

# 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:

- 6 soil sites (known as Solid Waste Management Units) are in Corrective Action Complete regulatory process
- 3 active mission soil sites with deferred corrective action
- Burn Site Groundwater AOC:
  - Completed aquifer pumping test
  - Reviewing corrective action options for nitrate in groundwater
- Tijeras Arroyo Groundwater Investigation AOC:
  - Assessing corrective actions for nitrate in groundwater
- Technical Area-V Groundwater Investigation AOC:
  - Completed first field test of in-situ bio-remediation system to treat nitrate and trichloroethene in groundwater.

## Are there any known human health impacts from SNL's contaminated groundwater?

- There are no known human health impacts:
  - No one is drinking contaminated groundwater
  - No drinking water wells are located or planned 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.

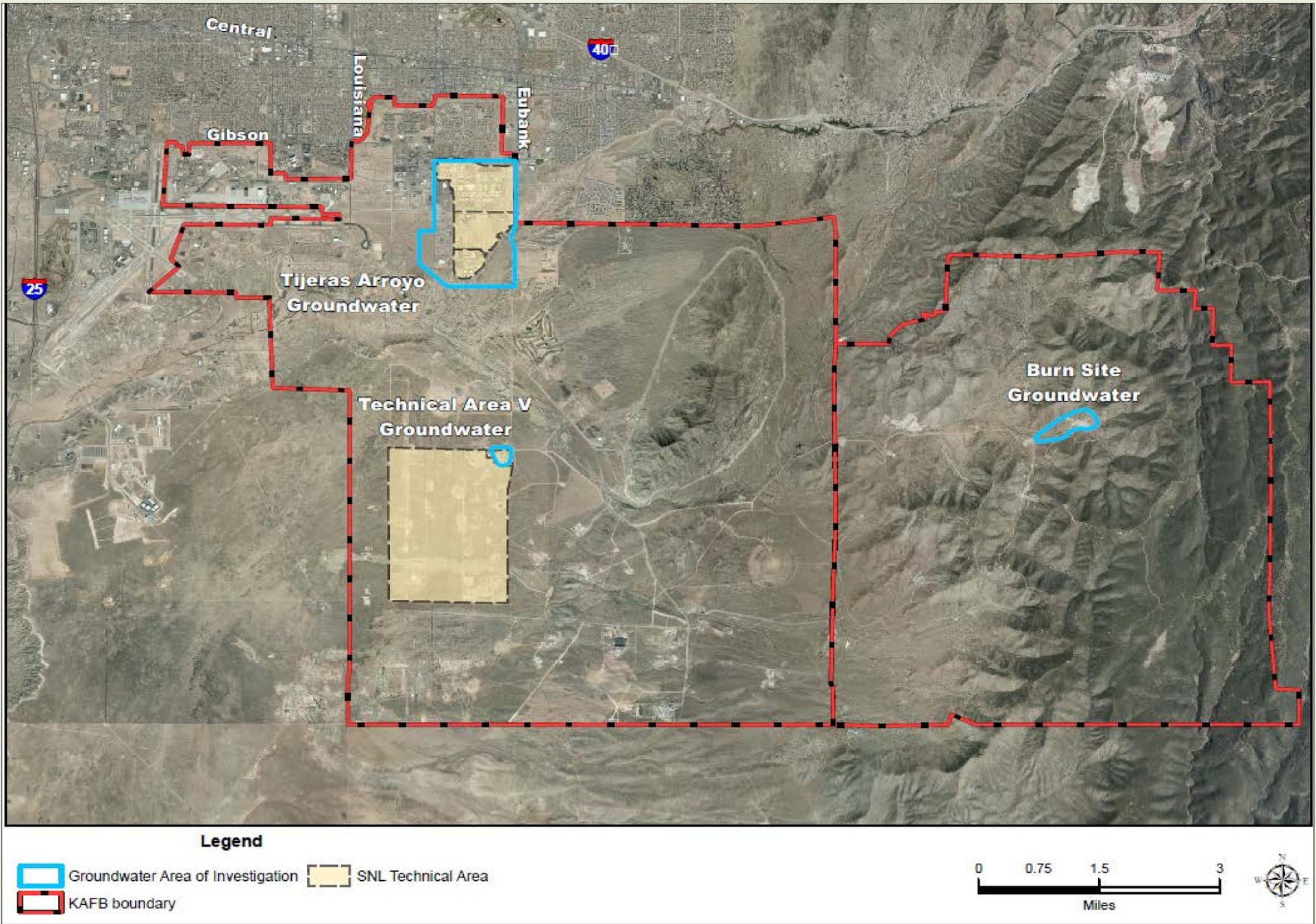


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Map of Kirtland Air Force Base showing location of 3 Sandia National Laboratories Groundwater Areas of Concern



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# Burn Site Groundwater Investigation

## Site Description

- The Burn Site Groundwater Investigation Area of Concern (AOC) is located in a remote area in the Manzanita Mountains, south of the Tijeras Cement Plant on U.S. Forest Service property that is withdrawn from public access for exclusive use by the U.S. Air Force and U.S. Department of Energy for Sandia National Laboratories (SNL).
- Situated within Lurance Canyon, 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 very old Precambrian-age fractured metavolcanics, quartzite, metasediments (schists and phyllites), and granitic gneiss that is recharged by infiltration of precipitation mostly during summer thundershowers and some winter snowfall.
- Groundwater flow is controlled by the underlying geologic framework such as lithologic changes and structural features (i.e., changes in rock type and faults/fractures).
- Groundwater monitoring began 1996.
  - Depth to groundwater is 100 to 327 feet below ground surface and groundwater flows to the west.
  - The monitoring network consists of 12 monitoring wells, of which 10 are sampled.
- 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 drinking water standard.
- The nitrate contaminant plume is 79 acres in size.

Constituent of Concern	Maximum Concentration in 2016	MCL
Nitrate	38.8 milligrams per liter (well CYN-MW13)	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: 1) ammonium nitrate slurry, 2) wastewater discharges, and 3) degradation of HE compounds.

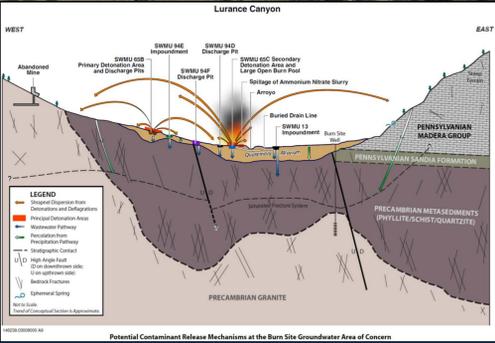
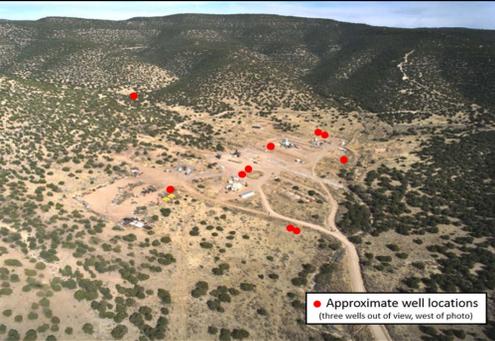


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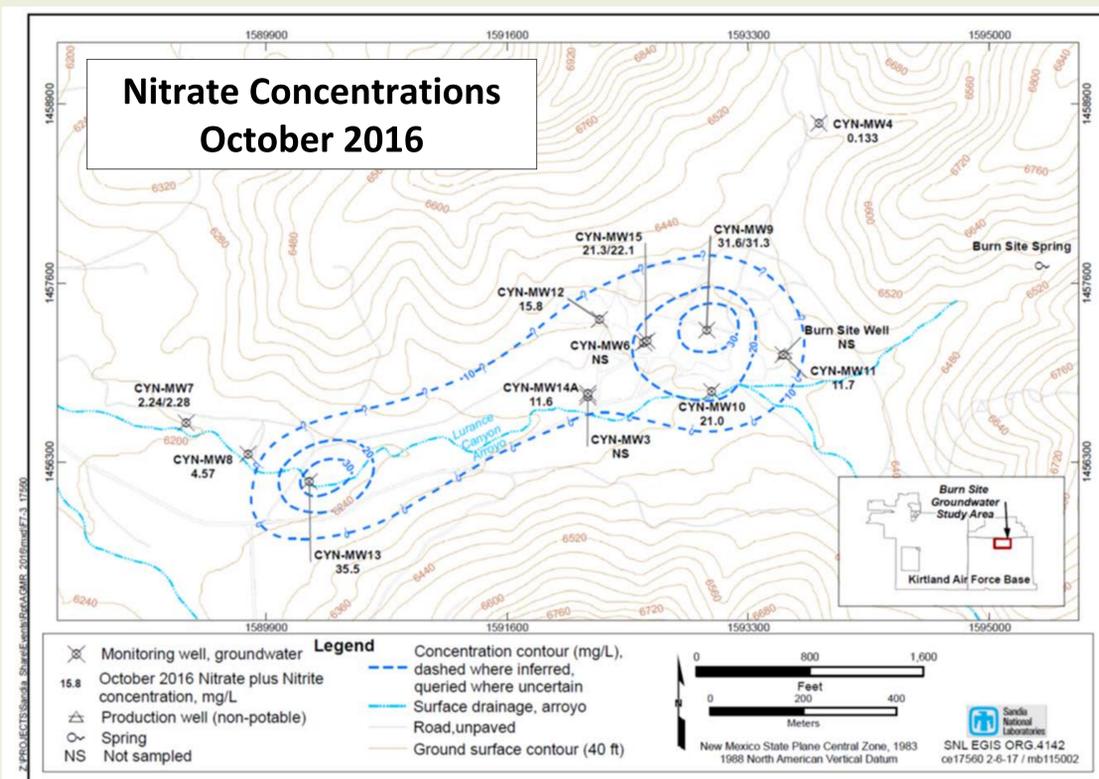
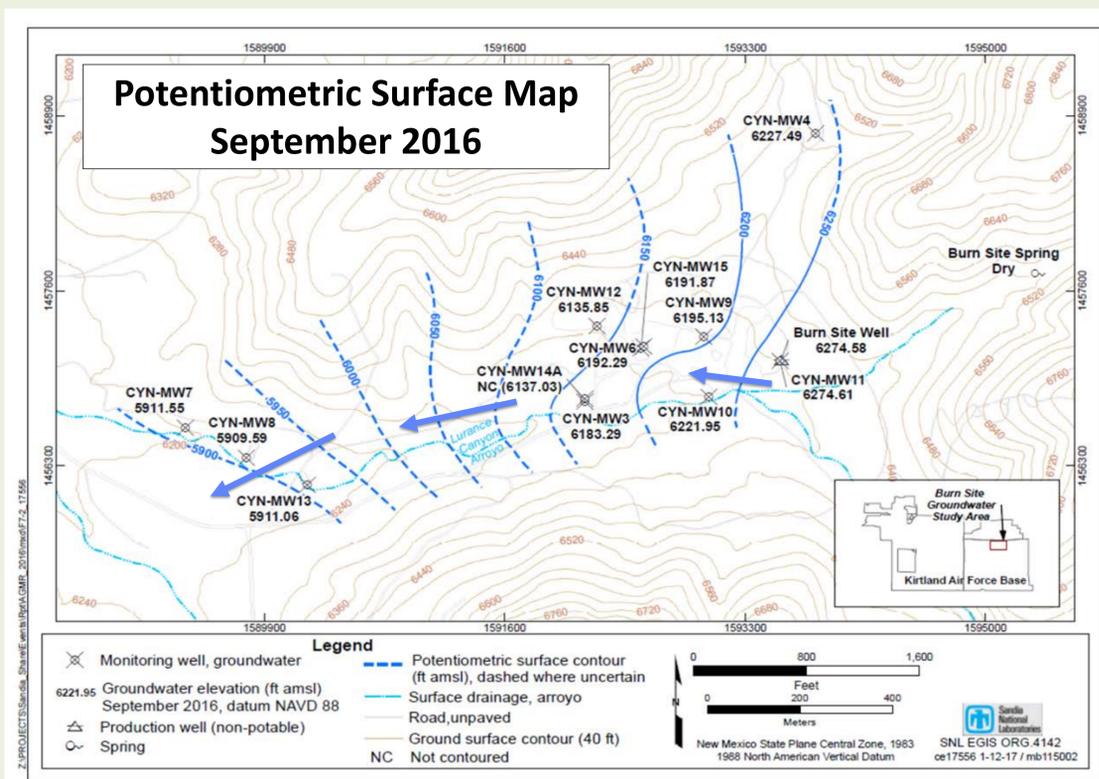
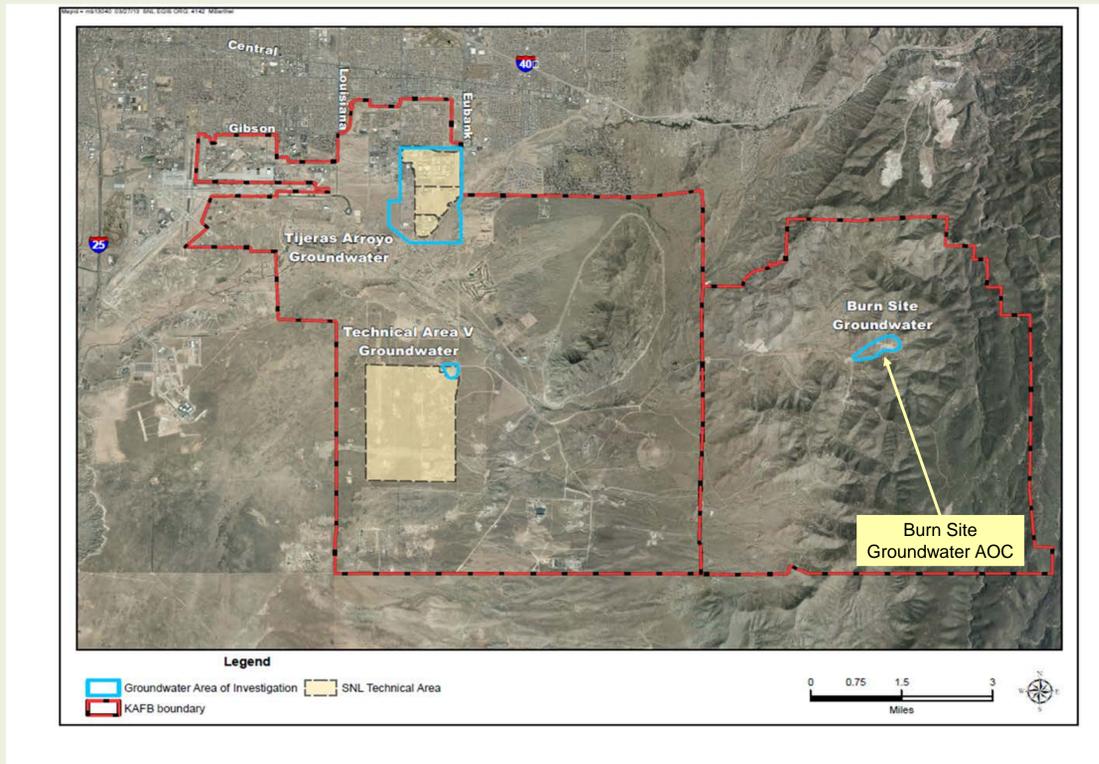
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# Burn Site Groundwater Investigation



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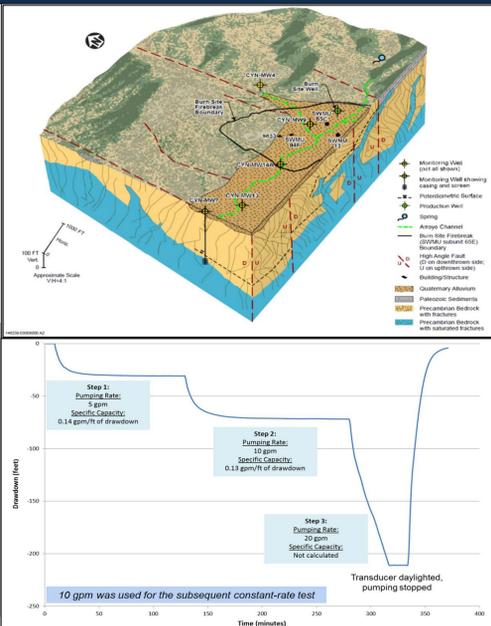
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# Burn Site Groundwater Investigation

## 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.
- Recent investigation activities include:
  - Installed monitoring wells CYN-MW14A and CYN-MW15 in 2014 to replace existing wells that had gone dry (CYN-MW3 and CYN-MW6).
  - Performed isotopic analyses to date the groundwater from all monitoring wells.
  - Conducted long-term transducer study to determine aquifer properties.
  - Completed step-drawdown and constant-rate aquifer pumping test.
  - Performed nitrate interval sampling during the constant-rate test.
  - 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 2017.
- To meet the NMED requirements specified in their April 2016 letter, *Summary of Agreements and Proposed Milestones*, the following activities were completed or are underway:
  - *Aquifer Pumping Test Work Plan* was submitted to the NMED in June 2016, and approved by NMED in June 2016.
  - Field program for the aquifer pumping test was performed in March 2017.
  - *Aquifer Pumping Test Report* was delivered to the NMED in December 2017, and approved by NMED in January 2018.
  - Recommendations for future characterization activities are due to the NMED in June 2018.



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# 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 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 an average depth of approximately 290 feet below the ground surface. The PGWS was created by manmade activities, including recharge from sewage lagoons, 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 17 feet of saturation remains in the central TAG AOC.
  - Thickness of the saturated layer is decreasing. Water mostly percolates downward.
  - The Regional Aquifer occurs at an average depth of 410 feet below the ground surface and is vertically separated from the PGWS by about 200 feet of dry strata.
- In the PGWS, groundwater flows to the southeast at approximately 23 feet per year, and merges with the Regional Aquifer along Powerline Road on KAFB. In the Regional Aquifer, groundwater flows to the west and northwest at approximately 64 feet per year.
- Groundwater monitoring began in 1992.
  - The U.S. Department of Energy (DOE) and its prime contractor for SNL 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 very little water (typically about 1 to 2 gallons per minute).
- Groundwater in the PGWS is contaminated with nitrate at concentrations above the maximum contaminant level (MCL); the drinking water standard.
  - The nitrate plume in the PGWS is approximately 280 acres in size and does not pose a threat to drinking water in the Regional Aquifer.

Constituent of Concern	Maximum Concentration in Perched Groundwater System, 2016	Maximum Concentration in Regional Aquifer, 2016	MCL, mg/L
Nitrate	25.9 milligrams per liter (well TA2-W-28)	4.15 milligrams per liter (well TA2-NW1-595)	10.0
Trichloroethene	4.36 milligrams per liter (well TJA-7)	Non-detect	<0.3

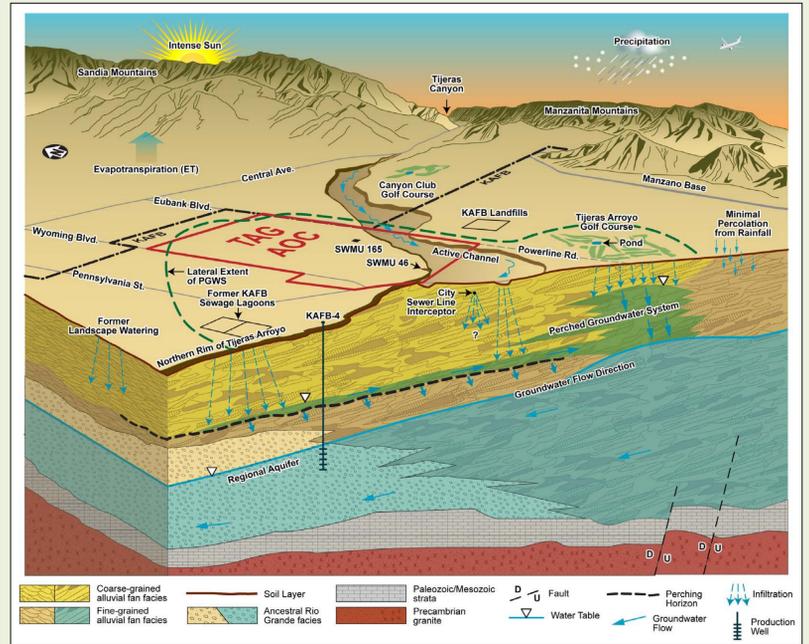
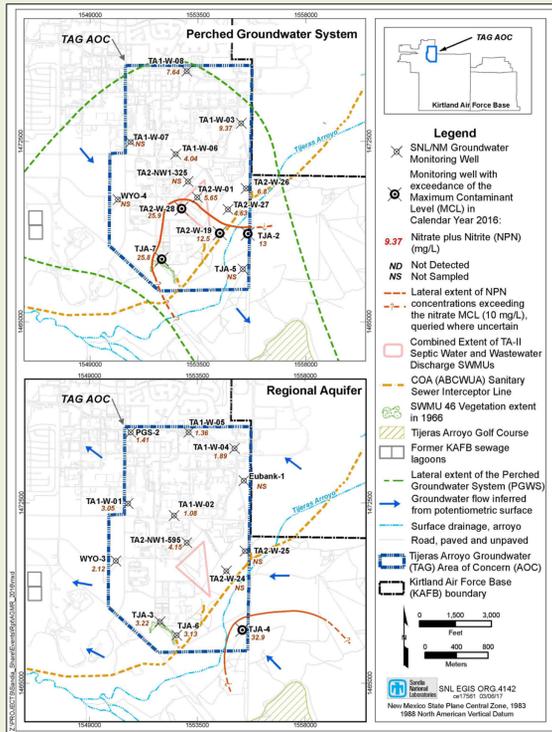
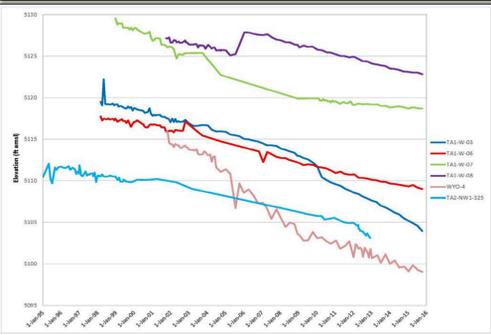
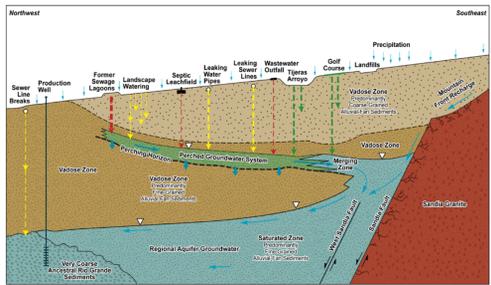


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# Tijeras Arroyo Groundwater Investigation

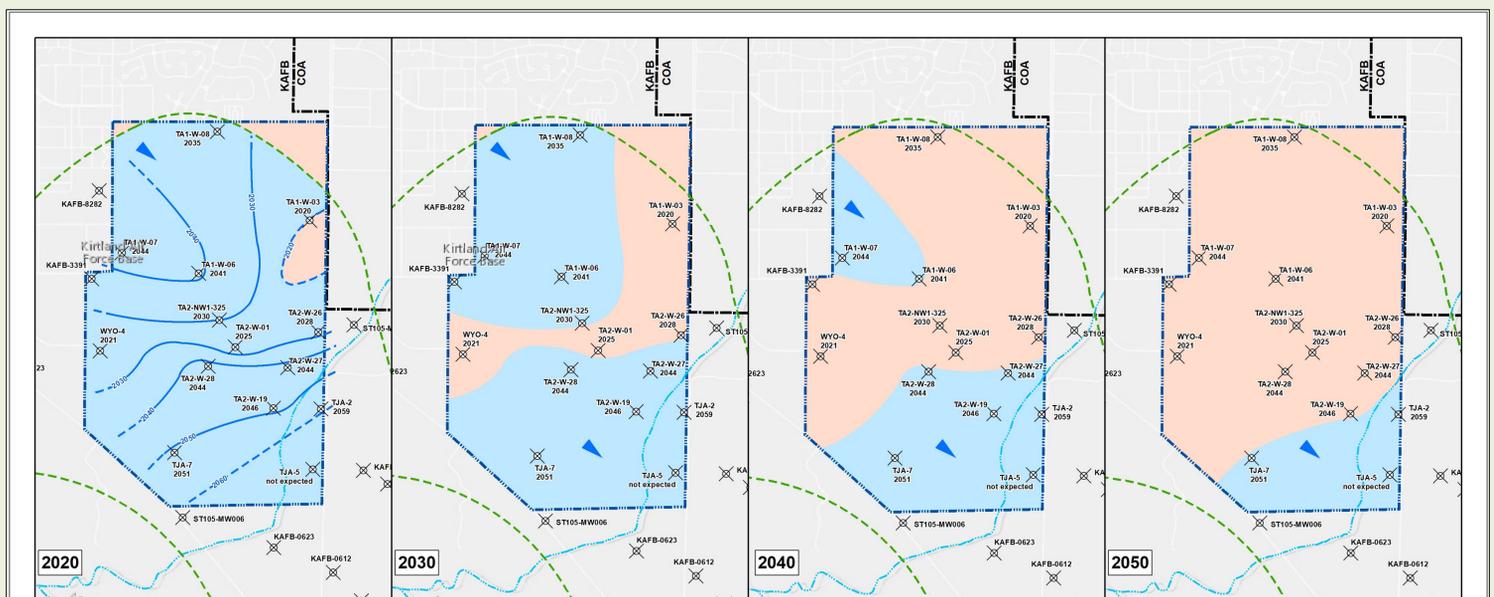


**Maximum 2016 Nitrate Concentrations in the Perched Groundwater System and the Regional Aquifer**

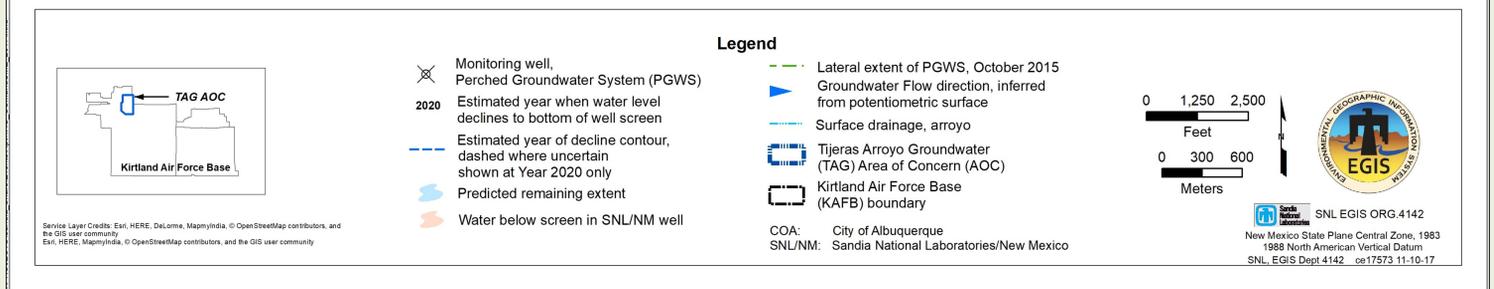
**Conceptual Site Model for the TAG Vicinity**



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



**Dewatering of the Perched Groundwater System from 2020 - 2050**

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# Tijeras Arroyo Groundwater Investigation

## Site Description (continued)

- The groundwater from the PGWS is not used for any purpose; no one is drinking contaminated groundwater.
- The nearest downgradient 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. The nearest Albuquerque Bernalillo County Water Utility Authority well is Ridgecrest 1 located approximately 2 miles to north of the elevated nitrate concentrations.
- Trichloroethene (TCE) concentrations in the PGWS are less than the MCL.
- Nitrate is typically derived from both man-made and natural sources, and may include: 1) septic leach fields, 2) wastewater discharges, 3) fertilizers, and 4) degradation of minerals in soil.
- TCE is used in industrial processes.

## Current Status and Recent Activities

- Evaluating three remedial alternatives for nitrate contamination in the PGWS.
- The New Mexico Environment Department (NMED) Hazardous Waste Bureau will select the remedial alternative.
- Recent investigation activities include:
  - Installed monitoring well TA2-W-28 in December 2014 to replace well TA2-SW1-320 that was damaged and going dry.
  - Interpreted geophysical well logs and evaluated in more detail the thickness of the PGWS.
  - Ongoing water level measurements and groundwater sampling that is scheduled to be presented in the next *Annual Groundwater Monitoring Report* submission to the NMED in June 2018.
- The DOE and its prime contractor for SNL submitted the *TAG Current Conceptual Model and Corrective Measures Evaluation (CCM and CME) Report* to the NMED in December 2016.
- Based on a May 2017 NMED letter requesting more information for remedial alternatives, a *Revised TAG CCM and CME Report* was submitted to the NMED in February 2018.



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# Technical Area-V Groundwater Investigation

## Site Description

- Technical Area-V (TA-V) Groundwater Area of Concern (AOC) covers 35 acres of industrial land in central portion of Kirtland Air Force Base (KAFB).
- Sandia National Laboratories (SNL) activities at TA-V began in 1961 for testing the radiation effects on components and operating research reactors.
- Corrective action is required only for groundwater at TA-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 monitoring network consists of 18 monitoring wells.
- Groundwater is contaminated with nitrate and trichloroethene (TCE) at concentrations above the maximum contaminant level (MCL); the drinking water standard.
  - The nitrate contaminant plume is 1.4 acres in size.
  - The TCE contaminant plume is 13 acres in size.
  - The two contaminant plumes are not moving.

Constituent of Concern	Maximum concentration, 2016	MCL
Nitrate	15.2 milligrams per liter (well TAV-MW10)	10 milligrams per liter
Trichloroethene (TCE)	19.2 micrograms per liter (well LWDS-MW1)	5 micrograms per liter

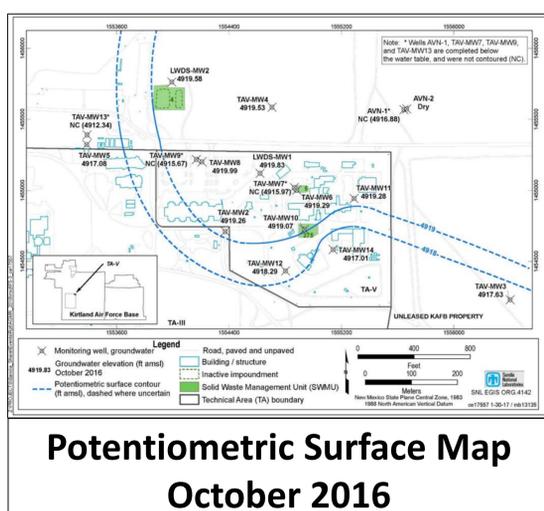
- Groundwater in this area is not used for any purpose; no one is drinking contaminated groundwater.
- The nearest drinking water production well (KAFB-4) is located 2.7 miles to the north and downgradient of TA-V.
- No ongoing wastewater release or recharge occurs to groundwater at TA-V.
- Nitrate is typically derived from both man-made and natural sources, and may include: 1) septic leach fields, 2) wastewater discharges, and 3) degradation of minerals in soil.
- TCE is used in industrial processes.



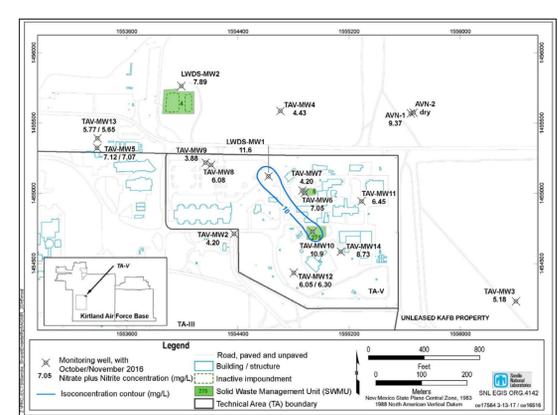
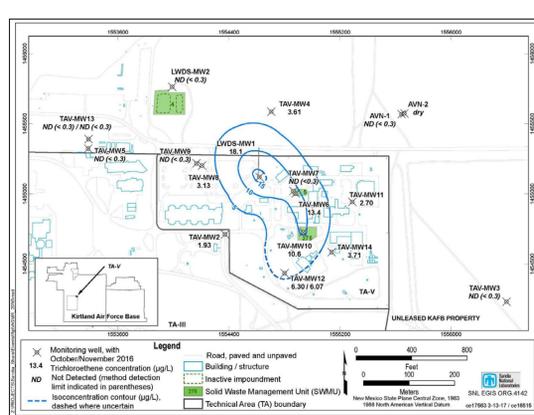
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**Potentiometric Surface Map  
October 2016**

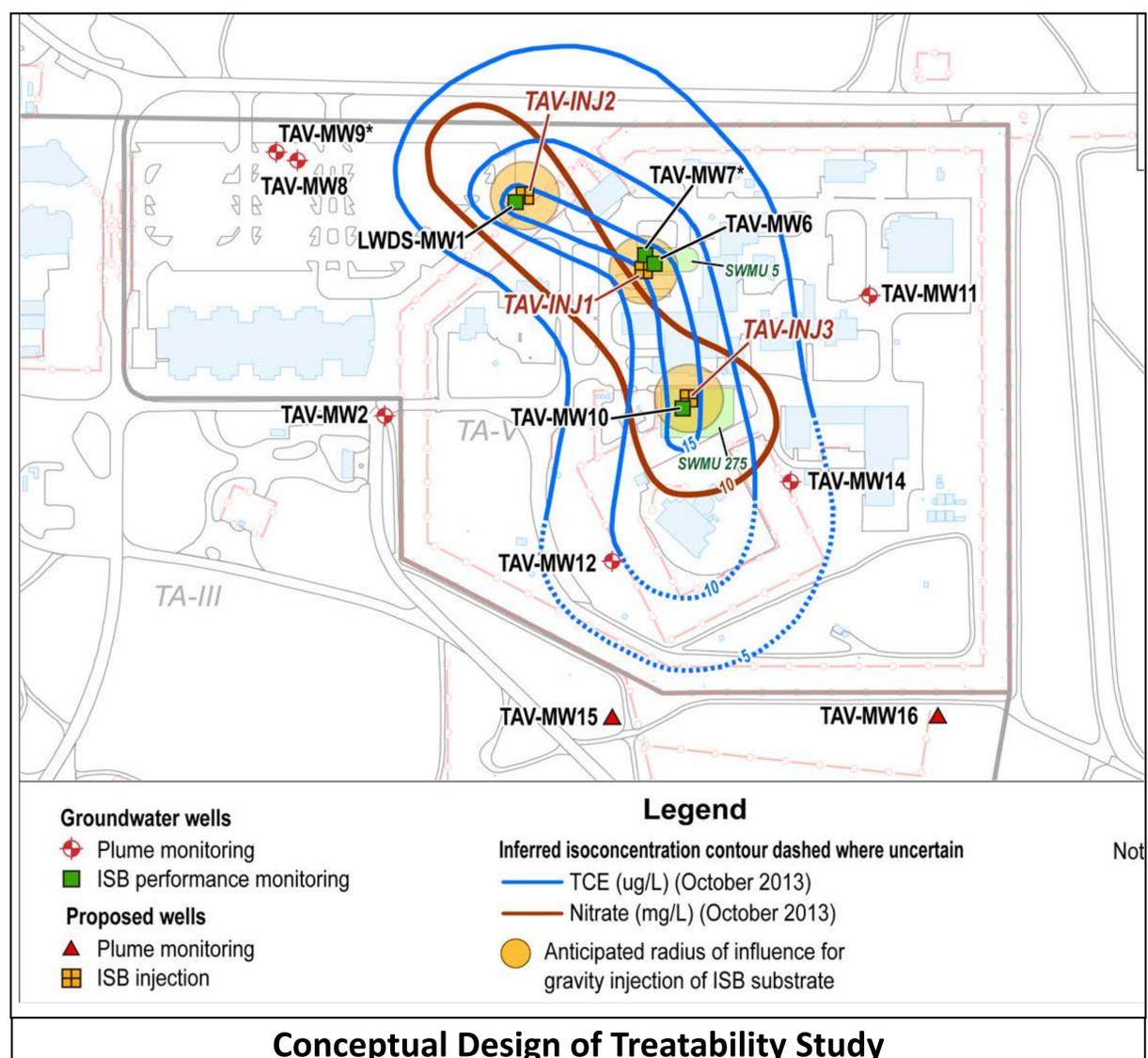


**Plume Maps, October/November 2016, Left: TCE; Right: Nitrate**

# Technical Area-V Groundwater Investigation

## Current Status and Recent Activities

- Conducting a Treatability Study using 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 TCE 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.
  - Deliver bioremediation solution using one injection well; potential for up to three injection wells.
- The New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB) approved the Treatability Study Work Plan in May 2016.
- The NMED Ground Water Quality Bureau granted Discharge Permit DP-1845 in May 2017 to inject bioremediation solution.
- First injection well installed in October 2017.
- Conducted a pilot test of the Treatability Study in November 2017.
- Notification to NMED HWB by July 2018 if we plan to proceed with full scale Treatability Study.



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# Technical Area-V Groundwater Investigation

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**Pilot Test**  
**Above: Injection System**  
**Left: Injection in Progress**

