



Environmental Restoration Overview

Mission:

Identify, characterize, and remediate sites where hazardous and/or radioactive materials may have been released to the environment.

Regulation:

- Activities regulated by New Mexico Environment Department (NMED):
 - 2004 Sandia National Laboratories (SNL) Compliance Order on Consent for corrective action under authority of Hazardous Waste Bureau.
 - 2017 Discharge Permit for Technical Area-V Groundwater Area of Concern (AOC) under authority of Ground Water Quality Bureau.

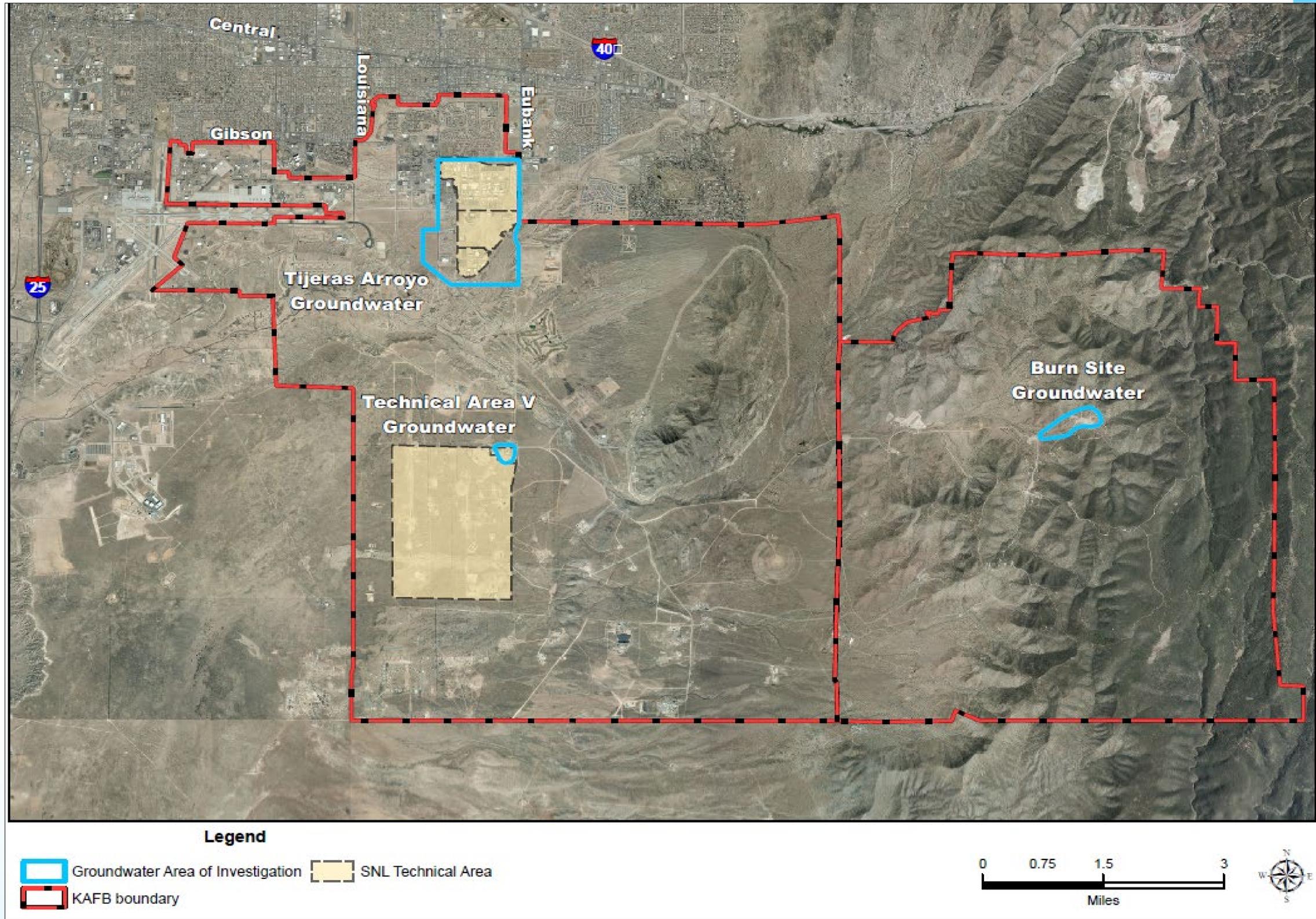
Current Activities:

- Burn Site Groundwater Investigation AOC:
 - Preparing to install up to 8 additional groundwater monitoring wells to characterize nitrates in the groundwater.
- Technical Area-V Groundwater Investigation AOC:
 - Conducting full-scale treatability study for using in-situ bio-remediation to treat nitrate and trichloroethene in groundwater.
- Tijeras Arroyo Groundwater Investigation AOC:
 - Proposed options to the NMED for remediation of nitrate contamination in the perched groundwater system.

What are the health risks of contaminated groundwater at SNL?

- There is no known harm to human health because:
 - No one is drinking contaminated groundwater.
 - There are no drinking water wells in or near the contaminated groundwater.
 - Boundaries of groundwater contamination are defined.
 - On-going monitoring of contaminated groundwater continues.
- Drinking water standards serve as groundwater cleanup goals for human health and environmental protection.





Map of Kirtland Air Force Base showing location of 3 Sandia National Laboratories Groundwater Areas of Concern

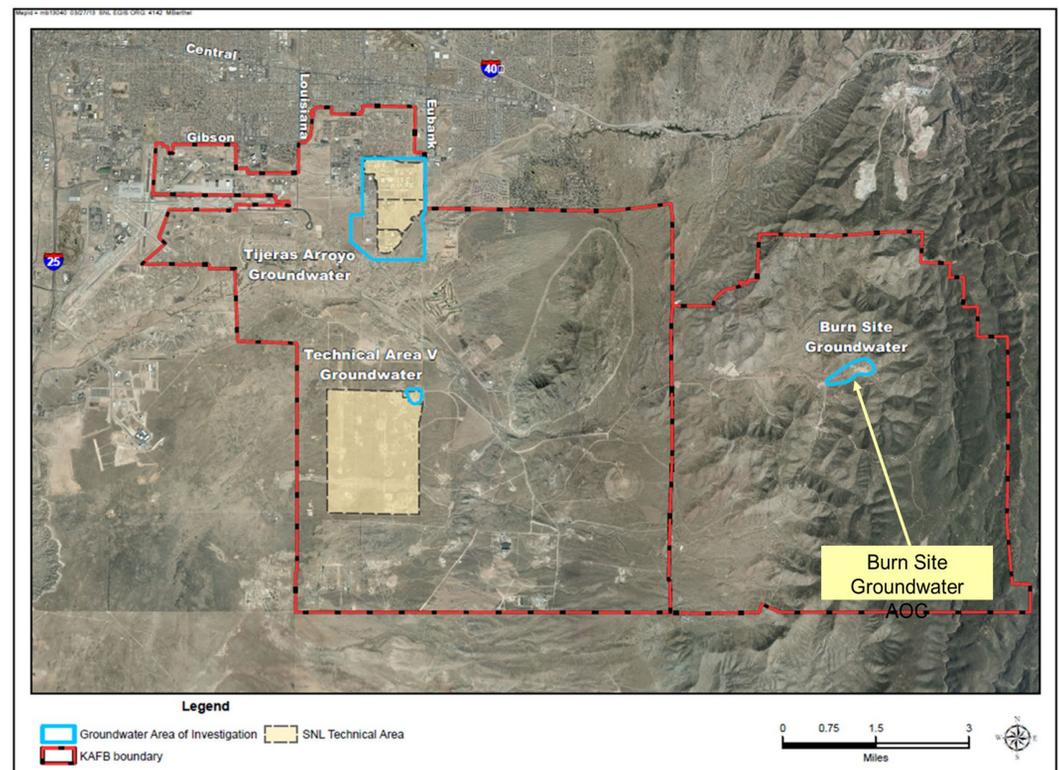
For more detail, see *Calendar Year 2017 Annual Groundwater Report, June 2018* available at: <https://www.env.nm.gov/hazardous-waste/sandia-national-laboratories/#SNLGWMonRpts>



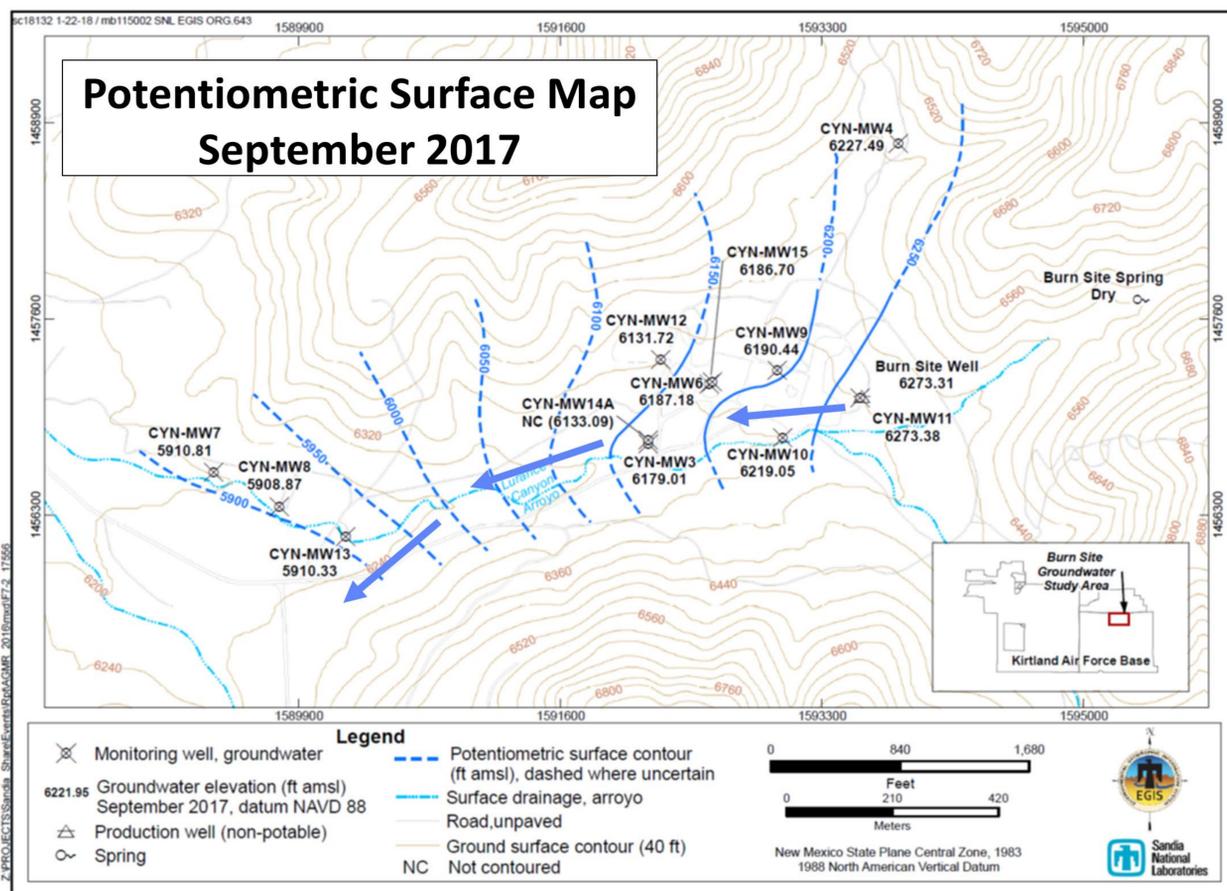
Burn Site Groundwater Investigation

Site Description

- The Burn Site Groundwater Investigation Area of Concern is located in a remote area in the Manzanita Mountains.
- Lurance Canyon is a west-flowing drainage deeply incised into Paleozoic and Precambrian rocks in moderately- to heavily-wooded pinon-juniper forest.
- SNL activities at the Burn Site began in 1967; early site test activities included explosives testing, current use is fire-survivability studies (i.e., burn testing).



- Corrective action is required only for groundwater at the Burn Site.
- Groundwater occurs in Precambrian fractured bedrock that is recharged by infiltration of precipitation; flow is controlled by changes in rock type and faults/fractures.



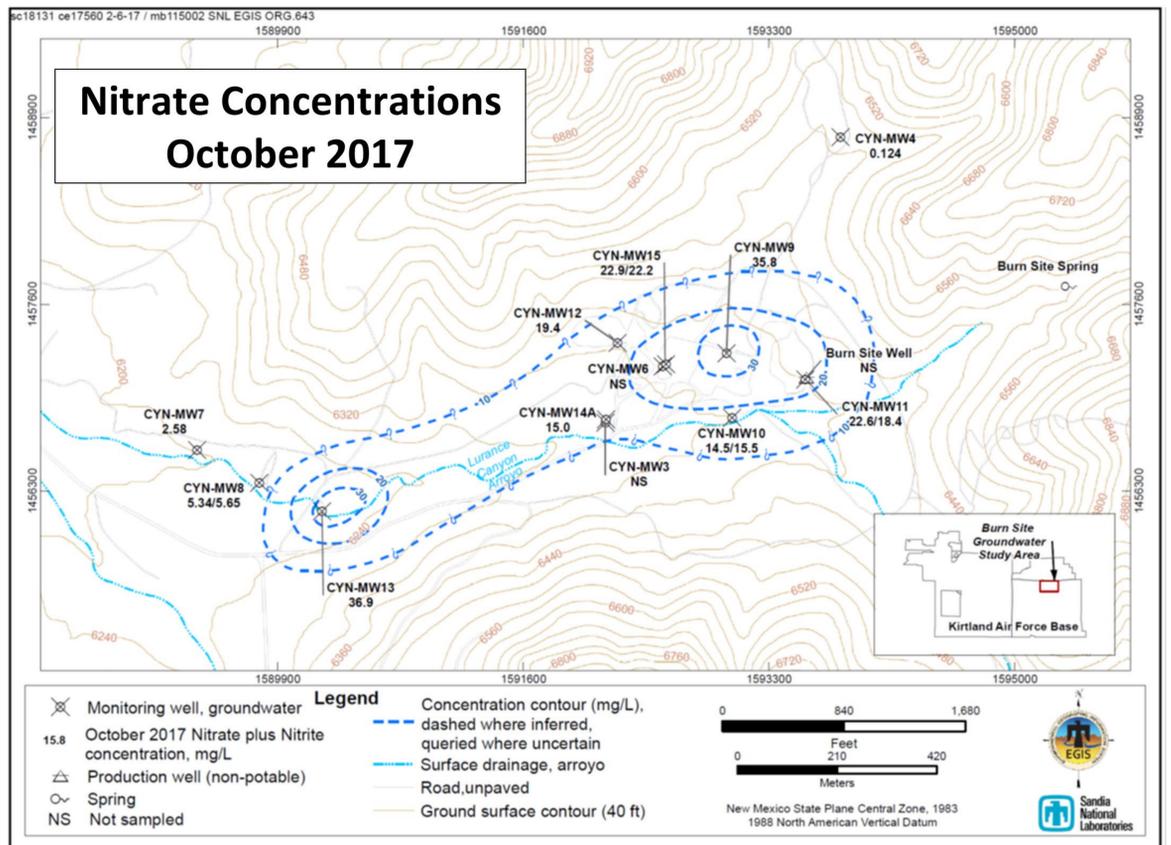
- Groundwater monitoring began 1996.
- Depth to groundwater ranges from 100 to 327 feet below ground surface and groundwater flows to the west.
- The monitoring network consists of 12 monitoring wells.



Burn Site Groundwater Investigation

- The constituent of concern is nitrate, which has been detected in 7 of the 10 wells that are sampled.
- Groundwater is contaminated with nitrate at concentrations above the maximum contaminant level (MCL); the plume is 79 acres.

Constituent of Concern	Maximum Concentration in 2017	MCL
Nitrate	44.9 milligrams per liter (well CYN-MW9)	10.0 milligrams per liter

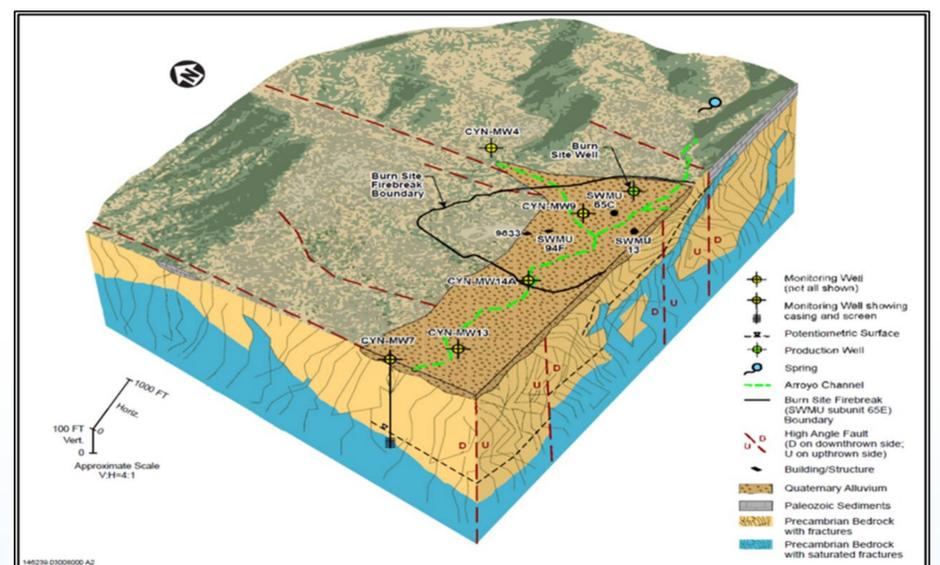


- Groundwater in this area is not used for any purpose; no one is drinking contaminated groundwater. The nearest downgradient drinking-water supply well (KAFB-4) is 8.4 miles to the west.
- Nitrate is derived from both man-made and natural sources, and may include ammonium nitrate slurry, wastewater discharges, and degradation of explosive compounds.

Current Status and Recent Activities

- Completing characterization of the nature and extent of nitrate contamination before resuming the corrective action process and proposing alternatives for a remedy.
- Performed quarterly water level measurements and semiannual groundwater sampling that was presented in the *Annual Groundwater Monitoring Report* submitted to the New Mexico Environment Department (NMED) in June 2018 (approved by NMED July 2018).
- Recommendations for future characterization were submitted to the NMED in June 2018; and NMED responded in June 2018 requesting four wells.
- Submitted a Monitoring Well Installation Work Plan to NMED in January 2019. Approved by NMED in February 2019.

Conceptual Site Model for the BSG Vicinity





Tijeras Arroyo Groundwater Investigation

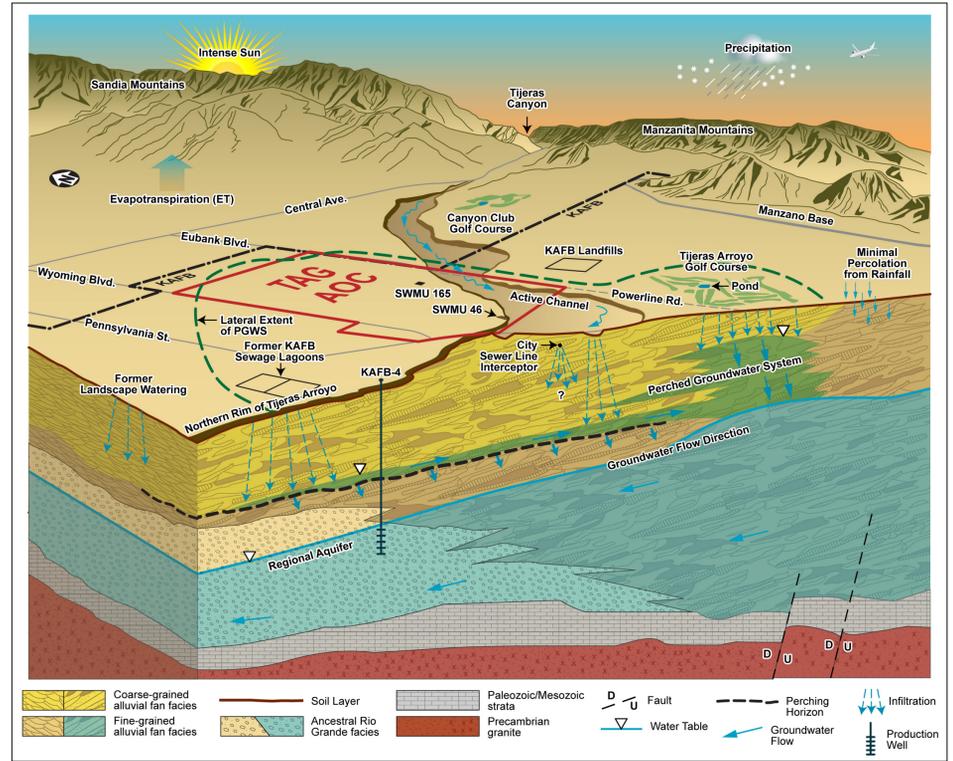
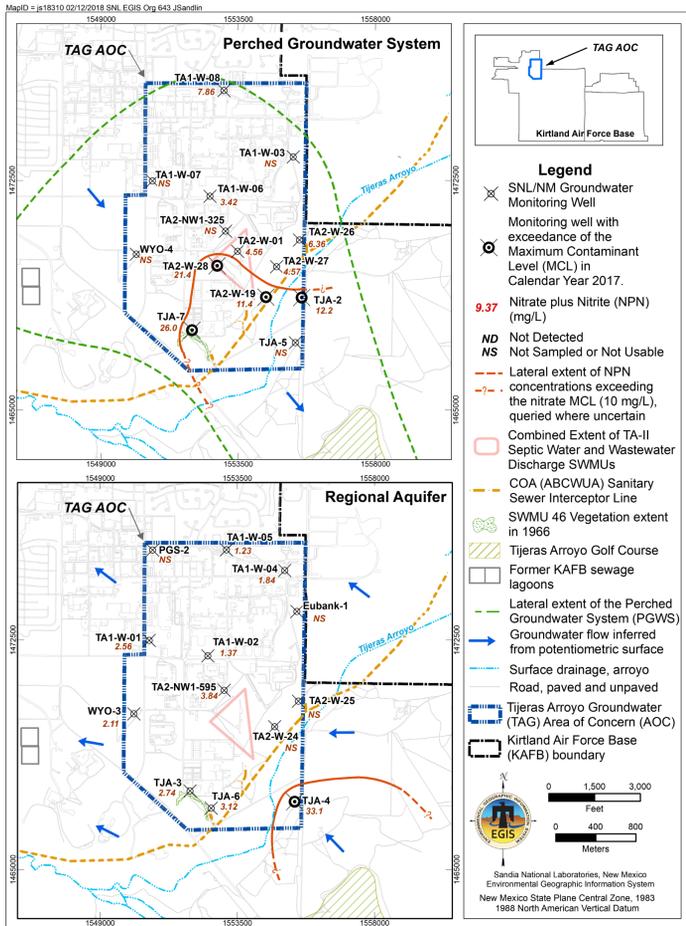
Site Description

- The Tijeras Arroyo Groundwater (TAG) Investigation Area of Concern (AOC) covers 1.82 square miles (1,165 acres) within the northern part of Kirtland Air Force Base (KAFB), and extends across Sandia National Laboratories (SNL) Technical Areas I, II, and IV.
- SNL activities at TAG began in 1948 and primarily involve weapons development and energy research.
- Corrective action is required only for the groundwater in the TAG AOC.
- Two water-bearing units, the Perched Groundwater System (PGWS) and the Regional Aquifer, are present in the alluvial fan sediments under the TAG AOC.
 - The PGWS water table occurs at a depth of approximately 330 feet below the ground surface at TA-II. The PGWS was created by manmade activities, including recharge from a sewage system, landscape watering, and wastewater outfalls. These activities have been eliminated and the PGWS is naturally dewatering (drying up) at approximately 0.5 feet per year. A thin layer of 7 to 20 feet of saturation remains in the central TAG AOC.
 - Thickness of the saturated layer is consistently decreasing; water mostly percolates downward.
 - The Regional Aquifer occurs at a depth of 520 feet below the ground surface; it is vertically separated from the PGWS by a Perching Horizon and about 200 feet of unsaturated strata.
- Groundwater in the PGWS flows southeast at approximately 24 feet per year on average, and merges with the Regional Aquifer along Powerline Road on KAFB. Groundwater in the Regional Aquifer flows west and northwest at approximately 55 feet per year.
- Groundwater monitoring began in 1992.
 - The U.S. Department of Energy (DOE) and its prime contractor for SNL have installed 31 monitoring wells in the TAG AOC.
 - KAFB and the City of Albuquerque have installed 70 monitoring wells in the surrounding area.
 - Monitoring wells screened in the PGWS yield small volumes of water (typically one to two gallons per minute).
- Groundwater in the PGWS is contaminated with nitrate at concentrations slightly above the maximum contaminant level (MCL); the plume in the southeast corner of the TAG AOC is approximately 280 acres and does not pose a threat to drinking water in the Regional Aquifer. No other chemicals exceed the MCL.

Constituent of Concern	Maximum Concentration in Perched Groundwater System, 2017	Maximum Concentration in Regional Aquifer, 2017	MCL
Nitrate	26.0 milligrams per liter (well TJA-7)	3.84 milligrams per liter (well TA2-NW1-595) 33.1 milligrams per liter (well TJA-4, merging zone)	10 milligrams per liter
Trichloroethene	4.00 micrograms per liter (well TJA-2)	0.35J micrograms per liter (well TJA-3)	5 micrograms per liter

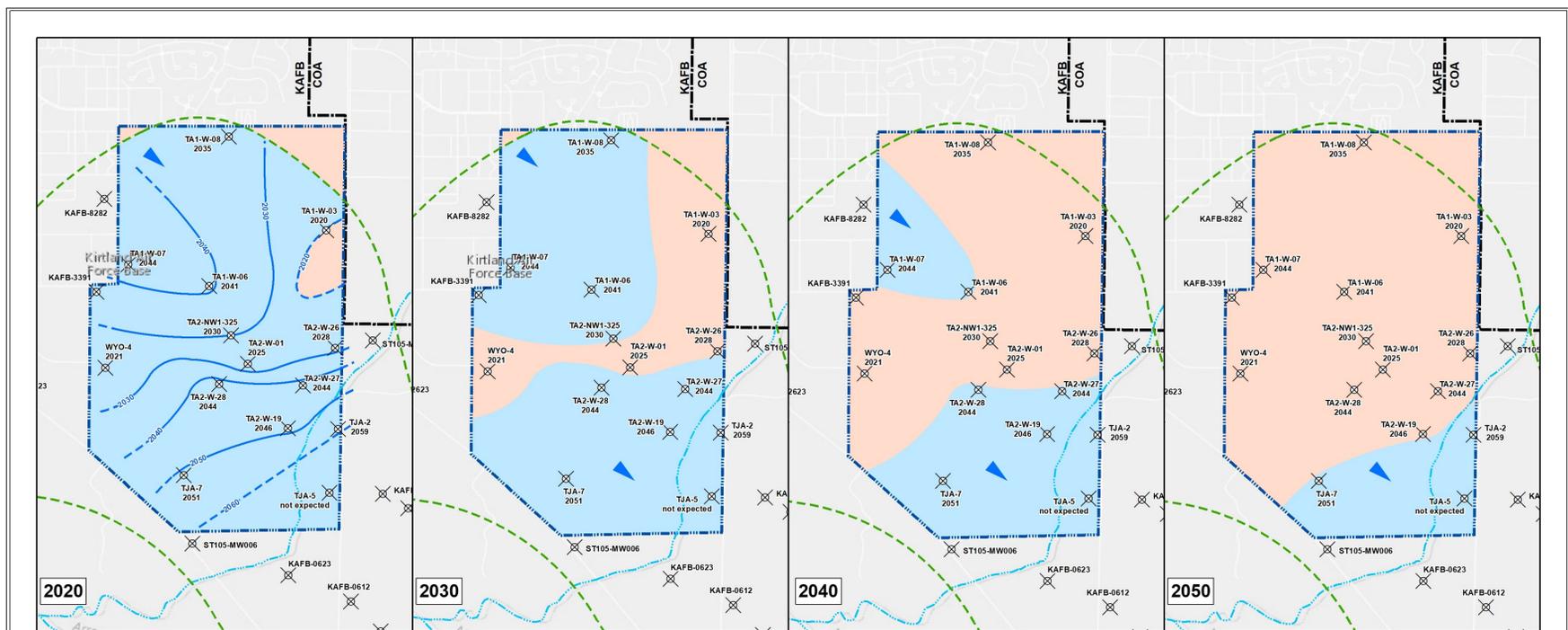


Tijeras Arroyo Groundwater Investigation

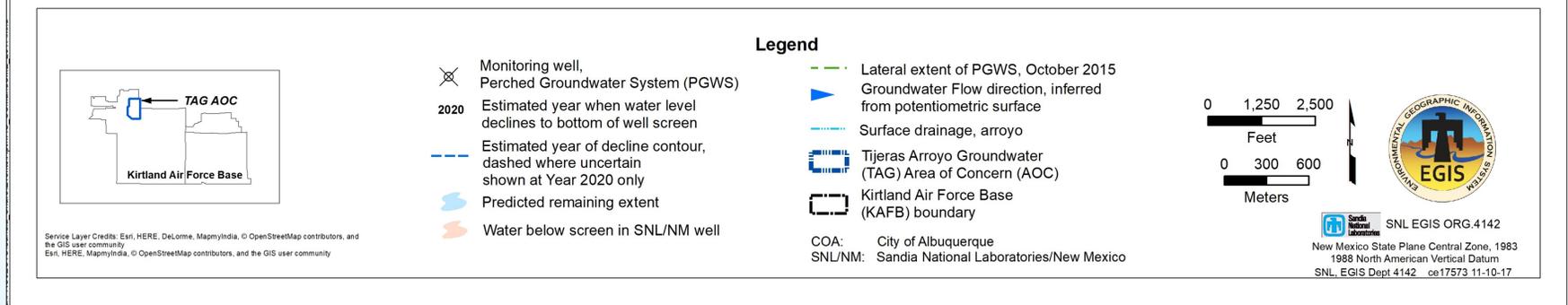


Conceptual Site Model for the TAG Vicinity

Maximum 2017 Nitrate Concentrations in the Perched Groundwater System and the Regional Aquifer



Predicted lateral extent of the Perched Groundwater System (Years 2020-2050) when water level is estimated to decline to bottom of well screen.



Predicted Declining Water Levels in the Perched Groundwater System from 2020 - 2050



Tijeras Arroyo Groundwater Investigation

Site Description (continued)

- Perched groundwater is not used for any purpose at SNL; no one is drinking contaminated groundwater. Perched groundwater flows to the southeast.
- Depending on location, PGWS monitoring wells will go dry in 5 to 44 years, except in the extreme southeast corner of the AOC.
- SNL operations have not contaminated the Regional Aquifer.
- The nearest drinking-water production well in the Regional Aquifer is KAFB-20, which is located approximately 1 mile to the west of the elevated nitrate concentrations that are in the PGWS. The nearest Albuquerque Bernalillo County Water Utility Authority well is Ridgecrest I which is located approximately 2 miles to the north of the elevated nitrate concentrations that are in the PGWS.
- Nitrate is typically derived from both man-made and natural sources, and may include septic leach fields, wastewater discharges, fertilizers, and degradation of minerals in soil.

Current Status and Recent Activities

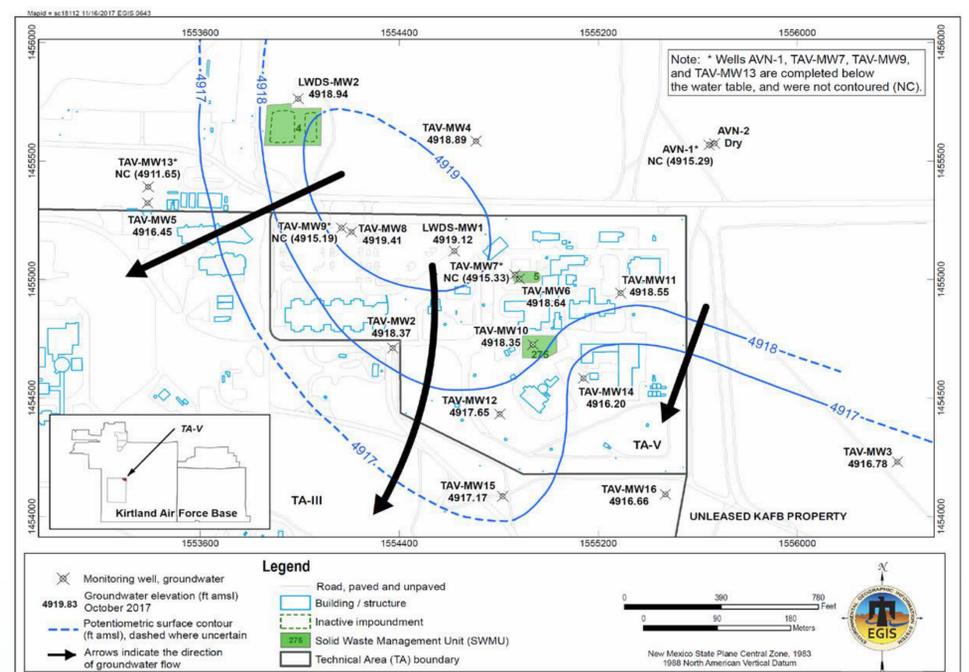
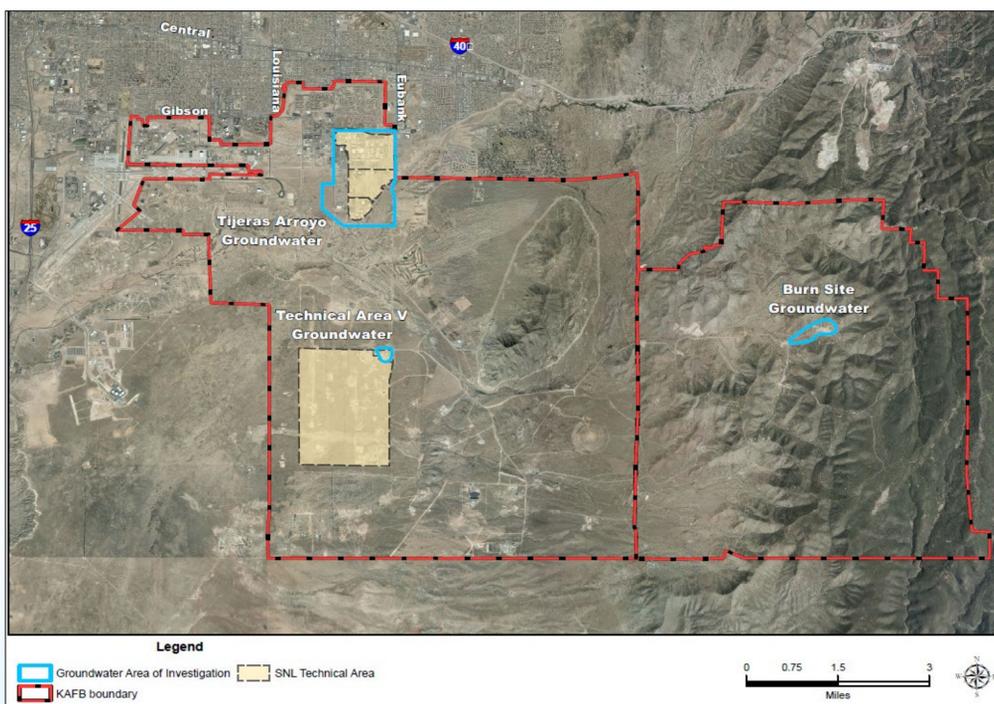
- Results from ongoing water-level measurements and groundwater sampling will be presented in the next *Annual Groundwater Monitoring Report* that will be submitted to the New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB) in June 2019.
- The *TAG Current Conceptual Model and Corrective Measures Evaluation (CCM/CME) Report* was submitted to the NMED HWB in December 2016.
- Based on a May 2017 NMED HWB letter requesting more information for the proposed remedial alternatives, a *Revised TAG CCM/CME Report* was submitted to the NMED HWB in February 2018.
- Three remedial alternatives were proposed in the revised CCM/CME report:
 - Monitored natural attenuation using the existing well network.
 - In-situ bioremediation requiring installation of numerous wells.
 - Groundwater extraction and treatment requiring installation of numerous wells.
- All three remedial alternatives require the semiannual sampling of both water-bearing units.
- NMED HWB is anticipated to select a remedial alternative in 2019.



Technical Area V Groundwater Investigation

Site Description

- Technical Area V Groundwater Area of Concern covers 35 acres of industrial land in central portion of Kirtland Air Force Base.
- Sandia National Laboratories activities at Technical Area V (operating research reactors) began in 1961.
- Corrective action is required only for groundwater at Technical Area V.
- Groundwater in the Regional Aquifer occurs approximately 500 feet below ground in alluvial-fan sediments consisting of clays, silts, and sands.
- Groundwater migrates very slowly to the west, southwest, and south on a local scale.
- Groundwater monitoring began in 1993; current network is 18 monitoring wells.
- No ongoing wastewater release or natural recharge occurs to groundwater at Technical Area V.
- Nitrate was derived from both man-made and natural sources, and may include septic leach fields, wastewater discharges, and degradation of minerals in soil.
- Trichloroethene was commonly used in laboratory settings and was used at Technical Area V.
- Wastewater including septic waste discharged from the 1960s until 1992; however, discharges did not contain organic solvents such as trichloroethene after the early 1980s.
- Groundwater in this area is not used for any purpose; no one is drinking contaminated groundwater. The nearest downgradient drinking-water supply well is 2.7 miles to the north.



Potentiometric Surface Map October 2017

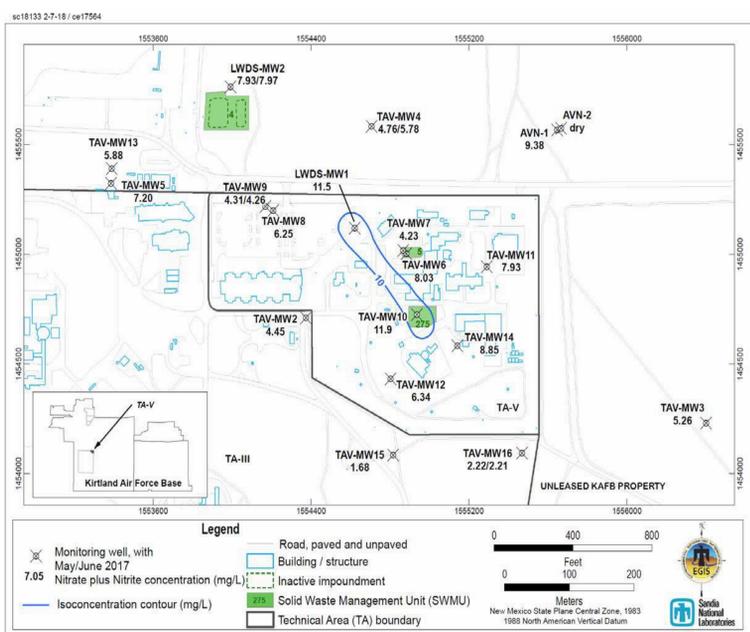


Technical Area V Groundwater Investigation

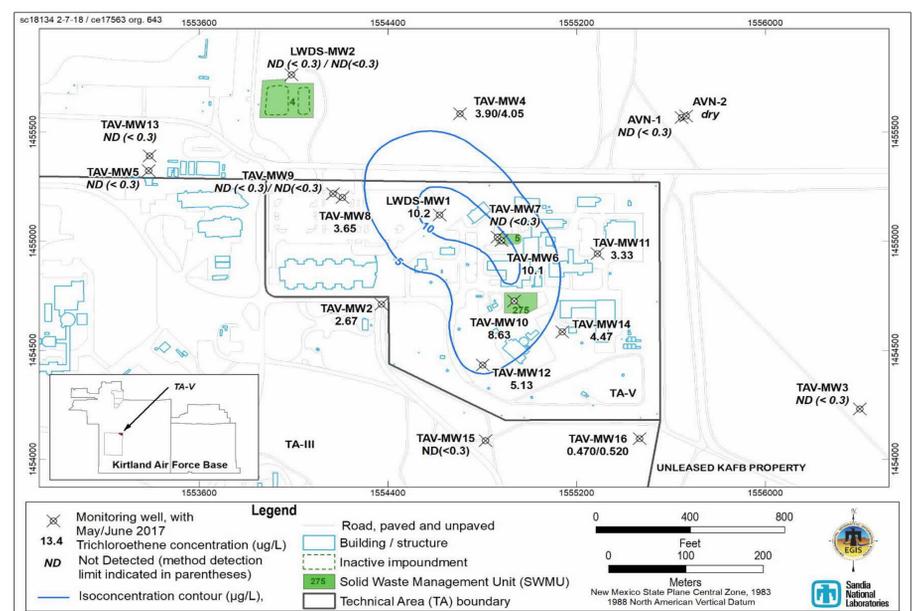
Site Description (Continued)

- Groundwater is contaminated with nitrate and trichloroethene at concentrations above the maximum contaminant levels; the drinking water standards established by the Environmental Protection Agency.
 - The nitrate contaminant plume is 1.4 acres.
 - The trichloroethene contaminant plume is 13 acres.
 - The two contaminant plumes are not moving.

Constituent of Concern	Maximum Concentration in 2017	Maximum Contaminant Level
Nitrate	12.2 milligrams per liter (well TAV-MW10)	10 milligrams per liter
Trichloroethene	17.4 micrograms per liter (well LWDS-MW1)	5 micrograms per liter



Nitrate Plume Map May/June 2017



Trichloroethene Plume Map May/June 2017

Treatability Study of In-Situ Bioremediation

- “In-situ” means treating the contamination in-place (in the sediments).
- “Bioremediation” uses biological processes (natural bacteria) to remediate the groundwater by degrading the nitrate and trichloroethene below drinking water standards.
- In-situ bioremediation is commonly used to treat contaminated groundwater in the U.S., but not where groundwater is 500 feet deep.
- The treatability study plan is to deliver bioremediation solution using one injection well first and possibly up to three injection wells.
- The New Mexico Environment Department Hazardous Waste Bureau approved the Revised Treatability Study Work Plan in May 2016.
- The New Mexico Environment Department Ground Water Quality Bureau granted Discharge Permit-1845 in May 2017 for injecting bioremediation solution.



Technical Area-V Groundwater Investigation

Treatability Study Pilot Test

- Installed the first injection well (TAV-INJ1) in October 2017.
- 9,000 gallons of bioremediation solution mixed with 1.6 gallons of solution containing trichloroethene-degrading bacteria were injected in November 2017.
- Completed seven months of groundwater monitoring at the injection well TAV-INJ1 and two nearby monitoring wells TAV-MW6 and TAV-MW7 in June 2018.
- Major findings of the pilot test:
 - The aquifer can accept bioremediation solution at 15 gallons per minute for an extended period of time.
 - Groundwater at TAV-INJ1 has been maintaining optimal conditions for biodegradation.

Treatability Study Full-Scale Operations

- Full-scale operations started in November 2018 at the first injection well TAV-INJ1.
- The goal is injection of approximately 530,000 gallons of bioremediation solution mixed with trichloroethene-degrading bacteria.
- Injections will take six months to complete (completion expected by May 2019) at a rate of 4,500-5,000 gallons per day.
- After injections are complete, groundwater at wells TAV-INJ1 and TAV-MW6 will be monitored for two years to track in-situ bioremediation.
- Nine surrounding wells will be monitored for two years to determine potential impact on groundwater quality caused by the full-scale injections.



Mixed Waste Landfill Five-Year Report

Report Background

- In the May 2005 Final Order, the New Mexico Environment Department selected an evapotranspirative cover with a biointrusion barrier (ET Cover) as the remedy for the Mixed Waste Landfill (MWL) and established the requirement for a five-year report.



Report Requirements

- This first Five-Year Report was due January 8, 2019 - five years after New Mexico Environment Department-approval of the MWL Long-Term Monitoring & Maintenance Plan on January 8, 2014.
 - **Report was delivered to the New Mexico Environment Department on January 4, 2019.**
- The following documents define the MWL Five-Year Report requirements.

Document Date	Document Source	Document Name
May 2005	New Mexico Environment Department	<i>Final Order In the Matter of Request for a Class 3 Permit Modification for Corrective Measures for the Mixed Waste Landfill Sandia National Laboratories EPA ID No. NM5890110518, No. HWB-SNL-04-11(M)</i>
March 2012	Sandia National Laboratories	<i>Long-Term Monitoring and Maintenance Plan for The Mixed Waste Landfill</i>
February 2016	New Mexico Environment Department	<i>Final Order In the Matter of Proposed Permit Modification for Sandia National Laboratories EPA ID No. NM5890110518 to Determine Corrective Action Complete with Controls at the Mixed Waste Landfill, HWB-SNL-15-18(P)</i>

Requirements for this Reporting Period

- Summarize the applicable monitoring, inspection, and maintenance results.
- Evaluate effectiveness of the remedy/ET Cover and present all efforts to ensure any future releases or movement of contaminants are detected and addressed.
- Update the MWL fate and transport model if monitoring results indicate current conditions are different from the conditions modeled in 2005.
- Reevaluate the feasibility of MWL excavation with both offsite and onsite disposal alternatives.



Mixed Waste Landfill Five-Year Report



Report Structure & Content

Chapter & Main Sections	Content Explanation
1.0 Introduction and Background	Describes context and regulatory process as well as report organization.
2.0 Monitoring & Inspections Summary	Review of multi-media monitoring and inspection/maintenance results for the purpose of evaluating remedy/ET Cover effectiveness and establishing current site conditions.
3.0 Fate & Transport Model Review	Updates the 2005 Fate & Transport Model and reevaluates the likelihood of contaminants reaching groundwater.
4.0 Evaluate Effectiveness of the Remedy	Uses monitoring, inspection, and modeling results presented in Chapters 2 and 3 to: 1) evaluate the effectiveness of the ET Cover and 2) detail all efforts to ensure future releases or movement of contaminants are detected and addressed.
5.0 Reevaluate Feasibility of Excavation	Reevaluates the feasibility of complete MWL excavation with offsite and onsite disposal alternatives.
6.0 Five-Year Summary & Conclusions	Summarizes how requirements have been met and provides conclusions.
7.0 References	Lists references.
Appendices A-D	Supporting documentation.

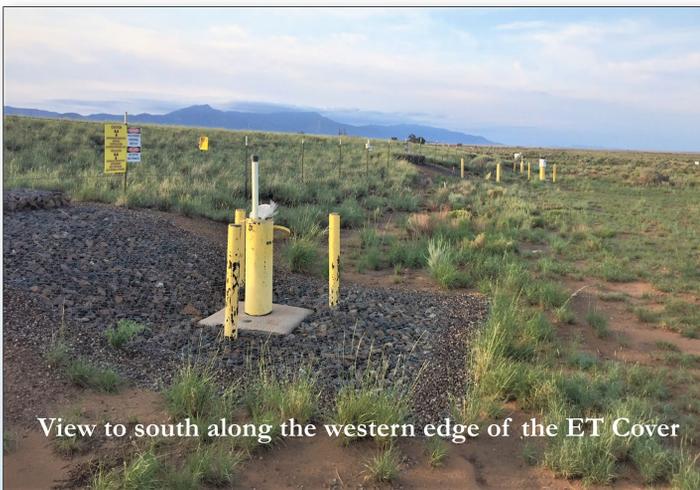
How to Access the Five-Year Report & MWL Annual Reports

- Federal repository at the University of New Mexico, Main Campus, Albuquerque, Zimmerman Library.
- Digital repository in the Sandia Technical Reports Collection under the “Facilities-Units” page.
➤ [http://digitalrepository.unm.edu/snl fu/](http://digitalrepository.unm.edu/snl_fu/)



Review & Public Comment Period

- The New Mexico Environment Department is responsible for review and approval of this report, and providing a process whereby members of the public may comment on the report and its conclusions. They are also responsible for responding in writing to all submitted public comments.

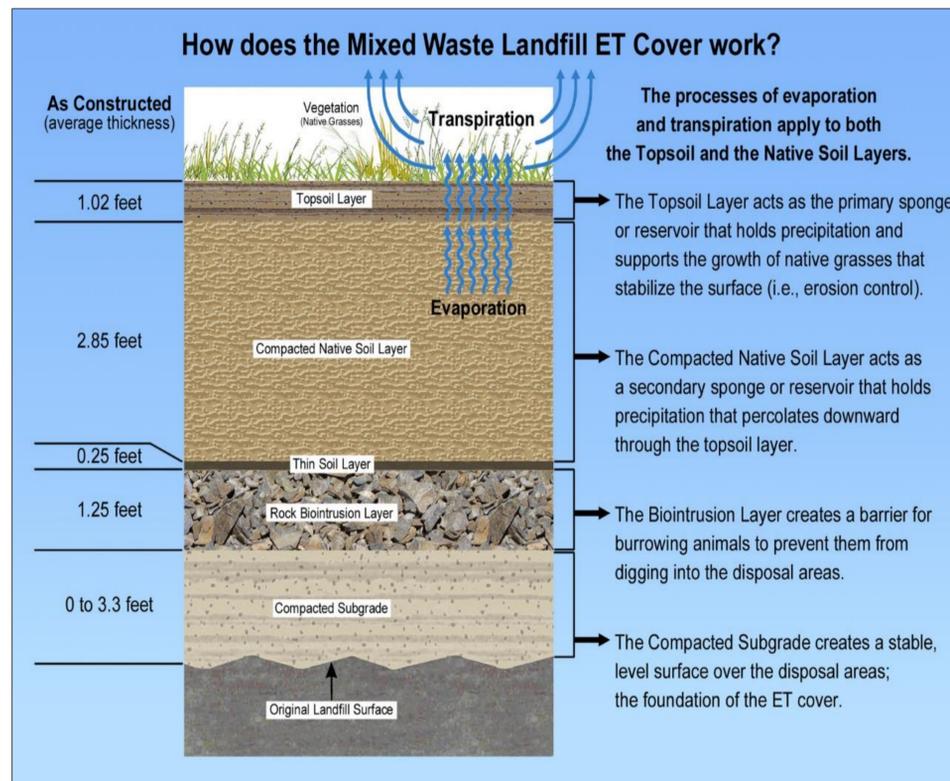
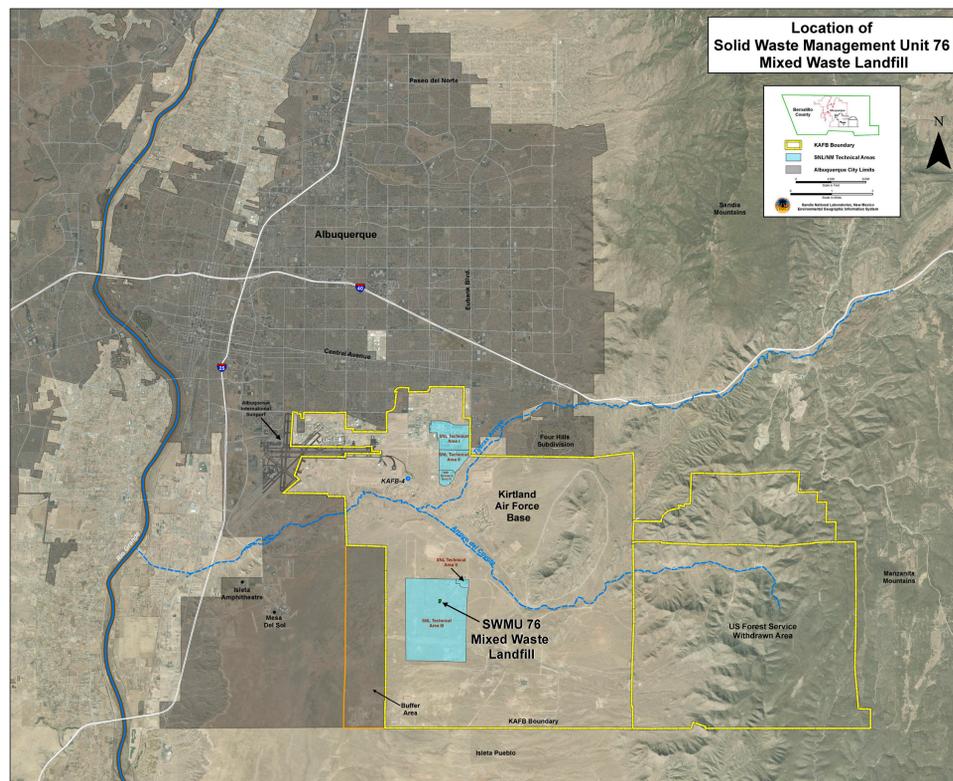


- New Mexico Environment Department will issue Public Notice
- Public Notice & Five-Year Report will be available at:
 - New Mexico Environment Department Reading Room
 - <http://www.nmenv.state.nm.us/HWB/snlperm.html>
- Comments can be sent to New Mexico Environment Department via regular mail or email
 - Instructions for accessing report and submitting comments will be in the Public Notice

Mixed Waste Landfill Five-Year Report

Continued Reporting

- Department of Energy /National Nuclear Security Administration will continue to submit MWL Annual Long-Term Monitoring & Maintenance Reports in June of each year.
- Deadline for next Five-Year Report is January 8, 2024.



Safeguards are in Place

The Trigger Level Process, as defined in the MWL Long-Term Monitoring and Maintenance Plan, applies when a monitoring trigger is exceeded or there is some other indication of changing conditions that could result in increased risk to human health and the environment.

