Department of Energy/National Nuclear Security Administration and Sandia National Laboratories

- Semiannual public meeting
  - Virtual session held in response to New Mexico Executive and Public Health Orders
- Environmental restoration activities at Sandia National Laboratories (SNL)
- Information resources
  - New Mexico Environment Department Hazardous Waste Bureau
    https://www.env.nm.gov/hazardous-waste/sandia-national-laboratories/
  - Sandia National Laboratories
    https://www.sandia.gov/about/environment/index.html
    https://www.sandia.gov/about/environment/environmental_management_system/index.html
- Questions? Send email to envinfo@sandia.gov

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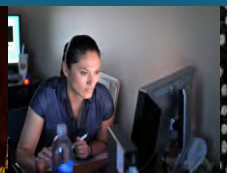
Environmental Restoration Activities at Sandia National Laboratories

- Mission: identify, characterize, and remediate sites where hazardous materials may have been released to the environment.
- Current activities: investigations at three areas of concern (AOCs)
  - Burn Site Groundwater Investigation AOC
  - Tijeras Arroyo Groundwater Investigation AOC
  - Technical Area V Groundwater Investigation AOC
- Activities are regulated by the New Mexico Environment Department
  - 2004 Compliance Order on Consent under the Hazardous Waste Bureau
  - 2017 Discharge Permit for Technical Area V Groundwater Investigation AOC under the Ground Water Quality Bureau
- Drinking water standards serve as groundwater cleanup goals for human health and environmental protection
  - No drinking water production wells are located in or near the contaminated groundwater
  - Boundaries of contaminated groundwater at each area are defined
  - No one is drinking contaminated groundwater

Burn Site Groundwater (BSG) Investigation



Michael Skelly
Environmental Restoration Operations

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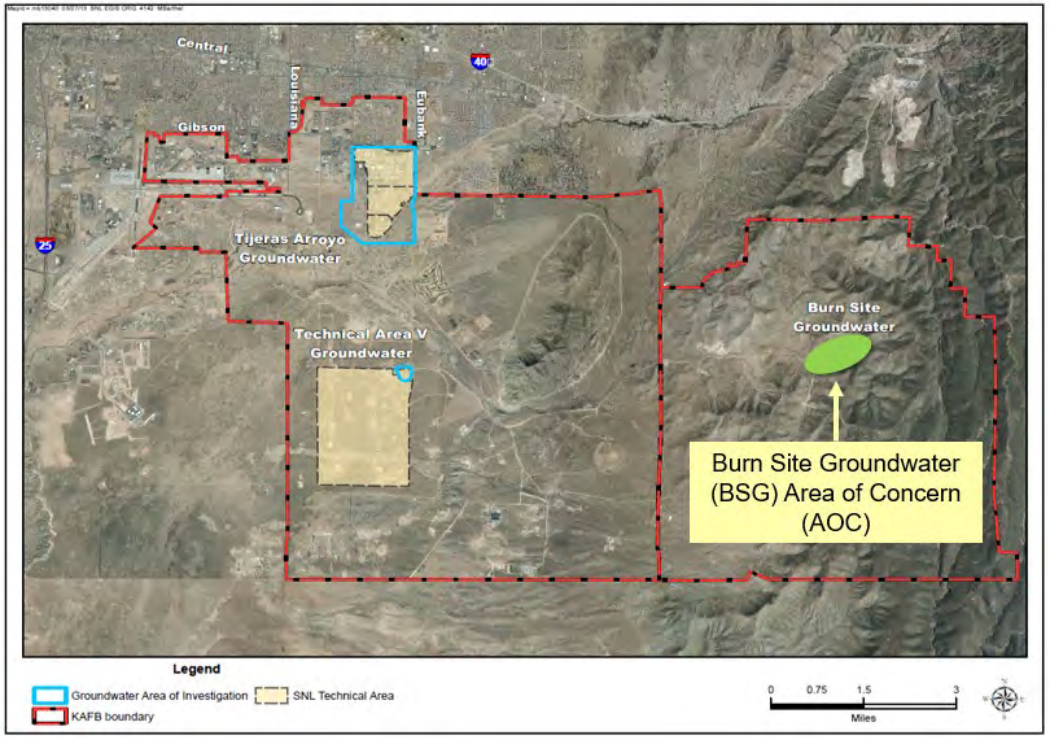
BSG Site Description

- The BSG Area of Concern is located in Lurance Canyon.
- It is in a remote area of the Manzanita Mountains.
- Lurance Canyon is a west-flowing drainage deeply incised into Paleozoic and Precambrian bedrock in moderately- to heavily-wooded pinon-juniper forest.

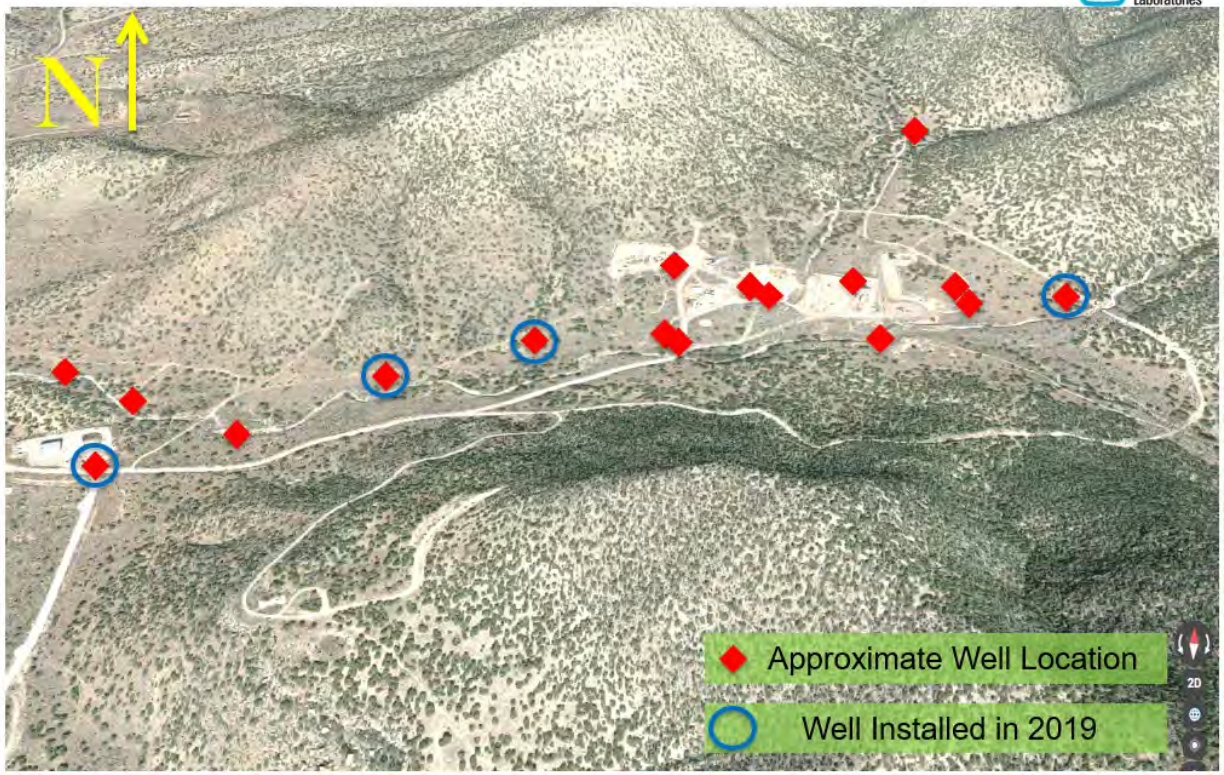


- SNL activities at the Burn Site testing area began in 1967; early site test activities included explosives testing, current use is fire-survivability studies (i.e., burn testing).
- Corrective action is required only for the groundwater in the BSG AOC.
- Groundwater occurs in fractured Precambrian bedrock that is recharged by infiltration of precipitation; flow is controlled by changes in rock type and faults/fractures.

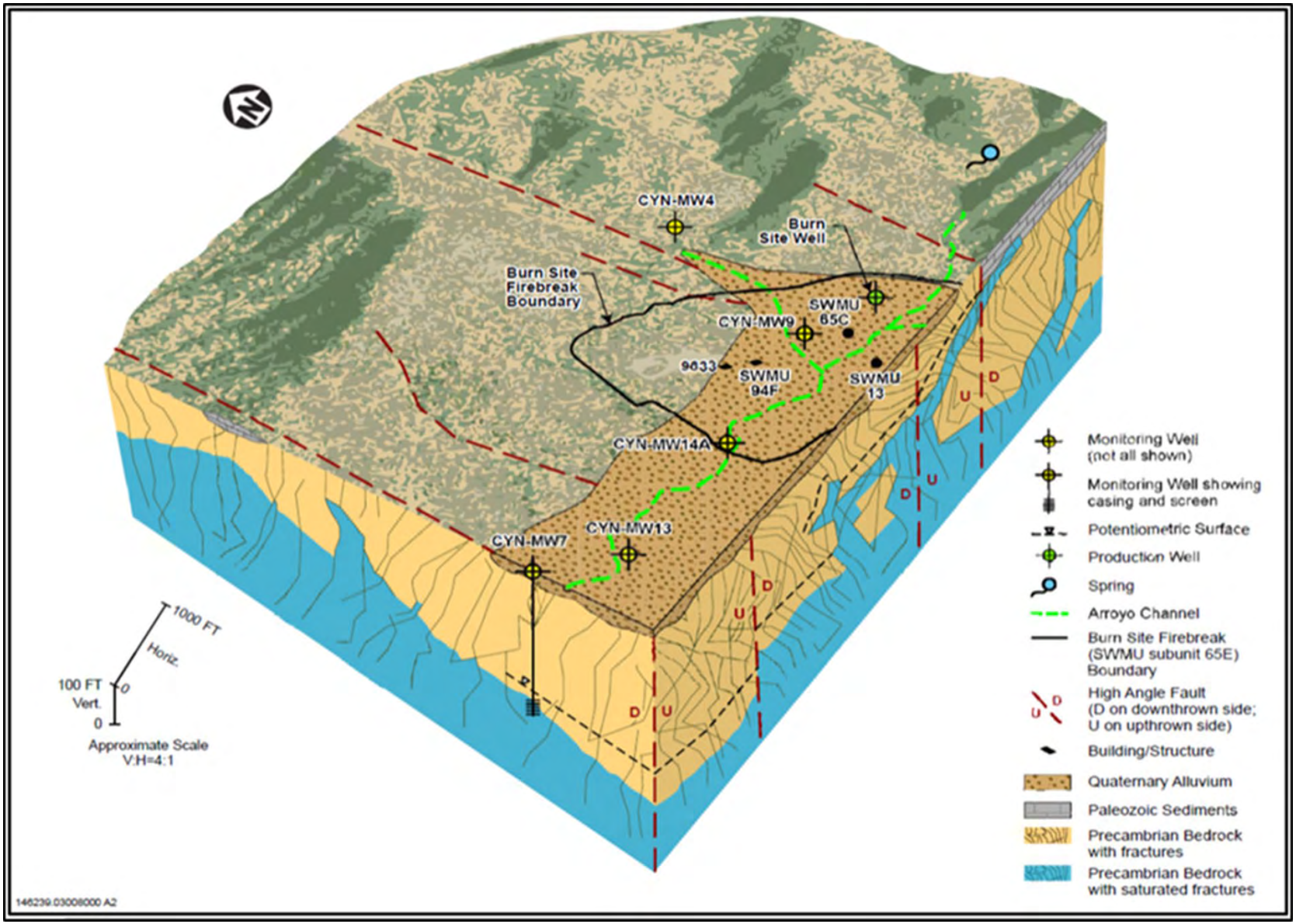
BSG Groundwater Monitoring

- Groundwater monitoring began in 1996.
- Depth to groundwater ranges from 45 to 360 feet below ground surface and groundwater flows to the west.
- The monitoring network consists of 16 monitoring wells and an inactive production well, with 4 newest wells installed in October/November 2019.

Oblique Aerial View of the BSG AOC; View is toward the North



Conceptual Site Model for the BSG AOC

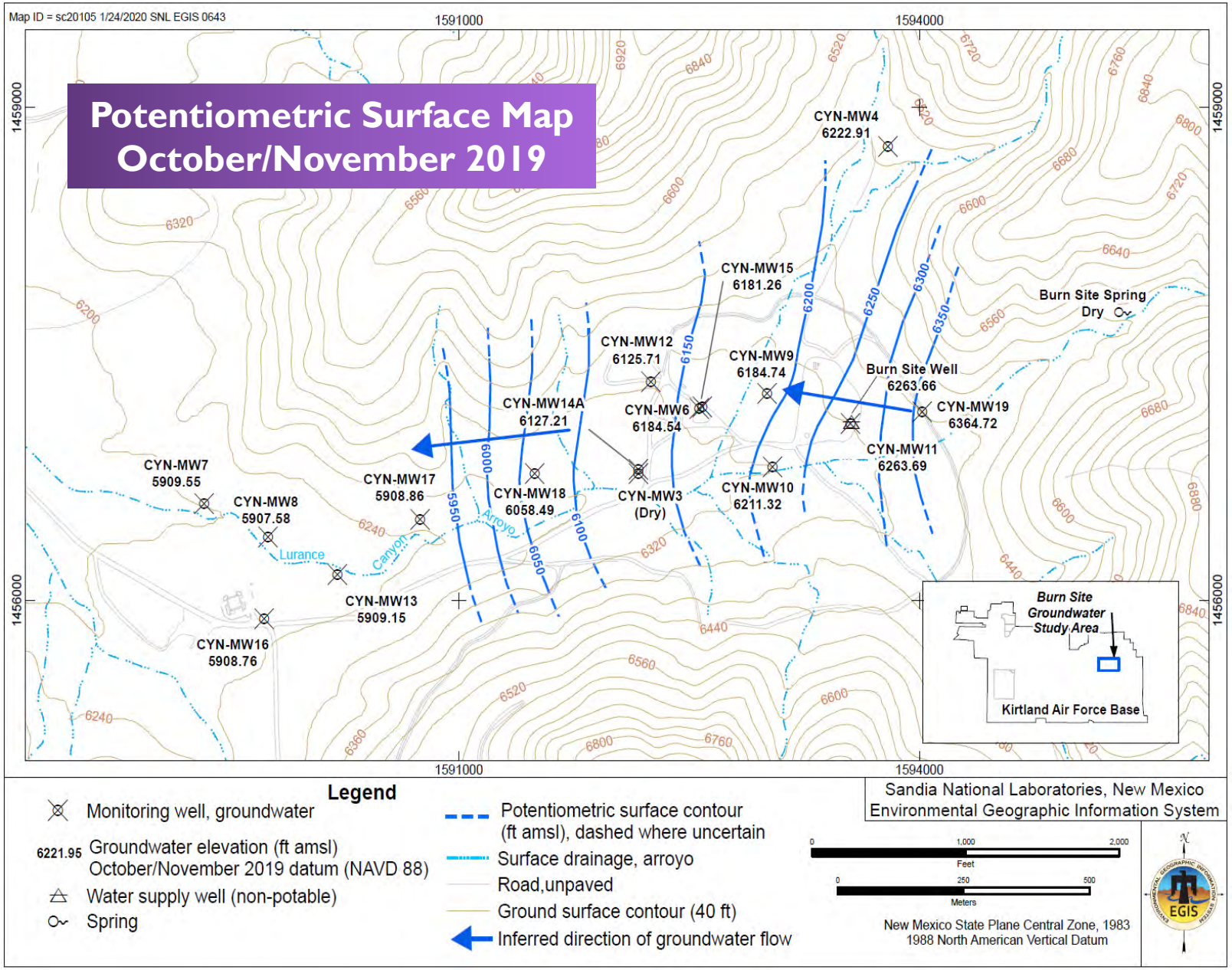


BSG Groundwater Monitoring

- Groundwater is contaminated with nitrate at concentrations above the maximum contaminant level (MCL).
- Nitrate has been detected above the MCL in several of the wells that are sampled.
- The plume is approximately 60 acres.
- Groundwater in the 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 typically derived from both man-made and natural sources, and may include ammonium nitrate slurry, wastewater discharges, and degradation of explosive compounds.
- No other chemicals exceed the MCL.

Constituent of Concern	Maximum Concentration in 2019	MCL
Nitrate	40.3 milligrams per liter (well CYN-MW9)	10.0 milligrams per liter

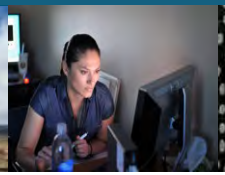
Potentiometric Surface Map October/November 2019



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 quarterly or semiannual groundwater sampling that was presented in the Annual Groundwater Monitoring Report submitted to the New Mexico Environment Department (NMED) in June 2020 (approved by NMED in August 2020).
- Submitted a Monitoring Well Installation Work Plan to NMED in January 2019; and approved by NMED in February 2019.
- Four monitoring wells were installed in October/November 2019.
- Submitted a Monitoring Well Installation Report to NMED in May 2020; and approved by NMED in July 2020.
- Met with NMED in September 2020 to discuss recent groundwater data.
- Preparing the Annual Groundwater Monitoring Report for 2020; anticipate delivery to NMED by June 2021.

Tijeras Arroyo Groundwater (TAG) Investigation



John R. Copland
Environmental Restoration Operations

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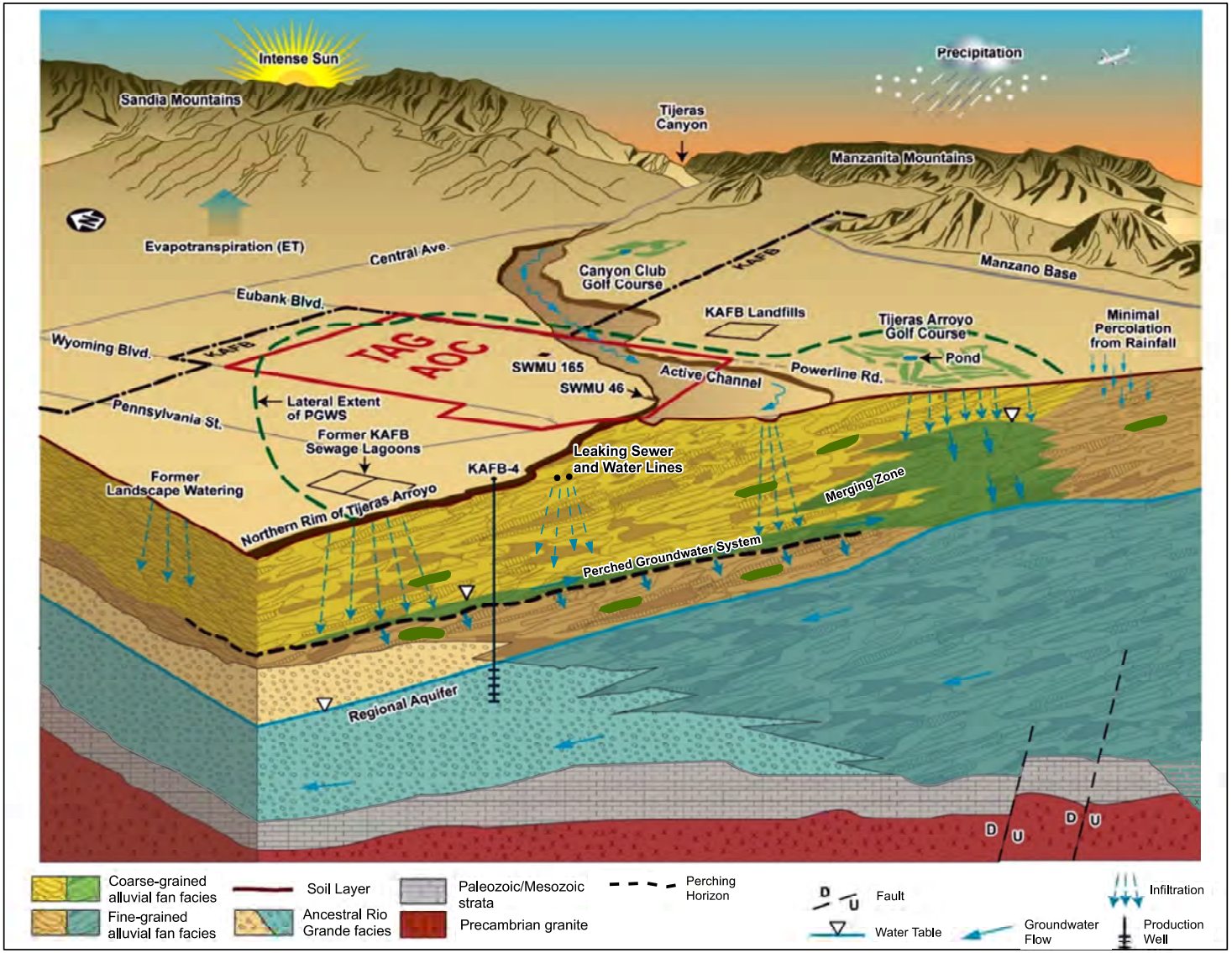
TAG Site Description

- The Tijeras Arroyo Groundwater (TAG) Investigation Area of Concern (AOC) covers approximately 1.8 square miles in the north-central portion of Kirtland Air Force Base (KAFB) and is located just south of the Wyoming and Eubank gates.
- Technical Areas I, II, and IV are located in the TAG AOC at Sandia National Laboratories (SNL).
- The Tech Areas were built on land that had been previously developed by commercial airline operators starting in 1928. This area was further developed by the U.S. military during World War II.
- Activities began in 1948 and have primarily involved weapons development and energy research.
- Two water-bearing units, the Perched Groundwater System (PGWS) and the Regional Aquifer, are present in the alluvial-fan sediments that consist mostly of sands and gravels. Twenty-one monitoring wells are currently sampled in the TAG AOC.

TAG Groundwater Description

- **Perched Groundwater System (PGWS)**
  - The PGWS has a water table ranging in depth from approximately 270 to 330 feet below the ground surface across the TAG AOC. The water table slopes to the southeast.
  - The PGWS was mostly created by manmade activities including sewage systems and waste-water outfalls. All of these discharge activities were eliminated in 1992.
  - A thin layer of about 7 to 20 feet of saturated silty sand remains in the PGWS.
  - Groundwater migrates slowly to the southeast at approximately 24 feet per year. A portion of groundwater also percolates slowly downward through the clayey Perching Horizon.
  - The thickness of saturation in the PGWS is decreasing as the layer naturally dewaters at an average of approximately half a foot per year. This dewatering continues to occur.
  - The PGWS merges with the Regional Aquifer near the Tijeras Arroyo Golf Course.
- **Regional Aquifer**
  - The Regional Aquifer occurs at a depth ranging from approximately 440 to 560 feet.
  - The Regional Aquifer is vertically separated from the PGWS by approximately 200 feet of unsaturated strata, except where the two water-bearing units merge near the golf course.
  - Groundwater in the Regional Aquifer flows west and northwest at approximately 55 feet per year.

Conceptual Site Model for the TAG Vicinity



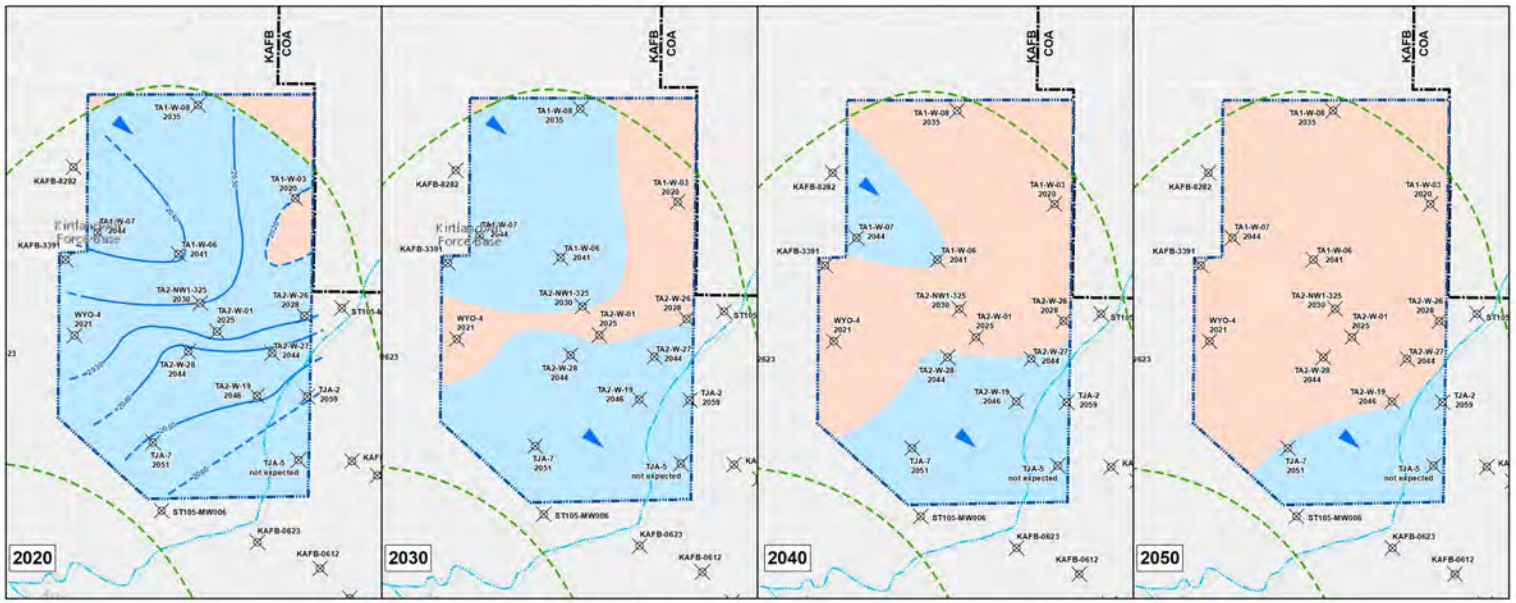
TAG Groundwater Monitoring

- Began collecting groundwater samples at TAG AOC in 1992.
- Installed 31 monitoring wells in the TAG AOC.
- Groundwater samples are analyzed for volatile organic compounds, metals, nitrate, and radionuclides.
- The KAFB Environmental Restoration Program and the City of Albuquerque - Environmental Health Department have installed 89 monitoring wells in the surrounding area.
- In addition to groundwater sampling conducted by SNL, KAFB, and the City personnel, the United States Geological Survey has also independently collected groundwater samples for the purpose of evaluating naturally occurring nitrate sources in sediments below the Tijeras Arroyo floodplain.
- Cooperation and data sharing between the four entities enhances our understanding of the hydrogeologic setting in a broad perspective.

TAG Groundwater Monitoring Results for Nitrate

- Groundwater in the PGWS is contaminated with nitrate at concentrations above the maximum contaminant level (MCL).
- Therefore, corrective action per New Mexico Environment Department (NMED) guidance is required for elevated nitrate concentrations in the PGWS.
- Nitrate can be produced by both man-made and natural sources. Possible nitrate sources include septic leach fields, wastewater discharges, nitrate fertilizers, and the degradation of minerals and plant material in soil.
- Monitoring wells screened in the PGWS yield only small volumes of water typically at one to two gallons per minute. Water from the PGWS is not used for any purpose at SNL; no one is drinking contaminated groundwater.
- Depending on location, PGWS monitoring wells will go dry in 5 to 44 years, except in the extreme southeast corner of the AOC. This is shown on the next slide.

The expected progression of dewatering within the PGWS is shown in 10 year intervals. Year 2020 is at the left side. Hydrograph estimates were used for creating the 2030, 2040, and 2050 panels. The tan areas show where monitoring wells are projected to no longer produce enough groundwater for sampling in those years.



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

TAG Groundwater Monitoring

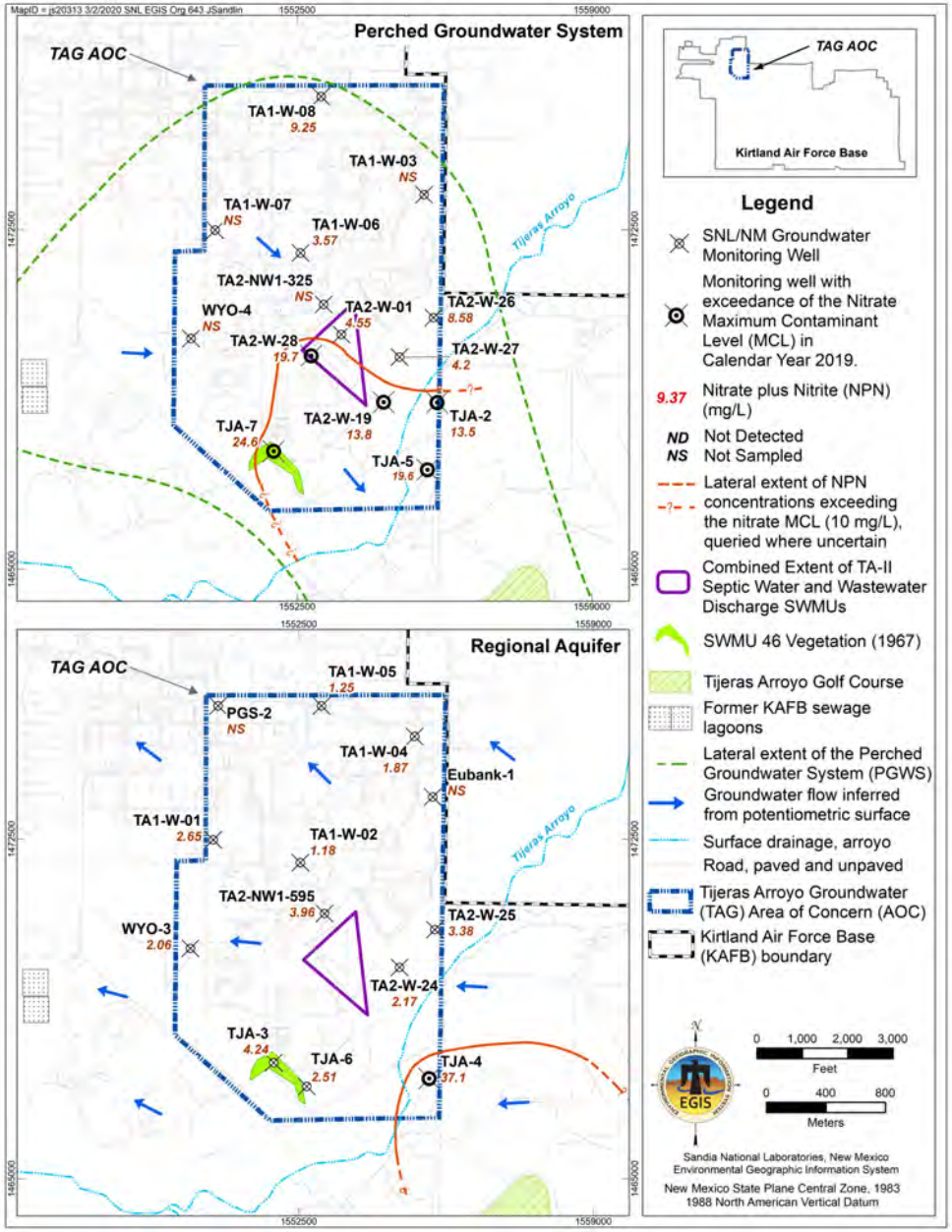
- Elevated nitrate concentrations in the PGWS do not pose a threat to drinking water in the Regional Aquifer. Sandia operations have not contaminated the Regional Aquifer. Computer modeling and ongoing groundwater sampling continue to demonstrate that the Regional Aquifer will not be impacted.
- The 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 in the PGWS.
- The nearest Albuquerque Bernalillo County Water Utility Authority well is Regional Aquifer well Ridgecrest 1, which is located approximately 2 miles to the north of the elevated nitrate concentrations in the PGWS.
- Two constituents of concern, nitrate and TCE, were identified by NMED in the 2004 Consent Order.

Constituent of Concern	Maximum Concentration in Perched Groundwater System, 2019	Maximum Concentration in Regional Aquifer, 2019	MCL
Nitrate	24.6 milligrams per liter (well TJA-7)	4.24 milligrams per liter (well TJA-3); 37.1 milligrams per liter (well TJA-4, merging zone)	10 milligrams per liter
Trichloroethene	5.71 micrograms per liter, at well TJA-2, this is a one-time exceedance since the well was installed in 1994. Sampled five times since the exceedance; all results were less than the MCL.	0.700J micrograms per liter (well TJA-3); <0.300 micrograms per liter (well TJA-4)	5 micrograms per liter

The 2019 maximum nitrate concentrations for the PGWS are shown in the upper panel. The lower panel shows results for the Regional Aquifer.

For the PGWS, the red line shows that nitrate exceeds the MCL at five monitoring wells in the southeast corner of the TAG AOC. The blue arrows show that groundwater flows to the southeast and away from production wells.

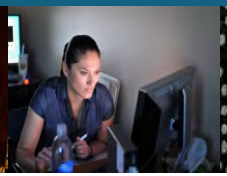
For the Regional Aquifer, one monitoring well in the far southeast corner of the TAG AOC exceeded the nitrate MCL. However, the groundwater sampled at merging-zone well TJA-4 is likely from an upgradient source such as the golf course.



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 NMED Hazardous Waste Bureau (HWB) in June 2021.
- The *Revised TAG Current Conceptual Model (CCM) and Corrective Measures Evaluation (CME) Report* was submitted to the NMED HWB in February 2018.
- Three remedial alternatives were proposed in the Revised CCM/CME report:
  1. Monitored natural attenuation using the existing well network. This involves sampling of 16 wells over a period of 41 years and is projected to cost $7.8 M.
  2. Groundwater Extraction and Treatment would require the installation of 73 extraction wells and 25 performance-monitoring wells. The estimated total cost is $61.5 M over a period of 27 years.
  3. In-situ Bioremediation would require the installation of 575 injection wells and 25 performance-monitoring wells. The estimated total cost is $173.3 M over a period of 27 years.
- Each remedial alternative requires the semiannual sampling of both water-bearing units.
- In September 2020, a virtual meeting was held with personnel from SNL, DOE, and NMED HWB to discuss the Revised CCM and CME report.
- NMED HWB is anticipated to select a remedial alternative in 2021.

Technical Area-V Groundwater Investigation



Jun Li
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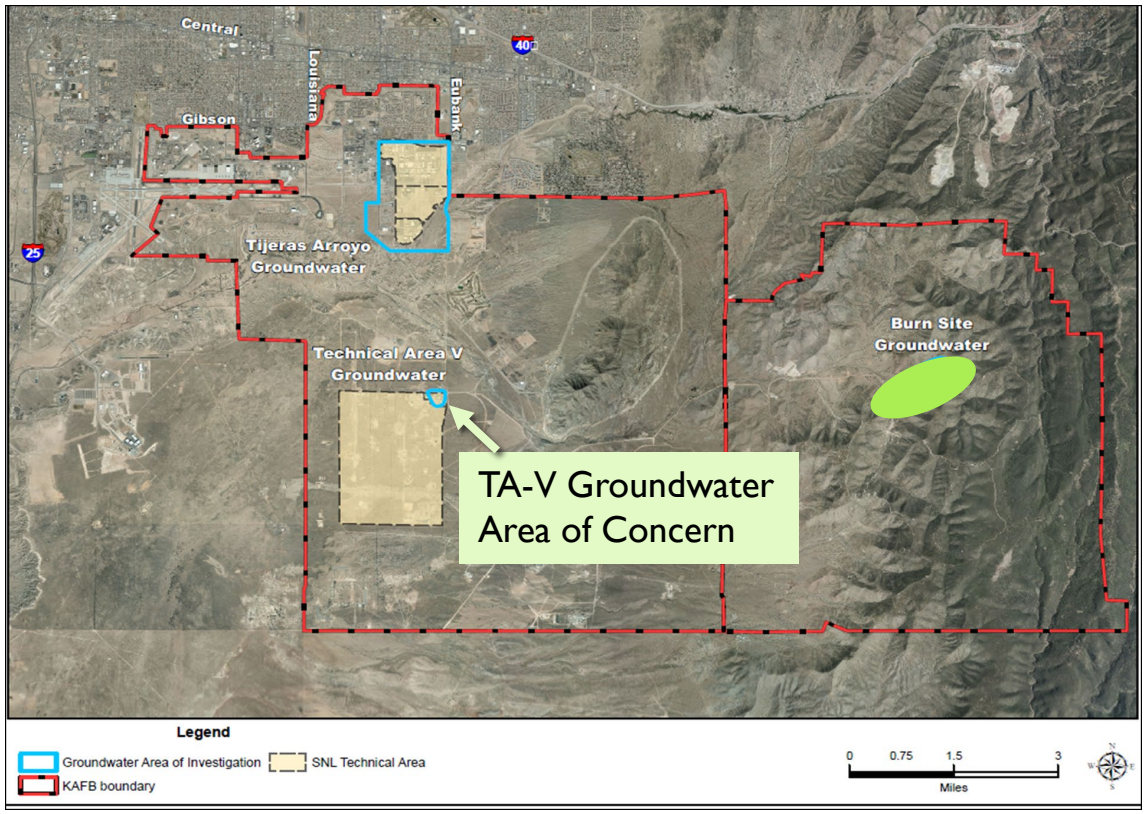
TA-V Groundwater Area of Concern Site Description

- The groundwater at Technical Area-V (TA-V) at Sandia National Laboratories (SNL) is designated an Area of Concern (AOC) in the Compliance Order on Consent.
- TA-V is an industrial area in the west-central portion on Kirtland Air Force Base (KAFB). The area of TA-V is approximately 35 acres.

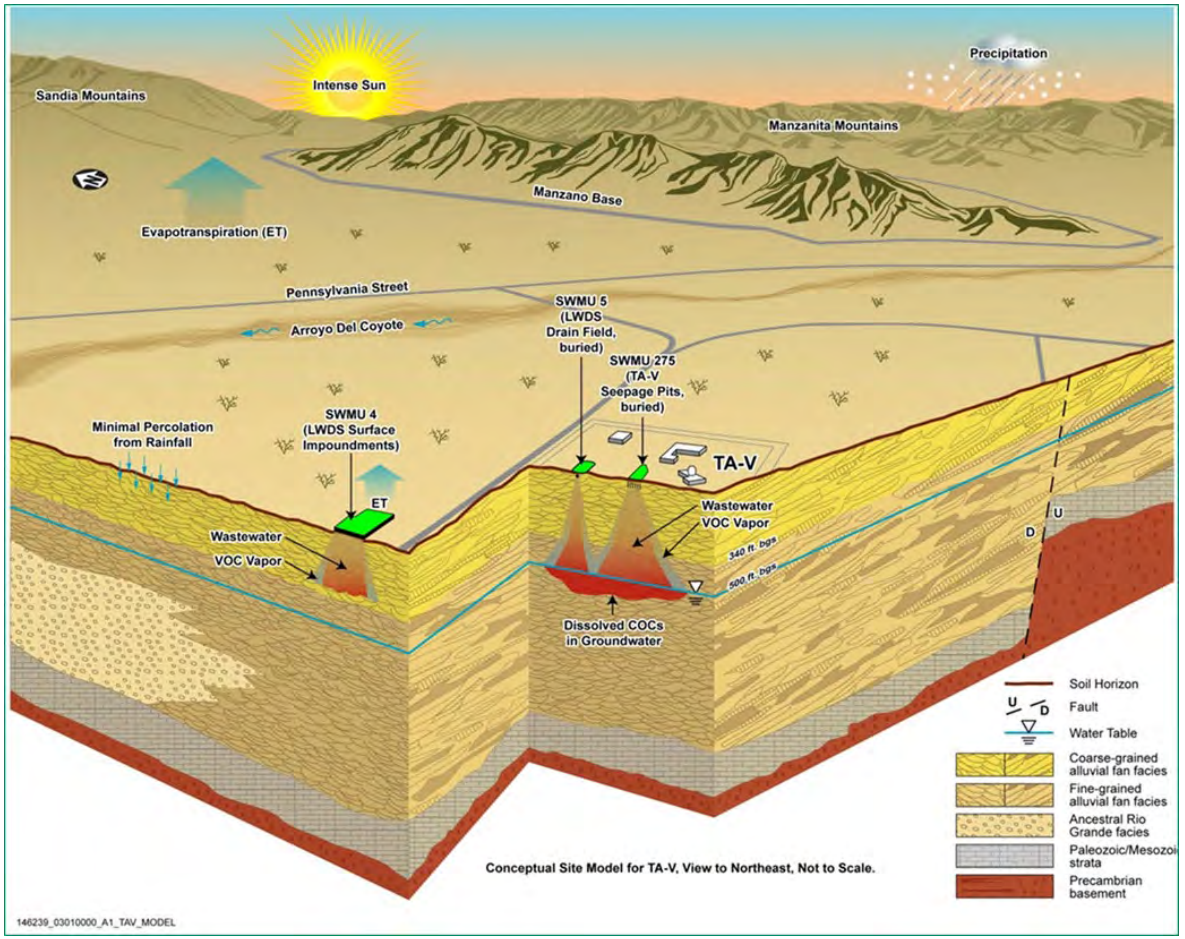


TA-V Groundwater Area of Concern Site Description

- SNL activities at TA-V began in 1961 and involve operating research reactors.
- All the surface and shallow subsurface contamination has been addressed and corrective action is complete. Now corrective action is required only for the groundwater at TA-V.

TA-V Groundwater Area of Concern Site Description

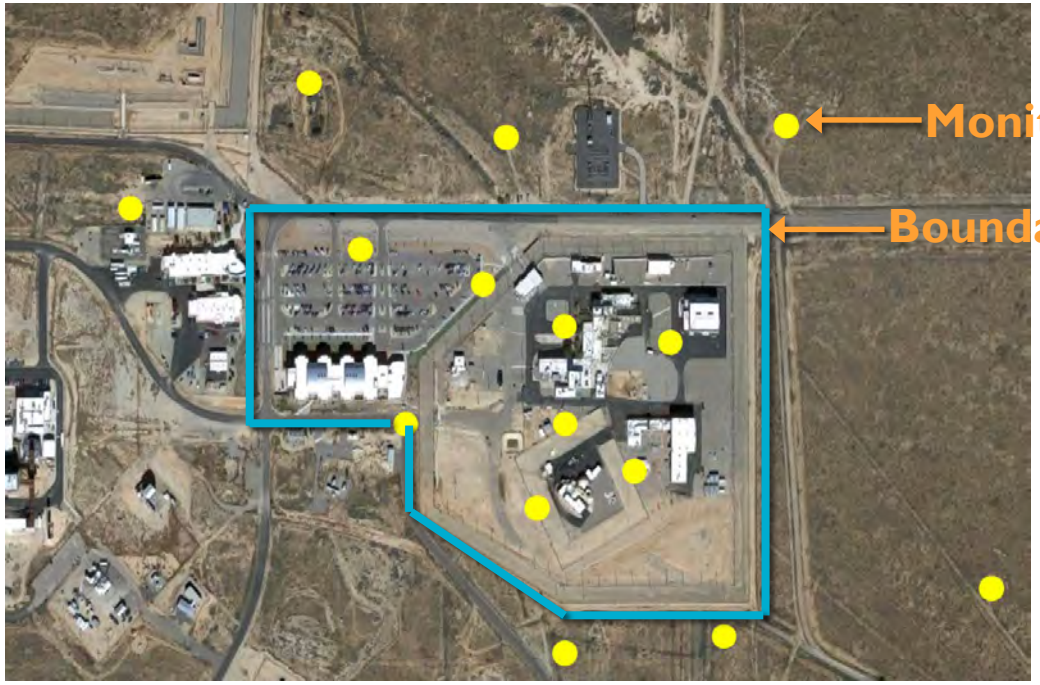
- Groundwater at TA-V occurs in the Regional Aquifer that resides in fine-grained, clay-rich, alluvial fan sediments. The water table is approximately 500 – 520 feet below the ground surface at TA-V.



Conceptual Site Model of Groundwater Contamination Process at TA-V

TA-V Groundwater Monitoring

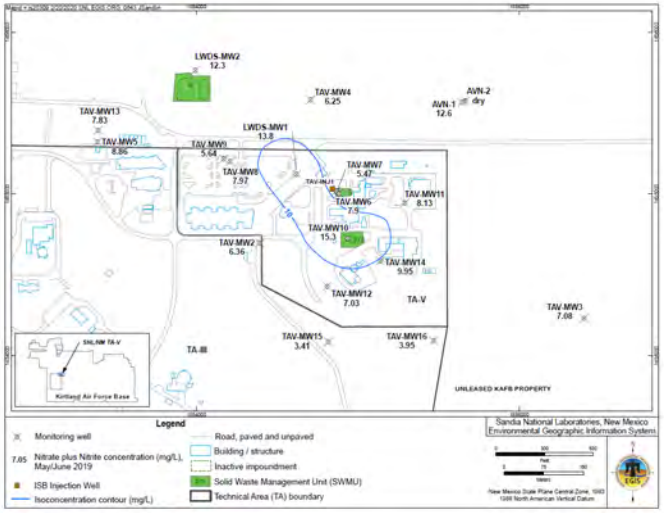
- Groundwater monitoring began in 1992.
- Current monitoring network consists of 18 wells.
- Groundwater is contaminated with nitrate and trichloroethene (TCE) at concentrations above the U.S. Environmental Protection Agency maximum contaminant levels (MCLs) for drinking water.
- No other constituents in TA-V groundwater exceed the MCLs.

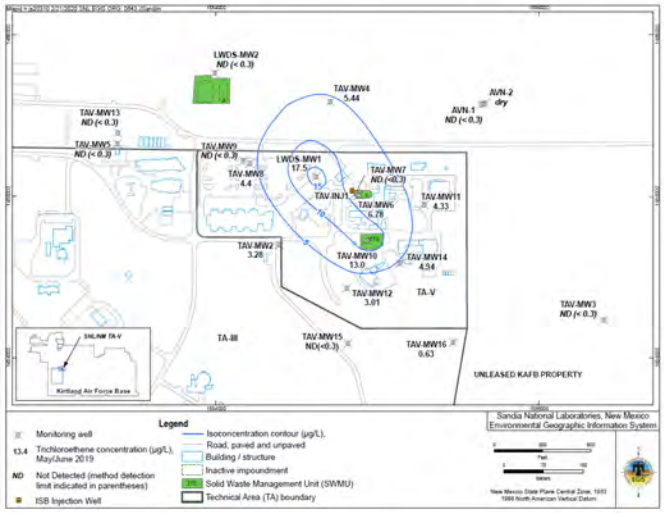


TA-V Groundwater Monitoring

- Nitrate plume covers approximately 1.4 acres.
- Trichloroethene plume covers approximately 13 acres.
- Both plumes are stable. Neither plume is moving away from TA-V.

Constituent of Concern	Maximum Concentration in 2019	MCL
Nitrate	15.3 milligrams per liter (well TAV-MW10)	10 milligrams per liter
Trichloroethene	20.2 micrograms per liter (well LWDS-MW1)	5 micrograms per liter





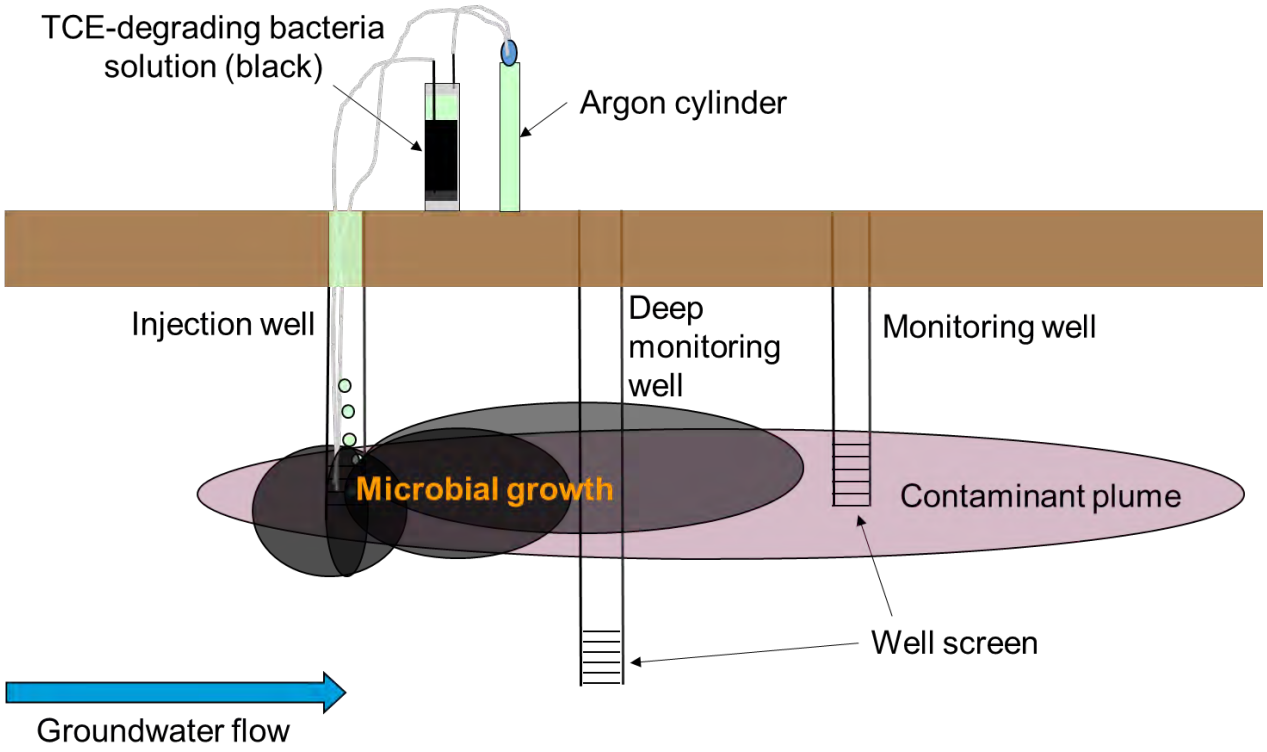
Source: 2019 Annual Groundwater Monitoring Report, Nitrate Plume (left) and TCE Plume (right)

TA-V Groundwater Monitoring

- Groundwater in this area is not used for any purpose.
- Nearest downgradient drinking-water supply well (KAFB-4) is 2.7 miles to the north.
- The plumes are not adversely impacting human health and the environment.

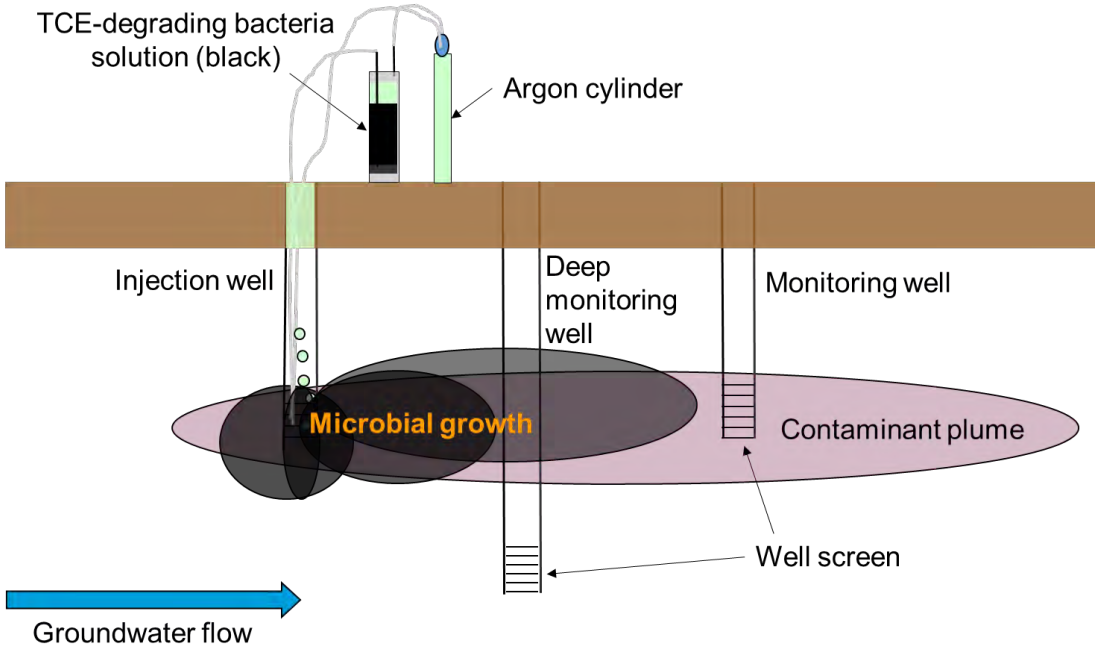
Treatability Study of In-Situ Bioremediation at TA-V

- The plan of the treatability study is to deliver bioremediation solution using one injection well.
- The objective is to evaluate the effectiveness of in-situ bioremediation as a corrective measure for the TA-V Groundwater AOC.



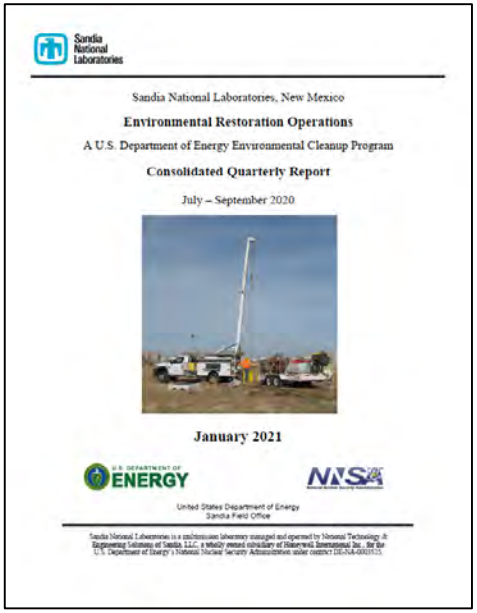
Treatability Study of In-Situ Bioremediation at TA-V

- Groundwater at TA-V is aerobic, and biodegradation is not naturally occurring.
- Bioremediation solution provides the nutrients and pH buffer for the bacteria to biodegrade nitrate and trichloroethene.
- How large an area can be treated by the bioremediation solution injected?



Treatability Study of In-Situ Bioremediation at TA-V

- The New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB) is the regulator for the investigation.
- The NMED Ground Water Quality Bureau (GWQB) issued the Discharge Permit DP-1845 to discharge bioremediation solution to groundwater using injection well.
- Progress on the treatability study is provided to the NMED HWB and GWQB through quarterly reporting.


Sandia National Laboratories

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Environmental Restoration Operations

A U.S. Department of Energy Environmental Cleanup Program

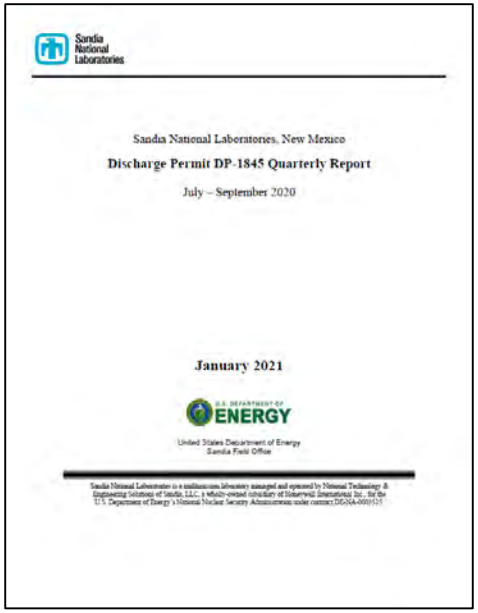
Consolidated Quarterly Report

July – September 2020

January 2021

DOE ENERGY NNSA

United States Department of Energy
Sandia Field Office


Sandia National Laboratories

Sandia National Laboratories, New Mexico

Discharge Permit DP-1845 Quarterly Report

July – September 2020

January 2021

DOE ENERGY

United States Department of Energy
Sandia Field Office

Treatability Study at Injection Well TAV-INJ1

- Injected approximately 531,000 gallons of bioremediation solution and 123 liters of trichloroethene-degrading bacteria from November 2018 to April 2019.
- Injection well TAV-INJ1 and monitoring well TAV-MW6 are monitored for the performance of in-situ bioremediation.
- One deep well and eight surrounding wells are monitored to determine potential impact on groundwater quality caused by the bioremediation solution injected.

Findings of Treatability Study at Injection Well TAV-INJ1

- Groundwater at injection well TAV-INJ1 has been maintaining optimal conditions for biodegradation.
- The inert tracer (bromide) injected with the bioremediation solution has reached monitoring well TAV-MW6.
- Dissolved oxygen level has decreased in the groundwater at well TAV-MW6; however, anaerobic condition is not established.
- No change in groundwater quality has been observed in the deep monitoring well and the eight surrounding wells.

Findings of Treatability Study at Injection Well TAV-INJ1

- Delivery of bioremediation solution was limited by low hydraulic conductivities of the aquifer at TA-V.
- Infrastructure at TA-V (buildings and utilities) limits installation of multiple injection wells impeding the success of the in-situ bioremediation technology at this site.
- Findings of the treatability study of in-situ bioremediation at injection well TAV-INJ1 were shared with NMED HWB in September 2020.
- Complete the two-year performance monitoring in May 2021.

That's a wrap for the evening!