detect >3X the value of the intercept and will not be qualified.

Blanks

No target analytes were detected in any of the blanks. A DIW QC sample, sample -021, was submitted with ARCOC 620720 and was used for equipment decontamination after collection of the samples on ARCOC 620719. Cl was detected at ≤ the PQL in sample -021. No field sample results will be qualified.

Laboratory Control Sample (LCS)

All LCS acceptance criteria were met.

Matrix Spike and Matrix Spike Duplicate (MS/MSD)

The MS/PS met QC acceptance criteria.

Laboratory Replicate

The replicate analysis met all QC acceptance criteria except as noted above in the Summary section.

Detection Limits/Dilutions

All detection limits were properly reported and correctly adjusted for dilutions. The following dilutions were performed due to elevated amounts of target analyte present in the samples.

Anions:
Sample -006 was diluted 10X for chloride and sulfate.

Nitrate/nitrite:
Sample -005 was diluted 5X.

Other QC

A DIW QC sample was submitted with ARCOC 620720 and was used for equipment decontamination after collection of the samples on ARCOC 620719.

No other specific issues that affect data quality were identified.

Reviewed by: Mary Donivan **Level:** I **Date:** 02/24/2020

Sample Findings Summary

AR/COC: 620719, 620720

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
DOE EML HASL-300, U-02-RC			
	112090-012/CYN-MW19	Uranium-235/236 (15117-96-1/13982-70-)	BD, FR3
EPA 900.0/SW846 9310			
	112090-011/CYN-MW19	BETA (12587-47-2)	J, FR7
EPA 901.1			
	112090-010/CYN-MW19	Americium-241 (14596-10-2)	BD, FR3
	112090-010/CYN-MW19	Cesium-137 (10045-97-3)	BD, FR3
	112090-010/CYN-MW19	Cobalt-60 (10198-40-0)	BD, FR3
	112090-010/CYN-MW19	Potassium-40 (13966-00-2)	BD, FR3
EPA 906.0 Modified			
	112090-013/CYN-MW19	Tritium (10028-17-8)	BD, FR3
SW846 3005A/6020B			
	112090-008/CYN-MW19	Cobalt (7440-48-4)	J+, CK2
	112090-008/CYN-MW19	Manganese (7439-96-5)	J-, CK3
	112090-008/CYN-MW19	Nickel (7440-02-0)	0.002UJ, B4
	112090-008/CYN-MW19	Vanadium (7440-62-2)	0.02U, B
	112090-009/CYN-MW19	Cobalt (7440-48-4)	J+, CK2
	112090-009/CYN-MW19	Copper (7440-50-8)	J+, CK2
	112090-009/CYN-MW19	Manganese (7439-96-5)	J-, CK3
	112090-009/CYN-MW19	Nickel (7440-02-0)	0.002UJ, B4
	112090-009/CYN-MW19	Vanadium (7440-62-2)	0.02U, B
	112092-008/ER Burn Site QC	Nickel (7440-02-0)	0.002UJ, B4
	112092-008/ER Burn Site QC	Vanadium (7440-62-2)	0.02U, B
SW846 3535A/8330B			
	112090-004/CYN-MW19	Nitrobenzene (98-95-3)	UJ, I4
	112092-004/ER Burn Site QC	Nitrobenzene (98-95-3)	UJ, I4

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
SW846 7470A			
	112090-008/CYN-MW19	Mercury (7439-97-6)	0.0002U, B
	112090-009/CYN-MW19	Mercury (7439-97-6)	0.0002U, B
	112092-008/ER Burn Site QC	Mercury (7439-97-6)	0.0002U, B
SW846 8260B DOE-AL			
	112090-001/CYN-MW19	Acetone (67-64-1)	10U, B1
	112090-001/CYN-MW19	Methylene chloride (75-09-2)	10U, B1
	112092-001/ER Burn Site QC	Acetone (67-64-1)	10U, B1
	112092-001/ER Burn Site QC	Bromodichloromethane (75-27-4)	J+, I5
	112092-001/ER Burn Site QC	Bromomethane (74-83-9)	UJ, I3,C3
	112092-001/ER Burn Site QC	Dibromochloromethane (124-48-1)	J+, I5
	112093-001/ER Burn Site-TB 3	Bromomethane (74-83-9)	UJ, I3,C3
SW846 9056A			
	112092-006/ER Burn Site QC	Chloride (16887-00-6)	J+, I5,RP1
	112092-006/ER Burn Site QC	Sulfate (14808-79-8)	UJ, RP1

All other analyses met QC acceptance criteria; no further data should be qualified.

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Memorandum

Date: February 25, 2020

To: File

From: Linda Thal

Subject: Inorganic Data Review and Validation – SNL
Site: ER Burn Site
ARCOC: 620721, 620722 and 620723
SDG: 501283
Laboratory: GEL
Project/Task: 176092.01.06
Analysis: General Chemistry

See the attached Data Validation Worksheets for supporting documentation on the data review and validation. This validation was performed according to SNL/NM SMO Procedure AOP 00-03 Rev 5.

Summary

Three samples were prepared and analyzed with accepted procedures using method EPA 9056A (anions by IC). Four samples were prepared and analyzed with accepted procedures using methods EPA 353.2 (nitrate/nitrite) and EPA 314.0 (perchlorate). Data were reported for all required analytes. Problems were identified with the data package that resulted in the qualification of data.

Anions batch 1964003:

1. The initial calibration intercept was > the MDL and positive for chloride. The associated result for sample 501283025 was a detect <3X the value of the intercept and will be **qualified J+,I5**.

2. The MS and duplicate analyses were performed on sample -006 and were diluted 25X for chloride and sulfate. Sample -025 (EB) was analyzed undiluted. The associated result for chloride was a detect and will be **qualified J,RP1**; the associated result for sulfate was non-detect and will be **qualified UJ,RP1** due to lack of matrix-specific precision data.

Data are acceptable and reported QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times and Preservation

The samples were prepared and analyzed within the prescribed holding times and were properly preserved.

Calibration

All initial and continuing calibration met QC acceptance criteria except as noted above in the Summary section and as follows. The initial calibration intercepts were > the MDL and positive for chloride. The associated results for samples -006 and -040 were detects >3X the value of the intercepts and will not be qualified.

Blanks

No target analytes were detected in any of the blanks except as follows. Chloride was detected at ≤ the PQL in the EB, sample -025 associated with sample -006. The associated sample result was a detect > the PQL and > 5X the EB value and will not be qualified.

Laboratory Control Sample (LCS)

All LCS acceptance criteria were met.

Matrix Spike and Matrix Spike Duplicate (MS/MSD)

The MS/PS met QC acceptance criteria. It should be noted that the PS for perchlorate and nitrate/nitrite were performed on SNL samples of similar matrix from another SDG. No data will be qualified.

Laboratory Replicate

The replicate analysis met all QC acceptance criteria except as noted above in the Summary section. It should be noted that the replicate for perchlorate and nitrate/nitrite were performed on SNL samples of similar matrix from another SDG. No data will be qualified.

Detection Limits/Dilutions

All detection limits were properly reported and correctly adjusted for dilutions. The following dilutions were performed due to elevated amounts of target analyte present in the samples.

Anions:
Sample -006 was diluted 25X and sample -040 was diluted 10X for chloride and sulfate.

Nitrate/nitrite:
Sample -039 was diluted 5X and samples -005 and -016 were diluted 10X.

Other QC

An EB was submitted with ARCOC 620722 and was associated with the samples on ARCOC 620723. Field duplicate pairs were submitted for perchlorate and nitrate/nitrite with ARCOC 620723. There are no "required" review criteria for field duplicate analyses comparability; no data will be qualified as a result.

No other specific issues that affect data quality were identified.

Reviewed by: Mary Donivan **Level:** I **Date:** 02/26/2020

Sample Findings Summary

AR/COC: 620721, 620722, 620723

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
DOE EML HASL-300, U-02-RC			
	112094-012/CYN-MW17	Uranium-235/236 (15117-96-1/13982-70-)	J, FR7
	112096-012/ER Burn Site- EB	Uranium-233/234 (13968-55-3/13966-29-)	BD, FR3
	112096-012/ER Burn Site- EB	Uranium-235/236 (15117-96-1/13982-70-)	BD, FR3
	112096-012/ER Burn Site- EB	Uranium-238 (7440-61-1)	BD, FR3
	112101-012/CYN-MW18	Uranium-235/236 (15117-96-1/13982-70-)	J, FR7
EPA 900.0/SW846 9310			
	112094-011/CYN-MW17	BETA (12587-47-2)	J, FR7
	112096-011/ER Burn Site- EB	ALPHA (12587-46-1)	BD, FR3
	112096-011/ER Burn Site- EB	BETA (12587-47-2)	BD, FR3
	112101-011/CYN-MW18	ALPHA (12587-46-1)	J, FR7
EPA 901.1			
	112094-010/CYN-MW17	Americium-241 (14596-10-2)	BD, FR3
	112094-010/CYN-MW17	Cesium-137 (10045-97-3)	BD, FR3
	112094-010/CYN-MW17	Cobalt-60 (10198-40-0)	BD, FR3
	112094-010/CYN-MW17	Potassium-40 (13966-00-2)	BD, FR3
	112096-010/ER Burn Site- EB	Americium-241 (14596-10-2)	BD, FR3
	112096-010/ER Burn Site- EB	Cesium-137 (10045-97-3)	BD, FR3
	112096-010/ER Burn Site- EB	Cobalt-60 (10198-40-0)	BD, FR3
	112096-010/ER Burn Site- EB	Potassium-40 (13966-00-2)	BD, FR3
	112101-010/CYN-MW18	Americium-241 (14596-10-2)	BD, FR3
	112101-010/CYN-MW18	Cesium-137 (10045-97-3)	R, Z2
	112101-010/CYN-MW18	Cobalt-60 (10198-40-0)	BD, FR3
	112101-010/CYN-MW18	Potassium-40 (13966-00-2)	BD, FR3

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
EPA 906.0 Modified			
	112094-013/CYN-MW17	Tritium (10028-17-8)	BD, FR3
	112096-013/ER Burn Site- EB	Tritium (10028-17-8)	BD, FR3
	112101-013/CYN-MW18	Tritium (10028-17-8)	BD, FR3
SW846 3005A/6020B			
	112094-008/CYN-MW17	Nickel (7440-02-0)	J-, B4
	112094-008/CYN-MW17	Vanadium (7440-62-2)	0.02U, B
	112094-009/CYN-MW17	Nickel (7440-02-0)	J-, B4
	112094-009/CYN-MW17	Vanadium (7440-62-2)	0.02U, B
	112096-008/ER Burn Site- EB	Nickel (7440-02-0)	0.002UJ, B4
	112096-008/ER Burn Site- EB	Vanadium (7440-62-2)	0.02U, B
	112096-009/ER Burn Site- EB	Nickel (7440-02-0)	0.002UJ, B4
	112096-009/ER Burn Site- EB	Vanadium (7440-62-2)	0.02U, B
	112101-008/CYN-MW18	Copper (7440-50-8)	0.002U, B2
	112101-008/CYN-MW18	Manganese (7439-96-5)	J-, CK3
	112101-008/CYN-MW18	Nickel (7440-02-0)	J-, B4
	112101-008/CYN-MW18	Vanadium (7440-62-2)	0.02U, B
	112101-009/CYN-MW18	Manganese (7439-96-5)	J-, CK3
	112101-009/CYN-MW18	Nickel (7440-02-0)	0.002UJ, B4
	112101-009/CYN-MW18	Vanadium (7440-62-2)	0.02U, B
SW846 3535A/8330B			
	112094-004/CYN-MW17	Nitrobenzene (98-95-3)	UJ, I4
	112096-004/ER Burn Site- EB	Nitrobenzene (98-95-3)	UJ, I4
	112101-004/CYN-MW18	Nitrobenzene (98-95-3)	UJ, I4
SW846 7470A			
	112094-008/CYN-MW17	Mercury (7439-97-6)	J+, I5
	112094-009/CYN-MW17	Mercury (7439-97-6)	J+, I5
	112096-009/ER Burn Site- EB	Mercury (7439-97-6)	J+, I5
SW846 8260B DOE-AL			
	112094-001/CYN-MW17	Acetone (67-64-1)	10U, B1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	112096-001/ER Burn Site- EB	Acetone (67-64-1)	10U, B1
	112096-001/ER Burn Site- EB	Bromomethane (74-83-9)	UJ, I3,C3
	112096-001/ER Burn Site- EB	Dibromochloromethane (124-48-1)	J+, I5
	112101-001/CYN-MW18	Acetone (67-64-1)	10U, B1
	112101-001/CYN-MW18	Bromomethane (74-83-9)	UJ, I3,C3
	112103-001/ER Burn Site-TB 9	Bromomethane (74-83-9)	UJ, I3,C3
SW846 9056A			
	112096-006/ER Burn Site- EB	Chloride (16887-00-6)	J+, I5,RP1
	112096-006/ER Burn Site- EB	Sulfate (14808-79-8)	UJ, RP1

All other analyses met QC acceptance criteria; no further data should be qualified.

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Memorandum

Date: February 26, 2020

To: File

From: Linda Thal

Subject: Inorganic Data Review and Validation – SNL
Site: ER Burn Site
ARCOC: 620724
SDG: 501457
Laboratory: GEL
Project/Task: 176092.01.06
Analysis: General Chemistry

See the attached Data Validation Worksheets for supporting documentation on the data review and validation. This validation was performed according to SNL/NM SMO Procedure AOP 00-03 Rev 5.

Summary

One sample was prepared and analyzed with accepted procedures using methods EPA 9056A (anions by IC), EPA 353.2 (nitrate/nitrite) and EPA 314.0 (perchlorate). Data were reported for all required analytes. No problems were identified with the data package that resulted in the qualification of data.

Data are acceptable and reported QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times and Preservation

The sample was prepared and analyzed within the prescribed holding times and was properly preserved.

Calibration

All initial and continuing calibration met QC acceptance criteria except as follows. The initial calibration intercept was > the MDL and positive for chloride. The associated result for sample 501457008 was a detect >3X the value of the intercept and will not be qualified.

Blanks

No target analytes were detected in any of the blanks.

Laboratory Control Sample (LCS)

All LCS acceptance criteria were met.

Matrix Spike and Matrix Spike Duplicate (MS/MSD)

The MS/PS met QC acceptance criteria. It should be noted that the PS for all target analytes were performed on SNL samples of similar matrix from other SDGs. No data will be qualified.

Laboratory Replicate

The replicate analysis met all QC acceptance criteria. It should be noted that the replicate analyses for all target analytes were performed on SNL samples of similar matrix from other SDGs. No data will be qualified.

Detection Limits/Dilutions

All detection limits were properly reported and correctly adjusted for dilutions. The following dilutions were performed due to elevated amounts of target analyte present in the samples.

Anions:
Sample -008 was diluted 10X for chloride and sulfate.

Nitrate/nitrite:
Sample -007 was diluted 10X.

Other QC

No other specific issues that affect data quality were identified.

Reviewed by: Mary Donivan **Level:** I **Date:** 02/27/2020

Sample Findings Summary

AR/COC: 620724

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
EPA 900.0/SW846 9310			
	112105-011/CYN-MW16	BETA (12587-47-2)	J, FR7
EPA 901.1			
	112105-010/CYN-MW16	Americium-241 (14596-10-2)	BD, FR3
	112105-010/CYN-MW16	Cesium-137 (10045-97-3)	BD, FR3
	112105-010/CYN-MW16	Cobalt-60 (10198-40-0)	BD, FR3
	112105-010/CYN-MW16	Potassium-40 (13966-00-2)	BD, FR3
EPA 906.0 Modified			
	112105-013/CYN-MW16	Tritium (10028-17-8)	BD, FR3
SW846 3005A/6020B			
	112105-008/CYN-MW16	Manganese (7439-96-5)	J-, CK3
	112105-008/CYN-MW16	Vanadium (7440-62-2)	0.02U, B
	112105-009/CYN-MW16	Manganese (7439-96-5)	J-, CK3
	112105-009/CYN-MW16	Vanadium (7440-62-2)	0.02U, B
SW846 3535A/8330B			
	112105-004/CYN-MW16	Nitrobenzene (98-95-3)	UJ, I4
	112105-004/CYN-MW16	PETN (78-11-5)	UJ, MS5
SW846 8260B DOE-AL			
	112104-001/ER Burn Site-FB 1	Acetone (67-64-1)	J-, I5
	112104-001/ER Burn Site-FB 1	Bromoform (75-25-2)	J+, I5
	112104-001/ER Burn Site-FB 1	Methyl acetate (79-20-9)	UJ, I4
	112105-001/CYN-MW16	Acetone (67-64-1)	UJ, I5
	112105-001/CYN-MW16	Methyl acetate (79-20-9)	UJ, I4
	112106-001/ER Burn Site-TB 11	Acetone (67-64-1)	UJ, I5
	112106-001/ER Burn Site-TB 11	Methyl acetate (79-20-9)	UJ, I4

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC

All other analyses met QC acceptance criteria; no further data should be qualified.

SECTION III
TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES (concluded)

LIST OF TABLES

APPENDIX

Appendix A NMED's Approval Letter and DOE's Submittal with the Enclosure Describing Full-Scale Operation Modifications

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SECTION III
TECHNICAL AREA-V IN-SITU BIOREMEDIATION TREATABILITY STUDY PHASE I FULL-SCALE OPERATION, January – March 2020

1.0 Background

Sandia National Laboratories, New Mexico (SNL/NM) personnel are conducting a Treatability Study of in-situ bioremediation (ISB) to address the groundwater contamination by nitrate and trichloroethene (TCE) at Technical Area-V (TA-V) Groundwater (TAVG) Area of Concern (AOC). SNL/NM personnel planned to conduct the ISB Treatability Study in two phases. Phase I included a pilot test followed by full-scale operation at the first injection well (TAV-INJ1); Phase II will include well installation and full-scale operation at two additional injection wells (TAV-INJ2 and TAV-INJ3), contingent on the success of Phase I full-scale operation. The locations of the three injection wells TAV-INJ1, TAV-INJ2, and TAV-INJ3 are near monitoring wells TAV-MW6, TAV-MW10, and LWDS-MW1, respectively, where the highest contaminant concentrations in the TAVG AOC have been detected.

Table III-1 presents a timeline for the Phase I ISB Treatability Study at TAVG AOC. A Phase I pilot test began in November 2017 with injections at well TAV-INJ1 completed in November 2017, followed by pilot test performance monitoring through June 2018. SNL/NM personnel began Phase I full-scale operation at the same injection well in October 2018 and completed the six-month injection period in April 2019. Currently, SNL/NM personnel are conducting the two-year performance monitoring in the ISB treatment zone (Table III-1). The implementation of the Phase I full-scale operation at well TAV-INJ1 is governed by the Revised Treatability Study Work Plan (TSWP) (SNL/NM March 2016) and where applicable, the approved modifications for the full-scale operation at well TAV-INJ1 (U.S. Department of Energy [DOE] July 2018; New Mexico Environment Department [NMED] August 2018). Appendix A provides the NMED Hazardous Waste Bureau (HWB) approval letter and DOE's submittal of the proposed modifications.

This Section III of the Environmental Restoration Operations Consolidated Quarterly Report presents the monitoring results for the January – March 2020 reporting period for the Phase I full-scale operation. SNL/NM personnel are conducting a comprehensive evaluation of all the information and results gathered so far for Phase I of the ISB Treatability Study. A

recommendation on whether to proceed to Phase II of the ISB Treatability Study will be submitted to the NMED HWB later in 2020.

In accordance with the Revised TSWP (SNL/NM March 2016), a technical memorandum for the Phase I ISB Treatability Study will be produced after the performance monitoring period has concluded in May 2021 (Table III-1), and will include both the pilot test and the full-scale operation.

No field activities other than groundwater monitoring occurred during this reporting period. The SNL/NM Long-Term Stewardship (LTS) personnel conduct groundwater monitoring for the entire TAVG AOC, including the ISB treatment zone. Groundwater monitoring includes groundwater elevation measurements, field water quality measurements, and groundwater sampling.

2.0 Groundwater Elevations at Technical Area-V

Figure III-1 shows the January 2020 groundwater elevation contour map (potentiometric surface) for the Regional Aquifer at TA-V. The groundwater elevation contours have not changed significantly since the October 2017 pre-Treatability Study baseline (SNL/NM January 2018). Groundwater flows generally to the west and southwest at TA-V. Overall the groundwater elevation at TA-V has been declining at a rate of 0.5 to 0.8 feet per year (SNL/NM June 2020). Approximately 530,000 gallons of treatment solution were injected over a six-month period (November 2018 – April 2019) but did not create a noticeable effect on the potentiometric surface contours at TA-V.

3.0 Groundwater Monitoring for Phase I Treatability Study

The Phase I ISB Treatability Study treatment zone encompasses injection well TAV-INJ1 and two nearby monitoring wells (TAV-MW6 and TAV-MW7).

To collect field water quality data, In-Situ Incorporated Aqua TROLL® 600 multi-parameter sondes were installed in both injection well TAV-INJ1 and monitoring well TAV-MW6. The parameters measured by the sonde included water pressure over the sonde, dissolved oxygen (DO), oxidation reduction potential (ORP), potential of hydrogen (pH), specific conductivity (SC), temperature, and turbidity. Pressure readings were converted to

groundwater elevation above mean sea level. Sonde readings were collected at an interval of 15 minutes.

Performance monitoring involves groundwater sampling at injection well TAV-INJ1 and two monitoring wells (TAV-MW6 and TAV-MW7). Wells TAV-INJ1 and TAV-MW6 are screened at the water table; well TAV-MW7 is screened approximately 90 feet below the water table. Well TAV-MW7 was sampled for any potential vertical impact of the injected solution on deeper groundwater. Although neither water level nor water quality in this well has been affected by the injections at well TAV-INJ1, TAV-MW7 water quality data continues to be reported here for consistency and completeness.

The two-year performance monitoring includes three monthly sampling events followed by quarterly sampling events for the remainder of the two-year period, as described in the Revised TSWP (SNL/NM March 2016). The three monthly sampling events occurred in June (first and last week) and July 2019. The Phase I ISB Treatability Study performance monitoring is currently on a quarterly schedule until May 2021 (Table III-1).

Groundwater monitoring is also conducted at eight wells outside the treatment zone on a quarterly schedule to monitor any lateral impact of the injected solution, as described in the Revised TSWP (SNL/NM March 2016).

Before each well was sampled, field water quality parameters were collected using an aboveground Aqua TROLL® 600 multi-parameter sonde.

Table III-2 lists the sampling dates for the January – March 2020 reporting period for all above-mentioned wells pertinent to the Phase I ISB Treatability Study. Tables III-3 through III-6 present the analytical results. Table III-7 summarizes the stabilized field water quality parameters measured immediately before sample collection at each well.

3.1 Groundwater Monitoring inside the Treatment Zone

Groundwater monitoring inside the Phase I ISB treatment zone involves monitoring of the injection well TAV-INJ1 and monitoring wells TAV-MW6 and TAV-MW7.

3.1.1 Injection Well TAV-INJ1

Groundwater elevation at well TAV-INJ1 returned to the pre-injection static level after the injections were completed in April 2019 and remained unchanged through this reporting period.

With the influx of substrate solution, the water near the injection well has turned anaerobic with reducing conditions since the completion of pilot test injections in November 2017 (Table III-1). Since then, DO, ORP, and pH have remained at optimal levels at well TAV-INJ1 for the biodegradation of nitrate and TCE to occur. During this reporting period, pH was steady around 7.0; DO was at 0.0 milligrams per liter (mg/L); and ORP averaged negative (-) 360 millivolts.

SC was approximately 850 microsiemens per centimeter (µS/cm) before the start of full-scale injections (SNL/NM January 2020, Table III-2). SC increased after the end of injections in April 2019, peaked at around 3,500 µS/cm in July 2019, and gradually decreased to around 2,500 µS/cm in March 2020.

The baseline groundwater temperature in well TAV-INJ1 was approximately 21.1 degrees Celsius. The injected substrate solution, which was mainly potable water, was colder than groundwater because most of the injections occurred during the winter of 2018 – 2019. After injections were completed in April 2019, the water temperature in well TAV-INJ1 rose slowly and was approximately 20.3 degrees Celsius in March 2020.

Turbidity varied day to day between single digits and hundreds of nephelometric turbidity units during this reporting period, likely due to the suspension of sediments and biological growth in the well.

During groundwater sampling at injection well TAV-INJ1, SNL/NM personnel discovered significant sediment accumulation in the well. This is probably due to the repeated disturbance of the geological formation by the 110 injections over the six-month period. As a result, the sampling pump was placed at approximately mid-depth of the water column, higher than where the pump was previously set during the pre-full-scale operation sampling when the well was relatively free of sediment. The purge volume (before sample collection) at well TAV-INJ1 was determined to be 59 gallons during the baseline sampling before Phase I ISB Treatability Study. However, the pump was repeatedly clogged by the sediment during purging. To prevent pump failure, for the January 2020 sampling of the injection well, SNL/NM personnel used bailers to remove groundwater and sediment on the day

before sampling, allowed the well to recover overnight, and collected samples the next day. This follows the standard practice of the SNL/NM LTS Program for sampling low-yield wells.

The analytical parameters for groundwater samples from well TAV-INJ1 include the following, in accordance with Modification #8 (Appendix A):

- Alkalinity (total, bicarbonate, and carbonate)
- Ammonia (as nitrogen)
- Anions (bromide and sulfate)
- *Dehalococcoides* (Dhc) and, if Dhc is present, vinyl chloride reductase
- Dissolved metals (arsenic, iron, and manganese)
- Methane/ethane/ethene
- Nitrate plus nitrite (NPN)
- Total organic carbon (TOC)
- Volatile organic compounds (VOCs)

Table III-3 provides the analytical results for the January – March 2020 sampling event at well TAV-INJ1.

Since the start of Phase I full-scale operation performance monitoring in June 2019, a total of five sampling events have occurred: the first and last week in June 2019, July 2019, October 2019, and January 2020. For the two constituents of concern at TAVG AOC, NPN has not been detected; TCE was detected for the first time at an estimated value (J-qualified) of 0.4 micrograms per liter (µg/L) in January 2020 (Table III-3).

Figures III-2 through III-10 show the changes of concentrations with time for alkalinity, ammonia, bromide, sulfate, Dhc, dissolved metals, methane, ethane, and TOC, respectively. Ethene, NPN, and TCE have either no detects or no more than two detects; therefore, concentration profiles were not generated. Figures III-3 through III-10 show the following:

- Ammonia (Figure III-3) and TOC (Figure III-10) serve as the nitrogen and carbon source for microbial activity, respectively. Both were being consumed over time, with TOC being consumed more rapidly than ammonia.
- Bromide (Figure III-4), the inert tracer, maintained its concentration in the groundwater around the injection well.
- The population of Dhc (Figure III-6) has decreased to non-detect. Dhc did not establish a significant population in the groundwater around the injection well.
- Concentrations of dissolved arsenic have exceeded the U.S. Environmental Protection Agency maximum contaminant level of 0.01 mg/L since June 2019

(Figure III-7). Concentrations of dissolved iron were variable; while concentrations of dissolved manganese have gradually increased since June 2019 (Figure III-7). In baseline sampling for dissolved metals in November 2017 at the injection well, arsenic and iron were not detected, and manganese was at 0.0931 mg/L (SNL/NM October 2018). Elevated dissolved metal concentrations are to be expected during bioremediation. During ISB, the substrate solution produces strongly anaerobic redox conditions in the aquifer that solubilize and mobilize naturally occurring metals and metalloids. The solubilization of these metals is a transient phenomenon and is limited to the treatment zone. Solubilized metals and metalloids will precipitate into solid form once they leave the anaerobic treatment zone and enter the aerobic aquifer.

- The level of methane remained high (13,000 µg/L) in January 2020 (Figure III-8).
- Additional monitoring data is necessary to evaluate the concentration trend for the remaining parameters (e.g., sulfate and ethane).

3.1.2 Monitoring Well TAV-MW6

Well TAV-MW6 is located approximately 50 feet east-southeast of well TAV-INJ1 and is screened across the water table as is well TAV-INJ1. The groundwater elevation in well TAV-MW6 remained at static levels during this reporting period. There were no significant changes in ORP, pH, SC, temperature, and turbidity in this well during this reporting period. However, the concentration of DO has decreased from the baseline of approximately 7.0 mg/L to approximately 4.0 mg/L in October 2019. Since then the DO concentration increased to approximately 4.6 mg/L in March 2020.

The analytical parameters for groundwater samples from well TAV-MW6 are the same as those for well TAV-INJ1 in accordance with Modification #8 (Appendix A). Table III-4 provides the analytical results for January – March 2020 sampling event at well TAV-MW6.

- There were no significant changes in the concentrations of NPN and TCE from the levels before full-scale operation (SNL/NM April 2019). However, additional monitoring data is necessary to evaluate any potential impact from the injections at well TAV-INJ1.
- Bromide (an inert tracer) was added to the substrate solution injected at well TAV-INJ1. Bromide concentrations are expected to increase in well TAV-MW6 as the

substrate solution moves away from well TAV-INJ1. The bromide concentration at well TAV-MW6 before full-scale operation was 0.815 mg/L in September 2018 (SNL/NM April 2019). Figure III-11 shows the bromide concentrations from September 2018 to January 2020. The bromide concentration at well TAV-MW6 reached its highest concentration of 4.12 mg/L in June 2019 and decreased to 1.24 mg/L in January 2020.

- Methane was not detected at well TAV-MW6 before full-scale operation. The methane concentration increased to 360 µg/L in October 2019 and decreased to 60 µg/L in January 2020 (Figure III-11).
- The results for the other analytes were consistent with the concentrations before full-scale operation at this well.

3.1.3 Monitoring Well TAV-MW7

Well TAV-MW7 is located approximately 27 feet east-southeast of well TAV-INJ1 and is screened approximately 90 feet below the water table. The groundwater elevation in well TAV-MW7 remained at static levels during this reporting period.

The analytical parameters for groundwater samples from well TAV-MW7 include the following in accordance with Modification #7 (Appendix A):

- Bromide
- Dissolved metals (arsenic, iron, and manganese)
- Ethene
- NPN
- VOCs

Table III-5 provides the analytical results for the January – March 2020 sampling event at well TAV-MW7. All the analytical results are consistent with the levels before full-scale operation, including NPN, TCE, and bromide (SNL/NM April 2019).

3.2 Groundwater Monitoring outside the Treatment Zone

In accordance with Section 5.5 of the Revised TSWP (SNL/NM March 2016), eight wells are sampled quarterly for dissolved metals (iron, manganese, and arsenic) to evaluate the potential impact of the substrate solution on groundwater conditions outside the Phase I ISB Treatability Study treatment zone. The eight wells are: LWDS-MW1, TAV-MW2,

TAV-MW4, TAV-MW8, TAV-MW10, TAV-MW11, TAV-MW12, and TAV-MW14. The analytical parameters for groundwater samples from these wells include:

- Dissolved metals (arsenic, iron, and manganese)
- NPN
- VOCs

These parameters are the same as those for the other monitoring wells in the TAVG AOC monitoring network (SNL/NM June 2020). Table III-6 provides the analytical results for the January – March 2020 sampling at these wells. Environmental duplicate samples were collected from wells LWDS-MW1, TAV-MW4, and TAV-MW12, per the monitoring requirements of the SNL/NM LTS Program for the TAVG AOC monitoring network. All the analytical results are consistent with the historical values at these eight wells (SNL/NM June 2020).

3.3 Summary of Groundwater Monitoring Results for Phase I Treatability Study

The water quality and analytical results from injection well TAV-INJ1 show the following:

- The water temperature in the well has been slowly rising, indicating the injected solution is mixing with the native groundwater (the injected solution was colder than the local groundwater).
- The water quality in the injection well has maintained optimal conditions for biodegradation of nitrate and TCE, as reflected by the DO, ORP, and pH levels.
- NPN was not detected. Nitrate would have been biodegraded by native bacteria as being the most favorable electron acceptor after DO was depleted (see Section 3.0 of the Revised TSWP [SNL/NM March 2016]).
- The dechlorination bacteria, Dhc, did not establish a significant population in the groundwater around the injection well.
- The methane level remained high and TOC continued to be consumed, indicating active methanogenic microbial activity.
- TCE was detected for the first time since full-scale injections started at an estimated value (J-qualified) of 0.4 micrograms per liter (µg/L) in January 2020.
- Additional monitoring is necessary to confirm if dechlorination is occurring at the injection well.

Well TAV-MW6 serves as the monitoring well for evaluating the effectiveness of ISB inside the treatment zone. The water quality and analytical results from this well show the following:

- Bromide, the inert tracer, has migrated to well TAV-MW6; however, bromide reached its highest concentration (4.12 mg/L) in June 2019 and then began to decrease over time.
- The DO concentration at well TAV-MW6 reached the lowest point of approximately 4 mg/L in October 2019, and then began to increase over time.
- The methane concentration at well TAV-MW6 reached the highest point of 360 µg/L in October 2019, and then began to decrease over time.
- The Dhc have not established or reached well TAV-MW6.
- Dechlorination is not occurring at well TAV-MW6 and TCE concentrations remain unchanged at this well.

The water quality and analytical results from well TAV-MW7 indicate that there is no impact on the deeper groundwater monitored by this well from the substrate solution injected at well TAV-INJ1.

For the eight wells located outside the treatment zone, there is no impact on the groundwater chemistry at these wells from the substrate solution injected at well TAV-INJ1.

4.0 Deviation

No deviations were encountered with regards to the Revised TWSP (SNL/NM March 2016) and where applicable, the approved modifications for the full-scale operation at well TAV-INJ1 (DOE July 2018; NMED August 2018).

5.0 References

DOE, see U.S. Department of Energy.

New Mexico Environment Department (NMED), August 2018. Letter to J.P. Harrell (U.S. Department of Energy NNSA/Sandia Field Office) and R.O. Griffith (Sandia National Laboratories), "Approval: Technical Area-V (TA-V) Treatability Study Notification of Full-Scale Operation at Well TAV-INJ1, Sandia National Laboratory, EPA ID# NM5890110518, HWB-SNL-15-020," August 13, 2018.

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Sandia National Laboratories, New Mexico (SNL/NM), January 2018. *Discharge Permit-1845 Quarterly Status Report, July – September 2017,* Sandia National Laboratories, Albuquerque, New Mexico.

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SNL/NM, see Sandia National Laboratories, New Mexico.

U.S. Department of Energy (DOE), July 2018. Letter to J. E. Kieling (New Mexico Environment Department), "Technical Area-V (TA-V) Treatability Study Notification of Full-Scale Operation at Well TAV-INJ1," July 20, 2018.

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Figures

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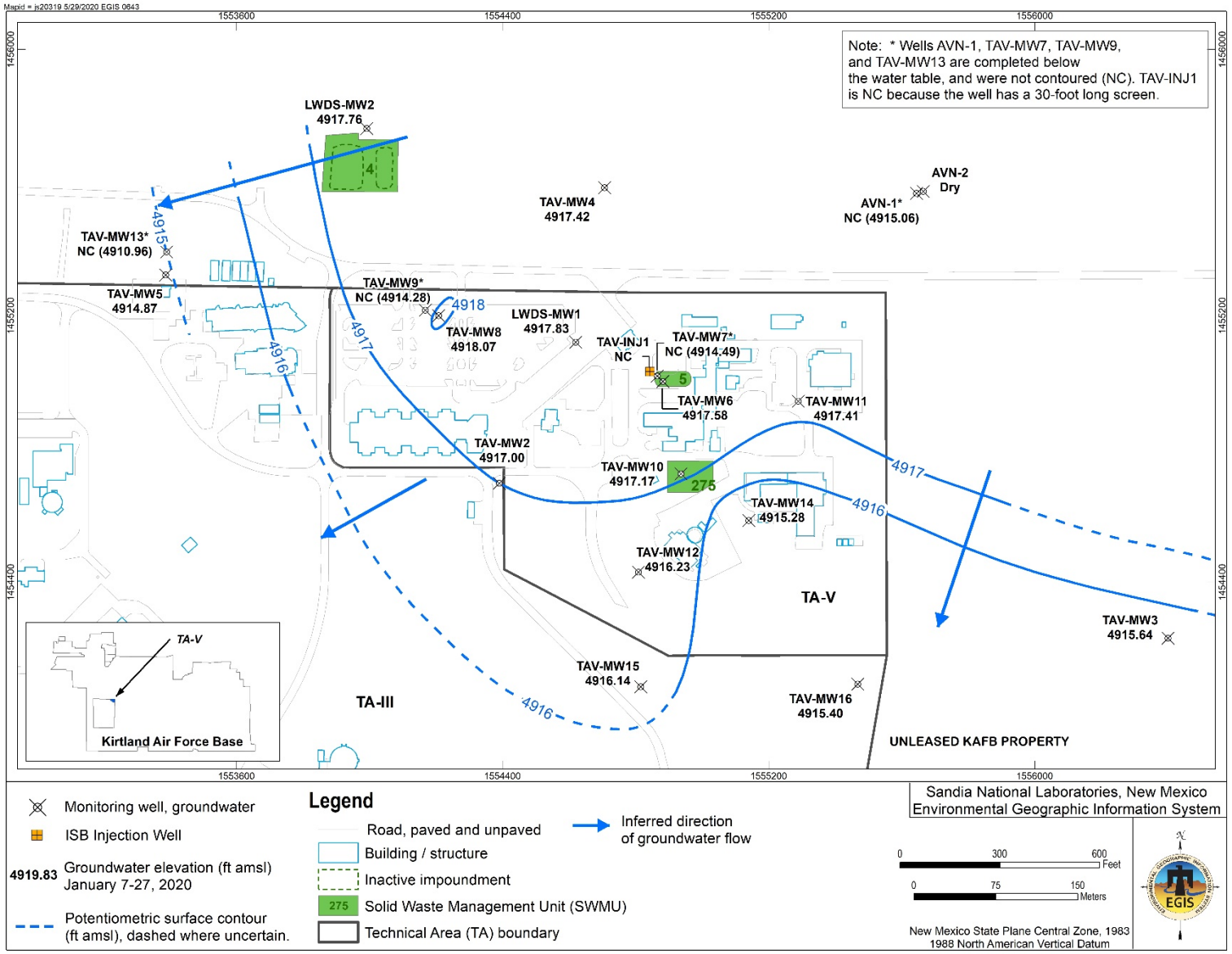

Figure III-1

Well Locations and Potentiometric Surface Contours for January 2020

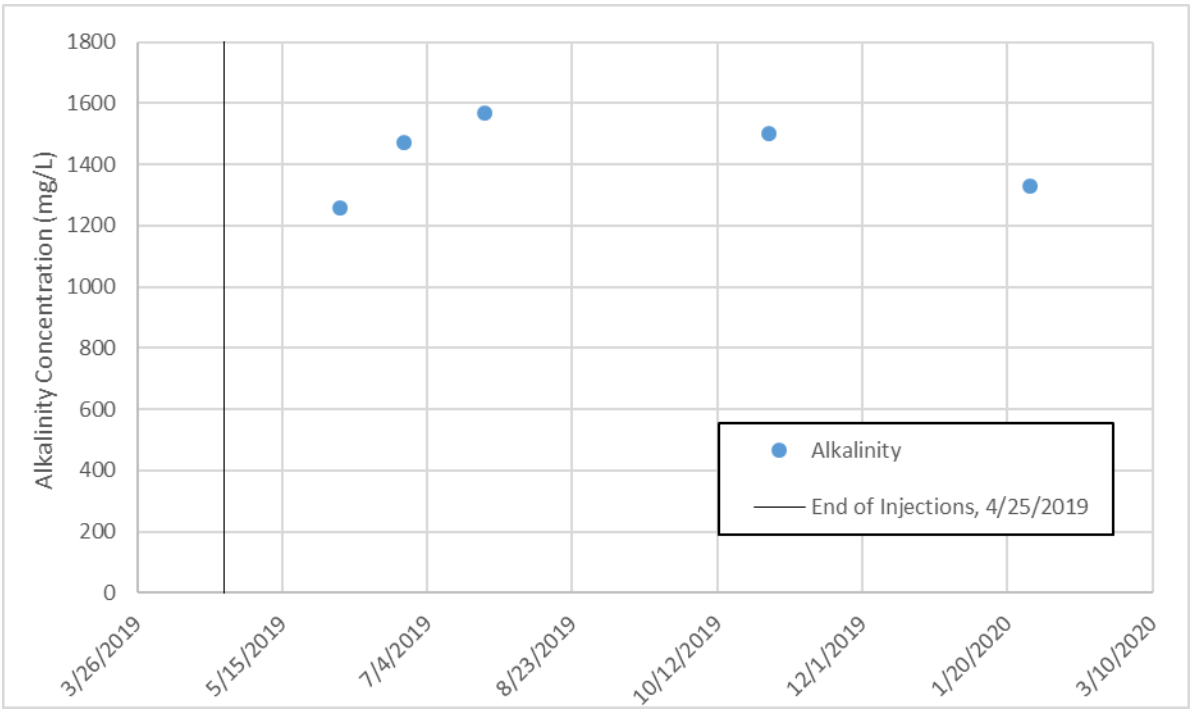

Figure III-2
Concentration of Alkalinity at Injection Well TAV-INJ1, June 2019 – January 2020

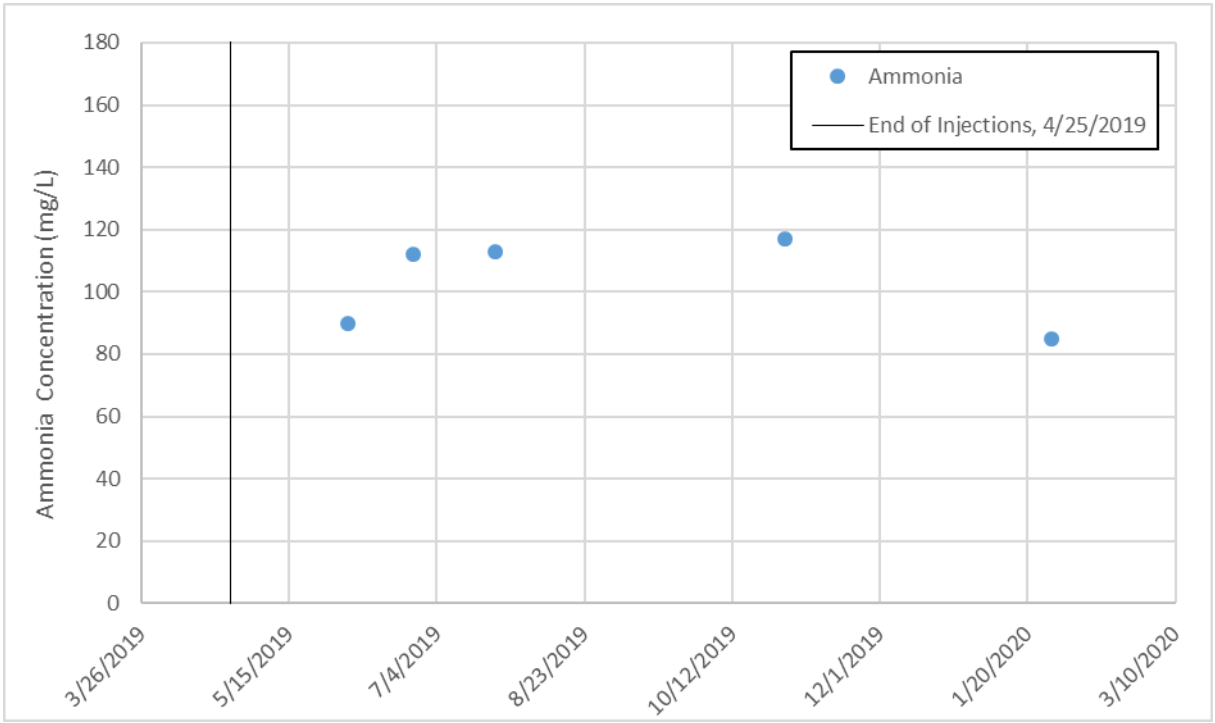

Figure III-3
Concentration of Ammonia at Injection Well TAV-INJ1, June 2019 – January 2020

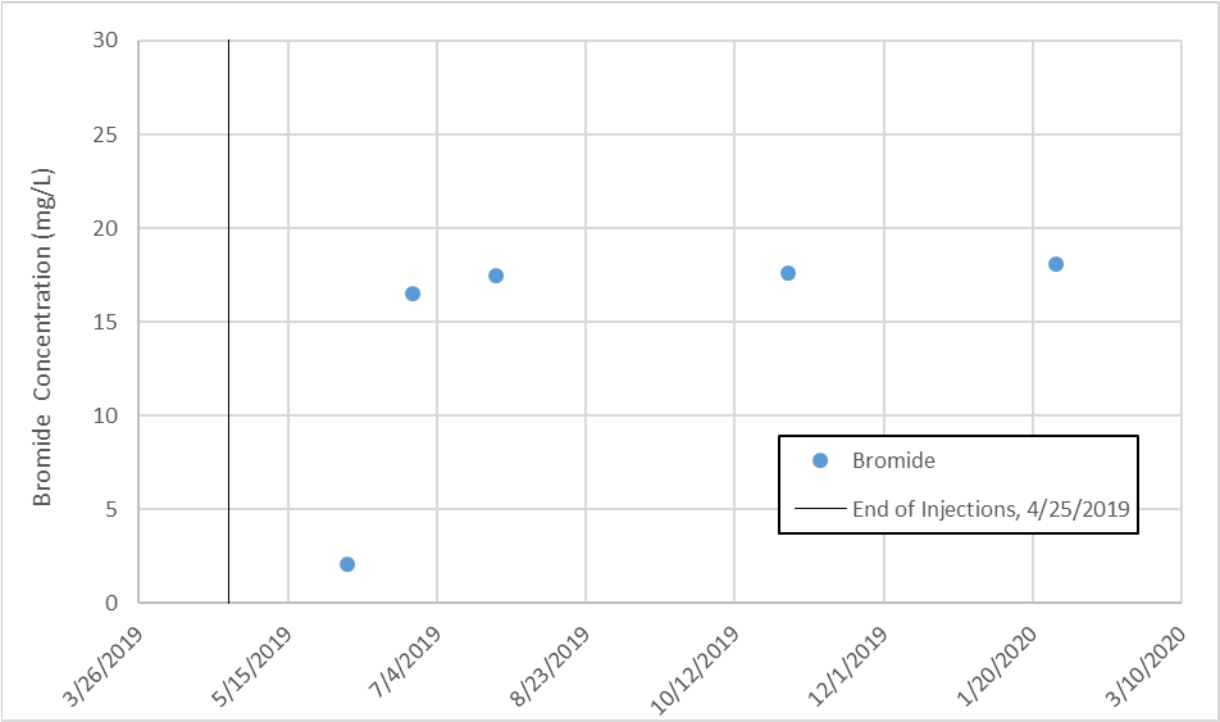

Figure III-4
Concentration of Bromide at Injection Well TAV-INJ1, June 2019 – January 2020

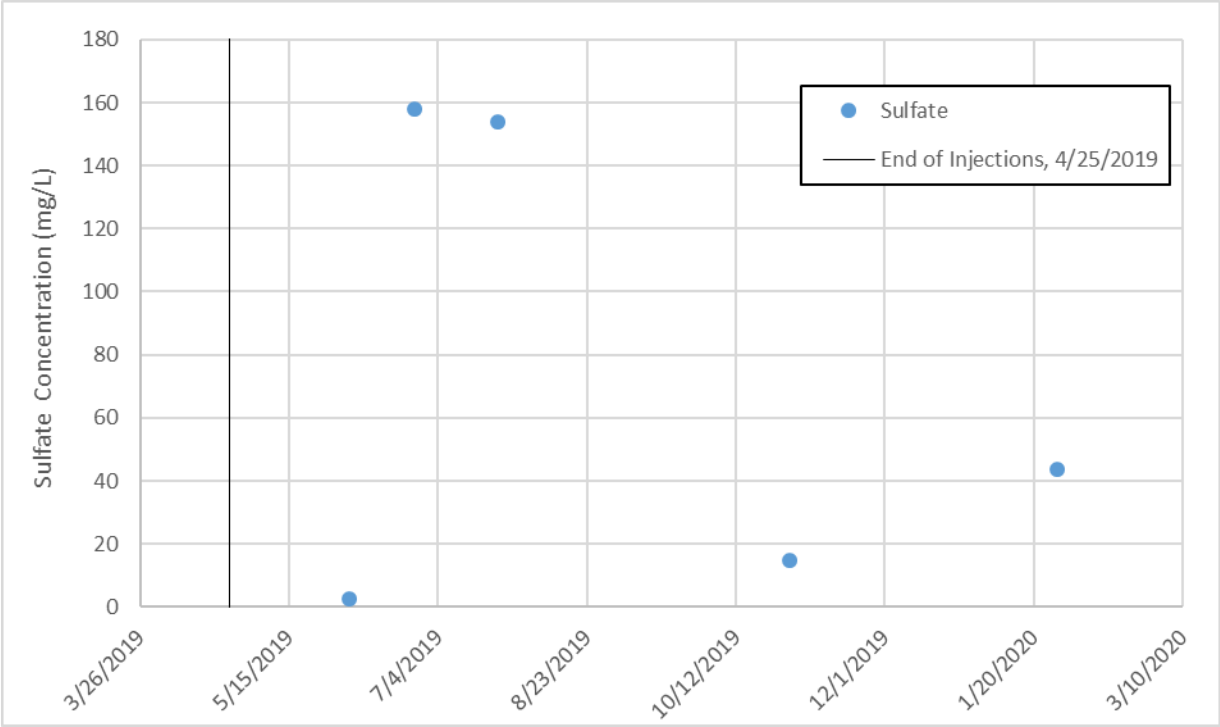

Figure III-5
Concentration of Sulfate at Injection Well TAV-INJ1, June 2019 – January 2020

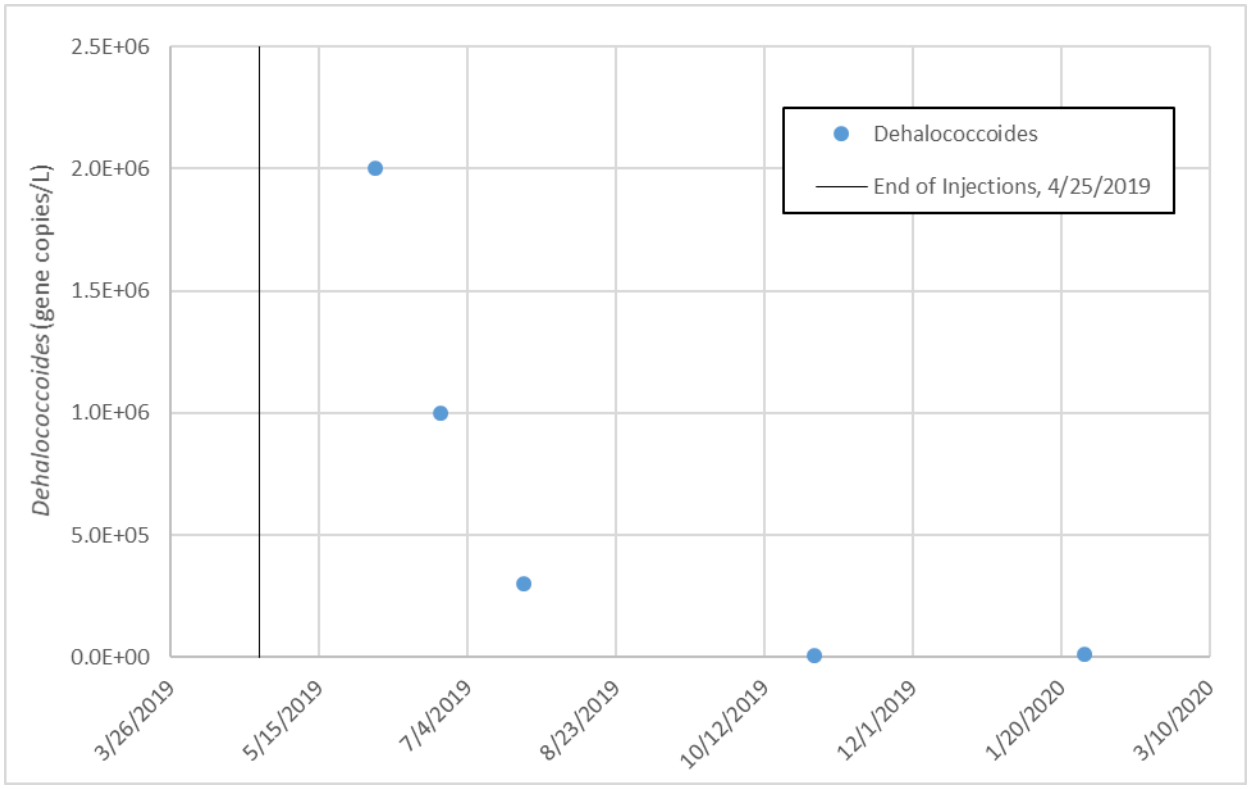

Figure III-6

Concentration of *Dehalococcoides* at Injection Well TAV-INJ1, June 2019 – January 2020

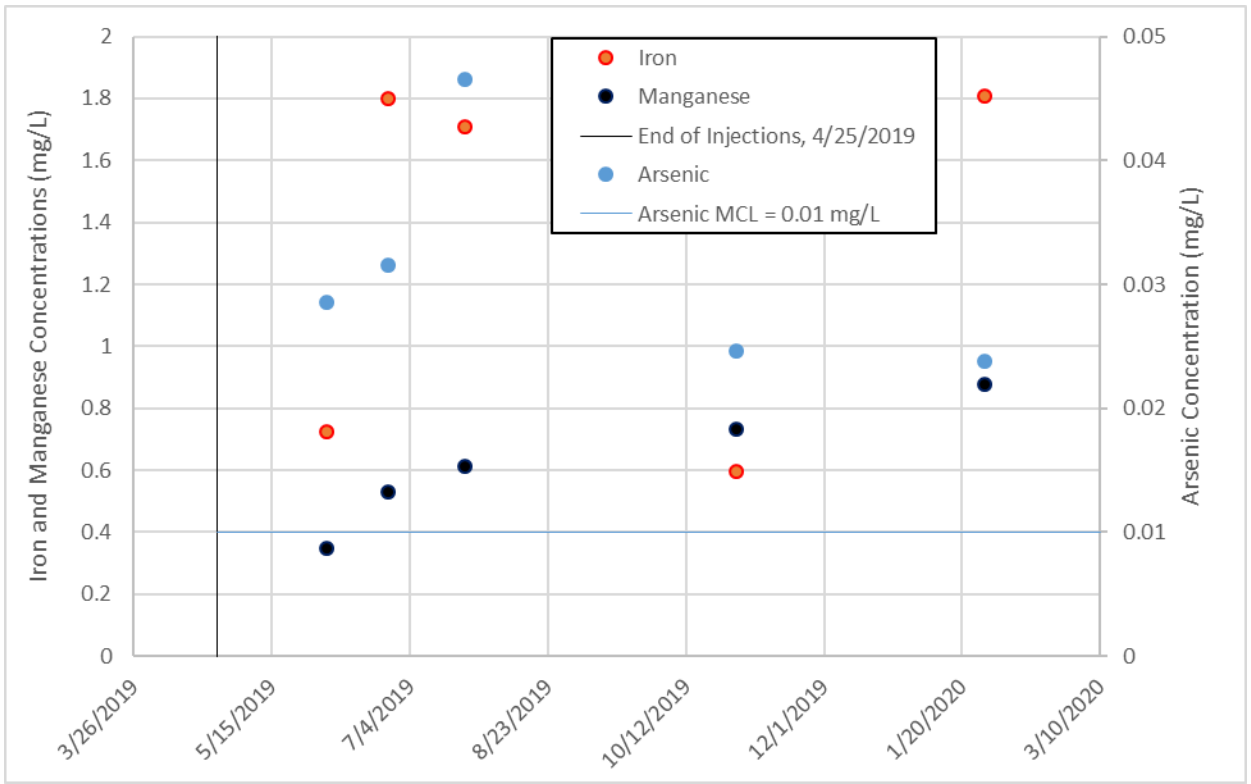

Figure III-7

Concentrations of Dissolved Metals at Injection Well TAV-INJ1, June 2019 – January 2020

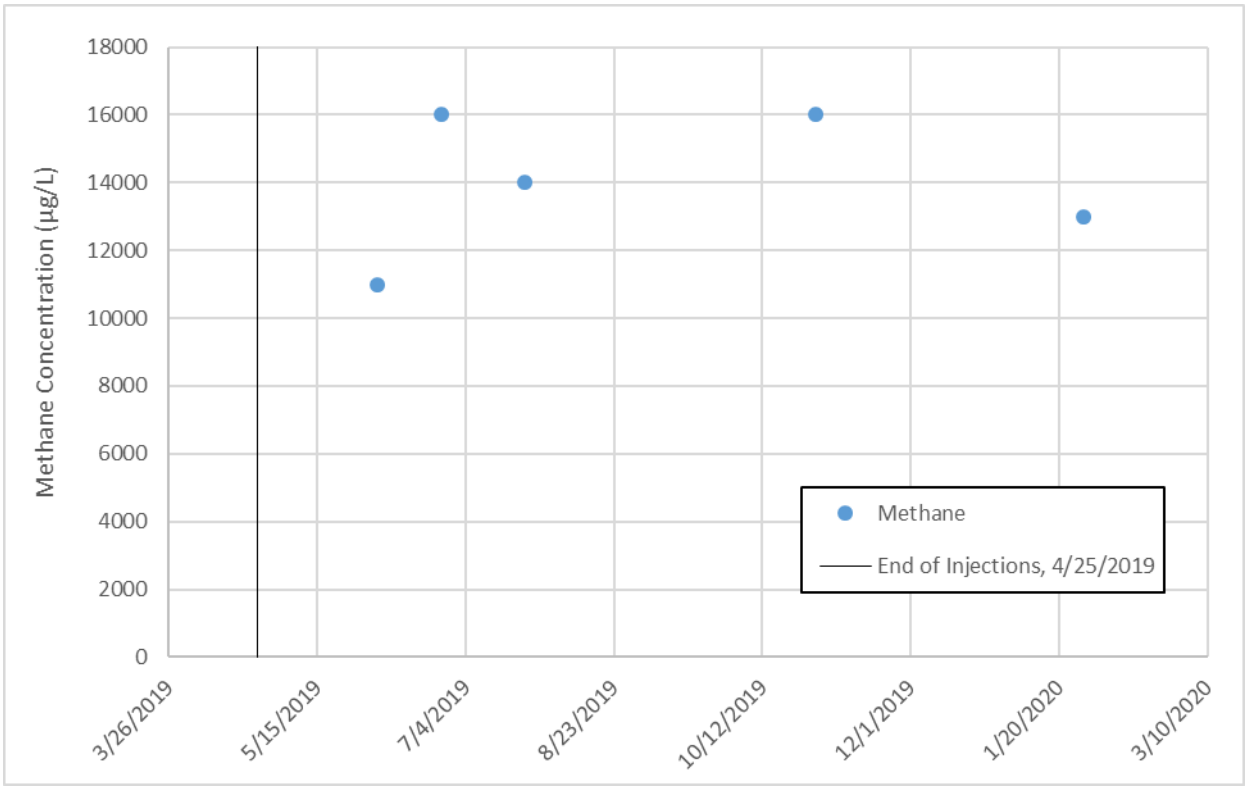

Figure III-8
Concentration of Methane at Injection Well TAV-INJ1, June 2019 – January 2020

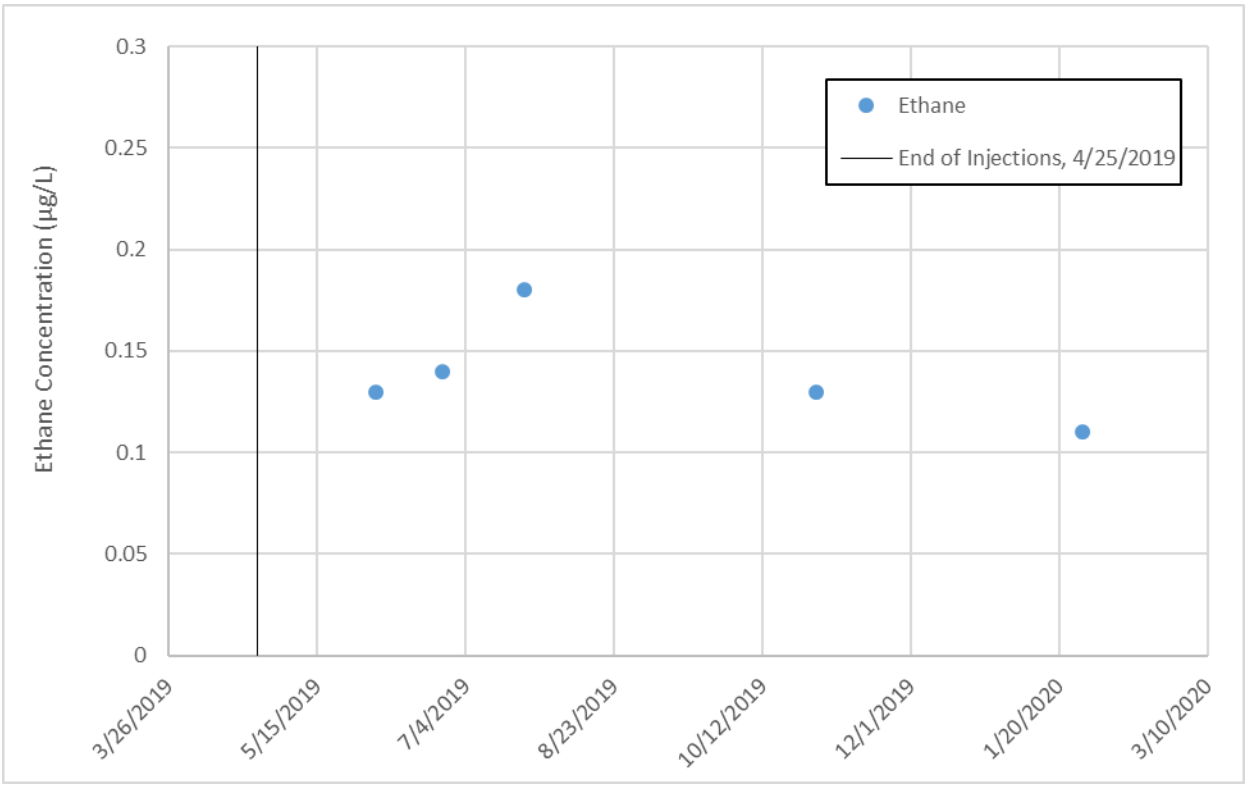

Figure III-9
Concentration of Ethane at Injection Well TAV-INJ1, June 2019 – January 2020

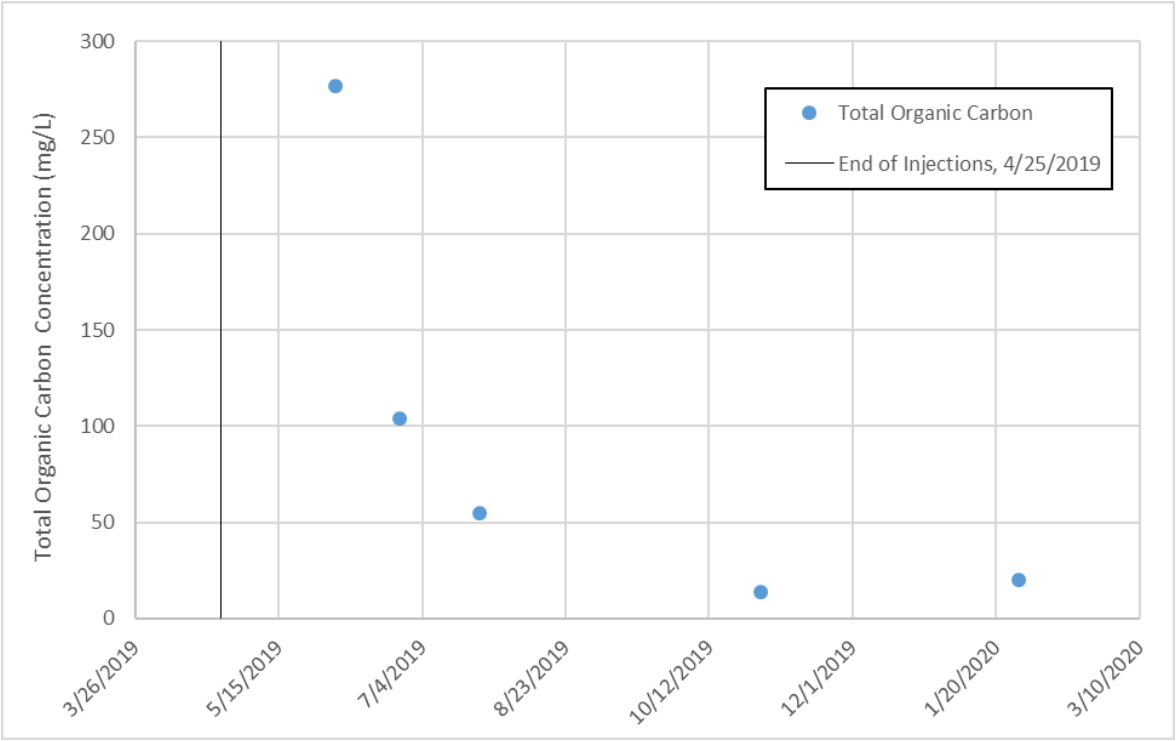

Figure III-10
Concentration of Total Organic Carbon at Injection Well TAV-INJ1, June 2019 – January 2020

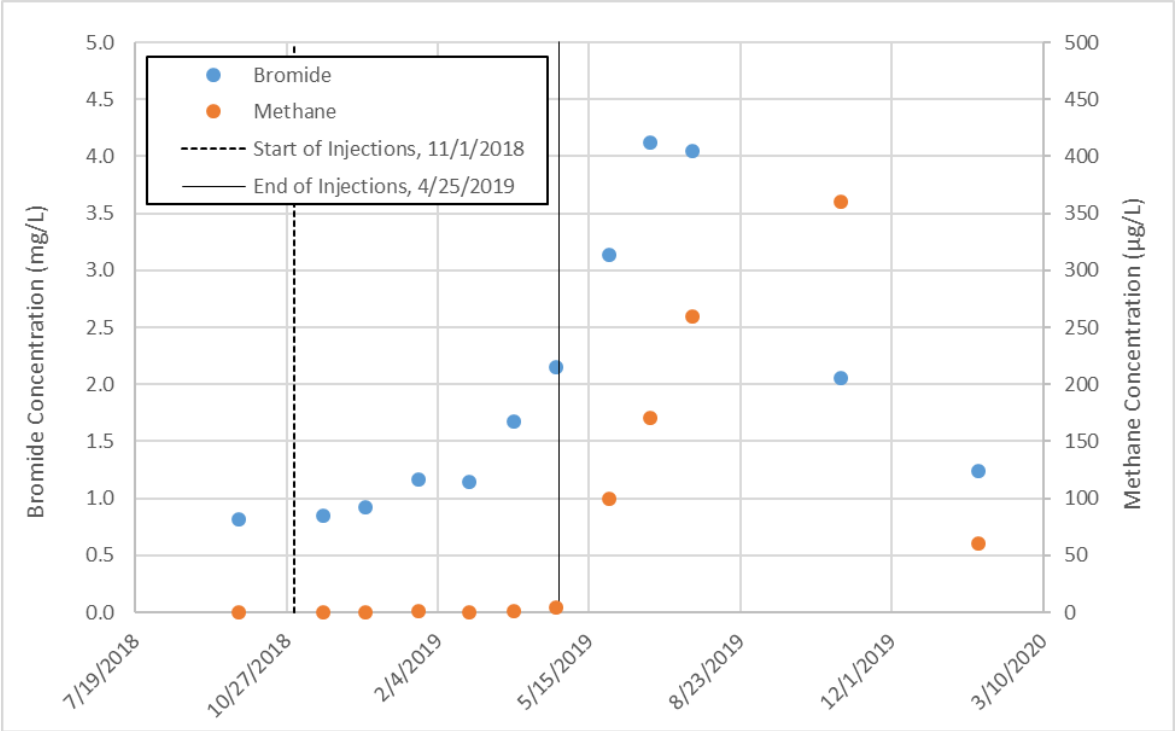

Figure III-11
Concentrations of Bromide and Methane at Monitoring Well TAV-MW6, September 2018 – January 2020

Tables

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Table III-1
Timeline of Phase I In-Situ Bioremediation Treatability Study at TAVG AOC

Time	Event
July 2015	Personnel from DOE/NNSA, DOE Office of Environmental Management, SNL/NM, and NMED HWB agreed on a phased Treatability Study of In-Situ Bioremediation (ISB) to evaluate if ISB is a viable technology to treat groundwater contamination at the TAVG AOC.
May 2016	NMED HWB approved the Revised Treatability Study Work Plan.
August 2016	NMOSE issued Permit to Drill to install injection well TAV-INJ1.
May 2017	NMED GWQB issued Discharge Permit (DP)-1845 to DOE/NNSA for the TA-V Treatability Study injection wells.
November 2017	SNL/NM personnel completed installation of injection well TAV-INJ1.
November 2017	Began and completed Phase I pilot test injections at well TAV-INJ1. Began performance monitoring for Phase I pilot test injections.
June 2018	Completed performance monitoring of Phase I pilot test.
October 2018	SNL/NM personnel started Phase I full-scale operation of the ISB Treatability Study.
November 1, 2018 – April 25, 2019	Completed the six-month injection period of the Phase I full-scale operation at well TAV-INJ1.
May 2019	Started the two-year performance monitoring of Phase I full-scale operation.
Fall 2020	Anticipate making a decision on whether or not to proceed to Phase II of the ISB Treatability Study.
May 2021	Anticipate completing the performance monitoring of the Phase I full-scale operation.

Notes:
AOC = Area of Concern.
DOE = U.S. Department of Defense.
GWQB = Ground Water Quality Bureau.
HWB = Hazardous Waste Bureau.
INJ = Injection (acronym used for well identification only).
NMED = New Mexico Environment Department.
NMOSE = New Mexico Office of the State Engineer.
NNSA = Nation Nuclear Security Administration.
SNL/NM = Sandia National Laboratories, New Mexico.
TA-V = Technical Area–V.
TAV = Technical Area-V (acronym used for well identification only).
TAVG = Technical Area-V Groundwater.

Table III-2
Groundwater Sampling Conducted for Treatability Study, January – March 2020

Well Sampled	Sampling Date
Wells inside the Treatment Zone	
TAV-INJ1	28 Jan 2020
TAV-MW6	27 Jan 2020
TAV-MW7	3 Feb 2020
Wells outside the Treatment Zone	
LWDS-MW1	17 Feb 2020
TAV-MW2	6 Feb 2020
TAV-MW4	7 Feb 2020
TAV-MW8	12 Feb 2020
TAV-MW10	20 Feb 2020
TAV-MW11	10 Feb 2020
TAV-MW12	19 Feb 2020
TAV-MW14	13 Feb 2020

Notes:
INJ = Injection well.
LWDS = Liquid waste disposal system.
MW = Monitoring well.
TAV = Technical Area-V.

Table III-3
Analytical Results for Groundwater Samples Collected at Injection Well TAV-INJ1, January – March 2020

Sample Date	Analyses	Analyte	Result[a]	MDL[b]	PQL[c]	MCL[d]	Units	Lab Qual[e]	Val Qual[f]	Sample No.	Analtyical Method[g]	Lab[h]
28-Jan-20	Alkalinity	Alkalinity as $CaCO_3$	1,330	1.45	4.00	NE	mg/L		J	112202-005	SM 2320B	GEL
28-Jan-20	Alkalinity	Alkalinity, bicarb as $CaCO_3$	1,330	1.45	4.00	NE	mg/L			112202-005	SM 2320B	GEL
28-Jan-20	Alkalinity	Alkalinity, carb as $CaCO_3$	ND	1.45	4.00	NE	mg/L	U		112202-005	SM 2320B	GEL
28-Jan-20	Ammonia	Ammonia	84.8	4.25	12.5	NE	mg/L		J	112202-001	EPA 350.1	GEL
28-Jan-20	Anions	Bromide	18.1	0.335	1.00	NE	mg/L			112202-003	SW846 9056A	GEL
28-Jan-20	Anions	Sulfate	43.6	0.665	2.00	NE	mg/L			112202-003	SW846 9056A	GEL
28-Jan-20	Microbial	Dehalococcoides	ND	10,000	10,000	NE	Enumeration/L	U		112190-001	Dhc	SRM
28-Jan-20	Dissolved Metals	Arsenic	**0.0238**	0.002	0.005	0.01	mg/L			112202-006	SW846 3005A/6020B	GEL
28-Jan-20	Dissolved Metals	Iron	1.81	0.033	0.100	NE	mg/L			112202-006	SW846 3005A/6020B	GEL
28-Jan-20	Dissolved Metals	Manganese	0.878	0.001	0.005	NE	mg/L			112202-006	SW846 3005A/6020B	GEL
28-Jan-20	MEE	Methane	13,000	0.046	0.500	NE	µg/L		J	112192-001	AM20GAX	PACE
28-Jan-20	MEE	Ethane	0.11	0.005	0.100	NE	µg/L		J	112192-001	AM20GAX	PACE
28-Jan-20	MEE	Ethene	0.25	0.004	0.100	NE	µg/L		J	112192-001	AM20GAX	PACE
28-Jan-20	NPN	Nitrate plus nitrite as N	ND	0.017	0.050	10	mg/L	U	0.05UJ	112202-004	EPA 353.2	GEL
28-Jan-20	TOC	Total Organic Carbon Average	20.3	0.660	2.00	NE	mg/L			112202-002	SW846 9060A	GEL
28-Jan-20	VOC	Dichloroethene, cis-1,2-	ND	0.300	1.00	70	µg/L	U		112200-001	SW846 8260B	GEL
28-Jan-20	VOC	Trichloroethene	0.4	0.300	1.00	5	µg/L	J		112200-001	SW846 8260B	GEL

Note: Header nomenclature is explained following Table III-7 in the “Footnotes for Technical Area-V Analytical Results Tables” summary.

Table III-4
Analytical Results for Groundwater Samples Collected at Monitoring Well TAV-MW6, January – March 2020

Sample Date	Analyses	Analyte	Result[a]	MDL[b]	PQL[c]	MCL[d]	Units	Lab Qual[e]	Val Qual[f]	Sample No.	Analtyical Method[g]	Lab[h]
27-Jan-20	Alkalinity	Alkalinity as $CaCO_3$	204	1.45	4.00	NE	mg/L			112194-007	SM 2320B	GEL
27-Jan-20	Alkalinity	Alkalinity, bicarb as $CaCO_3$	204	1.45	4.00	NE	mg/L			112194-007	SM 2320B	GEL
27-Jan-20	Alkalinity	Alkalinity, carb as $CaCO_3$	ND	1.45	4.00	NE	mg/L	U		112194-007	SM 2320B	GEL
27-Jan-20	Ammonia	Ammonia	0.036	0.017	0.050	NE	mg/L	J	J-	112194-003	EPA 350.1	GEL
27-Jan-20	Anions	Bromide	1.24	0.067	0.200	NE	mg/L			112194-005	SW846 9056A	GEL
27-Jan-20	Anions	Sulfate	46.9	0.665	2.00	NE	mg/L			112194-005	SW846 9056A	GEL
27-Jan-20	Microbial	Dehalococcoides	ND	4,000	4,000	NE	Enumeration/L	U		112189-001	Dhc	SRM
27-Jan-20	Dissolved Metals	Arsenic	0.00235	0.002	0.005	0.01	mg/L	J		112194-008	SW846 3005A/6020B	GEL
27-Jan-20	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		112194-008	SW846 3005A/6020B	GEL
27-Jan-20	Dissolved Metals	Manganese	0.00237	0.001	0.005	NE	mg/L	J		112194-008	SW846 3005A/6020B	GEL
27-Jan-20	MEE	Methane	60	0.046	0.500	NE	µg/L		J	112191-001	AM20GAX	PACE
27-Jan-20	MEE	Ethane	ND	0.005	0.100	NE	µg/L	U	0.1UJ	112191-001	AM20GAX	PACE
27-Jan-20	MEE	Ethene	ND	0.004	0.100	NE	µg/L	U	0.1UJ	112191-001	AM20GAX	PACE
27-Jan-20	NPN	Nitrate plus nitrite as N	6.44	0.170	0.500	10	mg/L			112194-006	EPA 353.2	GEL
27-Jan-20	TOC	Total Organic Carbon Average	0.532	0.330	1.00	NE	mg/L	J		112194-004	SW846 9060A	GEL
27-Jan-20	VOC	Dichloroethene, cis-1,2-	1.15	0.300	1.00	70	µg/L			112194-001	SW846 8260B	GEL
27-Jan-20	VOC	Trichloroethene	**8.36**	0.300	1.00	5	µg/L			112194-001	SW846 8260B	GEL

Note: Header nomenclature is explained following Table III-7 in the “Footnotes for Technical Area-V Analytical Results Tables” summary.

Table III-5
Analytical Results for Groundwater Samples Collected at Monitoring Well TAV-MW7, January – March 2020

Sample Date	Analyses	Analyte	Result[a]	MDL[b]	PQL[c]	MCL[d]	Units	Lab Qual[e]	Val Qual[f]	Sample No.	Analtyical Method[g]	Lab[h]
3-Feb-20	Anions	Bromide	0.252	0.067	0.200	NE	mg/L			112235-001	SW846 9056A	GEL
3-Feb-20	Dissolved Metals	Arsenic	0.00307	0.002	0.005	0.01	mg/L	J		112255-004	SW846 3005A/6020B	GEL
3-Feb-20	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		112255-004	SW846 3005A/6020B	GEL
3-Feb-20	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		112255-004	SW846 3005A/6020B	GEL
3-Feb-20	MEE	Ethene	ND	0.008	0.100	NE	µg/L	U	0.1UJ	112232-001	AM20GAX	PACE
3-Feb-20	NPN	Nitrate plus nitrite as N	4.14	0.085	0.250	10	mg/L			112255-003	EPA 353.2	GEL
3-Feb-20	VOC	Dichloroethene, cis-1,2-	ND	0.300	1.00	70	µg/L	U		112255-001	SW846 8260B	GEL
3-Feb-20	VOC	Trichloroethene	ND	0.300	1.00	5	µg/L	U		112255-001	SW846 8260B	GEL

Note: Header nomenclature is explained following Table III-7 in the “Footnotes for Technical Area-V Analytical Results Tables” summary.

Table III-6
Analytical Results for Groundwater Samples Collected at Monitoring Wells
LWDS-MW1, TAV-MW2, TAV-MW4, TAV-MW8, TAV-MW10, TAV-MW11, TAV-MW12, and TAV MW14, January – March 2020

Sample Date	Analyses	Analyte	Result[a]	MDL[b]	PQL[c]	MCL[d]	Units	Lab Qual[e]	Val Qual[f]	Sample No.	Analtyical Method[g]	Lab[h]
LWDS-MW1												
17-Feb-20	Dissolved Metals	Arsenic	0.00366	0.002	0.005	0.01	mg/L	J	0.005U	112287-004	SW846 3005A/6020B	GEL
17-Feb-20	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		112287-004	SW846 3005A/6020B	GEL
17-Feb-20	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		112287-004	SW846 3005A/6020B	GEL
17-Feb-20	NPN	Nitrate plus nitrite as N	**13.7**	0.850	2.50	10	mg/L			112287-003	EPA 353.2	GEL
17-Feb-20	VOC	Dichloroethene, cis-1,2-	2.9	0.300	1.00	70	µg/L			112287-001	SW846 8260B DOE-AL	GEL
17-Feb-20	VOC	Trichloroethene	**11.2**	0.300	1.00	5	µg/L			112287-001	SW846 8260B DOE-AL	GEL
17-Feb-20 (DUP)	Dissolved Metals	Arsenic	0.00369	0.002	0.005	0.01	mg/L	J	0.005U	112288-004	SW846 3005A/6020B	GEL
17-Feb-20 (DUP)	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		112288-004	SW846 3005A/6020B	GEL
17-Feb-20 (DUP)	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		112288-004	SW846 3005A/6020B	GEL
17-Feb-20 (DUP)	NPN	Nitrate plus nitrite as N	**12.7**	0.850	2.50	10	mg/L			112288-003	EPA 353.2	GEL
17-Feb-20 (DUP)	VOC	Dichloroethene, cis-1,2-	3.39	0.300	1.00	70	µg/L			112288-001	SW846 8260B	GEL
17-Feb-20 (DUP)	VOC	Trichloroethene	**14.8**	0.300	1.00	5	µg/L			112288-001	SW846 8260B	GEL
TAV-MW2												
6-Feb-20	Dissolved Metals	Arsenic	ND	0.002	0.005	0.01	mg/L	U		112267-004	SW846 3005A/6020B	GEL
6-Feb-20	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		112267-004	SW846 3005A/6020B	GEL
6-Feb-20	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		112267-004	SW846 3005A/6020B	GEL
6-Feb-20	NPN	Nitrate plus nitrite as N	5.42	0.170	0.500	10	mg/L			112267-003	EPA 353.2	GEL
6-Feb-20	VOC	Dichloroethene, cis-1,2-	ND	0.300	1.00	70	µg/L	U		112267-001	SW846 8260B	GEL
6-Feb-20	VOC	Trichloroethene	3.65	0.300	1.00	5	µg/L			112267-001	SW846 8260B	GEL
TAV-MW4												
7-Feb-20	Dissolved Metals	Arsenic	ND	0.002	0.005	0.01	mg/L	U		112271-004	SW846 3005A/6020B	GEL
7-Feb-20	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		112271-004	SW846 3005A/6020B	GEL
7-Feb-20	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		112271-004	SW846 3005A/6020B	GEL
7-Feb-20	NPN	Nitrate plus nitrite as N	5.31	0.170	0.500	10	mg/L			112271-003	EPA 353.2	GEL
7-Feb-20	VOC	Dichloroethene, cis-1,2-	0.49	0.300	1.00	70	µg/L	J		112271-001	SW846 8260B	GEL
7-Feb-20	VOC	Trichloroethene	4.99	0.300	1.00	5	µg/L			112271-001	SW846 8260B	GEL
7-Feb-20 (DUP)	Dissolved Metals	Arsenic	ND	0.002	0.005	0.01	mg/L	U		112272-004	SW846 3005A/6020B	GEL
7-Feb-20 (DUP)	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		112272-004	SW846 3005A/6020B	GEL
7-Feb-20 (DUP)	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		112272-004	SW846 3005A/6020B	GEL
7-Feb-20 (DUP)	NPN	Nitrate plus nitrite as N	5.25	0.170	0.500	10	mg/L			112272-003	EPA 353.2	GEL
7-Feb-20 (DUP)	VOC	Dichloroethene, cis-1,2-	0.55	0.300	1.00	70	µg/L	J		112272-001	SW846 8260B	GEL
7-Feb-20 (DUP)	VOC	Trichloroethene	**5.03**	0.300	1.00	5	µg/L			112272-001	SW846 8260B	GEL
TAV-MW8												
12-Feb-20	Dissolved Metals	Arsenic	0.00345	0.002	0.005	0.01	mg/L	J		112277-004	SW846 3005A/6020B	GEL
12-Feb-20	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		112277-004	SW846 3005A/6020B	GEL
12-Feb-20	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		112277-004	SW846 3005A/6020B	GEL
12-Feb-20	NPN	Nitrate plus nitrite as N	7.18	0.170	0.500	10	mg/L			112277-003	EPA 353.2	GEL
12-Feb-20	VOC	Dichloroethene, cis-1,2-	0.45	0.300	1.00	70	µg/L	J		112277-001	SW846 8260B	GEL
12-Feb-20	VOC	Trichloroethene	4.67	0.300	1.00	5	µg/L			112277-001	SW846 8260B	GEL
TAV-MW10												
20-Feb-20	Dissolved Metals	Arsenic	0.00253	0.002	0.005	0.01	mg/L	J		112292-004	SW846 3005A/6020B	GEL
20-Feb-20	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		112292-004	SW846 3005A/6020B	GEL
20-Feb-20	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		112292-004	SW846 3005A/6020B	GEL
20-Feb-20	NPN	Nitrate plus nitrite as N	**11.4**	0.170	0.500	10	mg/L			112292-003	EPA 353.2	GEL
20-Feb-20	VOC	Dichloroethene, cis-1,2-	2.08	0.300	1.00	70	µg/L			112292-001	SW846 8260B	GEL
20-Feb-20	VOC	Trichloroethene	**12.4**	0.300	1.00	5	µg/L			112292-001	SW846 8260B	GEL

Note: Header nomenclature is explained following Table III-7 in the “Footnotes for Technical Area-V Analytical Results Tables” summary.

Table III-6
Analytical Results for Groundwater Samples Collected at Monitoring Wells
LWDS-MW1, TAV-MW2, TAV-MW4, TAV-MW8, TAV-MW10, TAV-MW11, TAV-MW12, and TAV MW14, January – March 2020 (concluded)

Sample Date	Analyses	Analyte	Result[a]	MDL[b]	PQL[c]	MCL[d]	Units	Lab Qual[e]	Val Qual[f]	Sample No.	Analtyical Method[g]	Lab[h]
TAV-MW11												
10-Feb-20	Dissolved Metals	Arsenic	0.00321	0.002	0.005	0.01	mg/L	J		112275-004	SW846 3005A/6020B	GEL
10-Feb-20	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		112275-004	SW846 3005A/6020B	GEL
10-Feb-20	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		112275-004	SW846 3005A/6020B	GEL
10-Feb-20	NPN	Nitrate plus nitrite as N	7.08	0.170	0.500	10	mg/L			112275-003	EPA 353.2	GEL
10-Feb-20	VOC	Dichloroethene, cis-1,2-	0.62	0.300	1.00	70	µg/L	J		112275-001	SW846 8260B	GEL
10-Feb-20	VOC	Trichloroethene	4.72	0.300	1.00	5	µg/L			112275-001	SW846 8260B	GEL
TAV-MW12												
19-Feb-20	Dissolved Metals	Arsenic	0.00216	0.002	0.005	0.01	mg/L	J		112283-004	SW846 3005A/6020B	GEL
19-Feb-20	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U	0.1UJ	112283-004	SW846 3005A/6020B	GEL
19-Feb-20	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U	0.005UJ	112283-004	SW846 3005A/6020B	GEL
19-Feb-20	NPN	Nitrate plus nitrite as N	4.43	0.170	0.500	10	mg/L			112283-003	EPA 353.2	GEL
19-Feb-20	VOC	Dichloroethene, cis-1,2-	ND	0.300	1.00	70	µg/L	U		112283-001	SW846 8260B	GEL
19-Feb-20	VOC	Trichloroethene	2.26	0.300	1.00	5	µg/L			112283-001	SW846 8260B	GEL
19-Feb-20 (DUP)	Dissolved Metals	Arsenic	0.00214	0.002	0.005	0.01	mg/L	J		112284-004	SW846 3005A/6020B	GEL
19-Feb-20 (DUP)	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		112284-004	SW846 3005A/6020B	GEL
19-Feb-20 (DUP)	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		112284-004	SW846 3005A/6020B	GEL
19-Feb-20 (DUP)	NPN	Nitrate plus nitrite as N	4.41	0.170	0.500	10	mg/L			112284-003	EPA 353.2	GEL
19-Feb-20 (DUP)	VOC	Dichloroethene, cis-1,2-	ND	0.300	1.00	70	µg/L	U		112284-001	SW846 8260B	GEL
19-Feb-20 (DUP)	VOC	Trichloroethene	2.22	0.300	1.00	5	µg/L			112284-001	SW846 8260B	GEL
TAV-MW14												
13-Feb-20	Dissolved Metals	Arsenic	0.00309	0.002	0.005	0.01	mg/L	J		112290-004	SW846 3005A/6020B	GEL
13-Feb-20	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		112290-004	SW846 3005A/6020B	GEL
13-Feb-20	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		112290-004	SW846 3005A/6020B	GEL
13-Feb-20	NPN	Nitrate plus nitrite as N	9.01	0.170	0.500	10	mg/L			112290-003	EPA 353.2	GEL
13-Feb-20	VOC	Dichloroethene, cis-1,2-	0.41	0.300	1.00	70	µg/L	J		112290-001	SW846 8260B	GEL
13-Feb-20	VOC	Trichloroethene	4.55	0.300	1.00	5	µg/L			112290-001	SW846 8260B	GEL

Note: Header nomenclature is explained following Table III-7 in the “Footnotes for Technical Area-V Analytical Results Tables” summary.

Table III-7
Field Water Quality Measurements[i], January – March 2020

Well ID	Sample Date	Temperature (°C)	Specific Conductivity (µmho/cm)	Oxidation Reduction Potential (mV)	pH	Turbidity (NTU)	Dissolved Oxygen (% Sat)	Dissolved Oxygen (mg/L)
TAV-INJ1	28-Jan-20	18.42	2685.6	-139.7	6.90	48.5	17.2	1.20
TAV-MW6	27-Jan-20	18.84	725.9	82.18	7.36	16.2	54.14	3.94
TAV-MW7	03-Feb-20	19.17	684.20	-92.8	7.45	1.69	7.86	0.68
LWDS-MW1	17-Feb-20	19.13	730.04	144.7	7.44	0.48	98.45	7.58
TAV-MW2	06-Feb-20	15.91	647.50	155.4	7.34	4.59	77.30	6.24
TAV-MW4	07-Feb-20	19.39	512.18	132.2	7.56	0.78	91.82	7.00
TAV-MW8	12-Feb-20	18.07	560.11	88.6	7.48	2.60	84.51	6.65
TAV-MW10	20-Feb-20	17.18	704.12	129.9	7.55	0.27	88.40	7.12
TAV-MW11	10-Feb-20	18.63	654.92	110.2	7.53	0.20	86.99	6.79
TAV-MW12	19-Feb-20	17.72	735.85	131.8	7.40	1.19	80.41	6.11
TAV-MW14	13-Feb-20	18.18	638.17	123.3	7.43	1.87	89.89	7.03

Note: Header nomenclature is explained following Table III-7 in the “Footnotes for Technical Area-V Analytical Results Tables” summary.

Footnotes for Technical Area-V Analytical Results Tables

% = Percent.
$CaCO_3$ = Calcium carbonate.
Dhc = *Dehalococcoides*.
DUP = Environmental duplicate sample.
Enumeration/L = gene copies per liter.
EPA = U.S. Environmental Protection Agency.
ID = Identifier.
INJ = Injection well (acronym used for well identification only).
LWDS = Liquid waste disposal system (acronym used for well identification only).
µg/L = Micrograms per liter.
mg/L = Milligrams per liter.
MEE = Methane, ethane, ethene.
MW = Monitoring well (acronym used for well identification only).
No. = Number.
NPN = Nitrate plus nitrite, as nitrogen.
TAV = Technical Area-V (acronym used for well identification only).
TOC = Total organic carbon.
VOC = Volatile organic compound.

[a]Result
Detected VOCs are presented in the tables.
Bold = Concentration exceeds the MCL.
ND = Not detected (at method detection limit).

[b]MDL
MDL = Method detection limit. The minimum concentration or activity that can be measured and reported with 99% confidence that the analyte is greater than zero, analyte is matrix specific.

[c]PQL
PQL = Practical quantitation limit. The lowest concentration of analytes in a sample that can be reliably determined within specified limits of precision and accuracy by that indicated method under routine laboratory operating conditions.

[d]MCL
MCL = Maximum contaminant level. 2018 Edition of the Drinking Water Standards and Health Advisories Tables, EPA 822-F-18-001, Office of Water, U.S. Environmental Protection Agency, Washington, D.C., March 2018.

NE = Not established.

[e]Lab Qualifier
If cell is blank, then all quality control samples met acceptance criteria with respect to submitted samples.
J = Estimated value, the analyte concentration fell above the method detection limit and below the practical quantitation limit.
U = Analyte is absent or below the method detection limit.

Footnotes for Technical Area-V Analytical Results Tables *(Continued)*

[f]Validation Qualifier

If cell is blank, then all quality control samples met acceptance criteria with respect to submitted samples.

J = The associated value is an estimated quantity.
J- = Estimated value with a suspected negative bias.
U = The analyte was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.
UJ = The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

[g]Analytical Method

AM20GAX = Proprietary method of Pace Analytical Services, LLC.
Gene-Trac Dhc = Proprietary method of SiREM.

Clesceri, Rice, Baird, and Eaton, 2012, *Standard Methods for the Examination of Water and Wastewater*, 22nd ed., Method 2320B, published jointly by American Public Health Association, American Water Works Association, and Water Environment Federation. Washington, D.C.

EPA, 1986, (and updates), "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., U.S. Environmental Protection Agency, Cincinnati, Ohio.

EPA, 1984, "Methods for Chemical Analysis of Water and Wastes." EPA 600-4-79-020, U.S. Environmental Protection Agency, Cincinnati, Ohio.

EPA, 1993, "Method 350.1, Determination of Ammonia Nitrogen by Semi-Automated Colorimetry." Revision 2.0.

EPA, 1993, "Method 353.2, Determination of Nitrate-Nitrite Nitrogen by Automated Colorimetry." Revision 2.0.

[h]Lab

GEL = GEL Laboratories LLC, 2040 Savage Road, Charleston, South Carolina 29407.
PACE = Pace Analytical Services, LLC, Energy Services Lab, 220 William Pitt Way, Pittsburgh, Pennsylvania, 15238.
SRM = SiREM, 130 Stone Road. W, Guelph, Ontario, N1G 3Z2, Canada.

[i]Field Water Quality Measurements

Field measurements collected prior to sampling.

°C = Degrees Celsius.
% Sat = Percent saturation.
µmho/cm = Micromhos per centimeter.
mg/L = Milligrams per liter.
mV = Millivolts.
NTU = Nephelometric turbidity units.
pH = Potential of hydrogen (negative logarithm of the hydrogen ion concentration).

Appendix A

NMED's Approval Letter and DOE's Submittal with the Enclosure Describing Full-Scale Operation Modifications

State of New Mexico
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6313
Phone (505) 476-6000 Fax (505) 476-6030
www.env.nm.gov

SUSANA MARTINEZ
Governor
JOHN A. SANCHEZ
Lieutenant Governor

BUTCH TONGATE
Cabinet Secretary
J. C. BORREGO
Deputy Secretary

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

August 13, 2018

Jeffrey P. Harrell
Manager
U.S. Department of Energy
NNSA/Sandia Field Office
P.O. Box 5400, MS 0184
Albuquerque, NM 87185-5400

Richard O. Griffith
Senior Manager
Sandia National Laboratories
P.O. Box 5800, MS 0726
Albuquerque, NM 87185-5400

RE: APPROVAL
TECHNICAL AREA-V (TA-V) TREATABILITY STUDY NOTIFICATION OF FULL-SCALE OPERATION AT WELL TAV-INJ1
SANDIA NATIONAL LABORATORY
EPA ID#NM5890110518
HWB-SNL-15-020

Dear Mr. Harrell and Mr. Griffith:

The New Mexico Environment Department (NMED) received the letter titled *Technical Area-V (TA-V) Treatability Study Notification of Full-Scale Operation at Well TAV-INJ1,* dated July 20, 2018, submitted by the U.S. Department of Energy on behalf of itself and NTESS (collectively, the Permittees), on July 26, 2018. NMED has reviewed the letter and hereby issues this Approval of the proposed modifications to the Work Plan and concurs with the decision to proceed with full-scale operation at well TAV-INJ1 of the Treatability Study/Interim Measure at TA-V.

If you have any questions regarding this matter, please contact Naomi Davidson of my staff at (505) 222-9504.

Sincerely,

John E. Kieling
Chief
Hazardous Waste Bureau

cc: D. Cobrain, NMED HWB
B. Wear, NMED HWB
N. Davidson, NMED HWB
L. King, EPA Region 6 (6PD-N)
J. Todd, DOE/NNSA/SFO, MS-0184
D. Rast, DOE/NNSA/SFO, MS-0184
J. Cochran, SNL/NM, MS-0719
E. Boatman, SNL/NM, MS-0718

File: SNL 2018 and Reading, SNL-15-020

Department of Energy
National Nuclear Security Administration
Sandia Field Office
P.O. Box 5400
Albuquerque, NM 87185

JUL 20 2018

Mr. John E. Kieling
Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Bldg. 1
Santa Fe, New Mexico 87505

Subject: Technical Area-V (TA-V) Treatability Study Notification of Full-Scale Operation at Well TAV-INJ1

Dear Mr. Kieling:

The Department of Energy/National Nuclear Security Administration/Sandia Field Office (DOE/NNSA/SFO) and its management and operating contractor, National Technology and Engineering Solutions of Sandia, LLC (NTESS) intend to proceed with full-scale operation at well TAV-INJ1 as part of the Treatability Study of in-situ bioremediation at TA-V Groundwater Area of Concern, Sandia National Laboratories/New Mexico (SNL/NM). Full-scale operation will not commence until at least 60 days after this notification is received at New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB), in accordance with the 2016 Revised Treatability Study Work Plan.

Associated modifications to the full-scale operation based on the experience and monitoring results of the pilot test at well TAV-INJ1 were discussed among personnel from DOE/NNSA/SFO, SNL/NM, and NMED HWB in a meeting held on June 20, 2018. The modifications and the rationale for the modifications to conduct full-scale operation at well TAV-INJ1 are provided in the enclosure.

If you have questions contact David Rast of our staff at (505) 845-5349.

Sincerely,

Jeffrey P. Harrell
Manager

Enclosure

cc: See Page 2

cc w/enclosure:
Naomi Davidson
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cc w/o enclosure:
Amy Blumberg, SNL/NM
Paul Shoemaker, SNL/NM
Christi Leigh, SNL/NM
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NNSA-2018-001960

Technical Area-V (TA-V) Treatability Study
Notification of Full-Scale Operation at Well TAV-INJ1

CERTIFICATION STATEMENT

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

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ENCLOSURE

The Department of Energy/National Nuclear Security Administration, Sandia Field Office and Sandia National Laboratories, New Mexico (SNL/NM) personnel (i.e., the project team) plan to implement the following modifications for the full-scale operation of the in-situ bioremediation (ISB) Treatability Study at the Technical Area-V (TA-V) Groundwater Area of Concern. The modifications were based on the experience and monitoring results of the pilot test conducted at well TAV-INJ1. The original proposal in the Revised Treatability Study Work Plan (TSWP) (SNL/NM March 2016; NMED May 2016) is repeated verbatim, followed by the rationale for modification and a summary statement of the modification to be implemented in full-scale operation at well TAV-INJ1.

#1: Method for Deoxygenation in Aboveground Tanks

In Section 4.2.2, Page 4-9, the Revised TSWP states, "*One tank will be inoculated with a small amount of soil core/cuttings from the injection well screened interval and have KB-1® Primer added. The purposes of adding soil core/cuttings to the substrate solution are to (1) inoculate the solution with native microorganisms, (2) create a diverse microbial community that will more likely work synergistically with the bioaugmentation culture, and (3) reduce the lag time for initiating biostimulation associated with utilization of the substrate in the subsurface.*"

Rationale for Modification: Two injections of the substrate solution were conducted during the pilot test. The soil core/cuttings were not added to the substrate solution during the first injection, but were added during the second injection. The pilot test results showed that KB-1® Primer itself could produce favorable conditions – low dissolved oxygen (DO) and negative oxidation-reduction potential (ORP) – for safely injecting KB-1® Dechlorinator. KB-1® Dechlorinator are the dechlorinating bacteria that require anaerobic environment to survive.

Based on the experience gained during the pilot test, it is not necessary to rely on growing the microbial community in the aboveground tanks to produce low DO and negative ORP inside the tanks. In fact, the KB-1® Primer alone can sufficiently produce these conditions. Not relying on microbial growth in the aboveground tanks eliminates the biofouling concern for the water stored in the tanks.

During full-scale injection, we will bioaugment the aquifer with KB-1® Dechlorinator throughout the six-month injection; therefore, the three purposes stated above become unnecessary because of the long-term bioaugmentation in the aquifer.

Full-Scale Operation Modification #1: Use substrate components (i.e., chemicals) only to deoxygenate potable water in aboveground tanks.

#2: Number of Aboveground Deoxygenation Tanks for Full-Scale Operation

In Section 4.2.2, Pages 4-9 and 4-10, the Revised TSWP states "*A similar process will be applied to the full-scale injections. Two pairs of tanks will be used for full-scale injection (see section 4.3.2). Both pairs of tanks will be filled halfway with potable water, inoculated, and have KB-1® Primer added. After turning anaerobic, the tanks will be filled with potable water and*

mixed with proportional amounts of the substrate solution components. As with the push/pull test, deoxygenation of the entire tank volume is expected within one to two days. Once anaerobic conditions are restored, half of the tank contents (from each pair) will be injected. This pair of tanks will then be refilled with potable water and mixed with proportional amounts of the substrate solution components. Provided that approximately half a tank of the deoxygenated solution remains in each tank, this accelerated deoxygenation schedule is expected to continue without further use of KB-1® Primer during the remainder of the injection period. By alternating two pair of tanks, injection would not be interrupted while waiting for the substrate solution to turn anaerobic."

Rationale for Modification: Using substrate components (i.e., chemicals) to achieve low DO and negative ORP of the substrate solution for safely injecting KB-1® Dechlorinator, the injection operation can be simplified by alternating two deoxygenation tanks. Based on the experience from the pilot test, the chemicals can lower the DO and ORP to desired levels within a couple of hours. It takes about five and a half hours to inject approximately 5,000 gallons of substrate solution. Therefore, theoretically we can prepare a tank of substrate solution and empty it within a single day. In practice, we will prepare one tank and empty its content the next day. We will alternate using the two existing tanks used in the pilot test. With this modification, we do not need to install two more tanks as proposed in the Revised TSWP.

Full-Scale Operation Modification #2: Use two existing 5,000-gallon aboveground tanks for full-scale injection.

#3: Substitute for KB-1® Primer

In Section 4.2.2, Page 4-8, the Revised TSWP states "*KB-1® Primer is a proprietary mixture of amino acids, potassium bicarbonate, and sodium sulfite that is used to accelerate deoxygenation of water inorganically (sodium sulfite) while still providing an electron donor (amino acids) and buffer (potassium bicarbonate). It can therefore be used as a substitute for ethyl lactate, diammonium phosphate, and yeast extract, although it is significantly more costly and therefore, not suitable for the large volumes planned under full scale injection.*"

Rationale for Modification: With the goal of using chemical method for deoxygenation, the project team conducted bench-scale, 5-gallon bucket tests to evaluate the functionality of the key components of KB-1® Primer. The results of the bucket tests showed that by using the two key ingredients, potassium bicarbonate and sodium sulfite, combined with ethyl lactate and diammonium phosphate, we could achieve the same desired conditions as using the KB-1® Primer alone. The functionality of ethyl lactate as the electron donor and diammonium phosphate as the nutrient can effectively substitute for the amino acids in the KB-1® Primer.

Attachment A includes the Safety Data Sheets (SDS) for potassium bicarbonate and sodium sulfite.

Full-Scale Operation Modification #3: Eliminate KB-1® Primer. Use potassium bicarbonate and sodium sulfite. A Revised Table 4-1 is provided below for the substrate solution components in full-scale operation.

Minor adjustments to the quantities of the substrate components could be necessary during full-scale operation depending on the in-situ water quality measurements of the aboveground tanks content and the groundwater in well TAV-INJ1.

Revised Table 4-1
Substrate Solution Components

Substrate Solution Component	Function	Mixing Ratio (by weight)	Weight per 1,000 gal Water
Primary Components			
Ethyl lactate	Electron donor (substrate)	80.4%	5.64 lbs
Diammonium phosphate	Nutrient and pH buffer	9.0%	0.63 lbs
Accelerite® [a]	Nutrient	6.4%	0.45 lbs
Potassium Bicarbonate	Buffer and acid reducer	1.7%	0.11 lbs
Sodium Sulfite	Deoxygenation and reduction agent	2.5%	0.17 lbs
Primary Components per 1,000 gal Potable Water		**100%**	**7 lbs**
Additional Component Mixed with Substrate Solution			
Sodium bromide	Inert tracer (as bromide)	Not applicable; adjusted per field condition	0.2 lbs

[a] Accelerite® Bioremediation Nutrient is a product of JRW Bioremediation, LLC.
% = Percent.
gal = Gallon(s).
lbs = Pounds.

#4: Substitute for Yeast Extract

In Section 4.2.1, Page 4-7, the Revised TSWP states "*Diammonium phosphate and yeast extract will be added as nutrients to support microbial growth.*"

Rationale for Modification: Accelerite® Bioremediation Nutrient is a product of JRW Bioremediation, LLC (JRW). The composition of Accelerite® is a proprietary nutrient blend of yeast metabolites including B-vitamins and other soluble nutrients. Accelerite® was tested in the bench-scale bucket tests and proved to function the same as the yeast extract obtained from Sigma-Aldrich. There are two advantages of using Accelerite®. First, it is significantly more concentrated, requiring less material to achieve the desired effect. The overall cost for Accelerite® is less than the yeast extract because less material is required. Secondly, Accelerite® is received in liquid form and is much easier to handle in the field than the powder-form yeast extract. Therefore, Accelerite® Bioremediation Nutrient from JRW is chosen to substitute for yeast extract in the full-scale operation.

Attachment A includes the SDS for Accelerite® is Bioremediation Nutrient.

Full-Scale Operation Modification #4: Use Accelerite® Bioremediation Nutrient in place of yeast extract. The Revised Table 4-1 provides the quantity needed for Accelerite® in full-scale operation.

#5: Sampling for Laboratory Analysis of Tank Content

In Section 5.4.2, Pages 5-17 and 5-18 of the Revised TSWP do not state that samples of the injected substrate solution during full-scale injections will be collected for laboratory analysis. However, sampling is implied as we did during the pilot test injections, in accordance with Section 5.4.1, Page 5-15, which states, "*A sample of the injected substrate solution will be collected as it is being injected and analyzed for parameters listed in Table 5-4 and measured for field parameters specified in section 5.3.*"

Rationale for Modification: Samples of the substrate solution in aboveground tanks were collected for laboratory analysis during the pilot test injections. The objective of sampling the tank content was to confirm the ingredients of the substrate solution. However, significant matrix interferences were reported by the analytical laboratory, which resulted in high dilutions for most samples. While preparing the substrate solution, the daily dose, masses or volumes of the substrate components as well as the KB-1® Dechlorinator could be accurately measured before mixing. The volume of the potable water could be accurately measured by the flow meter connected to the fire hydrant. These records provided sufficient information on what was being injected. The laboratory analysis of the tank content did not add any value because the process knowledge of the injectate was sufficient. Therefore, laboratory analysis of the substrate solution is not necessary. In addition, an in-situ water quality sonde is used to monitor the turbidity, specific conductance, pH, ORP, DO, temperature, and pressure in each tank.

Full-Scale Operation Modification #5: No sampling of the aboveground tank content.

#6: Groundwater Sampling at Well TAV-INJ1 during Injection

In Section 5.2.2, Page 5-18, the Revised TSWP states, "*During injection, DO, ORP, and pH will be monitored in well TAV-INJ1 using downhole electronic probes and a data logger. Water levels will also be frequently monitored immediately prior and throughout each workday during injections. Additionally, wells TAV-INJ1, TAV-MW6, and TAV-MW7 will be monitored monthly during injection for the analyses (Table 5-4) and the field parameters listed in section 5.3.*"

Rationale for Modification: During the performance monitoring of the pilot test, it was apparent that we were dominantly sampling the substrate solution that was injected at well TAV-INJ1 instead of the native groundwater. Strong matrix interferences were reported by the analytical laboratory due to the various substrate ingredients. Because we know exactly how we prepare the substrate solution in aboveground tanks, it is not necessary to collect groundwater samples from the injection well during the six-month injection period.

However, we will collect groundwater samples from well TAV-MW6 during injection as planned in the Revised TSWP. In addition, in-situ water quality sondes will be installed in wells TAV-INJ1 and TAV-MW6 during injection. Turbidity, specific conductance, pH, ORP, DO, temperature, and pressure (correlates to water level) will be logged continuously at a frequency set by the project team.

Full-Scale Operation Modification #6: No groundwater sampling at injection well TAV-INJ1 during the six-month injection. Groundwater sampling at well TAV-INJ1 will start one month after the completion of full-scale injections, as proposed for the post-injection monitoring in the Revised TSWP.

#7: ISB Performance Monitoring at Well TAV-MW7

In Section 5.2.2, Page 5-17 (top of page), the Revised TSWP states "*Did results from deeper well TAV-MW7 support the conclusion that further injections will not adversely affect deeper groundwater?"*

Increases in nitrate or bromide concentrations and detections of TCE or associated daughter products in well TAV-MW7 would indicate further injection could drive contamination deeper."

Rationale for Modification: During the pilot test injections, an in-situ water quality sonde was installed in each of the three wells (TAV-INJ1, TAV-MW6, and TAV-MW7). The sonde has sensors for turbidity, specific conductance, pH, ORP, DO, temperature, and pressure. The pressure reading correlates to the height of the water column above the sonde. These seven parameters were logged continuously at a pre-specified interval (e.g., every minute). When injections occurred in well TAV-INJ1 (Figure 1a), we observed instantaneous response in well TAV-MW6 (Figure 1b). However, no response was observed in well TAV-MW7 (Figure 1c). These results indicate that wells TAV-INJ1 and TAV-MW6, both screened across the groundwater table, are **not** hydrogeologically connected with well TAV-MW7, which is screened 90 feet deeper.

The results from the four-month performance monitoring after the pilot test injections also show no indication of any injected ingredient in well TAV-MW7, even though well TAV-MW7 is laterally closer to well TAV-INJ1 than well TAV-MW6. The monitoring results of well TAV-MW7 have been similar to its baseline sampling results in the October – December 2017 Discharge Permit DP-1845 Quarterly Report submitted to the NMED GWQB. A copy of this report was also provided to the NMED HWB.

Well TAV-MW7 would not be useful for monitoring the ISB treatment zone surrounding wells TAV-INJ1 and TAV-MW6. Therefore, we propose to revert it back to the TA-V groundwater monitoring network, which is administered by the SNL Long-Term Stewardship (LTS) group. Under the LTS monitoring plan, well TAV-MW7 is sampled semiannually for nitrate plus nitrite (NPN), volatile organic compounds, and dissolved metals (arsenic, iron, and manganese).

Full-Scale Operation Modification #7: Revert well TAV-MW7 back to the LTS sampling plan with the following additions:

- Increase the sampling frequency from semiannually to quarterly.
- Include bromide in the current analysis suite.
- Include ethene in the current analysis suite, per requirement of the Discharge Permit DP-1845.
- Install an in-situ water quality sonde in well TAV-MW7 in full-scale operation.

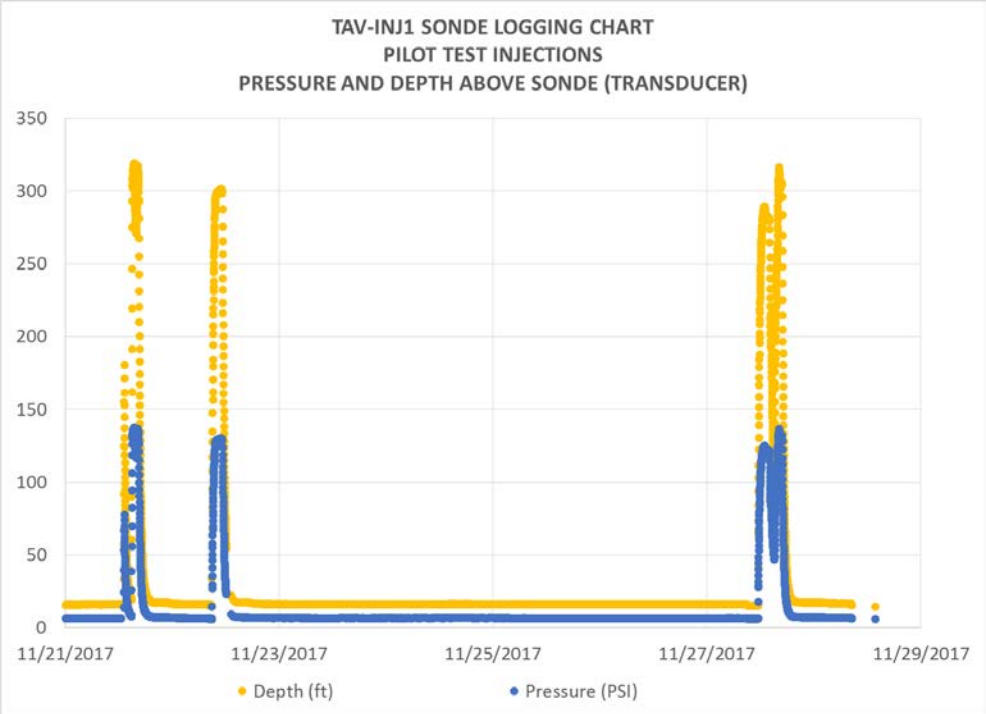

Figure 1a
Pressure and Water Column Height in well TAV-INJ1 during Injections

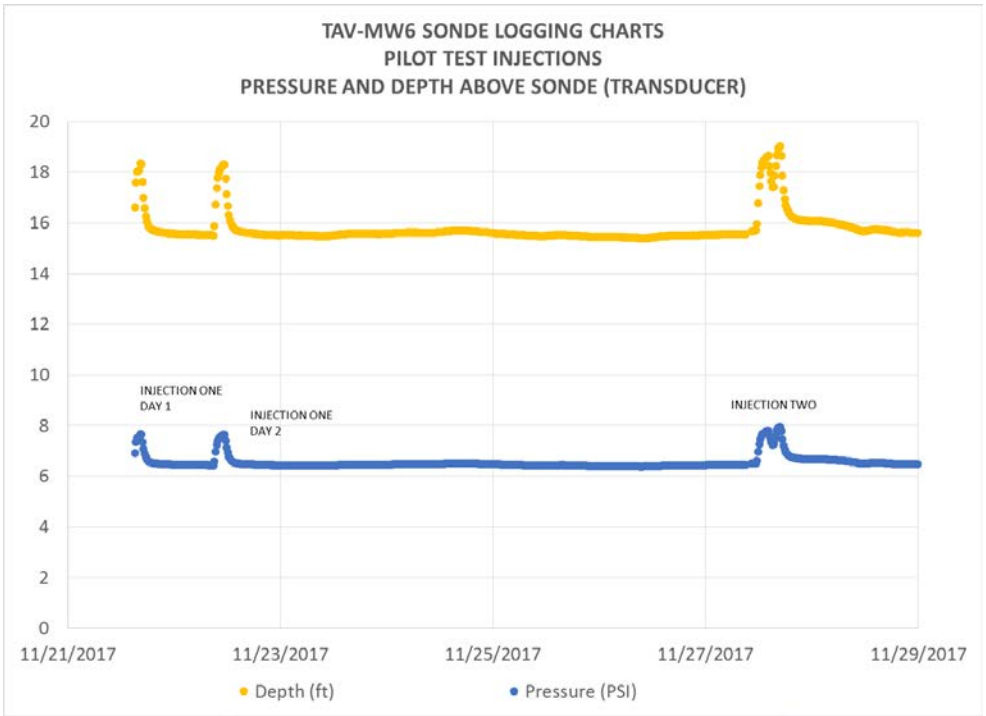

Figure 1b
Pressure and Water Column Height in well TAV-MW6 in
Response to Injections at well TAV-INJ1

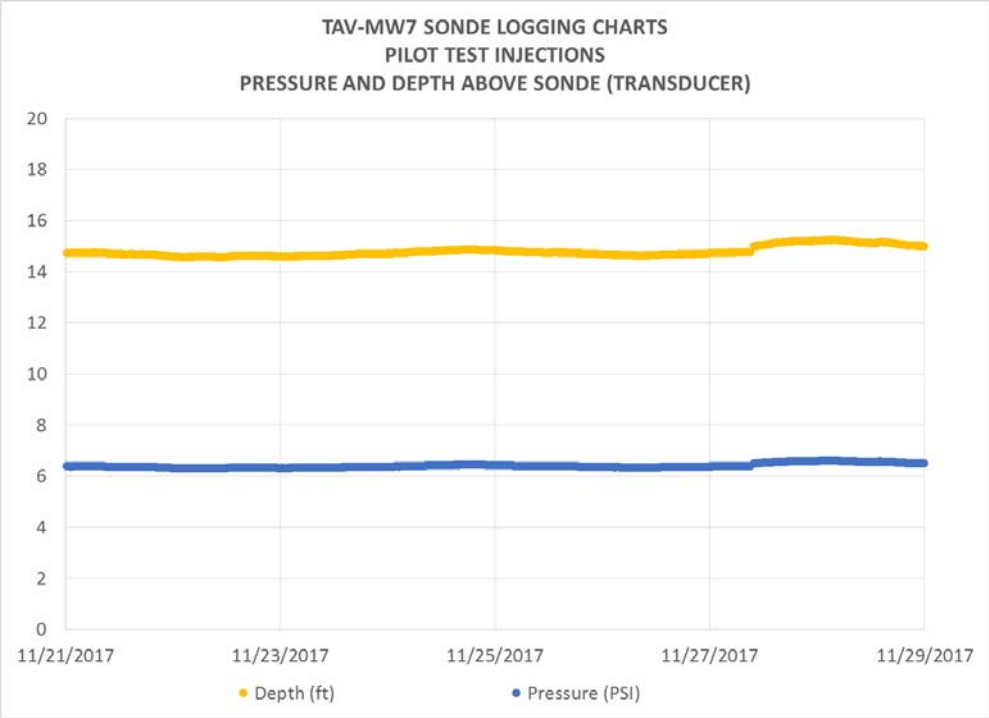

Figure 1c
Pressure and Water Column Height in well TAV-MW7 in
Response to Injections at well TAV-INJ1

In the unlikely event that the sonde readings or the analytical results from well TAV-MW7 show any variation from the baseline, it will be reinstated into the ISB performance monitoring campaign as soon as possible.

#8: Analytical Parameters for Groundwater Samples

In Section 5.3, Page 5-11, Table 5-4, the Revised TSWP provides the analytical parameters for groundwater samples to be collected during the Treatability Study.

Rationale for Modification: Table 5-4 is a comprehensive list that includes all potentially useful parameters identified in the **planning** stage. Based on the results from the pilot test performance monitoring, nine analytes will be eliminated for full-scale operation as explained below.

- Chloride and fluoride – These analytes are not indicative of the performance of the ISB; therefore, are not useful to monitor.

- Nitrite – Baseline samples were collected from injection well TAV-INJ1 and the two nearby monitoring wells TAV-MW6 and TAV-MW7 before the pilot test. Nitrite was either detected near the Practical Quantification Limit or was not detected in the baseline samples (see Table B-2 of the October – December 2017 DP-1845 Quarterly Report). During pilot test performance monitoring, nitrite was not

detected in any of the groundwater samples from wells TAV-INJ1, TAV-MW6, and TAV-MW7 (see Tables B-1 and B-4 of the October – December 2017 DP-1845 Quarterly Report).

Nitrite is highly reactive and is an intermediate compound formed during nitrification and denitrification. It can be oxidized to nitrate or reduced to ammonium in an aquifer. Results of the baseline sampling and the performance monitoring after pilot test injections (which generated reducing conditions in the aquifer) indicate that nitrite apparently does not exist at detectable concentrations during ISB at TA-V. Based on this understanding, nitrite will be eliminated from the analyte list in full-scale operation. Analyses for ammonia and NPN will remain.

- Calcium, magnesium, potassium, and sodium – These analytes are not indicative of the performance of the ISB; therefore, are not useful to monitor.

- Orthophosphate as P – Diammonium phosphate (DAP) is an ingredient of the substrate solution. It acts as a pH buffer and provides phosphorous to support microbial cell generation. Figure 2 presents the orthophosphate concentrations in well TAV-INJ1 during the pilot test performance monitoring. It shows that phosphorous was rapidly utilized by microbes. Figure 2 also presents the concentrations of Total Organic Carbon (TOC), which is the main source for microbial growth. Figure 2 shows the more gradual consumption of TOC compared to the exponential utilization of orthophosphate. It is expected that phosphorous will be completely consumed prior to the depletion of TOC. Therefore, TOC is a more robust and reliable indicator for microbial respiration and growth in the treatment zone. Based on this understanding, orthophosphate will be eliminated from the analyte list in full-scale operation. Analysis for TOC will remain.

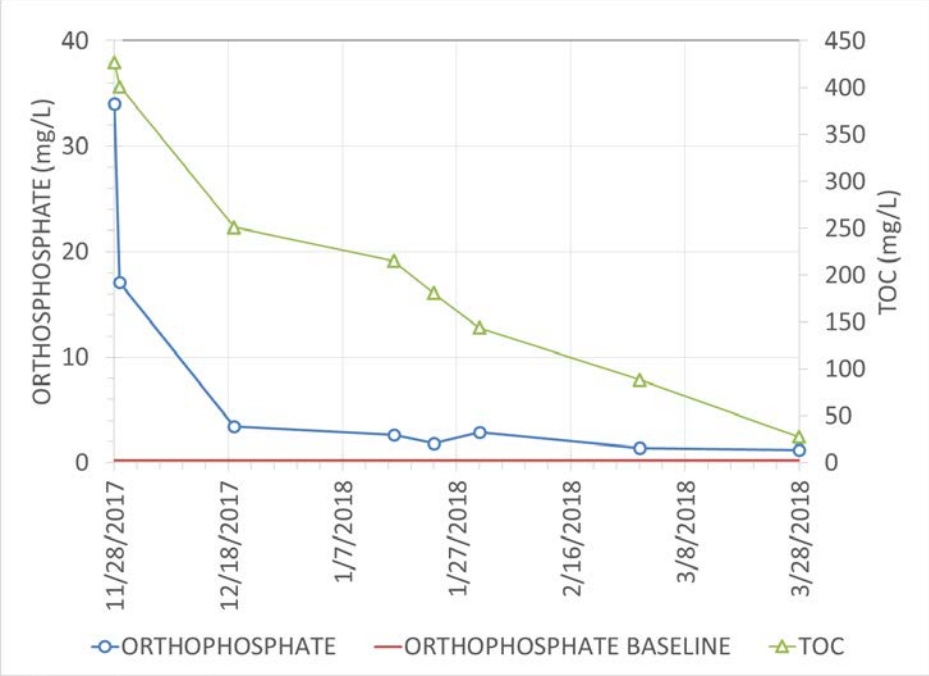

Figure 2
Orthophosphate and TOC Concentrations at TAV-INJ1 following Pilot Test Injections

- Sulfide – Similar to nitrite, sulfides generated during ISB are intermediate compounds and are not expected to persist in a dissolved state. Reactive sulfide was not detected in any of the groundwater samples from wells TAV-INJ1, TAV-MW6, and TAV-MW7 during the pilot test performance monitoring. Therefore, sampling for sulfides in the groundwater from the treatment zone is not warranted for the full-scale operation.

  However, due to the potential for hydrogen sulfide gas to accumulate in the well casing of the injection well, a handheld hydrogen sulfide gas meter will be used to monitor the hydrogen sulfide gas levels during the full-scale injections. The data may be useful to evaluate ISB performance and to address any worker safety concerns for conducting groundwater sampling.

Full-Scale Operation Modification #8: Eliminate unnecessary analytical parameters when wells TAV-INJ1 and TAV-MW6 are sampled. The Revised Table 5-4 is provided below for the analytical parameters for full-scale operation.

Revised Table 5-4
Analytical Parameters for Groundwater Samples

Analytical Group/Analyte in Table 5-4 of the Revised TSWP	Analyte in Table 5-4 of the Revised TSWP	Revised Analyte List for Full-Scale Operation
Alkalinity (total, bicarbonate, and carbonate)	Alkalinity	Yes
Ammonia (as Nitrogen)	Ammonia	Yes
Anions	Bromide	Yes
Anions	Chloride	No
Anions	Fluoride	No
Anions	Nitrite	No
Anions	Sulfate	Yes
Dehalococcoides (Dhc) and, if Dhc is present, vinyl chloride reductase (vcrA).	Dhc and vcrA	Yes
Dissolved Metals	Arsenic	Yes
Dissolved Metals	Calcium	No
Dissolved Metals	Iron	Yes
Dissolved Metals	Magnesium	No
Dissolved Metals	Manganese	Yes
Dissolved Metals	Potassium	No
Dissolved Metals	Sodium	No
Methane/Ethane/Ethene (MEE)	MEE	Yes
Nitrate plus Nitrite (NPN)	NPN	Yes
Orthophosphate (as P)	Orthophosphate (as P)	No
Total Organic Carbon (TOC)	TOC	Yes
Sulfide	Sulfide	No
Volatile Organic Compounds (VOCs)	VOCs	Yes

References

New Mexico Environment Department (NMED), May 2016. Letter to J. Harrell (U.S. Department of Energy NNSA/Sandia Field Office) and P. Davies (Sandia National Laboratories, New Mexico), “Approval Revised Treatability Study Work Plan for In-Situ Bioremediation at the Technical Area-V Groundwater Area of Concern, Sandia National Laboratories, EPA ID# NM5890110518, HWB-SNL-15-020,” NMED, Hazardous Waste Bureau, Santa Fe, New Mexico, May 10, 2016.

Sandia National Laboratories, New Mexico (SNL/NM), March 2016. *Revised Treatability Study Work Plan for In-Situ Bioremediation at the Technical Area-V Groundwater Area of Concern, Sandia National Laboratories, Albuquerque, New Mexico*.