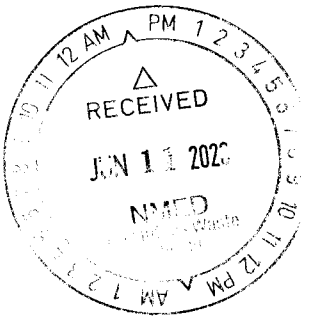
Department of Energy
National Nuclear Security Administration
Sandia Field Office
P.O. Box 5400
Albuquerque, NM 87185

National Nuclear Security Administration

4/29/2020



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

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

Dear Mr. Pierard:

Enclosed is the April Environmental Restoration Operations Consolidated Quarterly Report for SNL/NM, Environmental Protection Agency identification number NM5890110518. This report addresses all quarterly reporting (October through December 2019) set forth in the Compliance Order on Consent, for SNL/NM.

If you have questions, please contact me at (505) 845-6036 or David Rast of our staff at (505) 845-5349.

Sincerely,

Jeffrey P. Harrell
Manager

Enclosure

cc: See page 2

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NNSA-2020-001899

ENVIRONMENTAL RESTORATION OPERATIONS
CONSOLIDATED QUARTERLY REPORT, APRIL 2020

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.

Signature _____ Date 4/8/2020

Paul E. Shoemaker
Defense Waste Management Programs
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and

Signature _____ Date 4/28/2020

Jeffrey P. Harrell, Manager
U.S. Department of Energy
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Sandia Field Office
Owner

Sandia National Laboratories

Sandia National Laboratories, New Mexico

Environmental Restoration Operations

A U.S. Department of Energy Environmental Cleanup Program

Consolidated Quarterly Report

October – December 2019

April 2020

U.S. DEPARTMENT OF ENERGY

United States Department of Energy
Sandia Field Office

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CONSOLIDATED QUARTERLY REPORT

April 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: October – December 2019

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, October – December 2019

SECTION II: Perchlorate Screening Quarterly Groundwater Monitoring Report, October - December 2019

SECTION III: Technical Area-V In-Situ Bioremediation Treatability Study Phase I Full Scale Operation, October – December 2019

ABBREVIATIONS AND ACRONYMS

µg/L	microgram(s) per liter
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 only)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
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 numbers in tables only)
TA-V	Technical Area-V
TAVG	Technical Area-V Groundwater
TCE	trichloroethene
TJA	Tijeras Arroyo (acronym used for well identification numbers in tables only)
TOC	total organic carbon
TSWP	Treatability Study Work Plan
VOC	volatile organic compound

SECTION I
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SECTION I
ENVIRONMENTAL RESTORATION OPERATIONS CONSOLIDATED QUARTERLY REPORT, October – December 2019

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 October - December 2019 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. Except for the three SWMUs noted above, 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 October - December 2019 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 drinking water 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 through CYN-MW19).

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 October - December 2019 reporting period:

- Groundwater sampling was conducted in October and November 2019. Table I-3 presents the identification and the sampling frequency for these monitoring wells. The complete analytical results for Calendar Year (CY) 2019 groundwater monitoring will be presented in the SNL/NM CY 2019 Annual Groundwater Monitoring Report (AGMR), which is anticipated to be submitted to the NMED in the summer of 2020.

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

- Installed, developed, and surveyed groundwater monitoring wells CYN-MW16, CYN-MW17, CYN-MW18, and CYN-MW19. The Well Installation Report will be submitted to NMED in May 2020.

- Initial sampling event was performed at groundwater monitoring wells CYN-MW16, CYN-MW17, CYN-MW18, and CYN-MW19. A first-time exceedance of an EPA MCL occurred during this reporting period. Concentrations of nitrate plus nitrite in November in well CYN-MW16 were 10.8 mg/L and 11.1 mg/L in the environmental sample and environmental duplicate sample, respectively, exceeding the EPA MCL of 10 mg/L. These new wells will be sampled quarterly and the nitrate plus nitrite sampling results will be evaluated for any trends in subsequent ER Quarterly Reports.

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 drinking water 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 as a potential technology to treat the groundwater contamination at the TAVG AOC.

To implement the Treatability Study, SNL/NM personnel plan to install up to three injection wells (TAV-INJ1, TAV-INJ2, and TAV-INJ3) 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 is prepared in aboveground tanks. This substrate solution, along with the biodegradation bacteria, is gravity-injected to groundwater via the injection wells.

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 Treatability Study is conducted in two phases. Phase I includes a pilot test followed by full-scale operation at the first injection well (TAV-INJ1). Phase II of the Treatability Study includes 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 is dependent upon the findings of the Phase I full-scale operation.

The NMED Ground Water Quality Bureau (GWQB) required groundwater Discharge Permit (DP) for operation of the injection wells. NMED GWQB issued DP-1845 to DOE/NNSA for the SNL/NM TA-V Treatability Study injection wells on May 26, 2017 (NMED May 2017a). The DP-1845 term starts on May 30, 2017 and ends 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 in situ bioremediation. 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 May, June, and July 2019. The Phase I Treatability Study performance monitoring is currently on a quarterly schedule until May 2021.

The following activities occurred at TAVG AOC during the October – December 2019 reporting period:

- For the performance monitoring of the 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 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 a Treatability Study performance monitoring well and follows the sampling frequency and analytes specified for the 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 Treatability Study, although 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 Treatability Study.

- Table I-2 presents the CY 2019 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 October and November 2019. The SNL/NM CY 2019 AGMR will present the analytical results for CY 2019 groundwater monitoring, which is scheduled for submittal to the NMED HWB in the summer of 2020.

- 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). Data from subsequent quarterly sampling showed that TCE concentrations were 5.09 µg/L in August 2019 and 5.4 µg/L in November 2019. An evaluation of the TCE exceedance at well TAV-MW4 was provided in Appendix A of Section III of the January 2020 ER Quarterly Report (SNL/NM January 2020). Because this well is one of the eight monitoring wells

outside the Treatability Study treatment area that are sampled quarterly, 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 drinking water 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 "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 October - December 2019, groundwater samples were collected from seven monitoring wells (TA2-W-19, TA2-W-26, TA2-W-28, TJA-2, TJA-3, TJA-4, and TJA-7) scheduled for quarterly sampling. Table I-2 presents the CY 2019 sampling frequency for the TAG monitoring wells. The analytical results for the TAG AOC CY 2019 groundwater monitoring will be included in the SNL/NM CY 2019 AGMR, which is scheduled for submittal to the NMED HWB in the summer of 2020.

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.

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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.

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

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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 2019	Quarter of Sampling in CY 2019	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	Section II of ER Consolidated Quarterly Report	CYN-MW4, CYN-MW7, CYN-MW8, CYN-MW9, CYN-MW10, CYN-MW11, CYN-MW12, CYN-MW13, CYN-MW14A, CYN-MW15
	Quarterly	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 Treatability Study and follows a separate monitoring plan (see Section 2.1.2).
[b] Monitoring well WYO-4 was deleted from the 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.
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).

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SECTION II
PERCHLORATE SCREENING QUARTERLY GROUNDWATER MONITORING REPORT, October – December 2019

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 October – December 2019 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 forty-ninth perchlorate screening quarterly report submitted since the November 2005 letter report (SNL/NM February 2006).

Groundwater at BSG AOC monitoring well CYN-MW15 was sampled semiannually for the eleventh time during the reporting period; and wells CYN-MW16, CYN-MW17, CYN-MW18, and CYN-MW19 were sampled for the first 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 October – December 2019 perchlorate screening groundwater monitoring analytical results for wells CYN-MW15 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 well CYN-MW15 in October 2019 and at wells CYN-MW16 through CYN-MW19 in November 2019 (Table II-1). Groundwater sampling activities were conducted in accordance with procedures outlined in the *Burn Site Groundwater Monitoring, Mini-SAP for First Quarter, Fiscal Year 2020* (SNL/NM September 2019) and *Burn Site Groundwater Monitoring, Mini-SAP for First Quarter, Fiscal Year 2020—ER Wells* (SNL/NM November 2019).

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 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 first 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 five monitoring wells in the October - December 2019 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 October – December 2019 perchlorate data. For the sixth time in eleven sampling events (since December 2014), perchlorate was ND at the screening level/MDL of 4.0 µg/L in the October 2019 CYN-MW15 environmental groundwater sample (Figure II-2). The hydrograph for monitoring well CYN-MW15 (Figure II-2) shows that the water table elevation has been slightly decreasing over the past several years. Perchlorate was ND in the November 2019 environmental groundwater samples from all four new 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-SAPs (SNL/NM September 2019, SNL/NM November 2019), were identified during the October - December 2019 sampling activities except for turbidity measurements at CYN-MW15. The turbidity of the groundwater during sampling of CYN-MW15 (Table II-5) was much higher than historical values. There was heavy construction equipment traffic near this well for several months preceding sampling, and it is postulated that excessive vibrations from this equipment caused the filter pack to settle and infiltrate the screen. SNL/NM personnel will continue to monitor the turbidity levels during future monitoring events at CYN-MW15 and determine if well redevelopment is required.

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.

- The perchlorate concentration for the groundwater sample from monitoring well CYN-MW15 for the October - December 2019 sampling event was ND. This is the sixth sampling event (non-consecutive) that perchlorate was ND at this well since December 2014 (Figure II-2).

- 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 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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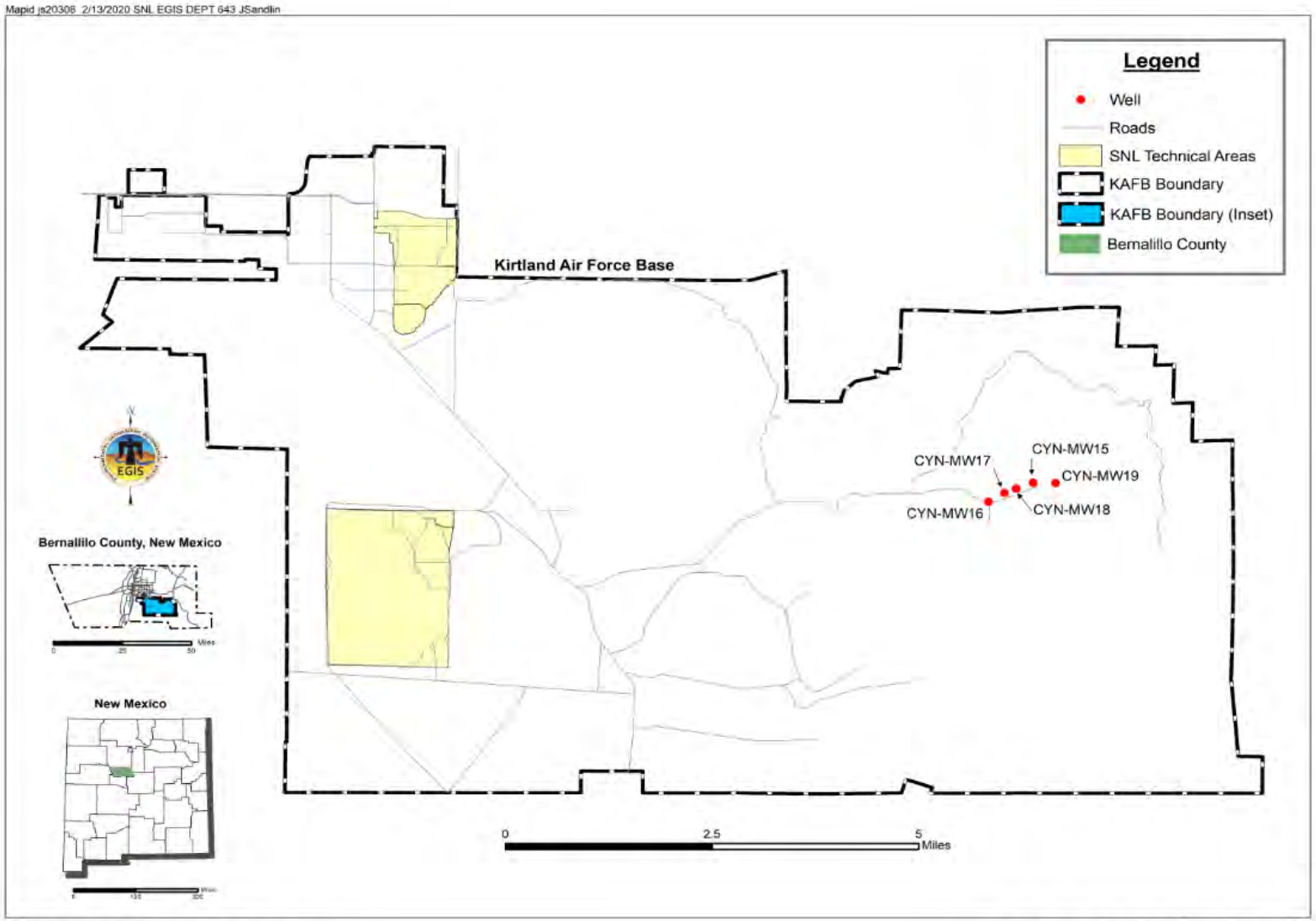

Figure II-1
Sandia National Laboratories, New Mexico
Current Perchlorate Screening Monitoring Well Network, October – December 2019

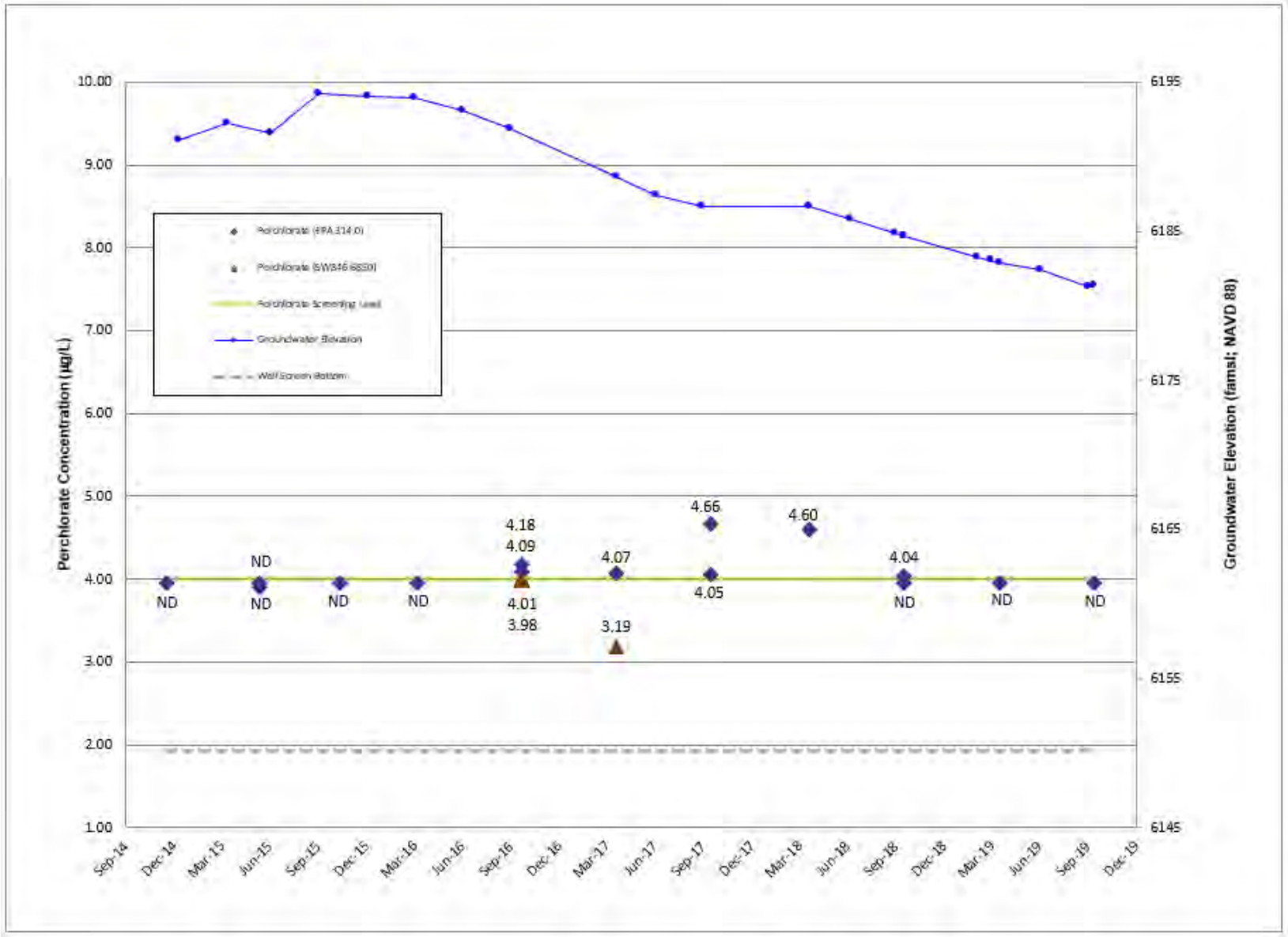

Figure II-2
Groundwater Elevations and Perchlorate Concentrations Over Time in CYN-MW15

Tables

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Table II-1
Current Perchlorate Screening Monitoring Well Network
October - December 2019

Well	Date Sampled	Number of Consecutive Sampling Events[a]	Remaining Number of Sampling Events	Sampling Equipment
CYN-MW15	11-Oct-19	11	TBD[b]	Bennett™ Pump
CYN-MW16	20-Nov-19	1	3	Bennett™ Pump
CYN-MW17	19-Nov-19	1	3	Bennett™ Pump
CYN-MW18	19-Nov-19	1	3	Bennett™ Pump
CYN-MW19	18-Nov-19	1	3	Bennett™ Pump

Notes

[a]Includes this sampling event.
[b]This well was installed as a replacement well for CYN-MW6. Because perchlorate concentrations in CYN-MW6 have exceeded the screening level/MDL, DOE/NNSA, SNL/NM, and the NMED HWB have agreed to further characterization through continued monitoring in the BSG AOC (NMED February 2010).

AOC = Area of Concern.
BSG = Burn Site Groundwater.
CYN = Canyons (Burn Site Groundwater Area of Concern).
DOE = U.S. Department of Energy.
HWB = Hazardous Waste Bureau.
MDL = Method detection limit.
MW = Monitoring well.
NMED = New Mexico Environment Department.
NNSA = National Nuclear Security Administration.
SNL/NM = Sandia National Laboratories, New Mexico.
TBD = To be determined.

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

Well	
CCBA-MW1	MWL-MW1
CCBA-MW2	MWL-MW7
CTF-MW1	MWL-MW8
CTF-MW2	MWL-MW9
CTF-MW3	NWTA3-MW2
CYN-MW1D	OBS-MW1
CYN-MW5	OBS-MW2
CYN-MW6	OBS-MW3
CYN-MW7	SWTA3-MW4
CYN-MW8	TA1-W-03
CYN-MW9	TA1-W-06
CYN-MW10	TA1-W-08
CYN-MW11	TA2-W-01
CYN-MW12	TA2-W-27
CYN-MW14A	TAV-MW11
LWDS-MW1	TAV-MW12
MRN-2	TAV-MW13
MRN-3D	TAV-MW14
MWL-BW1	TAV-MW15
MWL-BW2	TAV-MW16

Notes

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 October - December 2019 Perchlorate Sampling

Well	Sample Identification	AR/COC Number	Associated Groundwater Investigation
CYN-MW15	110529-004	620306	BSG AOC
CYN-MW16	111922-007 111923-004	620651	BSG AOC
CYN-MW17	111926-007	620652	BSG AOC
CYN-MW18	111929-007	620653	BSG AOC
CYN-MW19	111932-007	620654	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, October - December 2019

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-MW15	17-Dec-14	615941	096979-020	ND	4.0	12	NE	U		EPA 314.0	
	11-Jun-15	616178	097842-020	ND	4.0	12	NE	U		EPA 314.0	
			097843-020	ND	4.0	12	NE	U		EPA 314.0	Duplicate sample
	10-Nov-15	616396	098486-020	ND	4.0	12	NE	U		EPA 314.0	
	05-Apr-16	616862	099139-008	ND	4.0	12	NE	U		EPA 314.0	
	21-Oct-16	617385	100705-004	4.09	4.0	12	NE	J		EPA 314.0	
			100705-R04	3.98	0.25	1	NE			SW846 6850	
			100706-004	4.18	4.0	12	NE	J		EPA 314.0	Duplicate sample
			100706-R04	4.01	0.25	1	NE			SW846 6850	Duplicate sample
	19-Apr-17	617823	102400-013	4.07	4.0	12	NE	J		EPA 314.0	
			102400-R13	3.19	0.10	0.4	NE	Hh	J-	SW846 6850	
	13-Oct-17	618205	103748-004	4.05	4.0	12	NE	J		EPA 314.0	
			103749-004	4.66	4.0	12	NE	J		EPA 314.0	Duplicate sample
	19-Apr-18	618667	105068-008	4.60	4.0	12	NE	J		EPA 314.0	
	16-Oct-18	619203	106473-004	ND	4.0	12	NE	U		EPA 314.0	
			106474-004	4.04	4.0	12	NE	J		EPA 314.0	Duplicate sample
	17-Apr-19	619631	108030-008	ND	4.0	12	NE	U		EPA 314.0	
	11-Oct-19	620306	110529-004	ND	4.0	12	NE	NU		EPA 314.0	
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
CYN-MW17	19-Nov-19	620652	111926-007	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	
CYN-MW19	18-Nov-19	620654	111932-007	ND	4.0	12	NE	U		EPA 314.0	

Notes

[a]Laboratory Qualifier
If cell is blank, then all quality control samples meet acceptance criteria with respect to submitted samples.
H = Analytical holding time was exceeded.
h = Prep holding time exceeded.
J = Estimated value, the analyte concentration fell above the effective MDL and below the effective PQL.
N = Results associated with a spike analysis that was outside control limits.
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.
J- = The associated numerical value is an estimated quantity with a suspected negative bias.

Table II-4 (concluded)
Summary of Perchlorate Screening Analytical Results for the Current Monitoring Well Network, October - December 2019

Notes (continued)

[c]Analytical Method
EPA 314.0: EPA, November 1999, "Perchlorate in Drinking Water Using Ion Chromatography," EPA 815/R-00-014 .
SW846 6850: EPA, 1986 (and updates), "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., EPA, Washington, D.C.

% = 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.
SW = Solid waste.

Table II-5
Perchlorate Screening Groundwater Monitoring
Field Water Quality Measurements[a], October - December 2019

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-MW15	11-Oct-19	16.58	1153.2	157.7	7.09	134	21.33	1.70
CYN-MW16	20-Nov-19	17.55	722.9	20.6	7.29	0.82	14.50	1.22
CYN-MW17	19-Nov-19	18.01	644.2	-41.3	7.10	1.06	15.50	1.24
CYN-MW18	19-Nov-19	17.62	785.3	90.4	6.85	20.0	11.16	0.92
CYN-MW19	18-Nov-19	16.01	686.3	92.6	7.43	0.72	77.71	6.73

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

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SDG: 492859

SMO 2012-ARCOC (4-2012)

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY

AOP 95-16

Internal Lab

Batch No.

SMO Use

AR/COC 620306

Project Name:	BSG AOC	Date Samples Shipped:	10/11/19
Project/Task Manager:	Michael Skelly	Carrier/Waybill No.	305259
Project/Task Number:	195122.12.11.01	Lab Contact:	Edie Kent/843-769-7385
Service Order:	CF058-20	Lab Destination:	GEL
Tech Area:		Contract No.:	1983530
Building:	Room:	Operational Site:	

SMO Authorization:

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

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
110529	002	CYN-MW15	182	10/11/19 10:40	GW	AG	4x1 L	NONE	G	SA	TPH-DRO (SW846-8015)	003
110529	003	CYN-MW15	182	10/11/19 10:41	GW	P	125 ml	H2SO4	G	SA	NPN (EPA 353.2)	004
110529	004	CYN-MW15	182	10/11/19 10:42	GW	P	500 ml	None	G	SA	PERCHLORATE (EPA 314.0)	005

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:

Conditions on Receipt

Sample Team Members

Name	Signature	Init.	Company/Organization/Phone/Cell
William Gibson		WG	SNL/08888/505-284-3307/505-239-7367
Timmie Jackson		TJ	SNL/08888/505-284-2547/505-263-6639
Denisha Sanchez		DS	SNL/08888/505-545-7829/505-206-1375

Relinquished by		Org. 08888	Date 10/11/19	Time 11:30	Relinquished by	Org.	Date Time
Received by		Org. 08888	Date 10/11/19	Time 11:30	Received by	Org.	Date Time
Relinquished by		Org. 08888	Date 10/11/19	Time 12:10	Relinquished by	Org.	Date Time
Received by		Org.	Date 10/12/19	Time 9:10	Received by	Org.	Date Time

Lab Use

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

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

Certificate of Analysis

Report Date: November 11, 2019

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:	110529-004	Project:	SNLSGWtr
Sample ID:	492859005	Client ID:	SNLS005
Matrix:	AQUEOUS		
Collect Date:	11-OCT-19 10:42		
Receive Date:	12-OCT-19	Client Desc.:	CYN-MW15
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	NU	ND	0.004	0.012	mg/L		1	JLD1	11/07/19	1103	1934983	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: 497109

SMO 2012-ARCOC (4-2012)

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY

AOP 95-16

497109

Internal Lab Batch No. MA

AR/COC 620651

		SMO Use		
Project Name:	ER BURN SITE	Date Samples Shipped:	11/20/19	SMO Authorization:
Project/Task Manager:	Michael Skelly	Carrier/Waybill No.	30+090	SMO Contact Phone: Wendy Palencia/505-844-3132
Project/Task Number:	176092.01.06	Lab Contact:	Edie Kent/843-769-7385	
Service Order:	CF671-20	Lab Destination:	GEL	Send Report to SMO: Stephanie Montaño/505-284-2553
Tech Area:		Contract No:	1983530	
Building:	Room:	Operational Site:		

☐ 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
111921	001	ER-BSG-FB1	NA	11/20/19 09:56	DIW	G	3x40 ml	HCl	G	FB	VOC, TCL PRESERVED (SW846-8260B)	001
111922	001	ER-BSG-CYN-MW16	400	11/20/19 10:08	GW	G	3x40 ml	HCl	G	SA	VOC, TCL PRESERVED (SW846-8260B)	002
111922	002	ER-BSG-CYN-MW16	400	11/20/19 10:11	GW	AG	4x1 L	None	G	SA	HE (SW846-8330B LC/MS/MS)	003
111922	003	ER-BSG-CYN-MW16	400	11/20/19 10:13	GW	AG	4x1 L	NONE	G	SA	TPH-ORO (SW846-8015)	004
111922	004	ER-BSG-CYN-MW16	400	11/20/19 10:09	GW	AG	3x40 ml	NONE	G	SA	TPH-GRO (SW846-8015)	005
111922	005	ER-BSG-CYN-MW16	400	11/20/19 10:16	GW	P	125 ml	H2SO4	G	SA	NPN (EPA 353.2)	006
111922	006	ER-BSG-CYN-MW16	400	11/20/19 10:17	GW	P	125 ml	None	G	SA	ANIONS-Br,Cl,F,SO4 (SW846-9056)	007
111922	007	ER-BSG-CYN-MW16	400	11/20/19 10:18	GW	P	250 ml	None	G	SA	PERCHLORATE (EPA 314.0)	008
111922	008	ER-BSG-CYN-MW16	400	11/20/19 10:19	GW	P	500 ml	HNO3	G	SA	METALS, TAL + Mo (SW846-6020/7470)	009
111922	009	ER-BSG-CYN-MW16	400	11/20/19 10:21	FGW	P	500 ml	HNO3	G	SA	METALS, TAL + Mo (SW846-6020/7470)	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
	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. Trip blanks received from lab with head space.

Conditions on Receipt

Lab Use

Relinquished by		Org. 8888	Date 11-20-19	Time 1112	Relinquished by / Org. / Date / Time
Received by		Org. 0628	Date 11-20-19	Time 1112	Received by / Org. / Date / Time
Relinquished by		Org. 0628	Date 11/20/19	Time 1225	Relinquished by / Org. / Date / Time
Received by		Org.	Date 11/21/19	Time 740	Received by / Org. / Date / Time

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

SMO 2012-AR-030 (4-2012)

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY (Continuation)

AOP 95-16

AR/COC 620651

SDG: 497109

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
111922	010	ER-BSG-CYN-MW16	400	11/20/19 10:21	GW	P	1 L	HNO3	G	SA	GAMMA SPEC, SHORT LIST (EPA 901)	011
111922	011	ER-BSG-CYN-MW16	400	11/20/19 10:22	GW	P	1 L	HNO3	G	SA	GROSS-ALPHA/BETA (EPA 900)	012
111922	012	ER-BSG-CYN-MW16	400	11/20/19 10:23	GW	P	1 L	HNO3	G	SA	ISO U (HASL-300)	013
111922	013	ER-BSG-CYN-MW16	400	11/20/19 10:24	GW	AG	250 ml	NONE	G	SA	TRITIUM (EPA 906)	014
111923	001	ER-BSG-CYN-MW16	400	11/20/19 10:13	GW	AG	4x1 L	NONE	G	DU	TPH-DRO (SW846-8015)	015
111923	002	ER-BSG-CYN-MW16	400	11/20/19 10:09	GW	AG	3x40 ml	NONE	G	DU	TPH-GRO (SW846-8015)	016
111923	003	ER-BSG-CYN-MW16	400	11/20/19 10:16	GW	P	125 ml	H2SO4	G	DU	NPN (EPA 353.2)	017
111923	004	ER-BSG-CYN-MW16	400	11/20/19 10:18	GW	P	250 ml	None	G	DU	PERCHLORATE (EPA 314.0)	018
111924	001	ER-BSG-TB3	NA	11/20/19 10:09	DIW	AG	3x40 ml	NONE	G	TB	TPH-GRO (SW846-8015)	019
111925	001	ER-BSG-TB4	NA	11/20/19 09:56	DIW	G	3x40 ml	HCl	G	TB	VOC, TCL PRESERVED (SW846-8260B)	020

Recipient Initials_____

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

Certificate of Analysis

Report Date: December 5, 2019

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:	111922-007	Project:	SNLSGWtr
Sample ID:	497109008	Client ID:	SNLS005
Matrix:	AQUEOUS		
Collect Date:	20-NOV-19 10:18		
Receive Date:	21-NOV-19	Client Desc.:	ER-BSG-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	0.004	0.012	mg/L		1	LXA2	11/25/19	2325	1942561	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: December 5, 2019

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:	111923-004	Project:	SNLSGWtr
Sample ID:	497109018	Client ID:	SNLS005
Matrix:	AQUEOUS		
Collect Date:	20-NOV-19 10:18		
Receive Date:	21-NOV-19	Client Desc.:	ER-BSG-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	0.004	0.012	mg/L		1	LXA2	11/25/19	2346	1942561	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

497022

Internal Lab

Batch No.

SMO Use

Page 1 of 2

AR/COC 620652

Project Name: ER BURN SITE	Date Samples Shipped: 11/19/19	SMO Authorization:	☐ Waste Characterization
Project/Task Manager: Michael Skelly	Carrier/Waybill No. 307048	SMO Contact Phone: Wendy Palencia/505-844-3132	☐ RMA
Project/Task Number: 176092.01.06	Lab Contact: Edie Kent/843-769-7385	Send Report to SMO: Stephanie Montaño/505-284-2553	☐ Released by COC No.
Service Order: CF671-20	Lab Destination: GEL		☑ 4° Celsius
Tech Area:	Contract No.: 1983530		Bill to: Sandia National Laboratories (Accounts Payable), P.O. Box 5800, MS-0154 Albuquerque, NM 87185-0154
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
111926	001	ER-BSG-CYN-MW17	395	11/19/19 10:20	GW	G	3x40 ml	HCl	G	SA	VOC, TCL PRESERVED (SW846-8260B)	001
111926	002	ER-BSG-CYN-MW17	395	11/19/19 10:27	GW	AG	4x1 L	None	G	SA	HE (SW846-8330B LC/MS/MS)	002
111926	003	ER-BSG-CYN-MW17	395	11/19/19 10:29	GW	AG	4x1 L	NONE	G	SA	TPH-DRO (SW846-8015)	003
111926	004	ER-BSG-CYN-MW17	395	11/19/19 10:24	GW	AG	3x40 ml	NONE	G	SA	TPH-GRO (SW846-8015)	004
111926	005	ER-BSG-CYN-MW17	395	11/19/19 10:31	GW	P	125 ml	H2SO4	G	SA	NPN (EPA 353.2)	005
111926	006	ER-BSG-CYN-MW17	395	11/19/19 10:32	GW	P	125 ml	None	G	SA	ANIONS-Br,Cl,F,SO4 (SW846-9056)	006
111926	007	ER-BSG-CYN-MW17	395	11/19/19 10:33	GW	P	250 ml	None	G	SA	PERCHLORATE (EPA 314.0)	007
111926	008	ER-BSG-CYN-MW17	395	11/19/19 10:34	GW	P	500 ml	HNO3	G	SA	METALS, TAL + Mo (SW846-6020/7470)	008
111926	009	ER-BSG-CYN-MW17	395	11/19/19 10:36	FGW	P	500 ml	HNO3	G	SA	METALS, TAL + Mo (SW846-6020/7470)	009
111926	010	ER-BSG-CYN-MW17	395	11/19/19 10:37	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
	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. Trip blanks received form lab with head space.

Conditions on Receipt

Lab Use

Relinquished by		Org. 8888	Date 11-19-19	Time 1140	Relinquished by	Org.	Date Time
Received by		Org. 00624	Date 11/19/19	Time 1140	Received by	Org.	Date Time
Relinquished by		Org. 00641	Date	Time	Relinquished by	Org.	Date Time
Received by	Signature Date	Org.	Date 11-20-19	Time 928	Received by	Org.	Date Time

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

00641 TL

SMO 2012-ARCOC (4-2012)

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY (Continuation)

AOP 95-16

AR/COC 620652

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
111926	011	ER-BSG-CYN-MW17	395	11/19/19 10:38	GW	P	1 L	HNO3	G	SA	GROSS-ALPHA/BETA (EPA 900)	011
111926	012	ER-BSG-CYN-MW17	395	11/19/19 10:39	GW	P	1 L	HNO3	G	SA	ISO U (HASL-300)	012
111926	013	ER-BSG-CYN-MW17	395	11/19/19 10:40	GW	AG	250 ml	NONE	G	SA	TRITIUM (EPA 906)	013
111927	001	ER-BSG-TB5	NA	11/19/19 10:24	DIW	AG	3x40 ml	NONE	G	TB	TPH-GRO (SW846-8015)	014
111928	001	ER-BSG-TB6	NA	11/19/19 10:20	DIW	G	3x40 ml	HCl	G	TB	VOC, TCL PRESERVED (SW846-8260B)	015

Recipient Initials TC

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

Certificate of Analysis

Report Date: December 5, 2019

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:	111926-007	Project:	SNLSGWtr
Sample ID:	497022007	Client ID:	SNLS005
Matrix:	AQUEOUS		
Collect Date:	19-NOV-19 10:33		
Receive Date:	20-NOV-19	Client Desc.:	ER-BSG-CYN-MW17
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	0.004	0.012	mg/L		1	LXA2	11/25/19	2223	1942561	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

497030

Internal Lab

Batch No.

AR/COC 620653

		SMO Use		
Project Name:	ER BURN SITE	Date Samples Shipped:	11/19/19	SMO Authorization:
Project/Task Manager:	Michael Skelly	Carrier/Waybill No.	3072048	SMO Contact Phone: Wendy Palencia/505-844-3132
Project/Task Number:	176092.01.06	Lab Contact:	Edie Kent/843-769-7385	
Service Order:	CF671-20	Lab Destination:	GEL	Send Report to SMO: Stephanie Montaño/505-284-2553
Tech Area:		Contract No.:	1983530	
Building:	Room:	Operational Site:		

☐ 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
111929	001	ER-BSG-CYN-MW18	295	11/19/19 10:38	GW	G	3x40 ml	HCl	G	SA	VOC, TCL PRESERVED (SW846-8260B)	001
111929	002	ER-BSG-CYN-MW18	295	11/19/19 10:40	GW	AG	4x1 L	None	G	SA	HE (SW846-8330B LC/MS/MS)	002
111929	003	ER-BSG-CYN-MW18	295	11/19/19 10:42	GW	AG	4x1 L	NONE	G	SA	TPH-DRO (SW846-8015)	003
111929	004	ER-BSG-CYN-MW18	295	11/19/19 10:43	GW	AG	3x40 ml	NONE	G	SA	TPH-GRO (SW846-8015)	004
111929	005	ER-BSG-CYN-MW18	295	11/19/19 10:44	GW	P	125 ml	H2SO4	G	SA	NPN (EPA 353.2)	005
111929	006	ER-BSG-CYN-MW18	295	11/19/19 10:45	GW	P	125 ml	None	G	SA	ANIONS-Br,CL,F,SO4 (SW846-9056)	006
111929	007	ER-BSG-CYN-MW18	295	11/19/19 10:46	GW	P	250 ml	None	G	SA	PERCHLORATE (EPA 314.0)	007
111929	008	ER-BSG-CYN-MW18	295	11/19/19 10:47	GW	P	500 ml	HNO3	G	SA	METALS, TAL + Mo (SW846-6020/7470)	008
111929	009	ER-BSG-CYN-MW18	295	11/19/19 10:48	FGW	P	500 ml	HNO3	G	SA	METALS, TAL + Mo (SW846-6020/7470)	009
111929	010	ER-BSG-CYN-MW18	295	11/19/19 10:49	GW	P	1 L	HNO3	G	SA	GAMMA SPEC, SHORT LIST (EPA 901)	010

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

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. Trip blanks received from lab with head space.

Conditions on Receipt

Sample Team Members	Name	Signature	Init.	Company/Organization/Phone/Cell
	Zachary Tenorio		ZT	SNL/08888/505-845-8636/505-259-5765
	Timmie Jackson		TJ	SNL/08888/505-284-2547/505-263-6639

Relinquished by		Org. 8884	Date 11/19/19	Time 1115	Relinquished by	Org. 00641	Date 11/19/19 Time 1232
Received by		Org. 8888	Date 11-19-19	Time 1115	Received by	Org.	Date 11-20-19 Time 920
Relinquished by		Org. 8888	Date 11-19-19	Time 1151	Relinquished by	Org.	Date Time
Received by		Org. 00641	Date 11/19/19	Time 1151	Received by	Org.	Date Time

Lab Use

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

00641
TT
11/19/19

SDG: 497030 Rev2

SMO 2012-ARCOC (4-2012)

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY (Continuation)

AOP 95-16

AR/COC 620653

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
111929	011	ER-BSG-CYN-MW18	295	11/18/19 10:50	GW	P	1 L	HNO3	G	SA	GROSS-ALPHA/BETA (EPA 900)	011
111929	012	ER-BSG-CYN-MW18	295	11/18/19 10:51	GW	P	1 L	HNO3	G	SA	ISO U (HASL-300)	012
111929	013	ER-BSG-CYN-MW18	295	11/18/19 10:52	GW	AG	250 ml	NONE	G	SA	TRITIUM (EPA 906)	013
111930	001	ER-BSG-TB7	NA	11/18/19 10:43	DIW	AG	3x40 ml	NONE	G	TB	TPH-GRO (SW846-8015)	014
111931	001	ER-BSG-TB8	NA	11/18/19 10:38	DIW	G	3x40 ml	HCl	G	TB	VOC, TCL PRESERVED (SW846-8260B)	015

Recipient Initials

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

Certificate of Analysis

Report Date: December 5, 2019

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:	111929-007	Project:	SNLSGWtr
Sample ID:	497030007	Client ID:	SNLS005
Matrix:	AQUEOUS		
Collect Date:	19-NOV-19 10:46		
Receive Date:	20-NOV-19	Client Desc.:	ER-BSG-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	0.004	0.012	mg/L		1	LXA2	11/25/19	2244	1942561	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: 496802

SMO 2012-ARCOC (4-2012)

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY

AOP 95-16

496802

Internal Lab

Batch No. N/A

AR/COC 620654

Project Name:	ER BURN SITE	SMO Use / Date Samples Shipped:	11/18/19
Project/Task Manager:	Michael Skelly	Carrier/Waybill No:	3[illegible]
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
111932	001	ER-BSG-CYN-MW19	85	11/18/19 10:43	GW	G	3x40 ml	HCl	G	SA	VOC, TCL PRESERVED (SW846-8260B)	001
111932	002	ER-BSG-CYN-MW19	85	11/18/19 10:45	GW	AG	4x1 L	None	G	SA	HE (SW846-8330B LC/MS/MS)	002
111932	003	ER-BSG-CYN-MW19	85	11/18/19 10:47	GW	AG	4x1 L	NONE	G	SA	TPH-DRO (SW846-8015)	003
111932	004	ER-BSG-CYN-MW19	85	11/18/19 10:49	GW	AG	3x40 ml	NONE	G	SA	TPH-GRO (SW846-8015)	004
111932	005	ER-BSG-CYN-MW19	85	~~11/18/19 10:50~~	~~GW~~	~~P~~	~~125 ml~~	~~H2SO4~~	~~G~~	~~SA~~	~~NFN (EPA 353.2)~~	~~005~~
111932	006	ER-BSG-CYN-MW19	85	11/18/19 10:51	GW	P	125 ml	None	G	SA	ANIONS-Br,Cl,F,SO4 (SW846-9056)	006
111932	007	ER-BSG-CYN-MW19	85	11/18/19 10:52	GW	P	250 ml	None	G	SA	PERCHLORATE (EPA 314.0)	007
111932	008	ER-BSG-CYN-MW19	85	11/18/19 10:53	GW	P	500 ml	HNO3	G	SA	METALS, TAL + Mo (SW846-6020/7470)	008
111932	009	ER-BSG-CYN-MW19	85	11/18/19 10:54	FGW	P	500 ml	HNO3	G	SA	METALS, TAL + Mo (SW846-6020/7470)	009
111932	010	ER-BSG-CYN-MW19	85	11/18/19 10:55	GW	P	1 L	HNO3	G	SA	GAMMA SPEC, SHORT LIST (EPA 901)	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. Trip blanks received from lab with head space.

Conditions on Receipt

Lab Use

Sample Team Members	Name	Signature	Init.	Company/Organization/Phone/Cell
	Zachary Tenorio		ZT	SNL/08888/505-845-8636/505-259-5765
	Timmie Jackson		TJ	SNL/08888/505-284-2547/505-263-6639
	Denisha Sanchez		DS	SNL/08888/505-845-7829/505-208-1375

Relinquished by	Org. 08888	Date 11/18/19	Time 1140	Relinquished by / Org. / Date / Time
Received by	Org. 00028	Date 11/18/19	Time 1140	Received by / Org. / Date / Time
Relinquished by	Org. 00628	Date 11/15/19	Time 1330	Relinquished by / Org. / Date / Time
Received by	Org.	Date 11-19-19	Time 730	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 620654

SDG: 496802

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
111932	011	ER-BSG-CYN-MW19	85	11/18/19 10:56	GW	P	1 L	HNO3	G	SA	GROSS-ALPHA/BETA (EPA 900)	001
111932	012	ER-BSG-CYN-MW19	85	11/18/19 10:57	GW	P	1 L	HNO3	G	SA	ISO U (HASL-300)	002
111932	013	ER-BSG-CYN-MW19	85	11/18/19 10:58	GW	AG	250 ml	NONE	G	SA	TRITIUM (EPA 906)	003
111933	001	ER-BSG-TB9	NA	11/18/19 10:49	DIW	AG	3x40 ml	NONE	G	TB	TPH-GRO (SW846-8015)	004
111934	001	ER-BSG-TB10	NA	11/18/19 10:43	DIW	G	3x40 ml	HCl	G	TB	VOC, TCL PRESERVED (SW846-8260B)	005

Recipient Initials TLG

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

Certificate of Analysis

Report Date: December 5, 2019

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:	111932-007	Project:	SNLSGWtr
Sample ID:	496802007	Client ID:	SNLS005
Matrix:	AQUEOUS		
Collect Date:	18-NOV-19 10:52		
Receive Date:	19-NOV-19	Client Desc.:	ER-BSG-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	0.004	0.012	mg/L		1	LXA2	11/25/19	2120	1942561	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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ANALYTICAL QUALITY ASSOCIATES, INC.

PO Box 21987
Albuquerque, NM 87154
1-888-678-5447
www.aqainc.net

Memorandum

Date: November 14, 2019

To: File

From: Mary Donivan

Subject: Inorganic Data Review and Validation – SNL
Site: BSG AOC
ARCOC: 620303 and 620306
SDG: 492859
Laboratory: GEL
Project/Task: 195122.12.11.01
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 method EPA 353.2 (nitrate/nitrite) and one sample was prepared and analyzed with accepted procedures using method 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.

Nitrate/Nitrite:

1. Samples 492859002 and -004 were analyzed at a 50X dilution; however, the PS and replicate analyses were performed on an undiluted sample and considered a dissimilar matrix. The associated results for samples -002 and -004 were detects and will be **qualified J,MS1,RP1**.

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.

Blanks

No target analytes were detected in the blanks.

Laboratory Control Sample (LCS)

All LCS acceptance criteria were met.

Matrix Spike and Matrix Spike Duplicate (MS/MSD)

All MS/PS recoveries met QC acceptance criteria except as noted above in the Summary section and as follows. The PS %R was >125% for perchlorate. The associated sample result was non-detect and will not be qualified.

It should be noted that the PS analysis for nitrate/nitrite was performed on an SNL sample of similar matrix from another SDG.

Laboratory Replicate

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

It should be noted that the replicate analysis for nitrate/nitrite was performed on an SNL sample of similar matrix from another SDG.

Detection Limits/Dilutions

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

Nitrate/Nitrite
Samples -002 and -004 were diluted 50X.

Other QC

No other specific issues that affect data quality were identified.

Reviewed by: Ellen McEntee Level: 1 Date: 11/15/2019

Sample Findings Summary

AR/COC: 620303, 620306

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
EPA 353.2			
	109234-003/CYN-MW13	Nitrogen, Nitrate/Nitrite (NO3ASN)	J, MS1,RP1
	110529-003/CYN-MW15	Nitrogen, Nitrate/Nitrite (NO3ASN)	J, MS1,RP1

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

PO Box 21987
Albuquerque, NM 87154
1-888-678-5447
www.aqainc.net

Memorandum

Date: January 14, 2020

To: File

From: Mary Donivan

Subject: Inorganic Data Review and Validation – SNL
Site: ER Burn Site
ARCOC: 620651
SDG: 497109
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 353.2 (nitrate/nitrite) and EPA 314.0 (perchlorate) and one sample was prepared and analyzed using method EPA 9056A (anions by IC). Data were reported for all required analytes. Problems were identified with the data package that resulted in the qualification of data.

Nitrate/nitrite:

1. Samples 497109006 and -017 were analyzed at a100X dilution for nitrate/nitrite; however, the MS and replicate analyses were performed on an SNL sample from another SDG, sample 496802005 diluted 10X and considered a dissimilar matrix. The associated result for samples -006 and -017 were detects and will be will be **qualified J,MS1,RP1**.

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.

Blanks

No target analytes were detected in any of the blanks except as follows. Nitrate/nitrite was detected at ≤the PQL in the ICB, a bracketing CCB and EB1. EB1 was submitted on ARCOC 620650 in another SDG and associated with samples -006 and -017. The associated sample result for EB1 was qualified non-detect due to ICB/CCB contamination and was not be applied to any field sample results. The associated results for samples -006 and -017 were detects >5X the ICB/CCB concentration and will not be qualified.

Chloride was detected at ≤the PQL in EB1, sample 497108006, submitted in another SDG and associated with sample -007. The associated sample result was a detect >5X the EB concentration 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 except as noted above in the Summary section. It should be noted that the parent samples for the MS for perchlorate and nitrate/nitrite were SNL samples from other SDGs. 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 parent samples for the duplicates for perchlorate and nitrate/nitrite were SNL samples 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 -007 was diluted 10X for chloride and sulfate.

Nitrate/nitrite:
Samples -006 and -017 were diluted 100X.

Other QC

EB1 was submitted with ARCOC 620650 in another SDG and was associated with samples on ARCOC 620651. Field duplicate pairs were submitted with ARCOC 620651 for perchlorate and nitrate/nitrite. 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: Linda Thal **Level:** I **Date:** 01/17/2020

Sample Findings Summary

AR/COC: 620651

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
DOE EML HASL-300, U-02-RC			
	111922-012/ER-BSG-CYN-MW16	Uranium-235/236 (15117-96-1/13982-70-)	J, FR7
EPA 353.2			
	111922-005/ER-BSG-CYN-MW16	Nitrogen, Nitrate/Nitrite (NO3ASN)	J, MS1,RP1
	111923-003/ER-BSG-CYN-MW16	Nitrogen, Nitrate/Nitrite (NO3ASN)	J, MS1,RP1
EPA 900.0/SW846 9310			
	111922-011/ER-BSG-CYN-MW16	BETA (12587-47-2)	J, FR7
EPA 901.1			
	111922-010/ER-BSG-CYN-MW16	Americium-241 (14596-10-2)	BD, FR3
	111922-010/ER-BSG-CYN-MW16	Cesium-137 (10045-97-3)	BD, FR3
	111922-010/ER-BSG-CYN-MW16	Cobalt-60 (10198-40-0)	BD, FR3
	111922-010/ER-BSG-CYN-MW16	Potassium-40 (13966-00-2)	BD, FR3
EPA 906.0 Modified			
	111922-013/ER-BSG-CYN-MW16	Tritium (10028-17-8)	BD, FR3
SW846 3005A/6020B			
	111922-008/ER-BSG-CYN-MW16	Aluminum (7429-90-5)	UJ, MS1,RP1
	111922-008/ER-BSG-CYN-MW16	Antimony (7440-36-0)	UJ, MS1,RP1
	111922-008/ER-BSG-CYN-MW16	Arsenic (7440-38-2)	J, MS1,RP1
	111922-008/ER-BSG-CYN-MW16	Barium (7440-39-3)	J, MS1,RP1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111922-008/ER-BSG-CYN-MW16	Beryllium (7440-41-7)	UJ, MS1,RP1
	111922-008/ER-BSG-CYN-MW16	Cadmium (7440-43-9)	UJ, MS1,RP1
	111922-008/ER-BSG-CYN-MW16	Calcium (7440-70-2)	J, MS1,RP1
	111922-008/ER-BSG-CYN-MW16	Chromium (7440-47-3)	UJ, MS1,RP1
	111922-008/ER-BSG-CYN-MW16	Cobalt (7440-48-4)	UJ, MS1,RP1
	111922-008/ER-BSG-CYN-MW16	Copper (7440-50-8)	0.002UJ, B2,MS1,RP1
	111922-008/ER-BSG-CYN-MW16	Iron (7439-89-6)	J, MS1,RP1
	111922-008/ER-BSG-CYN-MW16	Lead (7439-92-1)	UJ, MS1,RP1
	111922-008/ER-BSG-CYN-MW16	Magnesium (7439-95-4)	J, MS1,RP1
	111922-008/ER-BSG-CYN-MW16	Manganese (7439-96-5)	J-, CK3,MS1,RP1
	111922-008/ER-BSG-CYN-MW16	Molybdenum (7439-98-7)	J, MS1,RP1
	111922-008/ER-BSG-CYN-MW16	Nickel (7440-02-0)	J, MS1,RP1
	111922-008/ER-BSG-CYN-MW16	Potassium (9/7/7440)	J, MS1,RP1
	111922-008/ER-BSG-CYN-MW16	Selenium (7782-49-2)	J, MS1,RP1
	111922-008/ER-BSG-CYN-MW16	Silver (7440-22-4)	UJ, MS1,RP1
	111922-008/ER-BSG-CYN-MW16	Sodium (7440-23-5)	J, MS1,RP1
	111922-008/ER-BSG-CYN-MW16	Thallium (7440-28-0)	UJ, MS1,RP1
	111922-008/ER-BSG-CYN-MW16	Vanadium (7440-62-2)	J, MS1,RP1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111922-008/ER-BSG-CYN-MW16	Zinc (7440-66-6)	UJ, MS1,RP1
	111922-009/ER-BSG-CYN-MW16	Aluminum (7429-90-5)	UJ, IS1,MS1,RP1
	111922-009/ER-BSG-CYN-MW16	Antimony (7440-36-0)	UJ, MS1,RP1
	111922-009/ER-BSG-CYN-MW16	Arsenic (7440-38-2)	J, MS1,RP1
	111922-009/ER-BSG-CYN-MW16	Barium (7440-39-3)	J, MS1,RP1
	111922-009/ER-BSG-CYN-MW16	Beryllium (7440-41-7)	UJ, IS1,MS1,RP1
	111922-009/ER-BSG-CYN-MW16	Cadmium (7440-43-9)	UJ, MS1,RP1
	111922-009/ER-BSG-CYN-MW16	Calcium (7440-70-2)	J, MS1,RP1
	111922-009/ER-BSG-CYN-MW16	Chromium (7440-47-3)	UJ, IS1,MS1,RP1
	111922-009/ER-BSG-CYN-MW16	Cobalt (7440-48-4)	UJ, MS1,RP1
	111922-009/ER-BSG-CYN-MW16	Copper (7440-50-8)	0.002UJ, B2,MS1,RP1
	111922-009/ER-BSG-CYN-MW16	Iron (7439-89-6)	UJ, IS1,MS1,RP1
	111922-009/ER-BSG-CYN-MW16	Lead (7439-92-1)	UJ, MS1,RP1
	111922-009/ER-BSG-CYN-MW16	Magnesium (7439-95-4)	J-, IS1,MS1,RP1
	111922-009/ER-BSG-CYN-MW16	Manganese (7439-96-5)	J-, CK3,IS1,MS1,RP
	111922-009/ER-BSG-CYN-MW16	Molybdenum (7439-98-7)	J, MS1,RP1
	111922-009/ER-BSG-CYN-MW16	Nickel (7440-02-0)	J-, IS1,MS1,RP1
	111922-009/ER-BSG-CYN-MW16	Potassium (9/7/7440)	J-, IS1,MS1,RP1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111922-009/ER-BSG-CYN-MW16	Selenium (7782-49-2)	J, MS1,RP1
	111922-009/ER-BSG-CYN-MW16	Silver (7440-22-4)	UJ, MS1,RP1
	111922-009/ER-BSG-CYN-MW16	Sodium (7440-23-5)	J-, IS1,MS1,RP1
	111922-009/ER-BSG-CYN-MW16	Thallium (7440-28-0)	UJ, MS1,RP1
	111922-009/ER-BSG-CYN-MW16	Vanadium (7440-62-2)	J-, IS1,MS1,RP1
	111922-009/ER-BSG-CYN-MW16	Zinc (7440-66-6)	J, MS1,RP1
SW846 3535A/8015D			
	111922-003/ER-BSG-CYN-MW16	Diesel Range Organics (68334-30-5)	UJ, MS5
	111923-001/ER-BSG-CYN-MW16	Diesel Range Organics (68334-30-5)	UJ, MS5
SW846 3535A/8330B			
	111922-002/ER-BSG-CYN-MW16	m-Nitrotoluene (99-08-1)	UJ, I4
	111922-002/ER-BSG-CYN-MW16	Nitrobenzene (98-95-3)	UJ, I4
	111922-002/ER-BSG-CYN-MW16	o-Nitrotoluene (88-72-2)	UJ, I4
	111922-002/ER-BSG-CYN-MW16	PETN (78-11-5)	UJ, C3,MS3
	111922-002/ER-BSG-CYN-MW16	p-Nitrotoluene (99-99-0)	UJ, I4
	111922-002/ER-BSG-CYN-MW16	Tetryl (479-45-8)	R, L3
SW846 8260B DOE-AL			
	111921-001/ER-BSG-FB1	Acetone (67-64-1)	UJ, MS3
	111921-001/ER-BSG-FB1	Methyl acetate (79-20-9)	UJ, I4
	111922-001/ER-BSG-CYN-MW16	Acetone (67-64-1)	UJ, MS3

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111922-001/ER-BSG-CYN-MW16	Methyl acetate (79-20-9)	UJ, I4
	111925-001/ER-BSG-TB4	Acetone (67-64-1)	J-, MS3
	111925-001/ER-BSG-TB4	Methyl acetate (79-20-9)	UJ, I4

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

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Memorandum

Date: January 14, 2020

To: File

From: Mary Donivan

Subject: Inorganic Data Review and Validation – SNL
Site: ER Burn Site
ARCOC: 620652
SDG: 497022
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. Problems were identified with the data package that resulted in the qualification of data.

Anions:

1. The MS and duplicate analyses were performed on an SNL DI water sample from another SDG. All associated sample results were detects will be **qualified J,MS1,RP1** due to lack of matrix-specific accuracy and 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.

Blanks

No target analytes were detected in any of the blanks except as follows. Nitrate/nitrite was detected at ≤the PQL in the ICB and a bracketing CCB. The associated result for sample 497022005 was a detect >5X the ICB/CCB concentration 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 except as noted above in the Summary section. It should be noted that the parent samples for the MS were SNL samples of similar matrix from other SDGs. 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 parent samples for the duplicates were 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 -006 was diluted 10X for chloride and sulfate.

Nitrate/nitrite:
Sample -005 was diluted 10X.

Other QC

No other specific issues that affect data quality were identified.

Reviewed by: Linda Thal **Level:** I **Date:** 01/17/2020

Sample Findings Summary

AR/COC: 620652

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
DOE EML HASL-300, U-02-RC			
	111926-012/ER-BSG-CYN-MW17	Uranium-235/236 (15117-96-1/13982-70-)	BD, FR3
EPA 901.1			
	111926-010/ER-BSG-CYN-MW17	Americium-241 (14596-10-2)	BD, FR3
	111926-010/ER-BSG-CYN-MW17	Cesium-137 (10045-97-3)	BD, FR3
	111926-010/ER-BSG-CYN-MW17	Cobalt-60 (10198-40-0)	BD, FR3
	111926-010/ER-BSG-CYN-MW17	Potassium-40 (13966-00-2)	R, Z2
EPA 906.0 Modified			
	111926-013/ER-BSG-CYN-MW17	Tritium (10028-17-8)	BD, FR3
SW846 3005A/6020B			
	111926-008/ER-BSG-CYN-MW17	Aluminum (7429-90-5)	UJ, MS1,RP1
	111926-008/ER-BSG-CYN-MW17	Antimony (7440-36-0)	UJ, MS1,RP1
	111926-008/ER-BSG-CYN-MW17	Arsenic (7440-38-2)	J, MS1,RP1
	111926-008/ER-BSG-CYN-MW17	Barium (7440-39-3)	J, MS1,RP1
	111926-008/ER-BSG-CYN-MW17	Beryllium (7440-41-7)	UJ, MS1,RP1
	111926-008/ER-BSG-CYN-MW17	Cadmium (7440-43-9)	UJ, MS1,RP1
	111926-008/ER-BSG-CYN-MW17	Calcium (7440-70-2)	J, MS1,RP1
	111926-008/ER-BSG-CYN-MW17	Chromium (7440-47-3)	UJ, MS1,RP1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111926-008/ER-BSG-CYN-MW17	Cobalt (7440-48-4)	J, MS1,RP1
	111926-008/ER-BSG-CYN-MW17	Copper (7440-50-8)	UJ, MS1,RP1
	111926-008/ER-BSG-CYN-MW17	Iron (7439-89-6)	J, MS1,RP1
	111926-008/ER-BSG-CYN-MW17	Lead (7439-92-1)	UJ, MS1,RP1
	111926-008/ER-BSG-CYN-MW17	Magnesium (7439-95-4)	J, MS1,RP1
	111926-008/ER-BSG-CYN-MW17	Manganese (7439-96-5)	J, MS1,RP1
	111926-008/ER-BSG-CYN-MW17	Molybdenum (7439-98-7)	J, MS1,RP1
	111926-008/ER-BSG-CYN-MW17	Nickel (7440-02-0)	J, MS1,RP1
	111926-008/ER-BSG-CYN-MW17	Potassium (7440-09-7)	J, MS1,RP1
	111926-008/ER-BSG-CYN-MW17	Selenium (7782-49-2)	J, MS1,RP1
	111926-008/ER-BSG-CYN-MW17	Silver (7440-22-4)	UJ, MS1,RP1
	111926-008/ER-BSG-CYN-MW17	Sodium (7440-23-5)	J, MS1,RP1
	111926-008/ER-BSG-CYN-MW17	Thallium (7440-28-0)	UJ, MS1,RP1
	111926-008/ER-BSG-CYN-MW17	Vanadium (7440-62-2)	UJ, MS1,RP1
	111926-008/ER-BSG-CYN-MW17	Zinc (7440-66-6)	J, MS1,RP1
	111926-009/ER-BSG-CYN-MW17	Aluminum (7429-90-5)	UJ, MS1,RP1
	111926-009/ER-BSG-CYN-MW17	Antimony (7440-36-0)	UJ, MS1,RP1
	111926-009/ER-BSG-CYN-MW17	Arsenic (7440-38-2)	J, MS1,RP1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111926-009/ER-BSG-CYN-MW17	Barium (7440-39-3)	J, MS1,RP1
	111926-009/ER-BSG-CYN-MW17	Beryllium (7440-41-7)	UJ, MS1,RP1
	111926-009/ER-BSG-CYN-MW17	Cadmium (7440-43-9)	UJ, MS1,RP1
	111926-009/ER-BSG-CYN-MW17	Calcium (7440-70-2)	J, MS1,RP1
	111926-009/ER-BSG-CYN-MW17	Chromium (7440-47-3)	UJ, MS1,RP1
	111926-009/ER-BSG-CYN-MW17	Cobalt (7440-48-4)	J, MS1,RP1
	111926-009/ER-BSG-CYN-MW17	Copper (7440-50-8)	UJ, MS1,RP1
	111926-009/ER-BSG-CYN-MW17	Iron (7439-89-6)	J, MS1,RP1
	111926-009/ER-BSG-CYN-MW17	Lead (7439-92-1)	UJ, MS1,RP1
	111926-009/ER-BSG-CYN-MW17	Magnesium (7439-95-4)	J, MS1,RP1
	111926-009/ER-BSG-CYN-MW17	Manganese (7439-96-5)	J, MS1,RP1
	111926-009/ER-BSG-CYN-MW17	Molybdenum (7439-98-7)	J, MS1,RP1
	111926-009/ER-BSG-CYN-MW17	Nickel (7440-02-0)	J, MS1,RP1
	111926-009/ER-BSG-CYN-MW17	Potassium (7440-09-7)	J, MS1,RP1
	111926-009/ER-BSG-CYN-MW17	Selenium (7782-49-2)	J, MS1,RP1
	111926-009/ER-BSG-CYN-MW17	Silver (7440-22-4)	UJ, MS1,RP1
	111926-009/ER-BSG-CYN-MW17	Sodium (7440-23-5)	J, MS1,RP1
	111926-009/ER-BSG-CYN-MW17	Thallium (7440-28-0)	UJ, MS1,RP1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111926-009/ER-BSG-CYN-MW17	Vanadium (7440-62-2)	UJ, MS1,RP1
	111926-009/ER-BSG-CYN-MW17	Zinc (7440-66-6)	UJ, MS1,RP1
SW846 3535A/8015D			
	111926-003/ER-BSG-CYN-MW17	Diesel Range Organics (68334-30-5)	UJ, MS5
SW846 3535A/8330B			
	111926-002/ER-BSG-CYN-MW17	m-Nitrotoluene (99-08-1)	UJ, I4
	111926-002/ER-BSG-CYN-MW17	Nitrobenzene (98-95-3)	UJ, I4
	111926-002/ER-BSG-CYN-MW17	o-Nitrotoluene (88-72-2)	UJ, I4
	111926-002/ER-BSG-CYN-MW17	PETN (78-11-5)	UJ, C3,MS3
	111926-002/ER-BSG-CYN-MW17	p-Nitrotoluene (99-99-0)	UJ, I4
	111926-002/ER-BSG-CYN-MW17	Tetryl (479-45-8)	R, L3
SW846 8260B DOE-AL			
	111926-001/ER-BSG-CYN-MW17	Acetone (67-64-1)	UJ, MS3
	111926-001/ER-BSG-CYN-MW17	Methyl acetate (79-20-9)	UJ, I4
	111928-001/ER-BSG-TB6	Acetone (67-64-1)	UJ, MS3
	111928-001/ER-BSG-TB6	Methyl acetate (79-20-9)	UJ, I4
SW846 9056A			
	111926-006/ER-BSG-CYN-MW17	Bromide (24959-67-9)	J, MS1,RP1
	111926-006/ER-BSG-CYN-MW17	Chloride (16887-00-6)	J, MS1,RP1
	111926-006/ER-BSG-CYN-MW17	Fluoride (16984-48-8)	J, MS1,RP1
	111926-006/ER-BSG-CYN-MW17	Sulfate (14808-79-8)	J, MS1,RP1

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

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

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Memorandum

Date: January 24, 2020

To: File

From: Mary Donivan

Subject: Inorganic Data Review and Validation – SNL
Site: ER Burn Site
ARCOC: 620653
SDG: 497030
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. Problems were identified with the data package that resulted in the qualification of data.

Anions:

1. The MS and duplicate analyses were performed on an SNL DI water sample from another SDG. All associated sample results were detects will be **qualified J,MS1,RP1** due to lack of matrix-specific accuracy and 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.

Blanks

No target analytes were detected in any of the blanks except as follows. Nitrate/nitrite was detected at ≤the PQL in the ICB and a bracketing CCB. The associated result for sample 497030005 was a detect >5X the ICB/CCB concentrations 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 except as noted above in the Summary section. It should be noted that the parent samples for the MS for perchlorate and nitrate/nitrite were SNL samples of similar matrix from other SDGs. 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 parent samples for the duplicates for perchlorate and nitrate/nitrite were 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 -006 was diluted 20X for chloride and sulfate.

Nitrate/nitrite:
Sample -005 was diluted 50X.

Other QC

No other specific issues that affect data quality were identified.

Sample Findings Summary

AR/COC: 620653

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
DOE EML HASL-300, U-02-RC			
	111929-012/ER-BSG-CYN-MW18	Uranium-235/236 (15117-96-1/13982-70-)	J, FR7
EPA 900.0/SW846 9310			
	111929-011/ER-BSG-CYN-MW18	ALPHA (12587-46-1)	J, FR7
EPA 901.1			
	111929-010/ER-BSG-CYN-MW18	Americium-241 (14596-10-2)	BD, FR3
	111929-010/ER-BSG-CYN-MW18	Cesium-137 (10045-97-3)	BD, FR3
	111929-010/ER-BSG-CYN-MW18	Cobalt-60 (10198-40-0)	BD, FR3
	111929-010/ER-BSG-CYN-MW18	Potassium-40 (13966-00-2)	BD, FR3
EPA 906.0 Modified			
	111929-013/ER-BSG-CYN-MW18	Tritium (10028-17-8)	BD, FR3
SW846 3005A/6020B			
	111929-008/ER-BSG-CYN-MW18	Aluminum (7429-90-5)	J, MS1,RP1
	111929-008/ER-BSG-CYN-MW18	Antimony (7440-36-0)	UJ, MS1,RP1
	111929-008/ER-BSG-CYN-MW18	Arsenic (7440-38-2)	J, MS1,RP1
	111929-008/ER-BSG-CYN-MW18	Barium (7440-39-3)	J, MS1,RP1
	111929-008/ER-BSG-CYN-MW18	Beryllium (7440-41-7)	J, MS1,RP1
	111929-008/ER-BSG-CYN-MW18	Cadmium (7440-43-9)	UJ, MS1,RP1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111929-008/ER-BSG-CYN-MW18	Calcium (7440-70-2)	J, MS1,RP1
	111929-008/ER-BSG-CYN-MW18	Chromium (7440-47-3)	UJ, MS1,RP1
	111929-008/ER-BSG-CYN-MW18	Cobalt (7440-48-4)	J, MS1,RP1
	111929-008/ER-BSG-CYN-MW18	Copper (7440-50-8)	J, MS1,RP1
	111929-008/ER-BSG-CYN-MW18	Iron (7439-89-6)	J, MS1,RP1
	111929-008/ER-BSG-CYN-MW18	Lead (7439-92-1)	UJ, MS1,RP1
	111929-008/ER-BSG-CYN-MW18	Magnesium (7439-95-4)	J, MS1,RP1
	111929-008/ER-BSG-CYN-MW18	Manganese (7439-96-5)	J-, CK3,MS1,RP1
	111929-008/ER-BSG-CYN-MW18	Molybdenum (7439-98-7)	J, MS1,RP1
	111929-008/ER-BSG-CYN-MW18	Nickel (7440-02-0)	J, MS1,RP1
	111929-008/ER-BSG-CYN-MW18	Potassium (7440-09-7)	J, MS1,RP1
	111929-008/ER-BSG-CYN-MW18	Selenium (7782-49-2)	J, MS1,RP1
	111929-008/ER-BSG-CYN-MW18	Silver (7440-22-4)	UJ, MS1,RP1
	111929-008/ER-BSG-CYN-MW18	Sodium (7440-23-5)	J, MS1,RP1
	111929-008/ER-BSG-CYN-MW18	Thallium (7440-28-0)	UJ, MS1,RP1
	111929-008/ER-BSG-CYN-MW18	Vanadium (7440-62-2)	UJ, MS1,RP1
	111929-008/ER-BSG-CYN-MW18	Zinc (7440-66-6)	UJ, MS1,RP1
	111929-009/ER-BSG-CYN-MW18	Aluminum (7429-90-5)	UJ, IS1,MS1,RP1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111929-009/ER-BSG-CYN-MW18	Antimony (7440-36-0)	UJ, MS1,RP1
	111929-009/ER-BSG-CYN-MW18	Arsenic (7440-38-2)	J, MS1,RP1
	111929-009/ER-BSG-CYN-MW18	Barium (7440-39-3)	J, MS1,RP1
	111929-009/ER-BSG-CYN-MW18	Beryllium (7440-41-7)	J-, IS1,MS1,RP1
	111929-009/ER-BSG-CYN-MW18	Cadmium (7440-43-9)	UJ, MS1,RP1
	111929-009/ER-BSG-CYN-MW18	Calcium (7440-70-2)	J, MS1,RP1
	111929-009/ER-BSG-CYN-MW18	Chromium (7440-47-3)	UJ, IS1,MS1,RP1
	111929-009/ER-BSG-CYN-MW18	Cobalt (7440-48-4)	J, MS1,RP1
	111929-009/ER-BSG-CYN-MW18	Copper (7440-50-8)	J, MS1,RP1
	111929-009/ER-BSG-CYN-MW18	Iron (7439-89-6)	J-, IS1,MS1,RP1
	111929-009/ER-BSG-CYN-MW18	Lead (7439-92-1)	UJ, MS1,RP1
	111929-009/ER-BSG-CYN-MW18	Magnesium (7439-95-4)	J-, IS1,MS1,RP1
	111929-009/ER-BSG-CYN-MW18	Manganese (7439-96-5)	J-, CK3,IS1,MS1,RP
	111929-009/ER-BSG-CYN-MW18	Molybdenum (7439-98-7)	J, MS1,RP1
	111929-009/ER-BSG-CYN-MW18	Nickel (7440-02-0)	J-, IS1,MS1,RP1
	111929-009/ER-BSG-CYN-MW18	Potassium (7440-09-7)	J-, IS1,MS1,RP1
	111929-009/ER-BSG-CYN-MW18	Selenium (7782-49-2)	J, MS1,RP1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111929-009/ER-BSG-CYN-MW18	Silver (7440-22-4)	UJ, MS1,RP1
	111929-009/ER-BSG-CYN-MW18	Sodium (7440-23-5)	J-, IS1,MS1,RP1
	111929-009/ER-BSG-CYN-MW18	Thallium (7440-28-0)	UJ, MS1,RP1
	111929-009/ER-BSG-CYN-MW18	Vanadium (7440-62-2)	UJ, IS1,MS1,RP1
	111929-009/ER-BSG-CYN-MW18	Zinc (7440-66-6)	UJ, MS1,RP1
SW846 3535A/8015D			
	111929-003/ER-BSG-CYN-MW18	Diesel Range Organics (68334-30-5)	UJ, MS5
SW846 3535A/8330B			
	111929-002/ER-BSG-CYN-MW18	m-Nitrotoluene (99-08-1)	UJ, I4
	111929-002/ER-BSG-CYN-MW18	Nitrobenzene (98-95-3)	UJ, I4
	111929-002/ER-BSG-CYN-MW18	o-Nitrotoluene (88-72-2)	UJ, I4
	111929-002/ER-BSG-CYN-MW18	PETN (78-11-5)	UJ, C3,MS3
	111929-002/ER-BSG-CYN-MW18	p-Nitrotoluene (99-99-0)	UJ, I4
	111929-002/ER-BSG-CYN-MW18	Tetryl (479-45-8)	R, L3
SW846 8260B DOE-AL			
	111929-001/ER-BSG-CYN-MW18	1,1,1-Trichloroethane (71-55-6)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	1,1,2,2-Tetrachloroethane (79-34-5)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	1,1,2-Trichloroethane (79-00-5)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	1,1-Dichloroethane (75-34-3)	UJ, MS1,RP1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111929-001/ER-BSG-CYN-MW18	1,1-Dichloroethylene (75-35-4)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	1,2,3-Trichlorobenzene (87-61-6)	UJ, IS,MS1,RP1
	111929-001/ER-BSG-CYN-MW18	1,2,4-Trichlorobenzene (120-82-1)	UJ, IS,MS1,RP1
	111929-001/ER-BSG-CYN-MW18	1,2-Dibromo-3-chloropropane (96-12-8)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	1,2-Dibromoethane (106-93-4)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	1,2-Dichlorobenzene (95-50-1)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	1,2-Dichloroethane (107-06-2)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	1,2-Dichloropropane (78-87-5)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	1,3-Dichlorobenzene (541-73-1)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	1,4-Dichlorobenzene (106-46-7)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	2-Butanone (78-93-3)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	2-Hexanone (591-78-6)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	4-Methyl-2-pentanone (108-10-1)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Acetone (67-64-1)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Benzene (71-43-2)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Bromochloromethane (74-97-5)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Bromodichloromethane (75-27-4)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Bromoform (75-25-2)	UJ, MS1,RP1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111929-001/ER-BSG-CYN-MW18	Bromomethane (74-83-9)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Carbon disulfide (75-15-0)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Carbon tetrachloride (56-23-5)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Chlorobenzene (108-90-7)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Chloroethane (75-00-3)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Chloroform (67-66-3)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Chloromethane (74-87-3)	UJ, I5,MS1,RP1
	111929-001/ER-BSG-CYN-MW18	cis-1,2-Dichloroethylene (156-59-2)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	cis-1,3-Dichloropropylene (10061-01-5)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Cyclohexane (110-82-7)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Dibromochloromethane (124-48-1)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Dichlorodifluoromethane (75-71-8)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Ethylbenzene (100-41-4)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Isopropylbenzene (98-82-8)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	m,p-Xylenes (N/A)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Methyl acetate (79-20-9)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Methylcyclohexane (108-87-2)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Methylene chloride (75-09-2)	UJ, MS1,RP1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111929-001/ER-BSG-CYN-MW18	o-Xylene (95-47-6)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Styrene (100-42-5)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	tert-Butyl methyl ether (1634-04-4)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Tetrachloroethylene (127-18-4)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Toluene (108-88-3)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	trans-1,2-Dichloroethylene (156-60-5)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	trans-1,3-Dichloropropylene (10061-02-6)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Trichloroethylene (79-01-6)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Trichlorofluoromethane (75-69-4)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Trichlorotrifluoroethane (76-13-1)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Vinyl chloride (75-01-4)	UJ, MS1,RP1
	111929-001/ER-BSG-CYN-MW18	Xylenes (total) (1330-20-7)	UJ, MS1,RP1
	111931-001/ER-BSG-TB8	1,1,1-Trichloroethane (71-55-6)	R, H1
	111931-001/ER-BSG-TB8	1,1,2,2-Tetrachloroethane (79-34-5)	R, H1
	111931-001/ER-BSG-TB8	1,1,2-Trichloroethane (79-00-5)	R, H1
	111931-001/ER-BSG-TB8	1,1-Dichloroethane (75-34-3)	R, H1
	111931-001/ER-BSG-TB8	1,1-Dichloroethylene (75-35-4)	R, H1
	111931-001/ER-BSG-TB8	1,2,3-Trichlorobenzene (87-61-6)	R, H1,I5
	111931-001/ER-BSG-TB8	1,2,4-Trichlorobenzene (120-82-1)	R, H1,I5
	111931-001/ER-BSG-TB8	1,2-Dibromo-3-chloropropane (96-12-8)	R, H1
	111931-001/ER-BSG-TB8	1,2-Dibromoethane (106-93-4)	R, H1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111931-001/ER-BSG-TB8	1,2-Dichlorobenzene (95-50-1)	R, H1
	111931-001/ER-BSG-TB8	1,2-Dichloroethane (107-06-2)	R, H1
	111931-001/ER-BSG-TB8	1,2-Dichloropropane (78-87-5)	R, H1
	111931-001/ER-BSG-TB8	1,3-Dichlorobenzene (541-73-1)	R, H1
	111931-001/ER-BSG-TB8	1,4-Dichlorobenzene (106-46-7)	R, H1
	111931-001/ER-BSG-TB8	2-Butanone (78-93-3)	R, H1
	111931-001/ER-BSG-TB8	2-Hexanone (591-78-6)	R, H1
	111931-001/ER-BSG-TB8	4-Methyl-2-pentanone (108-10-1)	R, H1
	111931-001/ER-BSG-TB8	Acetone (67-64-1)	J-, H1,C3
	111931-001/ER-BSG-TB8	Benzene (71-43-2)	R, H1
	111931-001/ER-BSG-TB8	Bromochloromethane (74-97-5)	R, H1
	111931-001/ER-BSG-TB8	Bromodichloromethane (75-27-4)	R, H1
	111931-001/ER-BSG-TB8	Bromoform (75-25-2)	R, H1
	111931-001/ER-BSG-TB8	Bromomethane (74-83-9)	R, H1
	111931-001/ER-BSG-TB8	Carbon disulfide (75-15-0)	R, H1
	111931-001/ER-BSG-TB8	Carbon tetrachloride (56-23-5)	R, H1
	111931-001/ER-BSG-TB8	Chlorobenzene (108-90-7)	R, H1
	111931-001/ER-BSG-TB8	Chloroethane (75-00-3)	R, H1
	111931-001/ER-BSG-TB8	Chloroform (67-66-3)	R, H1
	111931-001/ER-BSG-TB8	Chloromethane (74-87-3)	R, H1,I5
	111931-001/ER-BSG-TB8	cis-1,2-Dichloroethylene (156-59-2)	R, H1
	111931-001/ER-BSG-TB8	cis-1,3-Dichloropropylene (10061-01-5)	R, H1
	111931-001/ER-BSG-TB8	Cyclohexane (110-82-7)	R, H1
	111931-001/ER-BSG-TB8	Dibromochloromethane (124-48-1)	R, H1
	111931-001/ER-BSG-TB8	Dichlorodifluoromethane (75-71-8)	R, H1
	111931-001/ER-BSG-TB8	Ethylbenzene (100-41-4)	R, H1
	111931-001/ER-BSG-TB8	Isopropylbenzene (98-82-8)	R, H1
	111931-001/ER-BSG-TB8	m,p-Xylenes (N/A)	R, H1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111931-001/ER-BSG-TB8	Methyl acetate (79-20-9)	R, H1
	111931-001/ER-BSG-TB8	Methylcyclohexane (108-87-2)	R, H1
	111931-001/ER-BSG-TB8	Methylene chloride (75-09-2)	R, H1
	111931-001/ER-BSG-TB8	o-Xylene (95-47-6)	R, H1
	111931-001/ER-BSG-TB8	Styrene (100-42-5)	R, H1
	111931-001/ER-BSG-TB8	tert-Butyl methyl ether (1634-04-4)	R, H1
	111931-001/ER-BSG-TB8	Tetrachloroethylene (127-18-4)	R, H1
	111931-001/ER-BSG-TB8	Toluene (108-88-3)	R, H1
	111931-001/ER-BSG-TB8	trans-1,2-Dichloroethylene (156-60-5)	R, H1
	111931-001/ER-BSG-TB8	trans-1,3-Dichloropropylene (10061-02-6)	R, H1
	111931-001/ER-BSG-TB8	Trichloroethylene (79-01-6)	R, H1
	111931-001/ER-BSG-TB8	Trichlorofluoromethane (75-69-4)	R, H1
	111931-001/ER-BSG-TB8	Trichlorotrifluoroethane (76-13-1)	R, H1
	111931-001/ER-BSG-TB8	Vinyl chloride (75-01-4)	R, H1
	111931-001/ER-BSG-TB8	Xylenes (total) (1330-20-7)	R, H1
SW846 9056A			
	111929-006/ER-BSG-CYN-MW18	Bromide (24959-67-9)	J, MS1,RP1
	111929-006/ER-BSG-CYN-MW18	Chloride (16887-00-6)	J, MS1,RP1
	111929-006/ER-BSG-CYN-MW18	Fluoride (16984-48-8)	J, MS1,RP1
	111929-006/ER-BSG-CYN-MW18	Sulfate (14808-79-8)	J, MS1,RP1

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

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Memorandum

Date: January 24, 2020

To: File

From: Mary Donivan

Subject: Inorganic Data Review and Validation – SNL
Site: ER Burn Site
ARCOC: 620654
SDG: 496802
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. Problems were identified with the data package that resulted in the qualification of data.

Anions:

1. The MS and duplicate analyses were performed on an SNL DI water sample from another SDG. All associated sample results were detects will be **qualified J,MS1,RP1** due to lack of matrix-specific accuracy and 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.

Blanks

No target analytes were detected in any of the blanks except as follows. Nitrate/nitrite was detected at ≤the PQL in the ICB and bracketing CCBs. The associated result for sample 496802005 was a detect >5X the ICB/CCB concentration 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 except as noted above in the Summary section

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 10X.

Other QC

No other specific issues that affect data quality were identified.

Reviewed by: Linda Thal **Level:** I **Date:** 01/27/2020

Sample Findings Summary

AR/COC: 620654

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
DOE EML HASL-300, U-02-RC			
	111932-012/ER-BSG-CYN-MW19	Uranium-235/236 (15117-96-1/13982-70-)	J, FR7
EPA 900.0/SW846 9310			
	111932-011/ER-BSG-CYN-MW19	ALPHA (12587-46-1)	J, FR7
	111932-011/ER-BSG-CYN-MW19	BETA (12587-47-2)	J, FR7
EPA 901.1			
	111932-010/ER-BSG-CYN-MW19	Americium-241 (14596-10-2)	BD, FR3
	111932-010/ER-BSG-CYN-MW19	Cesium-137 (10045-97-3)	BD, FR3
	111932-010/ER-BSG-CYN-MW19	Cobalt-60 (10198-40-0)	BD, FR3
	111932-010/ER-BSG-CYN-MW19	Potassium-40 (13966-00-2)	R, Z2
EPA 906.0 Modified			
	111932-013/ER-BSG-CYN-MW19	Tritium (10028-17-8)	BD, FR3
SW846 3005A/6020B			
	111932-008/ER-BSG-CYN-MW19	Aluminum (7429-90-5)	UJ, MS1,RP1
	111932-008/ER-BSG-CYN-MW19	Antimony (7440-36-0)	UJ, MS1,RP1
	111932-008/ER-BSG-CYN-MW19	Arsenic (7440-38-2)	UJ, MS1,RP1
	111932-008/ER-BSG-CYN-MW19	Barium (7440-39-3)	J, MS1,RP1
	111932-008/ER-BSG-CYN-MW19	Beryllium (7440-41-7)	UJ, MS1,RP1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111932-008/ER-BSG-CYN-MW19	Cadmium (7440-43-9)	UJ, MS1,RP1
	111932-008/ER-BSG-CYN-MW19	Calcium (7440-70-2)	J, MS1,RP1
	111932-008/ER-BSG-CYN-MW19	Chromium (7440-47-3)	UJ, MS1,RP1
	111932-008/ER-BSG-CYN-MW19	Cobalt (7440-48-4)	UJ, MS1,RP1
	111932-008/ER-BSG-CYN-MW19	Copper (7440-50-8)	J, MS1,RP1
	111932-008/ER-BSG-CYN-MW19	Iron (7439-89-6)	J, MS1,RP1
	111932-008/ER-BSG-CYN-MW19	Lead (7439-92-1)	UJ, MS1,RP1
	111932-008/ER-BSG-CYN-MW19	Magnesium (7439-95-4)	J, MS1,RP1
	111932-008/ER-BSG-CYN-MW19	Manganese (7439-96-5)	J-, CK3,MS1,RP1
	111932-008/ER-BSG-CYN-MW19	Molybdenum (7439-98-7)	J, MS1,RP1
	111932-008/ER-BSG-CYN-MW19	Nickel (7440-02-0)	UJ, MS1,RP1
	111932-008/ER-BSG-CYN-MW19	Potassium (7440-09-7)	J, MS1,RP1
	111932-008/ER-BSG-CYN-MW19	Selenium (7782-49-2)	J, MS1,RP1
	111932-008/ER-BSG-CYN-MW19	Silver (7440-22-4)	UJ, MS1,RP1
	111932-008/ER-BSG-CYN-MW19	Sodium (7440-23-5)	J, MS1,RP1
	111932-008/ER-BSG-CYN-MW19	Thallium (7440-28-0)	UJ, MS1,RP1
	111932-008/ER-BSG-CYN-MW19	Vanadium (7440-62-2)	J, MS1,RP1
	111932-008/ER-BSG-CYN-MW19	Zinc (7440-66-6)	UJ, MS1,RP1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111932-009/ER-BSG-CYN-MW19	Aluminum (7429-90-5)	UJ, MS1,RP1
	111932-009/ER-BSG-CYN-MW19	Antimony (7440-36-0)	UJ, MS1,RP1
	111932-009/ER-BSG-CYN-MW19	Arsenic (7440-38-2)	UJ, MS1,RP1
	111932-009/ER-BSG-CYN-MW19	Barium (7440-39-3)	J, MS1,RP1
	111932-009/ER-BSG-CYN-MW19	Beryllium (7440-41-7)	UJ, MS1,RP1
	111932-009/ER-BSG-CYN-MW19	Cadmium (7440-43-9)	UJ, MS1,RP1
	111932-009/ER-BSG-CYN-MW19	Calcium (7440-70-2)	J, MS1,RP1
	111932-009/ER-BSG-CYN-MW19	Chromium (7440-47-3)	UJ, MS1,RP1
	111932-009/ER-BSG-CYN-MW19	Cobalt (7440-48-4)	UJ, MS1,RP1
	111932-009/ER-BSG-CYN-MW19	Copper (7440-50-8)	J, MS1,RP1
	111932-009/ER-BSG-CYN-MW19	Iron (7439-89-6)	UJ, MS1,RP1
	111932-009/ER-BSG-CYN-MW19	Lead (7439-92-1)	UJ, MS1,RP1
	111932-009/ER-BSG-CYN-MW19	Magnesium (7439-95-4)	J, MS1,RP1
	111932-009/ER-BSG-CYN-MW19	Manganese (7439-96-5)	J-, CK3,MS1,RP1
	111932-009/ER-BSG-CYN-MW19	Molybdenum (7439-98-7)	J, MS1,RP1
	111932-009/ER-BSG-CYN-MW19	Nickel (7440-02-0)	UJ, MS1,RP1
	111932-009/ER-BSG-CYN-MW19	Potassium (7440-09-7)	J, MS1,RP1
	111932-009/ER-BSG-CYN-MW19	Selenium (7782-49-2)	J, MS1,RP1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111932-009/ER-BSG-CYN-MW19	Silver (7440-22-4)	UJ, MS1,RP1
	111932-009/ER-BSG-CYN-MW19	Sodium (7440-23-5)	J, MS1,RP1
	111932-009/ER-BSG-CYN-MW19	Thallium (7440-28-0)	UJ, MS1,RP1
	111932-009/ER-BSG-CYN-MW19	Vanadium (7440-62-2)	J, MS1,RP1
	111932-009/ER-BSG-CYN-MW19	Zinc (7440-66-6)	UJ, MS1,RP1
SW846 3535A/8015D			
	111932-003/ER-BSG-CYN-MW19	Diesel Range Organics (68334-30-5)	UJ, MS5
SW846 3535A/8330B			
	111932-002/ER-BSG-CYN-MW19	m-Nitrotoluene (99-08-1)	UJ, I4
	111932-002/ER-BSG-CYN-MW19	Nitrobenzene (98-95-3)	UJ, I4
	111932-002/ER-BSG-CYN-MW19	o-Nitrotoluene (88-72-2)	UJ, I4
	111932-002/ER-BSG-CYN-MW19	PETN (78-11-5)	UJ, C3,MS3
	111932-002/ER-BSG-CYN-MW19	p-Nitrotoluene (99-99-0)	UJ, I4
	111932-002/ER-BSG-CYN-MW19	Tetryl (479-45-8)	R, L3
SW846 8260B DOE-AL			
	111932-001/ER-BSG-CYN-MW19	1,1,1-Trichloroethane (71-55-6)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	1,1,2,2-Tetrachloroethane (79-34-5)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	1,1,2-Trichloroethane (79-00-5)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	1,1-Dichloroethane (75-34-3)	UJ, MS1,RP1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111932-001/ER-BSG-CYN-MW19	1,1-Dichloroethylene (75-35-4)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	1,2,3-Trichlorobenzene (87-61-6)	UJ, I5,MS1,RP1
	111932-001/ER-BSG-CYN-MW19	1,2,4-Trichlorobenzene (120-82-1)	UJ, I5,MS1,RP1
	111932-001/ER-BSG-CYN-MW19	1,2-Dibromo-3-chloropropane (96-12-8)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	1,2-Dibromoethane (106-93-4)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	1,2-Dichlorobenzene (95-50-1)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	1,2-Dichloroethane (107-06-2)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	1,2-Dichloropropane (78-87-5)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	1,3-Dichlorobenzene (541-73-1)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	1,4-Dichlorobenzene (106-46-7)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	2-Butanone (78-93-3)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	2-Hexanone (591-78-6)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	4-Methyl-2-pentanone (108-10-1)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Acetone (67-64-1)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Benzene (71-43-2)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Bromochloromethane (74-97-5)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Bromodichloromethane (75-27-4)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Bromoform (75-25-2)	UJ, MS1,RP1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111932-001/ER-BSG-CYN-MW19	Bromomethane (74-83-9)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Carbon disulfide (75-15-0)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Carbon tetrachloride (56-23-5)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Chlorobenzene (108-90-7)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Chloroethane (75-00-3)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Chloroform (67-66-3)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Chloromethane (74-87-3)	UJ, I5,MS1,RP1
	111932-001/ER-BSG-CYN-MW19	cis-1,2-Dichloroethylene (156-59-2)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	cis-1,3-Dichloropropylene (10061-01-5)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Cyclohexane (110-82-7)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Dibromochloromethane (124-48-1)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Dichlorodifluoromethane (75-71-8)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Ethylbenzene (100-41-4)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Isopropylbenzene (98-82-8)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	m,p-Xylenes (N/A)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Methyl acetate (79-20-9)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Methylcyclohexane (108-87-2)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Methylene chloride (75-09-2)	UJ, MS1,RP1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111932-001/ER-BSG-CYN-MW19	o-Xylene (95-47-6)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Styrene (100-42-5)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	tert-Butyl methyl ether (1634-04-4)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Tetrachloroethylene (127-18-4)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Toluene (108-88-3)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	trans-1,2-Dichloroethylene (156-60-5)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	trans-1,3-Dichloropropylene (10061-02-6)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Trichloroethylene (79-01-6)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Trichlorofluoromethane (75-69-4)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Trichlorotrifluoroethane (76-13-1)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Vinyl chloride (75-01-4)	UJ, MS1,RP1
	111932-001/ER-BSG-CYN-MW19	Xylenes (total) (1330-20-7)	UJ, MS1,RP1
	111934-001/ER-BSG-TB10	1,1,1-Trichloroethane (71-55-6)	R, H1
	111934-001/ER-BSG-TB10	1,1,2,2-Tetrachloroethane (79-34-5)	R, H1
	111934-001/ER-BSG-TB10	1,1,2-Trichloroethane (79-00-5)	R, H1
	111934-001/ER-BSG-TB10	1,1-Dichloroethane (75-34-3)	R, H1
	111934-001/ER-BSG-TB10	1,1-Dichloroethylene (75-35-4)	R, H1
	111934-001/ER-BSG-TB10	1,2,3-Trichlorobenzene (87-61-6)	R, H1,I5
	111934-001/ER-BSG-TB10	1,2,4-Trichlorobenzene (120-82-1)	R, H1,I5
	111934-001/ER-BSG-TB10	1,2-Dibromo-3-chloropropane (96-12-8)	R, H1
	111934-001/ER-BSG-TB10	1,2-Dibromoethane (106-93-4)	R, H1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111934-001/ER-BSG-TB10	1,2-Dichlorobenzene (95-50-1)	R, H1
	111934-001/ER-BSG-TB10	1,2-Dichloroethane (107-06-2)	R, H1
	111934-001/ER-BSG-TB10	1,2-Dichloropropane (78-87-5)	R, H1
	111934-001/ER-BSG-TB10	1,3-Dichlorobenzene (541-73-1)	R, H1
	111934-001/ER-BSG-TB10	1,4-Dichlorobenzene (106-46-7)	R, H1
	111934-001/ER-BSG-TB10	2-Butanone (78-93-3)	R, H1
	111934-001/ER-BSG-TB10	2-Hexanone (591-78-6)	R, H1
	111934-001/ER-BSG-TB10	4-Methyl-2-pentanone (108-10-1)	R, H1
	111934-001/ER-BSG-TB10	Acetone (67-64-1)	J-, H1,C3
	111934-001/ER-BSG-TB10	Benzene (71-43-2)	R, H1
	111934-001/ER-BSG-TB10	Bromochloromethane (74-97-5)	R, H1
	111934-001/ER-BSG-TB10	Bromodichloromethane (75-27-4)	R, H1
	111934-001/ER-BSG-TB10	Bromoform (75-25-2)	R, H1
	111934-001/ER-BSG-TB10	Bromomethane (74-83-9)	R, H1
	111934-001/ER-BSG-TB10	Carbon disulfide (75-15-0)	R, H1
	111934-001/ER-BSG-TB10	Carbon tetrachloride (56-23-5)	R, H1
	111934-001/ER-BSG-TB10	Chlorobenzene (108-90-7)	R, H1
	111934-001/ER-BSG-TB10	Chloroethane (75-00-3)	R, H1
	111934-001/ER-BSG-TB10	Chloroform (67-66-3)	R, H1
	111934-001/ER-BSG-TB10	Chloromethane (74-87-3)	R, H1,I5
	111934-001/ER-BSG-TB10	cis-1,2-Dichloroethylene (156-59-2)	R, H1
	111934-001/ER-BSG-TB10	cis-1,3-Dichloropropylene (10061-01-5)	R, H1
	111934-001/ER-BSG-TB10	Cyclohexane (110-82-7)	R, H1
	111934-001/ER-BSG-TB10	Dibromochloromethane (124-48-1)	R, H1
	111934-001/ER-BSG-TB10	Dichlorodifluoromethane (75-71-8)	R, H1
	111934-001/ER-BSG-TB10	Ethylbenzene (100-41-4)	R, H1
	111934-001/ER-BSG-TB10	Isopropylbenzene (98-82-8)	R, H1
	111934-001/ER-BSG-TB10	m,p-Xylenes (N/A)	R, H1

Analytical Method	Sample ID	Analyte Name (CAS#)	Qualifier, RC
	111934-001/ER-BSG-TB10	Methyl acetate (79-20-9)	R, H1
	111934-001/ER-BSG-TB10	Methylcyclohexane (108-87-2)	R, H1
	111934-001/ER-BSG-TB10	Methylene chloride (75-09-2)	R, H1
	111934-001/ER-BSG-TB10	o-Xylene (95-47-6)	R, H1
	111934-001/ER-BSG-TB10	Styrene (100-42-5)	R, H1
	111934-001/ER-BSG-TB10	tert-Butyl methyl ether (1634-04-4)	R, H1
	111934-001/ER-BSG-TB10	Tetrachloroethylene (127-18-4)	R, H1
	111934-001/ER-BSG-TB10	Toluene (108-88-3)	R, H1
	111934-001/ER-BSG-TB10	trans-1,2-Dichloroethylene (156-60-5)	R, H1
	111934-001/ER-BSG-TB10	trans-1,3-Dichloropropylene (10061-02-6)	R, H1
	111934-001/ER-BSG-TB10	Trichloroethylene (79-01-6)	R, H1
	111934-001/ER-BSG-TB10	Trichlorofluoromethane (75-69-4)	R, H1
	111934-001/ER-BSG-TB10	Trichlorotrifluoroethane (76-13-1)	R, H1
	111934-001/ER-BSG-TB10	Vinyl chloride (75-01-4)	R, H1
	111934-001/ER-BSG-TB10	Xylenes (total) (1330-20-7)	R, H1
SW846 9056A			
	111932-006/ER-BSG-CYN-MW19	Bromide (24959-67-9)	J, MS1,RP1
	111932-006/ER-BSG-CYN-MW19	Chloride (16887-00-6)	J, MS1,RP1
	111932-006/ER-BSG-CYN-MW19	Fluoride (16984-48-8)	J, MS1,RP1
	111932-006/ER-BSG-CYN-MW19	Sulfate (14808-79-8)	J, MS1,RP1

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

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APPENDICES

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, October – December 2019

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 plan to conduct the ISB Treatability Study in two phases. Phase I includes a pilot test followed by full-scale operation at the first injection well (TAV-INJ1); Phase II includes well installation and full-scale operations 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 selected close to monitoring wells TAV-MW6, TAV-MW10, and LWDS-MW1, respectively, where the highest contaminant concentrations in TA-V groundwater have been detected.

Table III-1 presents a timeline for the Phase I ISB Treatability Study at TAVG AOC. SNL/NM personnel have begun the Phase I full-scale operation at injection well TAV-INJ1 in October 2018. 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 includes a copy of the NMED Hazardous Waste Bureau (HWB) approval letter and DOE's submittal of the proposed modifications.

This Section III of the Environmental Restoration Operations (ER) Consolidated Quarterly Report (ER Quarterly Report) presents the monitoring results for the October – December 2019 reporting period for the Phase I full-scale operation. No field activities other than groundwater monitoring occurred during this reporting period. 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 a discussion of both the pilot test and the full-scale operation.

SNL/NM personnel have completed the six-month injection period for the Phase I full-scale operation at injection well TAV-INJ1, and are conducting the two-year performance monitoring in the ISB treatment zone (Table III-1).

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 and groundwater sampling.

2.0 Groundwater Elevation at Technical Area-V

Figure III-1 shows the October/November 2019 groundwater elevation contour map (potentiometric surface) for the Regional Aquifer at TA-V. The general shape of the groundwater elevation contours has 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 0.51 to 0.88 feet per year (SNL/NM June 2019). The approximately 530,000 gallons of treatment solution injected over a six-month period (November 2018 – April 2019) did not create a noticeable impact on the contours of the potentiometric surface at TA-V.

3.0 Groundwater Monitoring for Phase I Treatability Study

The Phase I ISB Treatability Study treatment zone encompasses the injection well TAV-INJ1 and two nearby monitoring wells (TAV-MW6 and TAV-MW7). Performance monitoring involves groundwater monitoring of all three wells. Well TAV-MW7 is monitored in case there is any vertical impact of the injected solution because the well is screened approximately 90 feet below the water table.

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 May, June, 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, as described in the Revised TSWP (SNL/NM March 2016).

3.1 Groundwater Field Parameters inside the Treatment Zone

During this reporting period, an In-Situ Incorporated Aqua TROLL® 600 Multi-parameter sonde was installed in each of the three wells undergoing performance monitoring (TAV-INJ1, TAV-MW6, and TAV-MW7). The parameters measured by the sonde include pressure, dissolved oxygen (DO), oxidation reduction potential (ORP), potential of hydrogen (pH), specific conductivity (SC), temperature, and turbidity, in accordance with the Revised TSWP (SNL/NM March 2016). Pressure readings can be converted to groundwater elevation above mean sea level.

In the October 2019 ER Quarterly Report, SNL/NM personnel proposed to remove the sonde in well TAV-MW7 because neither water levels nor water quality in this well have been affected by the injection at well TA-INJ1 (SNL/NM October 2019). The NMED HWB subsequently approved the request (NMED November 2019). The sonde was removed from well TAV-MW7 on December 17, 2019. This quarterly report still evaluates the sonde data for well TAV-MW7 up to the date the sonde was removed. Groundwater field parameters at well TAV-MW7 will be measured each time before the well is sampled, and the measurements will be presented along with the analytical results.

3.1.1 Groundwater Quality at Injection Well TAV-INJ1

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

With the influx of substrate solution, the water has turned anaerobic with reduced conditions near the injection well since the completion of pilot test injections in November 2017 (Table III-1). Since then, DO, ORP, and pH have remained at optimal levels for the biodegradation of nitrate and TCE to occur. During this reporting period, pH was around 7.1; DO was at 0.0 milligrams per liter (mg/L); and ORP was approximately negative (-) 420 millivolts. There were no significant changes in SC and turbidity during this reporting period.

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

local groundwater. Another reason for the colder substrate solution was that most of the injections occurred in the winter season of 2018 – 2019. After injection was completed in April 2019, the water temperature in well TAV-INJ1 has been rising slowly, and was approximately 20.1 degrees Celsius in December 2019. Figure III-2 shows the groundwater temperature profile in the injection well since pre-full-scale operation in October 2018 to December 2019.

3.1.2 Groundwater Quality at Monitoring Wells TAV-MW6 and TAV-MW7

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, except for DO. The concentration of DO has decreased from the baseline of approximately 7.0 mg/L to approximately 4.0 mg/L in October 2019, and started to rise since then. Figure III-3 shows the DO concentration profile in monitoring well TAV-MW6 since pre-full-scale operation in October 2018 to December 2019.

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. There were no significant changes in any of the groundwater quality parameters in this well during this reporting period.

3.2 Groundwater Sampling Inside the Treatment Zone

Table III-2 lists the sampling dates for the October – December 2019 reporting period for all the wells pertinent to the ISB Treatability Study. Tables III-3 through III-6 presents all the analytical results. Table III-7 summarizes the stabilized water quality parameters measured immediately before sample collection at each well.

3.2.1 Groundwater Sampling at Injection Well TAV-INJ1

During groundwater sampling, the SNL/NM personnel discovered significant sediment accumulation in well TAV-INJ1. 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 a higher elevation than the pre-full-scale operation sampling when the well was relatively free of sediment. Even though the purge volume (before

sample collection) at well TAV-INJ1 was 59 gallons which was determined in the baseline sampling before the ISB Treatability Study, the pump daylighted during purging after pumping approximately 11.5 gallons of groundwater (with the pump set at approximately mid-depth of the water column). The standard practice of the SNL/NM LTS program for low-yield wells is to let the well recover overnight and collect samples the next day. However, the microbial sample was required to be collected immediately after purging on the first day. For the October sampling event at well TAV-INJ1, the microbial sample was collected on October 29 and the remainder of the samples were collected on October 30, 2019 (Table III-2).

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 October – December 2019 sampling event at well TAV-INJ1. The October 2019 results show that:

- The two constituents of concern in the groundwater at TA-V (NPN and TCE) were not detected.
- Alkalinity, ammonia, and bromide (Figure III-4) concentrations did not change significantly from the last sampling results collected in July 2019 (SNL/NM January 2020). Sulfate concentration decreased from 154 mg/L in July 2019 to 14.6 mg/L in October 2019.
- The population of Dhc decreased from 10E5 gene copies per liter in July 2019 to an estimated value (J-qualified) of 8E3 gene copies per liter in October 2019.
- Concentrations of dissolved arsenic and iron decreased from those of July 2019; while concentration of dissolved manganese increased from 0.613 mg/L in July 2019 to 0.734 mg/L in October 2019. Arsenic concentration (0.0246 mg/L) exceeded the U.S. Environmental Protection Agency maximum contaminant level of 0.01 mg/L in October 2019. This was anticipated. During the 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 (16,000 micrograms per liter [µg/L]) and was similar to the July 2019 concentration (14,000 µg/L). Ethene was not detected in October 2019.
- TOC concentration decreased from 54.7 mg/L in July 2019 to 13.7 mg/L in October 2019.

3.2.2 Groundwater Sampling at Monitoring Well TAV-MW6

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 October – December 2019 sampling event at well TAV-MW6. In comparison to the pre-full-scale operation baseline levels in September 2018 (SNL/NM April 2019), the October 2019 results show that:

- Concentrations of NPN and TCE were consistent with baseline levels.
- Bromide is the inert tracer that 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 baseline concentration of bromide was 0.815 mg/L. Figure III-4 shows the bromide concentrations in both TAV-INJ1 and TAV-MW6 since pre-full-scale operation in September 2018 to October 2019. Bromide in well TAV-MW6 reached its highest concentration in June 2019 then started to decrease.
- Methane was not detected in the baseline sample at well TAV-MW6. Methane concentration has increased to 360 µg/L in October 2019. Ethene has not been detected at this well.
- The results for the other analytes were consistent with the baseline levels.

3.2.3 Groundwater Sampling at Monitoring Well TAV-MW7

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 October – December 2019 sampling event at well TAV-MW7, which is screened 90 feet below the water table. All the analytical results are consistent with baseline levels, including NPN, TCE, and bromide (SNL/NM April 2019).

3.3 Groundwater Sampling 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 potential impact of substrate solution on groundwater 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 the following:

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

These parameters are the same as those for the other monitoring wells in the TA-V groundwater monitoring network (SNL/NM June 2019). Table III-6 provides the analytical results for the October – December 2019 sampling at the eight wells. Duplicate samples were collected from well TAV-MW2, per the monitoring scheme of the SNL/NM LTS program for the TA-V groundwater monitoring network. All the analytical results are consistent with the historical values at these eight wells (SNL/NM June 2019).

3.4 Summary of Groundwater Monitoring Results for Phase I Treatability Study

The groundwater elevations remained at static levels during this reporting period in the ISB treatment zone that encompasses the injection well TAV-INJ1 and two monitoring wells TAV-MW6 and TAV-MW7.

The groundwater quality and analytical results from injection well TAV-INJ1 show that:

- 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 local groundwater).
- The groundwater quality in the well remained optimal for biodegradation of nitrate and TCE as reflected by the DO, ORP, and pH levels.

- NPN and TCE were 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]). It is also possible that the native groundwater was displaced by the injections and has not flowed back or completely mixed with the injected solution.
- The population of Dhc declined, approaching the method detection limit (10E3) gene copies per liter in October 2019.
- The methane level remained high and TOC continued to be consumed, indicating active microbial activity along with carbon consumption.
- Ethene was not detected in October 2019. Ethene is the parameter indicating complete TCE dechlorination.
- 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 groundwater quality and analytical results from this well show that:

- The DO levels reached the lowest point of approximately 4 mg/L in October 2019 and then started to increase over time.
- 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 started to decrease over time.
- The Dhc have not reached well TAV-MW6.

The groundwater 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 deviation was 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 Recommendation

On Page 5-20 of the Revised TSWP (SNL/NM March 2016), SNL/NM personnel proposed:

"The monitoring data collected during the full-scale injection and during the six months after injection is completed will be evaluated …… to determine if the Treatability Study should proceed to Phase II. These interim performance results and any associated revisions to procedures will be communicated to NMED HWB along with the decision whether to proceed to Phase II."

Monitoring results since the end of the injection period in April 2019 to December 2019 are not yet conclusive enough for SNL/NM personnel to decide on whether to proceed to Phase II of the ISB Treatability Study. Additional monitoring is necessary before the decision can be made. Because the ISB Treatability Study performance monitoring is currently on a quarterly schedule, the decision on whether to proceed to Phase II is not anticipated until later in 2020.

6.0 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.

New Mexico Environment Department (NMED), November 2019. Letter to J.P. Harrell (U.S. Department of Energy NNSA/Sandia Field Office) and P. Shoemaker (Sandia National Laboratories), "Approval: Environmental Restoration Operations Consolidated Quarterly Report, April – June 2019, October 2019, Sandia National Laboratory, EPA ID# NM5890110518, HWB-SNL-19-017," November 25, 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.

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

Sandia National Laboratories, New Mexico (SNL/NM), April 2019. *Environmental Restoration Operations Consolidated Quarterly Report October – December 2018*, Sandia National Laboratories, Albuquerque, New Mexico.

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

Sandia National Laboratories, New Mexico (SNL/NM), January 2020. *Environmental Restoration Operations Consolidated Quarterly Report July – September 2019*, Sandia National Laboratories, Albuquerque, New Mexico.

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.

Figures

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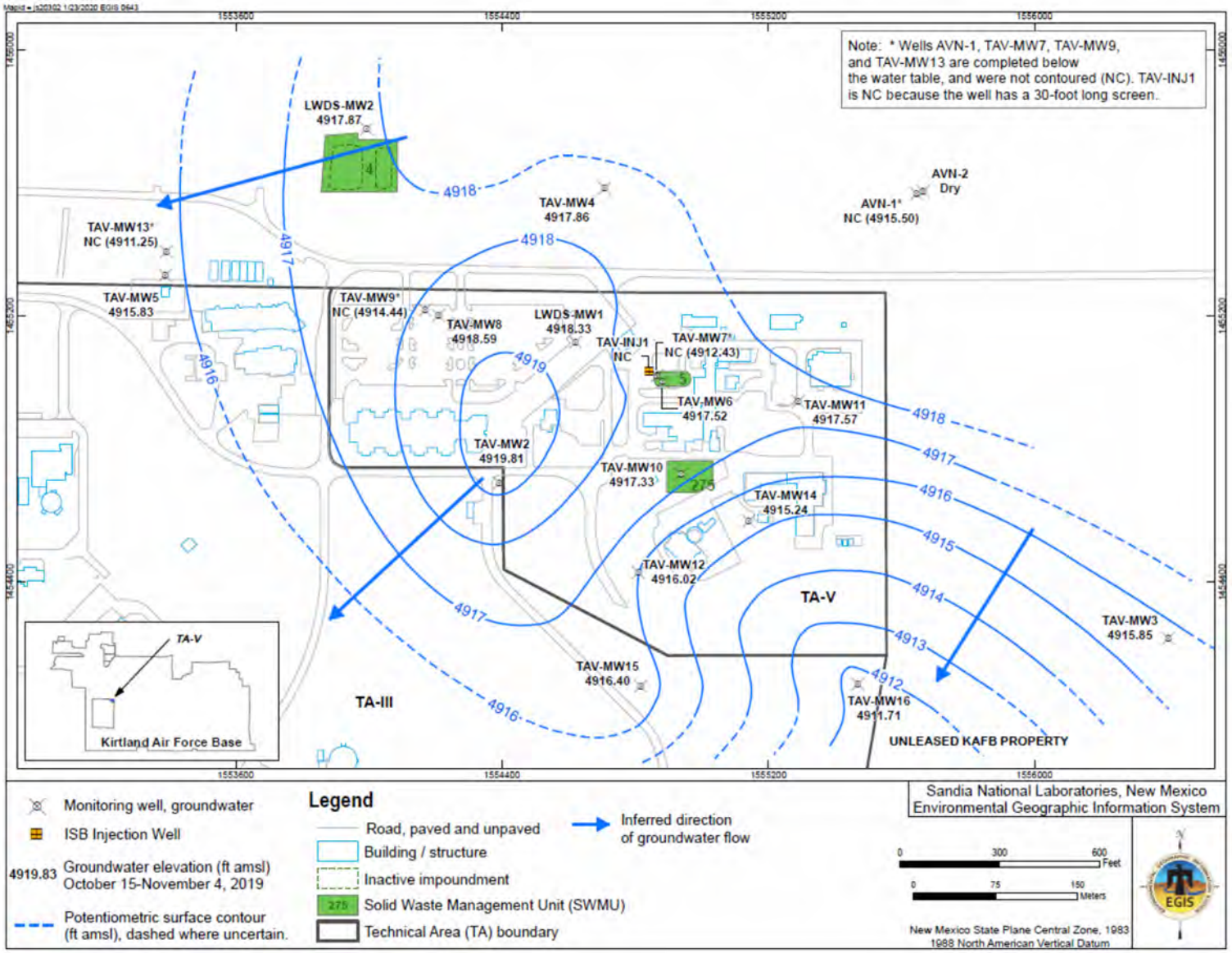

Figure III-1

Well Locations and Potentiometric Surface Contours for October/November 2019

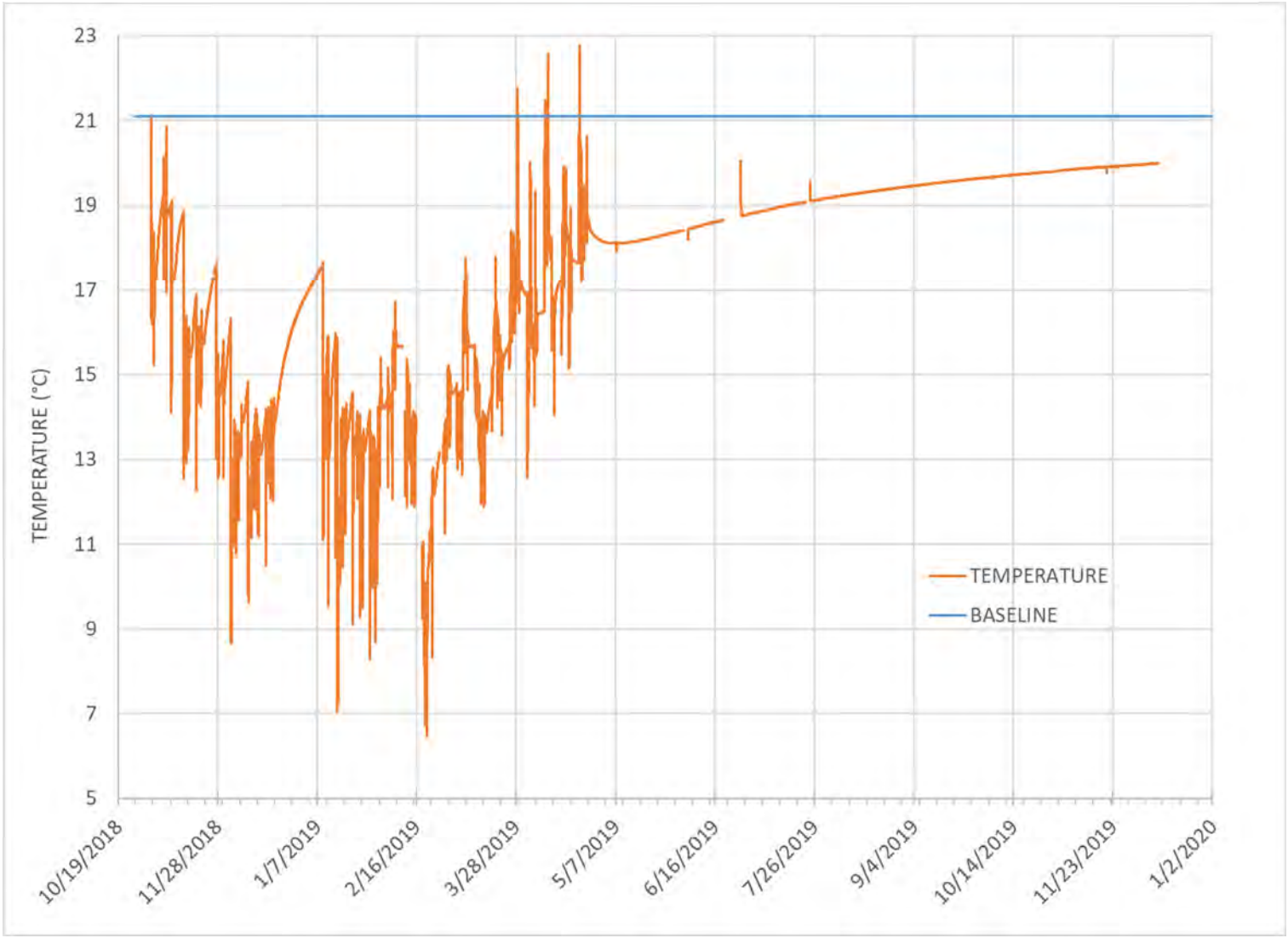

Figure III-2
Groundwater Temperature Profile in Injection Well TAV-INJ1, October 2018 – December 2019

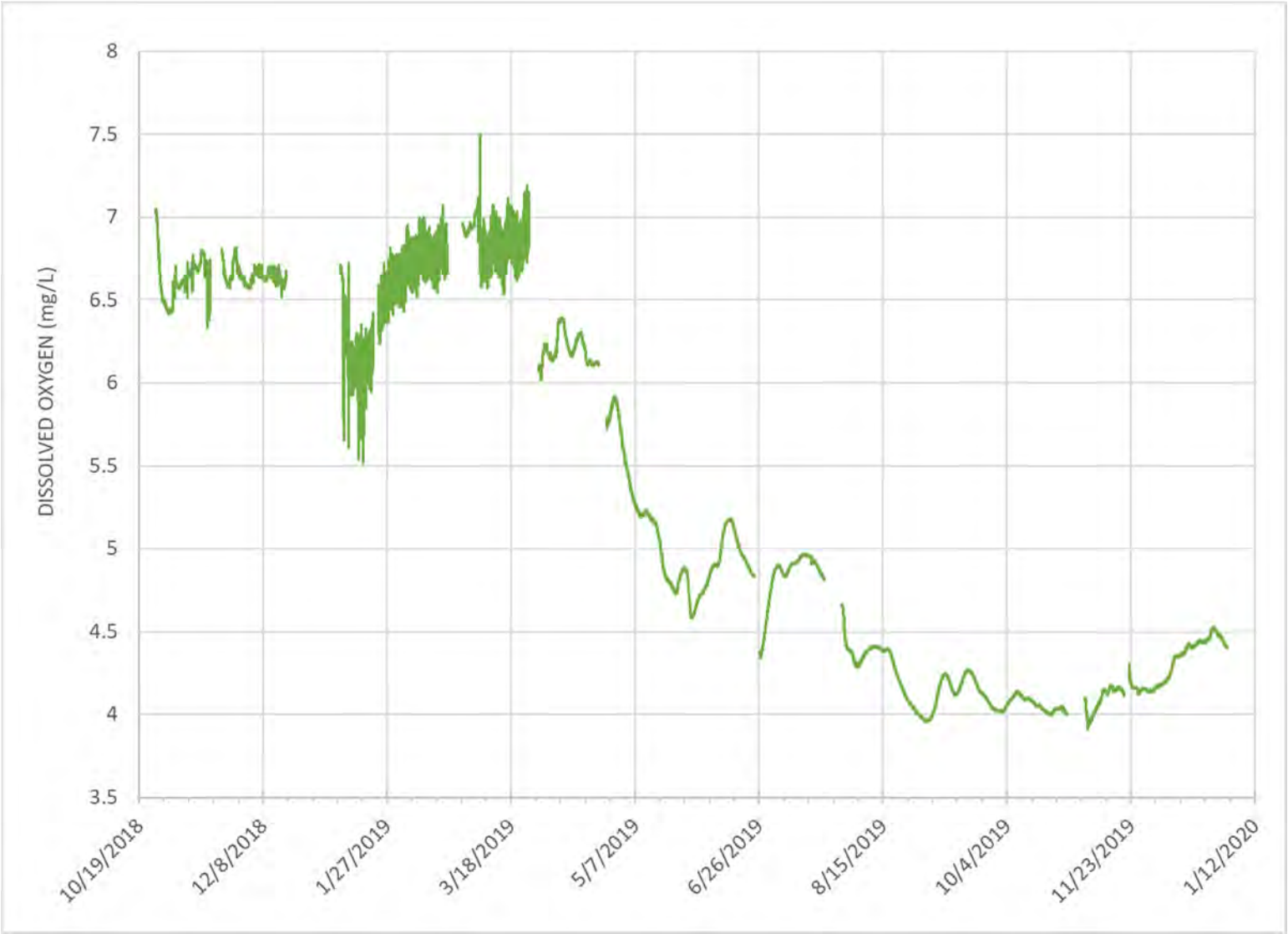

Figure III-3
Concentration of Dissolved Oxygen in Monitoring Well TAV-MW6, October 2018 – December 2019

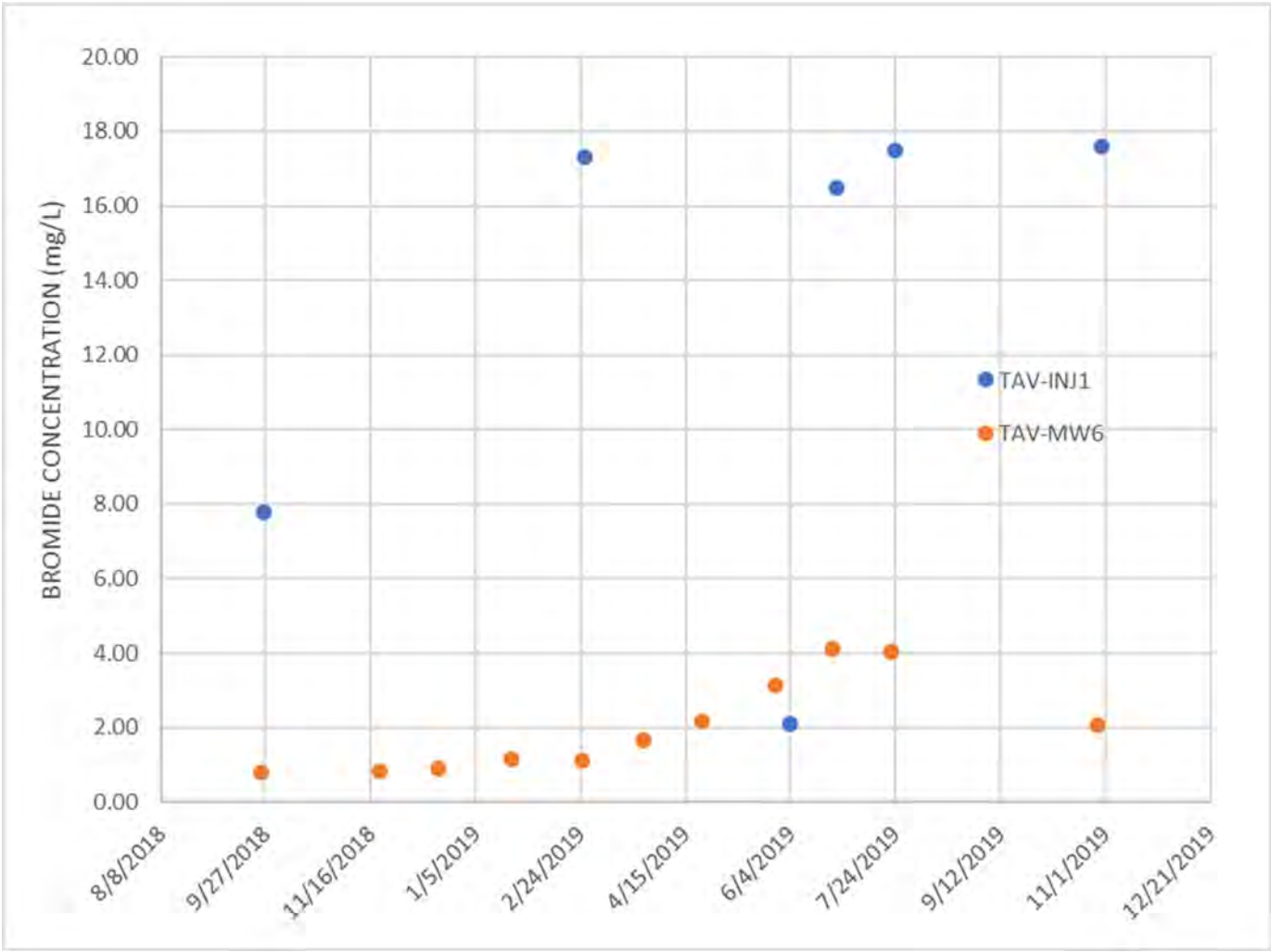

Figure III-4

Concentration of Bromide in Injection Well TAV-INJ1 and Monitoring Well TAV-MW6, September 2018 – October 2019

Note: The bromide concentration of the June 4, 2019 sample (2.09 mg/L) from well TAV-INJ1 was anomalous (SNL/NM 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 TAVG AOC.
May 2016	NMED HWB approved the Revised Treatability Study Work Plan.
August 2016	NMOSE approved the Permit to Drill application for 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	Completed Phase I pilot test injections at well TAV-INJ1.
June 2018	Completed performance monitoring of Phase I pilot test.
October 2018	SNL/NM personnel started Phase I full-scale operation of the 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 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, October – December 2019

Monitoring Well	Sampling Date
Wells Inside the Treatment Zone	
TAV-INJ1	29-30 Oct 2019 [a]
TAV-MW6	28 Oct 2019
TAV-MW7	22 Oct 2019
Wells Outside the Treatment Zone	
LWDS-MW1	18 Nov 2019
TAV-MW2	31 Oct 2019
TAV-MW4	5 Nov 2019
TAV-MW8	6 Nov 2019
TAV-MW10	13 Nov 2019
TAV-MW11	4 Nov 2019
TAV-MW12	12 Nov 2019
TAV-MW14	7 Nov 2019

Notes:

[a] Microbial sample was collected on October 29, and the remainder of the samples were collected on October 30, 2019 after the water level had recovered at well TAV-INJ1.

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, October – December 2019

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]
30-Oct-19	Alkalinity	Alkalinity as $CaCO_3$	1,500	1.45	4.00	NE	mg/L		J	110536-005	SM 2320B	GEL
30-Oct-19	Alkalinity	Alkalinity, bicarb as $CaCO_3$	1,500	1.45	4.00	NE	mg/L			110536-005	SM 2320B	GEL
30-Oct-19	Alkalinity	Alkalinity, carb as $CaCO_3$	ND	1.45	4.00	NE	mg/L	U		110536-005	SM 2320B	GEL
30-Oct-19	Ammonia	Ammonia	117	4.25	12.5	NE	mg/L		J	110536-001	EPA 350.1	GEL
30-Oct-19	Anions	Bromide	17.6	1.34	4.00	NE	mg/L			110536-003	SW846 9056A	GEL
30-Oct-19	Anions	Sulfate	14.6	0.133	0.400	NE	mg/L			110536-003	SW846 9056A	GEL
29-Oct-19	Microbial	Dehalococcoides	8,000	3,000	3,000	NE	Enumeration/L	J		110544-001	Dhc	SRM
30-Oct-19	Dissolved Metals	Arsenic	**0.0246**	0.002	0.005	0.01	mg/L			110536-006	SW846 3005A/6020B	GEL
30-Oct-19	Dissolved Metals	Iron	0.596	0.033	0.100	NE	mg/L			110536-006	SW846 3005A/6020B	GEL
30-Oct-19	Dissolved Metals	Manganese	0.734	0.001	0.005	NE	mg/L			110536-006	SW846 3005A/6020B	GEL
30-Oct-19	MEE	Methane	16,000	0.046	0.500	NE	µg/L		J	110540-001	AM20GAX	PACE
30-Oct-19	MEE	Ethane	0.13	0.005	0.100	NE	µg/L		J	110540-001	AM20GAX	PACE
30-Oct-19	MEE	Ethene	ND	0.004	0.100	NE	µg/L	U	0.100UJ	110540-001	AM20GAX	PACE
30-Oct-19	NPN	Nitrate plus nitrite as N	ND	0.017	0.050	10	mg/L	U		110536-004	EPA 353.2	GEL
30-Oct-19	TOC	Total Organic Carbon Average	13.7	0.660	2.00	NE	mg/L			110536-002	SW846 9060A	GEL
30-Oct-19	VOC	Dichloroethene, cis-1,2-	ND	0.300	1.00	70	µg/L	U		110537-001	SW846 8260B	GEL
30-Oct-19	VOC	Trichloroethene	ND	0.3	1.00	5	µg/L	U		110537-001	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, October – December 2019

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-Oct-19	Alkalinity	Alkalinity as $CaCO_3$	208	1.45	4.00	NE	mg/L			110534-006	SM 2320B	GEL
28-Oct-19	Alkalinity	Alkalinity, bicarb as $CaCO_3$	208	1.45	4.00	NE	mg/L			110534-006	SM 2320B	GEL
28-Oct-19	Alkalinity	Alkalinity, carb as $CaCO_3$	ND	1.45	4.00	NE	mg/L	U		110534-006	SM 2320B	GEL
28-Oct-19	Ammonia	Ammonia	0.0403	0.017	0.050	NE	mg/L	J		110534-002	EPA 350.1	GEL
28-Oct-19	Anions	Bromide	2.05	0.067	0.200	NE	mg/L			110534-004	SW846 9056A	GEL
28-Oct-19	Anions	Sulfate	39.7	0.665	2.00	NE	mg/L			110534-004	SW846 9056A	GEL
28-Oct-19	Microbial	Dehalococcoides	ND	3,000	3,000	NE	Enumeration/L	U		110542-001	Dhc	SRM
28-Oct-19	Dissolved Metals	Arsenic	0.00252	0.002	0.005	0.01	mg/L	J		110534-007	SW846 3005A/6020B	GEL
28-Oct-19	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		110534-007	SW846 3005A/6020B	GEL
28-Oct-19	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		110534-007	SW846 3005A/6020B	GEL
28-Oct-19	MEE	Methane	360	0.046	0.500	NE	µg/L		J	110541-001	AM20GAX	PACE
28-Oct-19	MEE	Ethane	ND	0.005	0.100	NE	µg/L	U	0.100UJ	110541-001	AM20GAX	PACE
28-Oct-19	MEE	Ethene	ND	0.004	0.100	NE	µg/L	U	0.100UJ	110541-001	AM20GAX	PACE
28-Oct-19	NPN	Nitrate plus nitrite as N	6.45	0.170	0.500	10	mg/L			110534-005	EPA 353.2	GEL
28-Oct-19	TOC	Total Organic Carbon Average	0.457	0.330	1.00	NE	mg/L	J		110534-003	SW846 9060A	GEL
28-Oct-19	VOC	Dichloroethene, cis-1,2-	0.96	0.300	1.00	70	µg/L	J		110534-001	SW846 8260B	GEL
28-Oct-19	VOC	Trichloroethene	**8.37**	0.300	1.00	5	µg/L			110534-001	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, October – December 2019

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]
22-Oct-19	Anions	Bromide	0.259	0.067	0.200	NE	mg/L			110549-001	SW846 9056A	GEL
22-Oct-19	Dissolved Metals	Arsenic	0.00276	0.002	0.005	0.01	mg/L	JB	0.005U	110564-003	SW846 3005A/6020B	GEL
22-Oct-19	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		110564-003	SW846 3005A/6020B	GEL
22-Oct-19	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		110564-003	SW846 3005A/6020B	GEL
22-Oct-19	MEE	Ethene	ND	0.008	0.100	NE	µg/L	U	0.100UJ	110546-001	AM20GAX	PACE
22-Oct-19	NPN	Nitrate plus nitrite as N	4.34	0.170	0.500	10	mg/L	N	J+	110564-002	EPA 353.2	GEL
22-Oct-19	VOC	Dichloroethene, cis-1,2-	ND	0.300	1.00	70	µg/L	U		110564-001	SW846 8260B	GEL
22-Oct-19	VOC	Trichloroethene	ND	0.300	1.00	5	µg/L	U		110564-001	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, October – December 2019

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												
18-Nov-19	Dissolved Metals	Arsenic	0.00368	0.002	0.005	0.01	mg/L	J		110553-003	SW846 3005A/6020B	GEL
18-Nov-19	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		110553-003	SW846 3005A/6020B	GEL
18-Nov-19	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		110553-003	SW846 3005A/6020B	GEL
18-Nov-19	NPN	Nitrate plus nitrite as N	**12.2**	0.425	1.25	10	mg/L			110553-002	EPA 353.2	GEL
18-Nov-19	VOC	Dichloroethene, cis-1,2-	4.18	0.300	1.00	70	µg/L			110553-001	SW846 8260B	GEL
18-Nov-19	VOC	Trichloroethene	**20.2**	0.300	1.00	5	µg/L			110553-001	SW846 8260B	GEL
TAV-MW2												
31-Oct-19	Dissolved Metals	Arsenic	0.00223	0.002	0.005	0.01	mg/L	J		110555-003	SW846 3005A/6020B	GEL
31-Oct-19	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		110555-003	SW846 3005A/6020B	GEL
31-Oct-19	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		110555-003	SW846 3005A/6020B	GEL
31-Oct-19	NPN	Nitrate plus nitrite as N	6.00	0.170	0.500	10	mg/L		J	110555-002	EPA 353.2	GEL
31-Oct-19	VOC	Dichloroethene, cis-1,2-	ND	0.300	1.00	70	µg/L	U		110555-001	SW846 8260B	GEL
31-Oct-19	VOC	Trichloroethene	4.08	0.300	1.00	5	µg/L			110555-001	SW846 8260B	GEL
31-Oct-19 (DUP)	Dissolved Metals	Arsenic	ND	0.002	0.005	0.01	mg/L	U		110556-003	SW846 3005A/6020B	GEL
31-Oct-19 (DUP)	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		110556-003	SW846 3005A/6020B	GEL
31-Oct-19 (DUP)	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		110556-003	SW846 3005A/6020B	GEL
31-Oct-19 (DUP)	NPN	Nitrate plus nitrite as N	5.69	0.170	0.500	10	mg/L		J	110556-002	EPA 353.2	GEL
31-Oct-19 (DUP)	VOC	Dichloroethene, cis-1,2-	ND	0.300	1.00	70	µg/L	U		110556-001	SW846 8260B	GEL
31-Oct-19 (DUP)	VOC	Trichloroethene	3.99	0.300	1.00	5	µg/L			110556-001	SW846 8260B	GEL
TAV-MW4												
5-Nov-19	Dissolved Metals	Arsenic	0.00232	0.002	0.005	0.01	mg/L	J		110561-003	SW846 3005A/6020B	GEL
5-Nov-19	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		110561-003	SW846 3005A/6020B	GEL
5-Nov-19	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		110561-003	SW846 3005A/6020B	GEL
5-Nov-19	NPN	Nitrate plus nitrite as N	4.62	0.170	0.500	10	mg/L			110561-002	EPA 353.2	GEL
5-Nov-19	VOC	Dichloroethene, cis-1,2-	0.48	0.300	1.00	70	µg/L	J		110561-001	SW846 8260B	GEL
5-Nov-19	VOC	Trichloroethene	**5.40**	0.300	1.00	5	µg/L			110561-001	SW846 8260B	GEL
TAV-MW8												
6-Nov-19	Dissolved Metals	Arsenic	0.00254	0.002	0.005	0.01	mg/L	J		110566-003	SW846 3005A/6020B	GEL
6-Nov-19	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		110566-003	SW846 3005A/6020B	GEL
6-Nov-19	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		110566-003	SW846 3005A/6020B	GEL
6-Nov-19	NPN	Nitrate plus nitrite as N	6.73	0.170	0.500	10	mg/L			110566-002	EPA 353.2	GEL
6-Nov-19	VOC	Dichloroethene, cis-1,2-	0.48	0.300	1.00	70	µg/L	J		110566-001	SW846 8260B	GEL
6-Nov-19	VOC	Trichloroethene	**5.66**	0.300	1.00	5	µg/L			110566-001	SW846 8260B	GEL
TAV-MW10												
13-Nov-19	Dissolved Metals	Arsenic	0.00215	0.002	0.005	0.01	mg/L	J		110568-003	SW846 3005A/6020B	GEL
13-Nov-19	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		110568-003	SW846 3005A/6020B	GEL
13-Nov-19	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		110568-003	SW846 3005A/6020B	GEL
13-Nov-19	NPN	Nitrate plus nitrite as N	**11.2**	0.425	1.25	10	mg/L			110568-002	EPA 353.2	GEL
13-Nov-19	VOC	Dichloroethene, cis-1,2-	2.38	0.300	1.00	70	µg/L			110568-001	SW846 8260B	GEL
13-Nov-19	VOC	Trichloroethene	**14.9**	0.300	1.00	5	µg/L			110568-001	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, October – December 2019 (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												
4-Nov-19	Dissolved Metals	Arsenic	0.00251	0.002	0.005	0.01	mg/L	J		110573-003	SW846 3005A/6020B	GEL
4-Nov-19	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		110573-003	SW846 3005A/6020B	GEL
4-Nov-19	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		110573-003	SW846 3005A/6020B	GEL
4-Nov-19	NPN	Nitrate plus nitrite as N	6.78	0.170	0.500	10	mg/L			110573-002	EPA 353.2	GEL
4-Nov-19	VOC	Dichloroethene, cis-1,2-	0.48	0.300	1.00	70	µg/L	J		110573-001	SW846 8260B	GEL
4-Nov-19	VOC	Trichloroethene	3.83	0.300	1.00	5	µg/L			110573-001	SW846 8260B	GEL
TAV-MW12												
12-Nov-19	Dissolved Metals	Arsenic	ND	0.002	0.005	0.01	mg/L	U		111912-003	SW846 3005A/6020B	GEL
12-Nov-19	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		111912-003	SW846 3005A/6020B	GEL
12-Nov-19	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		111912-003	SW846 3005A/6020B	GEL
12-Nov-19	NPN	Nitrate plus nitrite as N	4.54	0.170	0.500	10	mg/L			111912-002	EPA 353.2	GEL
12-Nov-19	VOC	Dichloroethene, cis-1,2-	ND	0.300	1.00	70	µg/L	U		111912-001	SW846 8260B	GEL
12-Nov-19	VOC	Trichloroethene	2.81	0.300	1.00	5	µg/L			111912-001	SW846 8260B	GEL
TAV-MW14												
7-Nov-19	Dissolved Metals	Arsenic	0.00224	0.002	0.005	0.01	mg/L	J		110575-003	SW846 3005A/6020B	GEL
7-Nov-19	Dissolved Metals	Iron	ND	0.033	0.100	NE	mg/L	U		110575-003	SW846 3005A/6020B	GEL
7-Nov-19	Dissolved Metals	Manganese	ND	0.001	0.005	NE	mg/L	U		110575-003	SW846 3005A/6020B	GEL
7-Nov-19	NPN	Nitrate plus nitrite as N	8.21	0.170	0.500	10	mg/L			110575-002	EPA 353.2	GEL
7-Nov-19	VOC	Dichloroethene, cis-1,2-	0.43	0.300	1.00	70	µg/L	J		110575-001	SW846 8260B	GEL
7-Nov-19	VOC	Trichloroethene	4.17	0.300	1.00	5	µg/L			110575-001	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], October – December 2019

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	29-Oct-19	18.70	2675.5	-267.1	6.89	20.7	0.56	0.04
TAV-INJ1	30-Oct-19	17.18	2533.7	-244.9	6.92	59.4	1.67	0.13
TAV-MW6	28-Oct-19	18.55	720.0	98.8	7.57	2.49	54.50	4.06
TAV-MW7	22-Oct-19	18.43	607.1	-67.3	7.43	1.36	3.33	0.26
LWDS-MW1	18-Nov-19	19.14	729.3	67.8	7.36	0.31	92.00	7.12
TAV-MW2	31-Oct-19	16.43	665.6	14.5	7.40	2.66	67.70	5.48
TAV-MW4	05-Nov-19	20.17	568.5	4.8	7.61	0.56	80.19	6.04
TAV-MW8	06-Nov-19	19.03	679.0	-2.9	7.56	3.16	75.99	5.82
TAV-MW10	13-Nov-19	19.48	625.7	35.7	7.51	0.51	81.90	6.24
TAV-MW11	04-Nov-19	21.51	626.1	15.2	7.54	0.28	79.55	5.69
TAV-MW12	12-Nov-19	17.94	726.5	73.3	7.44	2.49	71.35	5.64
TAV-MW14	07-Nov-19	16.95	712.7	25.2	7.36	1.30	74.55	5.98

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 = Duplicate environmental 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 = Value exceed the established 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, DC, 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.
B = The analyte was found in the blank above the effective MDL.
J = Estimated value, the analyte concentration fell above the effective MDL and below the effective PQL.
N = Results associated with a spike analysis that was outside control limits.
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 positive 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.
SiREM = 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:
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cc w/o enclosure:
Amy Blumberg, SNL/NM
Paul Shoemaker, SNL/NM
Christi Leigh, SNL/NM
John Cochran, SNL/NM
Jun Li, SNL/NM
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Howard Huie, DOE/EM-31
Douglas Tonkay, DOE/EM-31
Thomas Longo, NNSA/NA-533
Jessica Arcidiacono, NNSA/NA-533
Cynthia Wimberly, SFO/OOM
James Todd, SFO/ENG
Susan Lacy, SFO/ENG
Steven Black, SFO/ENG
David Rast, SFO/ENG
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.

Paul E. Shoemaker — Signature

July 10, 2018 — Date

Paul E. Shoemaker
Defense Waste Management Programs
Sandia National Laboratories/New Mexico
Albuquerque, New Mexico 87185
Operator

and

Signature

7/23/2018 — Date

Jeffrey P. Harrell, Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Field Office
Owner

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.

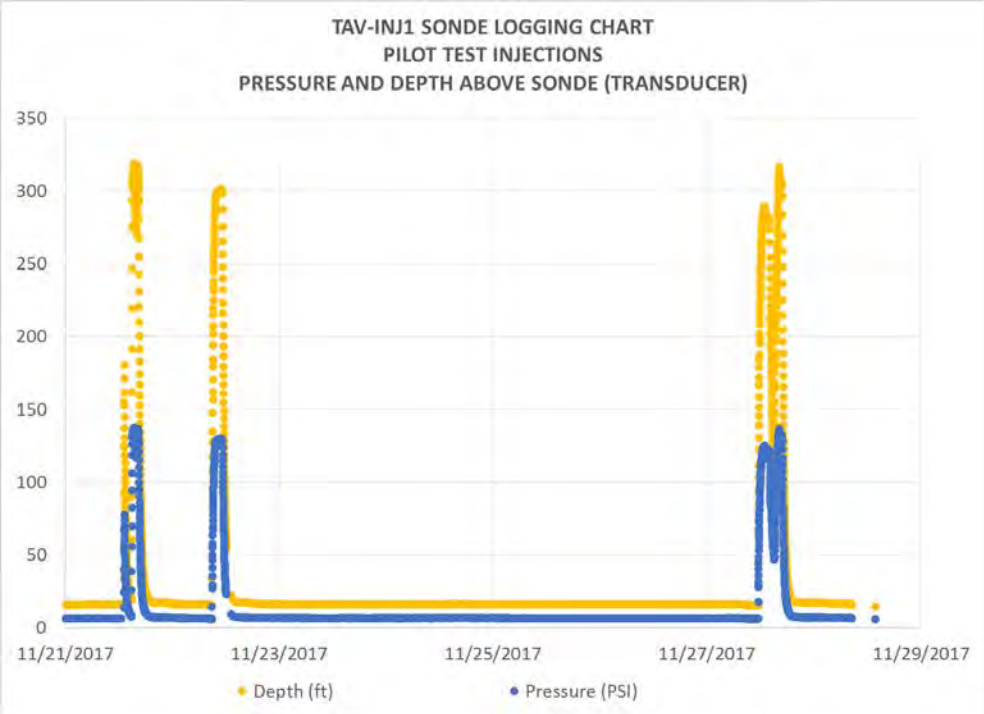

Figure 1a
Pressure and Water Column Height in well TAV-INJ1 during Injections

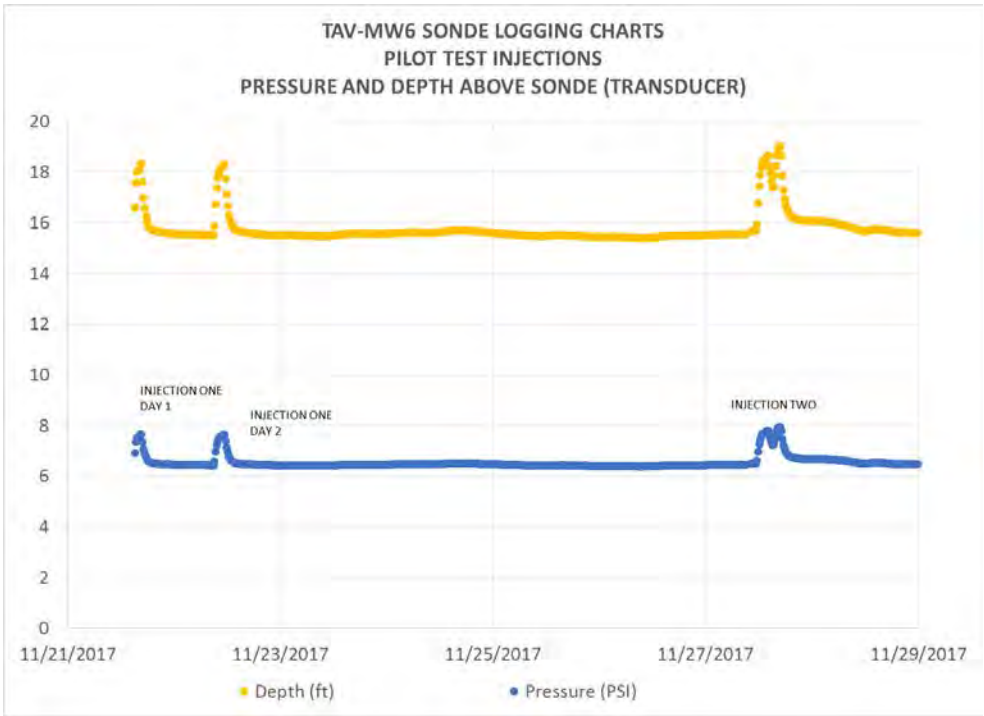

Figure 1b
Pressure and Water Column Height in well TAV-MW6 in
Response to Injections at well TAV-INJ1

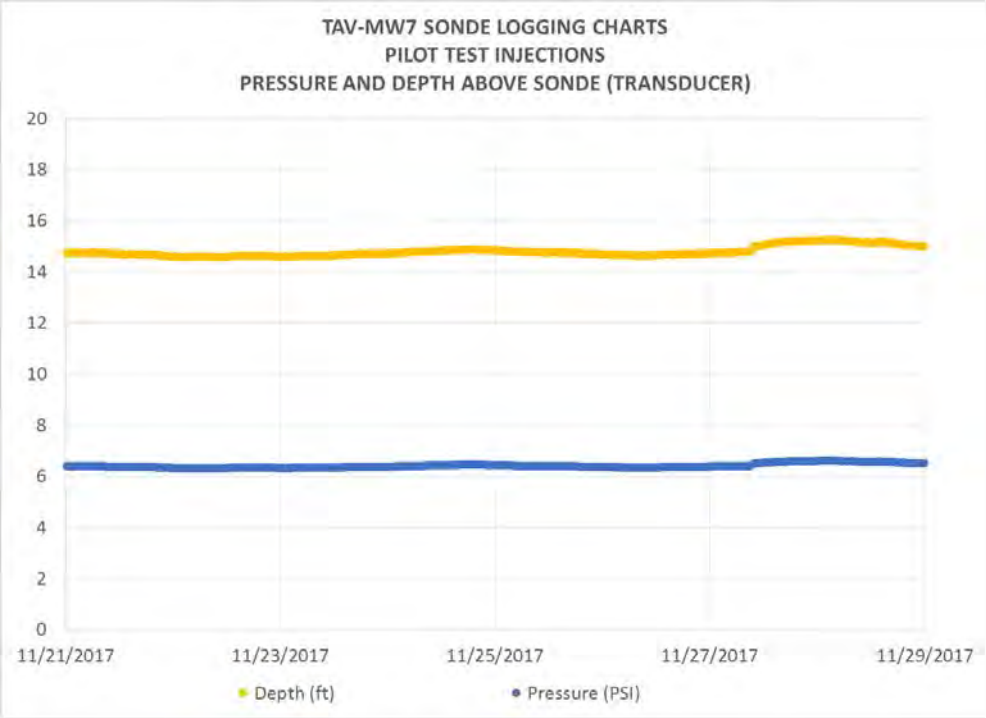

Figure 1c
Pressure and Water Column Height in well TAV-MW7 in
Response to Injections at well TAV-INJ1

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.

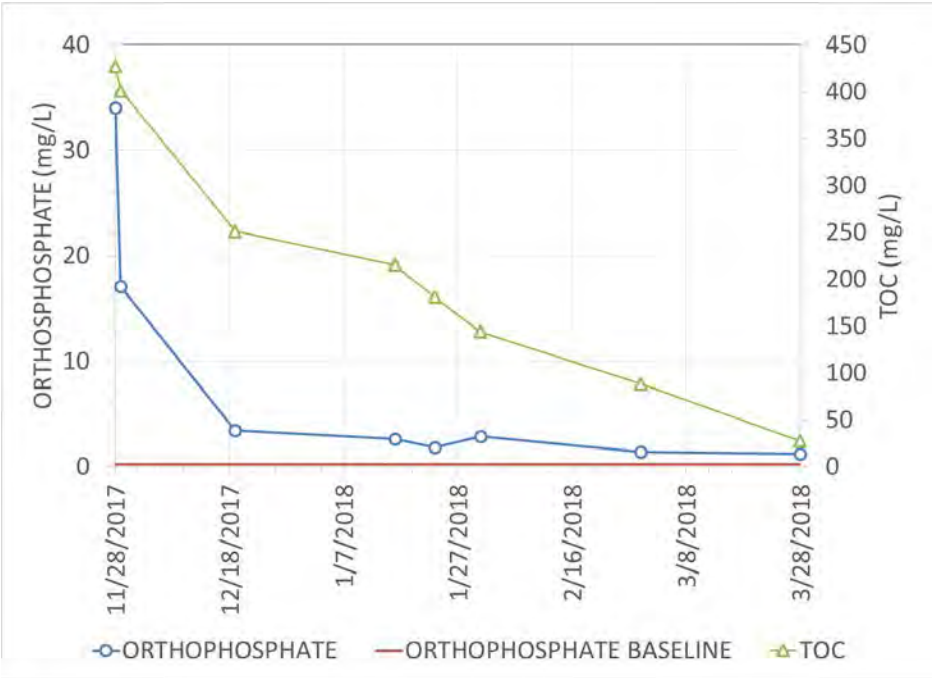

Figure 2
Orthophosphate and TOC Concentrations at TAV-INJ1 following Pilot Test Injections

- 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*.

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