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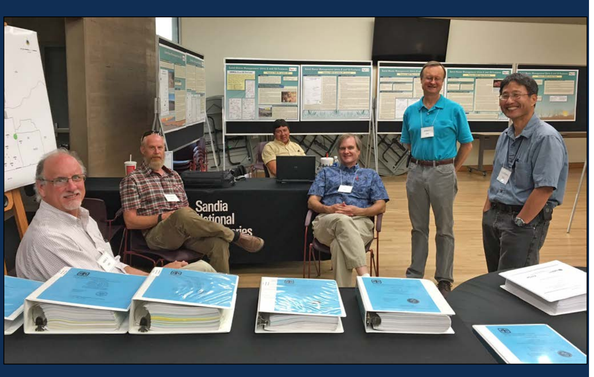

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John Cochran
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Sandia National Laboratories
New Mexico

Environmental Restoration Overview

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

Process: Activities are regulated by the New Mexico Environment Department (NMED).

- 2004 Sandia National Laboratories (SNL) Compliance Order on Consent with the NMED Hazardous Waste Bureau.
- 2017 SNL Discharge Permit with NMED Ground Water Quality Bureau for Technical Area-V Groundwater Investigation Area of Concern (AOC).

Status: 12 sites remain under the Environmental Restoration mission:

- 6 soil Solid Waste Management Units in Corrective Action Complete regulatory process.
- 3 active mission sites with deferred corrective action.
- 3 groundwater AOCs.

Current Activities:

- Burn Site Groundwater Investigation AOC – conducting site characterization.
- Technical Area -V Groundwater Investigation AOC – pilot test of method to treat contaminated groundwater.
- Tijeras Arroyo Groundwater Investigation AOC – assessing possible corrective actions of contaminated groundwater.

Are there any known human health impacts from the SNL Groundwater AOCs?

- There are no known human health impacts.
  - No one is drinking contaminated groundwater.
  - No drinking water wells are located or planned near any of the contamination.
  - Boundaries of groundwater contamination are well defined.
  - On-going monitoring of contaminated groundwater continues.
- Drinking water standards will serve as groundwater cleanup goals for human health and environmental protection.

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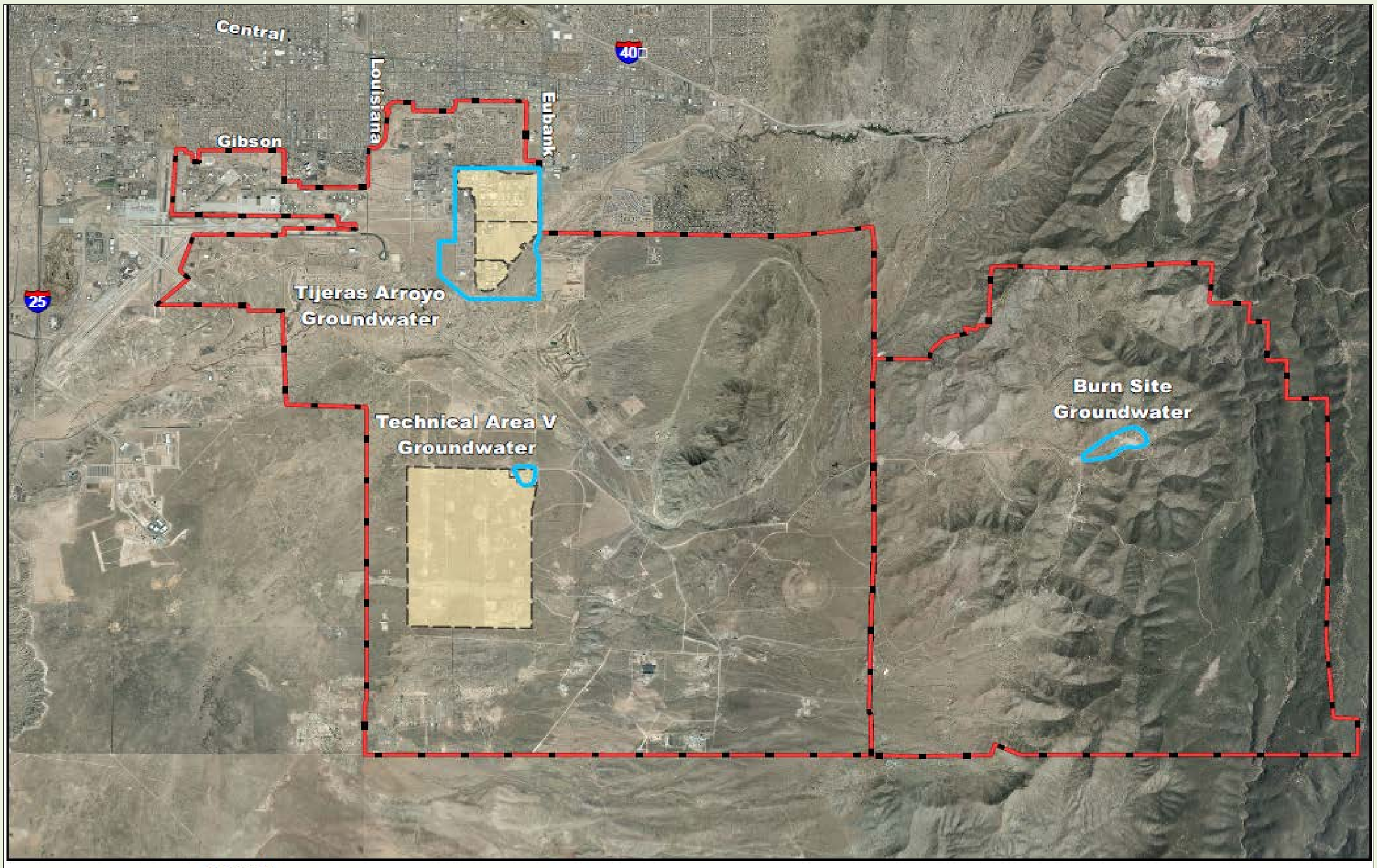

Map of Kirtland Air Force Base showing location of 3 Sandia National Laboratories Groundwater Investigation Areas of Concern

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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 beneath 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 waste-water 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.
    - 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 PGWS, October 2016, milligrams per liter (mg/L)	Maximum Concentration in Regional Aquifer, October 2016, mg/L	MCL, mg/L
Nitrate	25.9 at well TA2-W-28	4.15 at well TA2-NW1-595	10.0

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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.
- Nitrate is typically derived from both man-made and natural sources, and may include: 1) septic leach fields, 2) waste-water discharges, 3) fertilizers, and 4) degradation of minerals in soil.

Current Status and Recent Activities

- Evaluating several 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 *Current Conceptual Model and Corrective Measures (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 CCM and CME Report* will be submitted to the NMED in February 2018.

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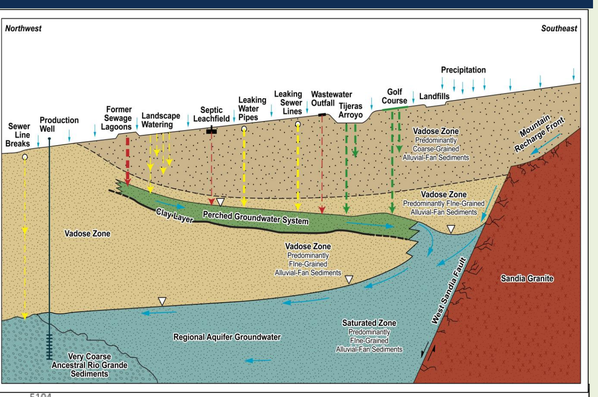
Tijeras Arroyo Groundwater Investigation



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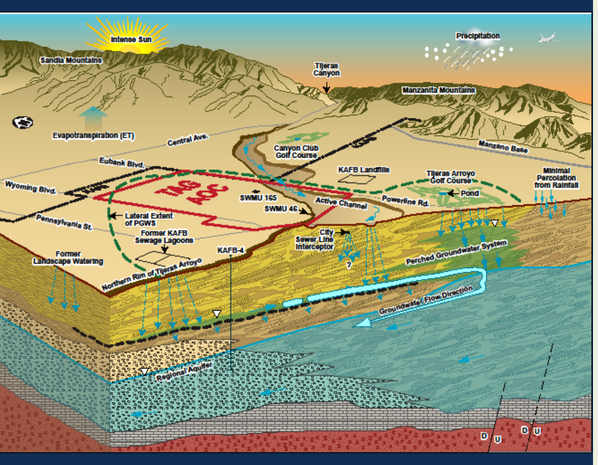

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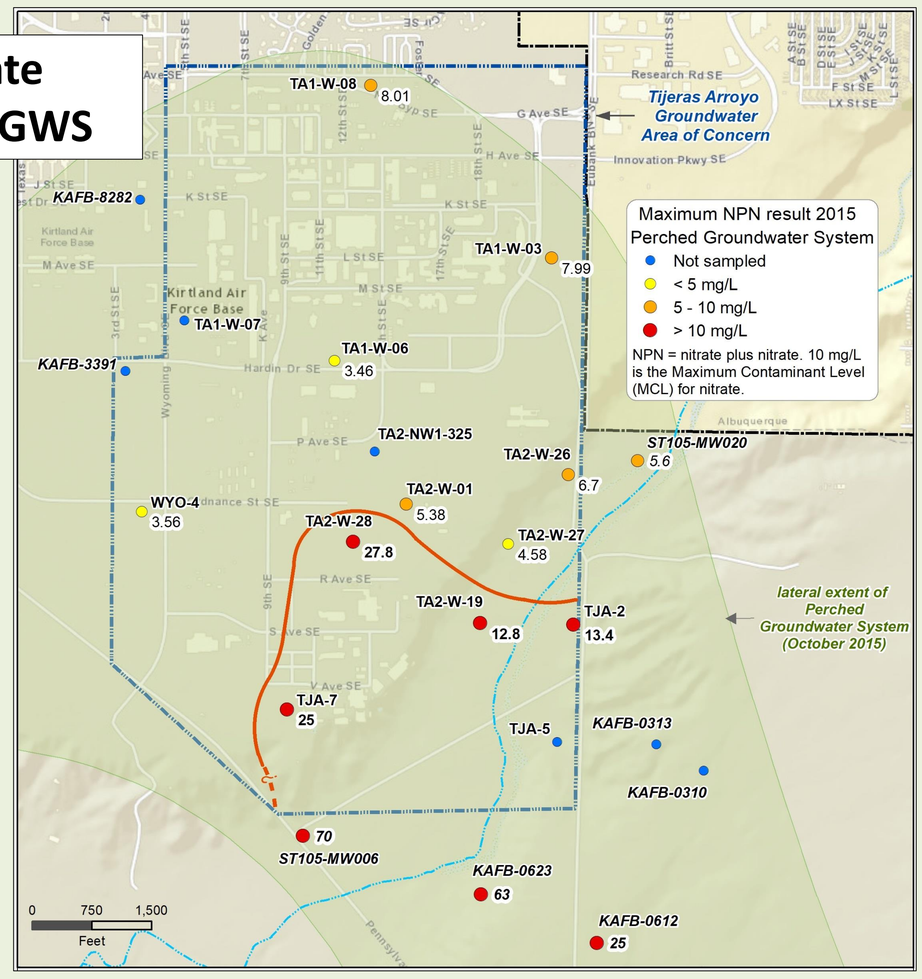
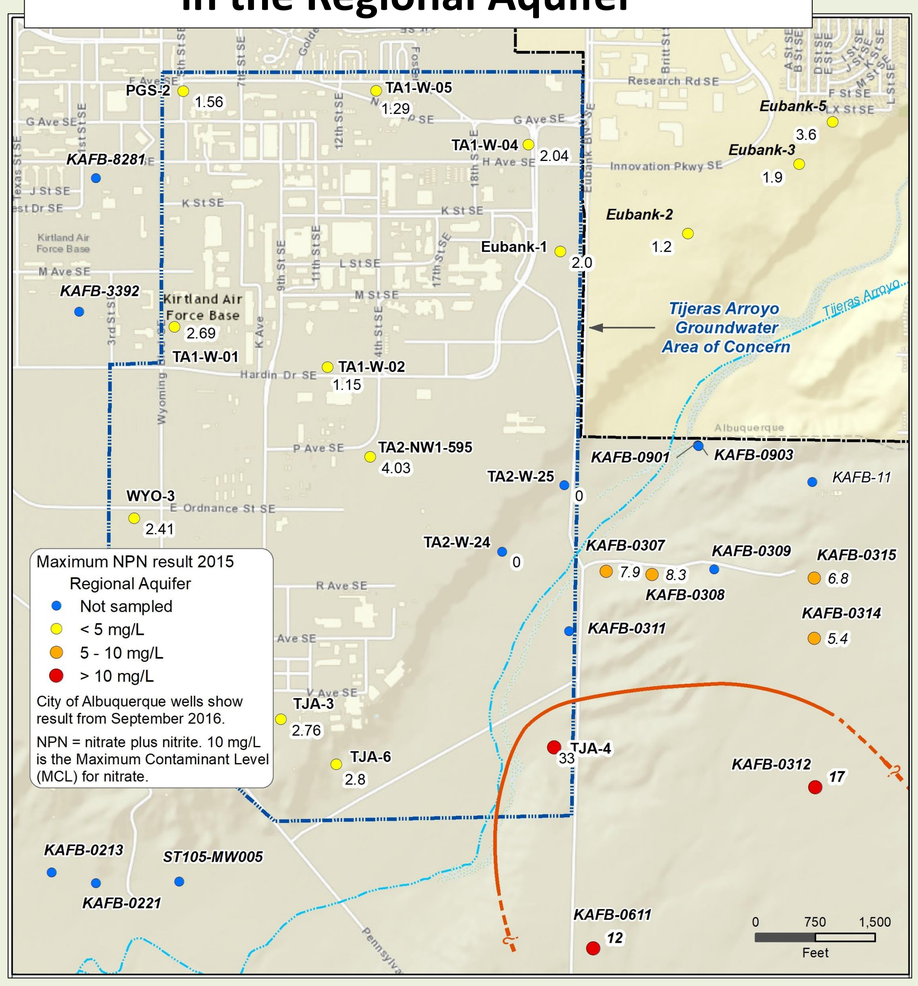
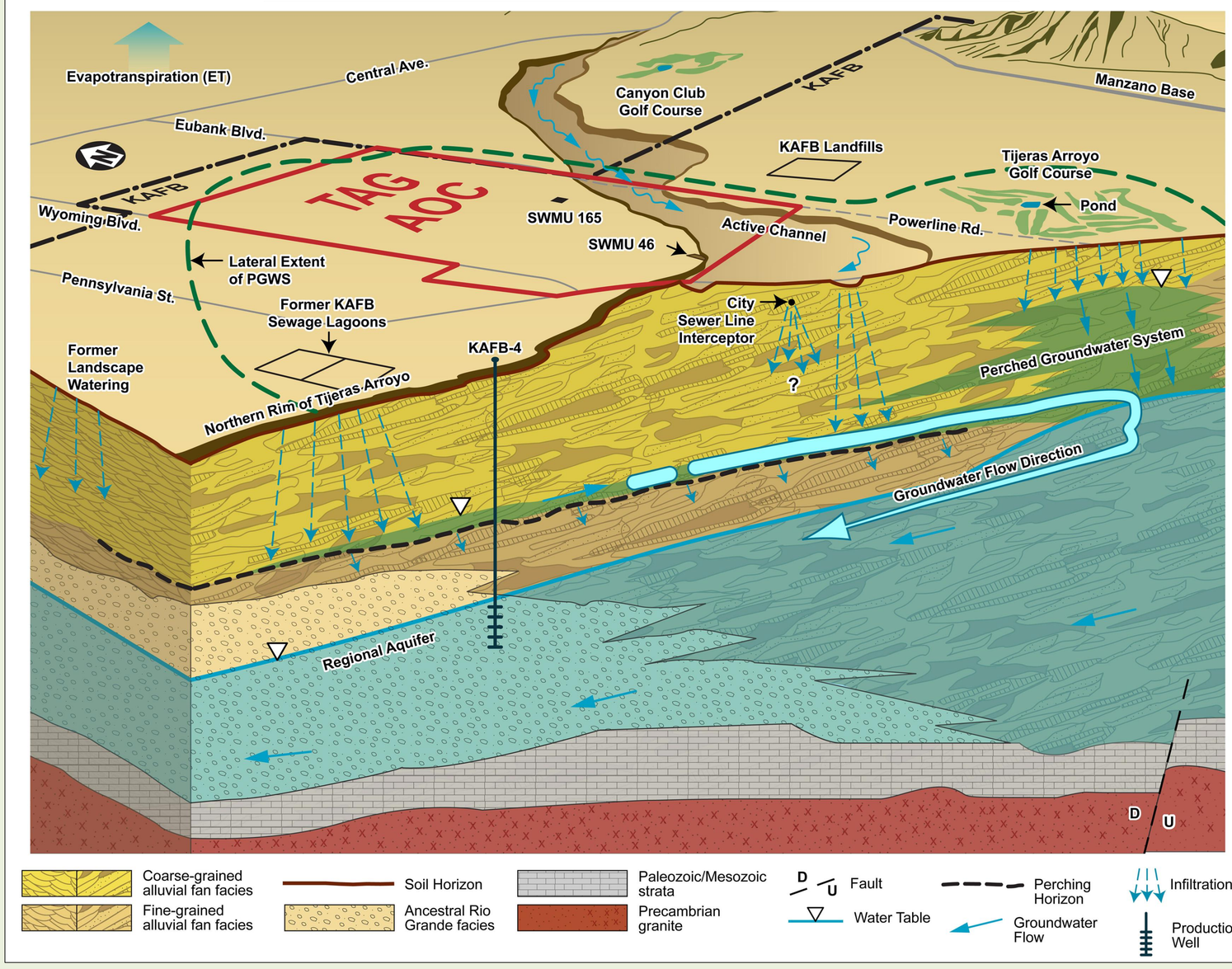
Maximum 2015 Nitrate Concentrations in the PGWS



Maximum 2015 Nitrate Concentrations in the Regional Aquifer



Conceptual Site Model for the TAG Vicinity



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Technical Area-V Groundwater Investigation

Site Description

- Technical Area-V (TA-V) Groundwater Investigation Area of Concern (AOC) covers 35 acres of industrial land in central portion of Kirtland Air Force Base (KAFB).
- 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 in Technical Area V (TA-V).
- Groundwater in the Regional Aquifer occurs approximately 500 feet below ground in alluvial-fan sediments consisting of clays/silts/sands.
- Groundwater migrates very slowly locally to the west, southwest, and south.
- Groundwater monitoring began in 1993.
    - The monitoring network consists of 18 monitoring wells.
    - Monitoring wells yield very little water (typically 1 to 2 gallons per minute).
- No ongoing wastewater release or recharge occurs to groundwater.
- 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 isolated and stable (i.e., not moving).

Constituent of Concern	Maximum concentration, 2016 (well)	MCL
Nitrate	15.2 milligrams per liter (TAV-MW10)	10 milligrams per liter
Trichloroethene (TCE)	19.2 micrograms per liter (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.
- Nitrate is typically derived from both man-made and natural sources, and may include: 1) septic leach fields, 2) waste-water discharges, and 3) degradation of minerals in soil.
- TCE is used in industrial processes.

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Technical Area-V Groundwater Investigation

Current Status and Recent Activities

- Conducting a Phased Treatability Study using In-Situ Bioremediation.
  - Up to 3 phases: Pilot, Phase 1, and Phase 2.
  - "In-Situ" means treating the contamination in-place (in the sediments).
  - "Bioremediation" will use biological processes (natural bacteria) to remediate the groundwater by degrading the nitrate and TCE below drinking water standards.
  - In-Situ Bioremediation is common in the U.S., but not where groundwater is 500 feet deep.
- The New Mexico Environment Department (NMED) Hazardous Waste Bureau approved the Treatability Study Work Plan in May 2016.
- Discharge Permit granted in May 2017 by the NMED Groundwater Bureau to inject bioremediation solution.
- Installed the first of possibly three injection wells in September 2017.
- Constructing aboveground injection system (mixing tanks and piping to the injection well).
- Anticipate starting the Pilot Phase in December 2017.

Google Earth Photo of TA-V
July 2016

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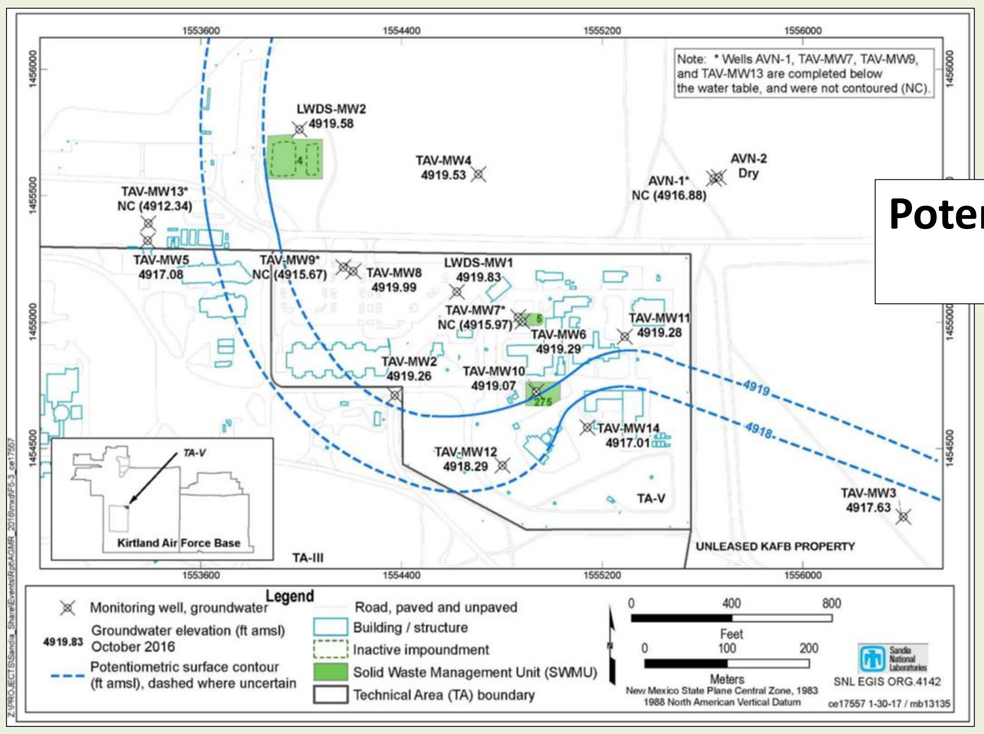
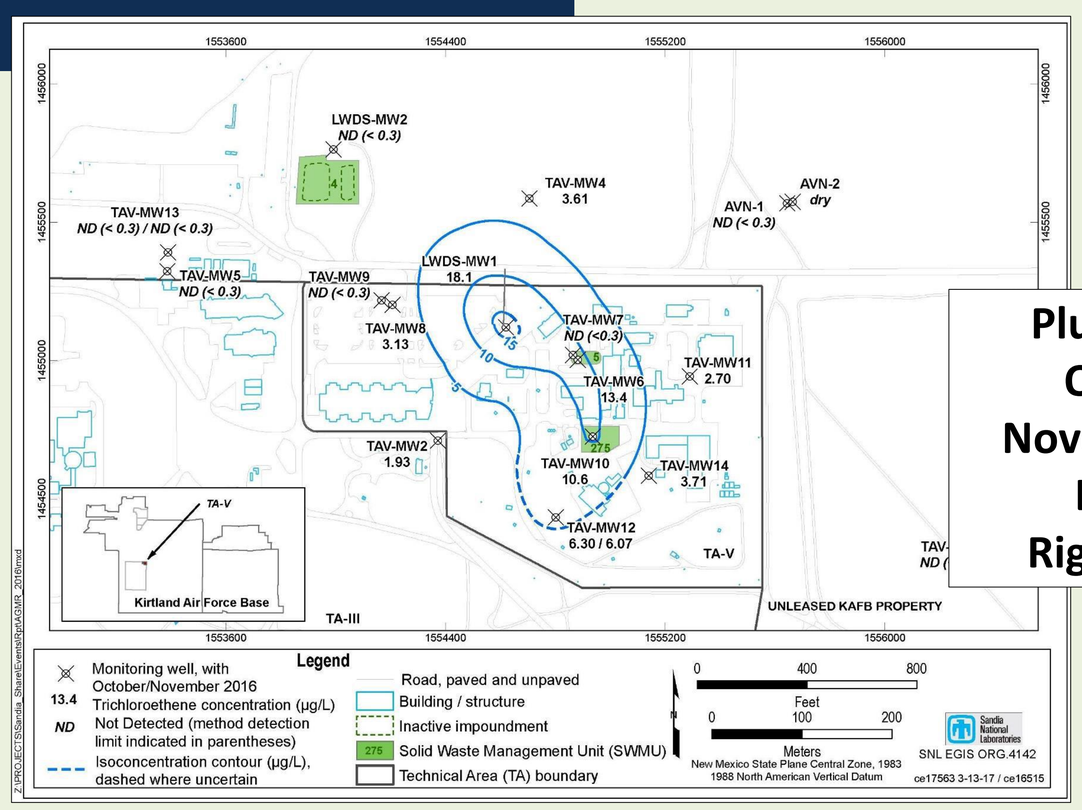
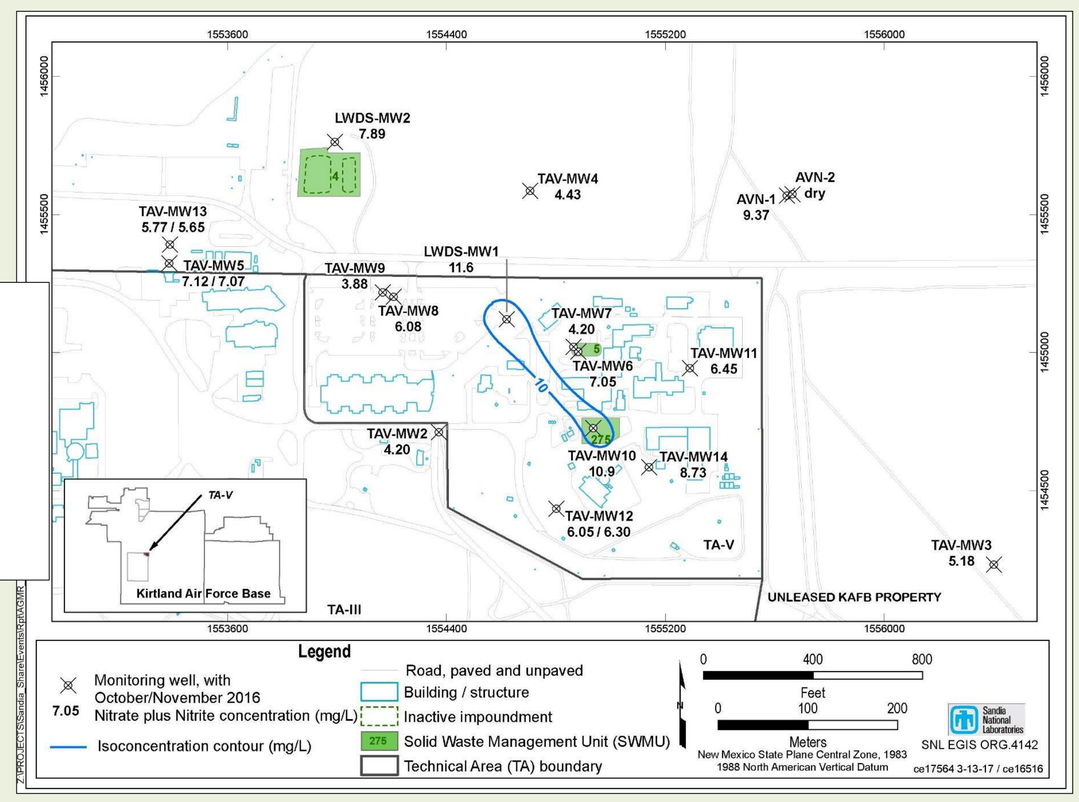
Technical Area-V Groundwater Investigation



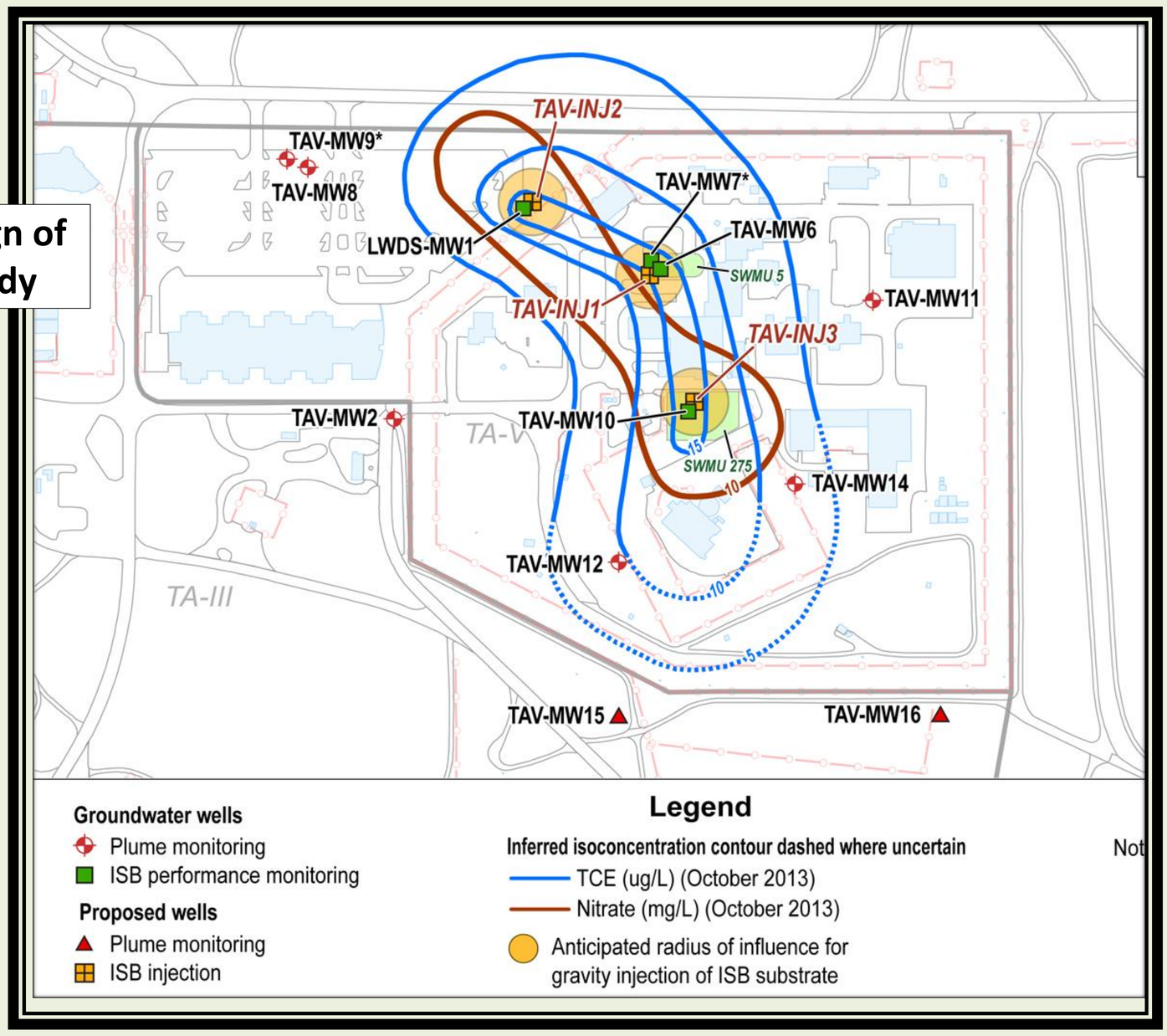
Potentiometric Surface Map October 2016



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



Conceptual Design of Treatability Study



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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 (well)	MCL
Nitrate	41.9 milligrams per liter (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: 1) ammonium nitrate slurry, 2) wastewater discharges, and 3) degradation of HE compounds.

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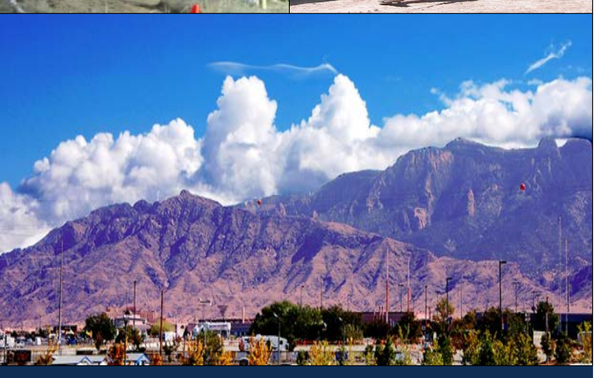

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Burn Site Groundwater Investigation

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* in preparation, delivery to the NMED in December 2017.

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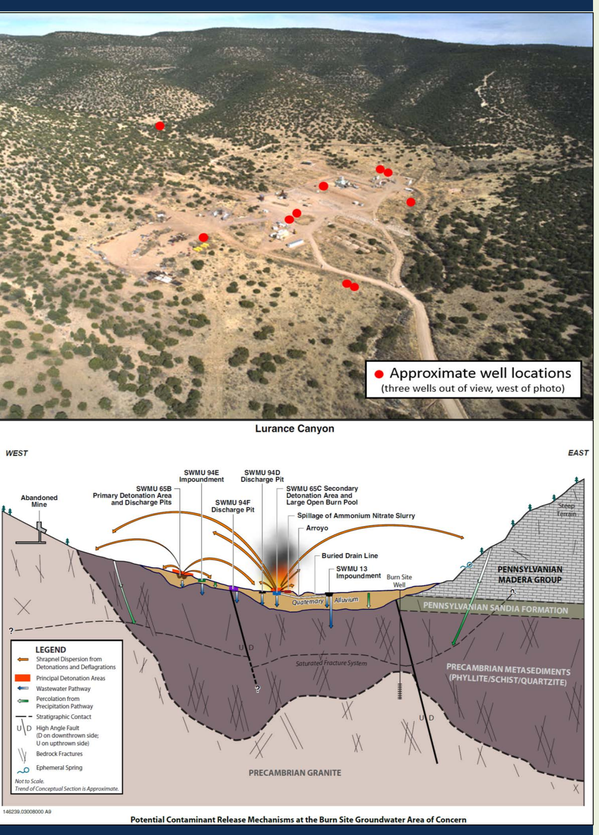
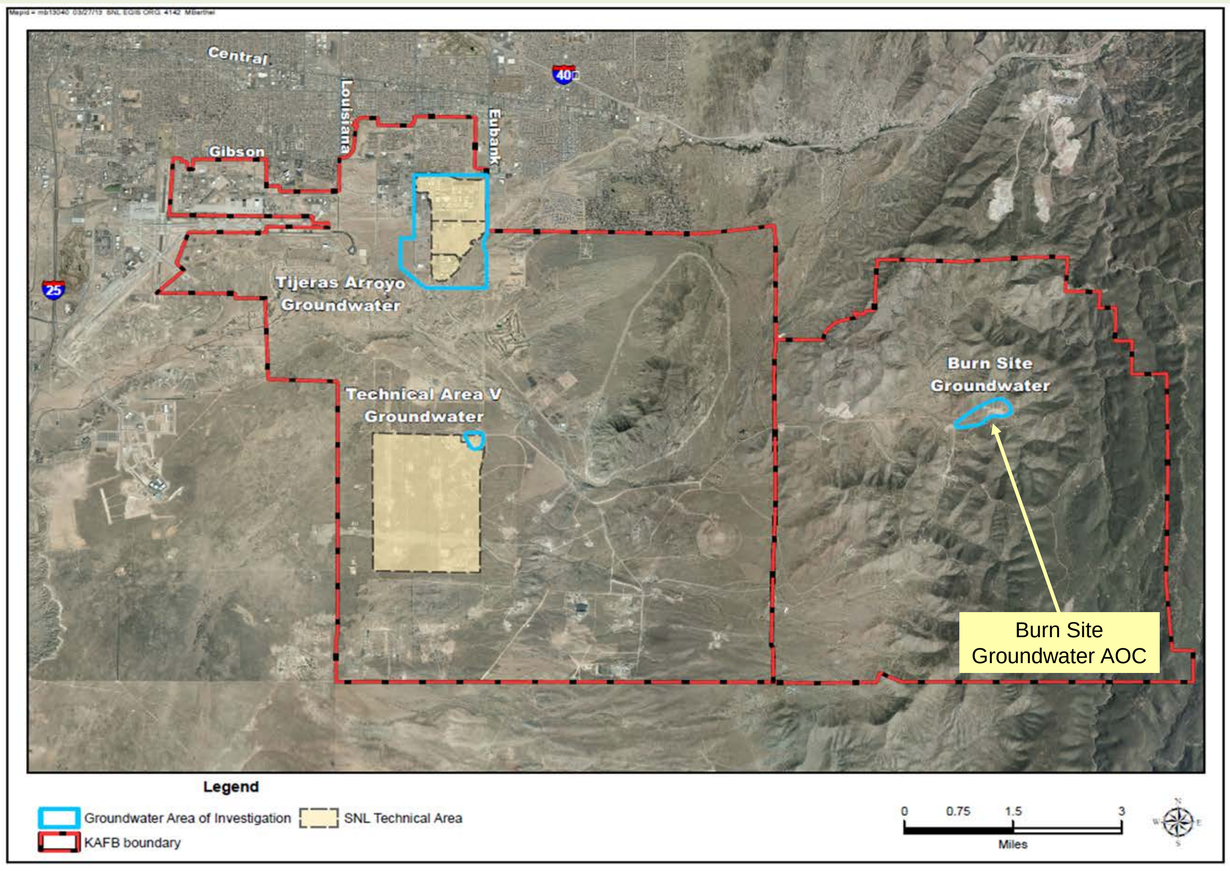
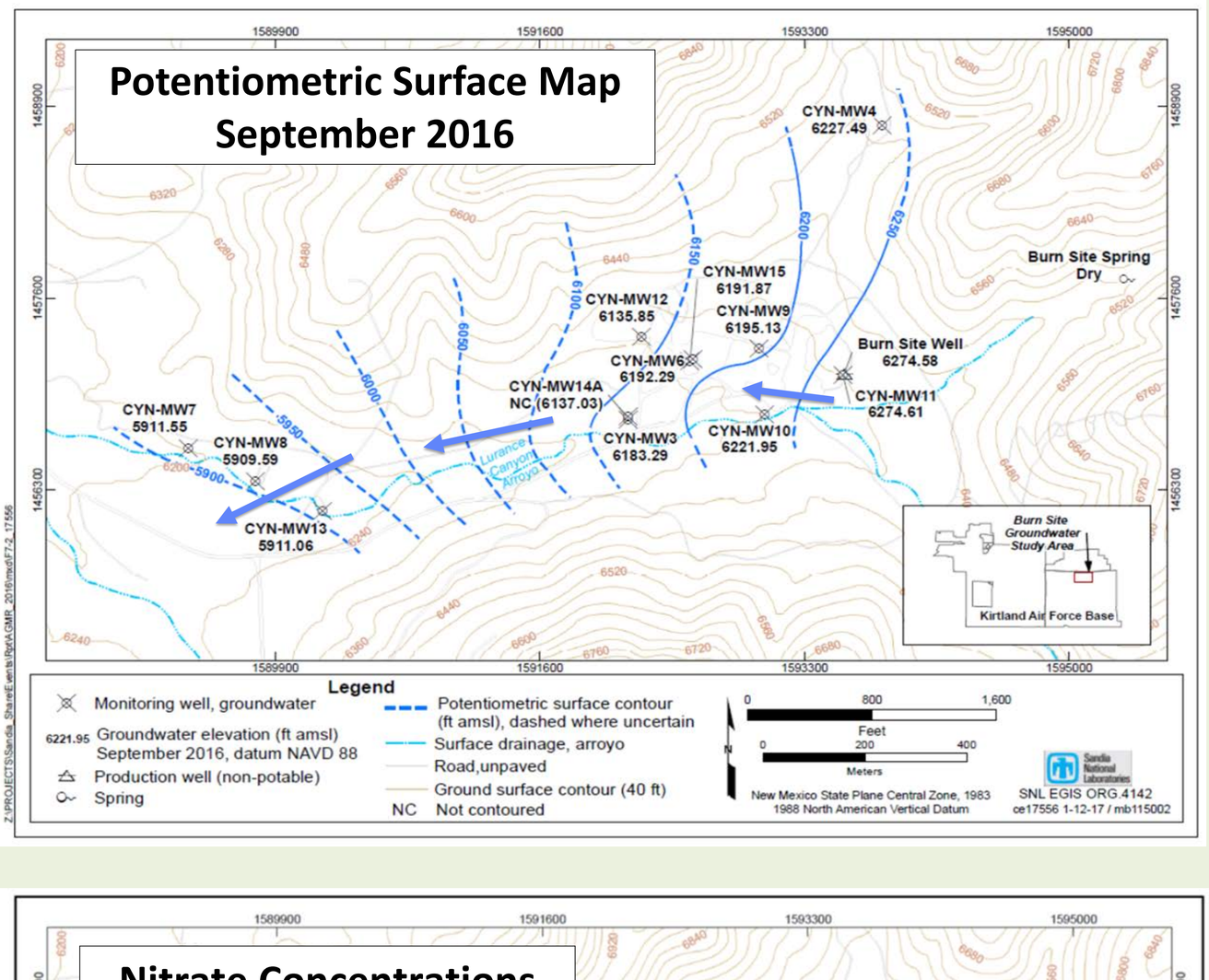
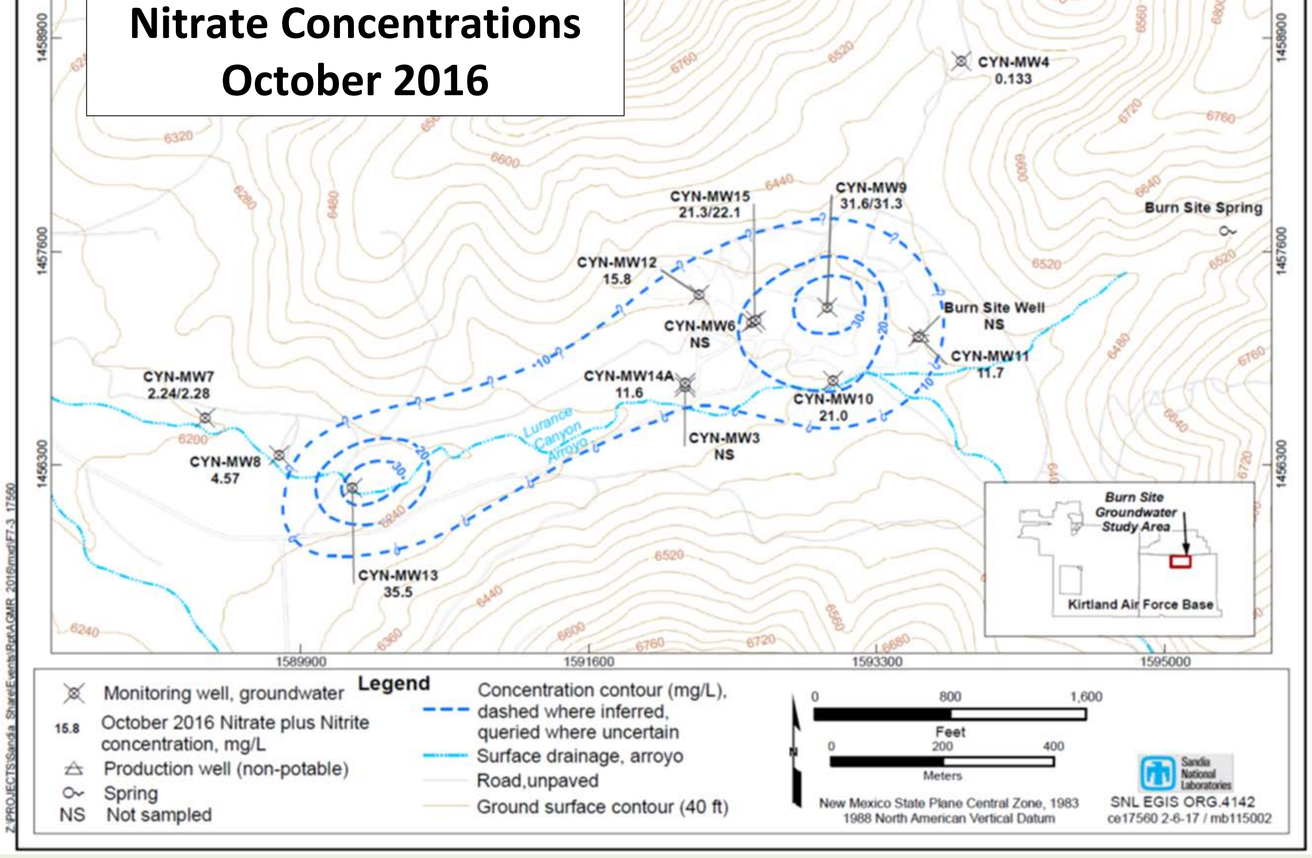
Burn Site Groundwater Investigation









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