

# Progress of Sandia's Environmental Restoration Operations



**Karen Oden**

**Environmental Restoration Operations**

**Federal Project Director**

**DOE/NNSA**

**Sandia Field Office**

**John R. Cochran**  
**Environmental Restoration Operations**  
**Project Manager**  
**Sandia National Laboratories**  
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# Overview of Sandia's Environmental Restoration Operations

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- Mission – Identify, characterize & remediate sites where hazardous &/or radioactive materials have been released
- Scope: 315 sites
  - Legally - Solid Waste Management Units or Areas of Concern
  - For presentation - Environmental Restoration sites or “ER sites”
- All activities regulated by New Mexico Environment Department (NMED) under the 2004 Compliance Order on Consent
- DOE/NNSA and Sandia Corporation are in compliance with: Compliance Order on Consent, Federal and State requirements



# Overview of Sandia's Environmental Restoration Operations

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- Very successful, completed corrective action at 303 of 315 ER sites
- 12 ER sites remain in corrective action process
- Presentation will review progress in completing corrective action at these 12 ER sites
- Focus on progress made during last 6 months



# Remaining 12 ER Sites

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- 6 “Soil sites”
- 3 “Active mission” sites with deferred corrective action
- 3 Groundwater Areas of Concern
  - Burn Site
  - Technical Area V
  - Tijeras Arroyo



# Remaining 9 ER Sites

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6 Soil sites

~~3 “Active mission” sites with deferred corrective action~~

3 Groundwater Areas of Concern

Burn Site

Technical Area V

Tijeras Arroyo



# Remaining 9 ER Sites

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- 6 Soil sites
- 3 Groundwater Areas of Concern
  - Burn Site
  - Technical Area V
  - Tijeras Arroyo



## Six Soil Sites

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- Completed corrective actions at sites 8/58, 68, 149, 154 and 502
- Received Certificates of Completion from NMED in letters January 19, 2016 (8/58, 68, 149, 154) & February 29, 2016 (502)
- Requested change to Resource Conservation and Recovery Act (RCRA) Facility permit, to change status of these sites to Corrective Action Complete (letter dated May 16, 2016)
- Published legal notice of request in *Albuquerque Journal* on May 25, 2016
- Mailed notice to all persons on NMED mailing list

# Six Soil Sites

- Held Public Meeting on June 21, 2016 (22 posters and 8 subject matter experts)
- 60-day public comment period, ended July 24, 2016
- NMED is reviewing our request





# Remaining 9 ER Sites

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6 Soil sites (five plus one)

→ 3 Groundwater Areas of Concern (AOCs)

Burn Site

Technical Area V

Tijeras Arroyo



## Remaining 9 ER Sites

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- 6 Soil sites (five plus one)
- 3 Groundwater Areas of Concern (AOCs)



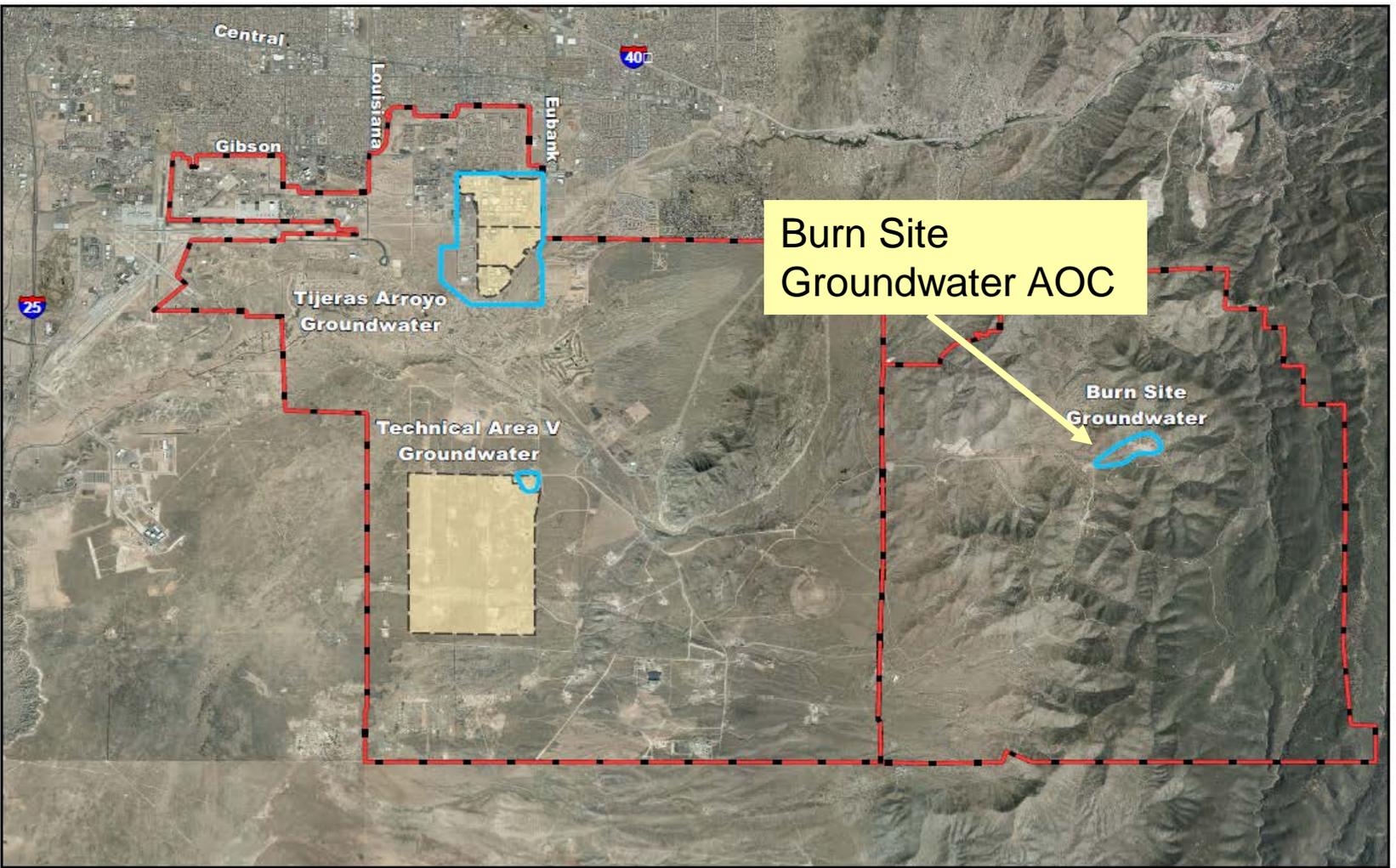
Burn Site

Technical Area V

Tijeras Arroyo

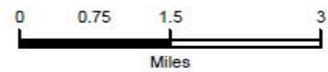


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**Legend**

-  Groundwater Area of Investigation
-  SNL Technical Area
-  KAFB boundary



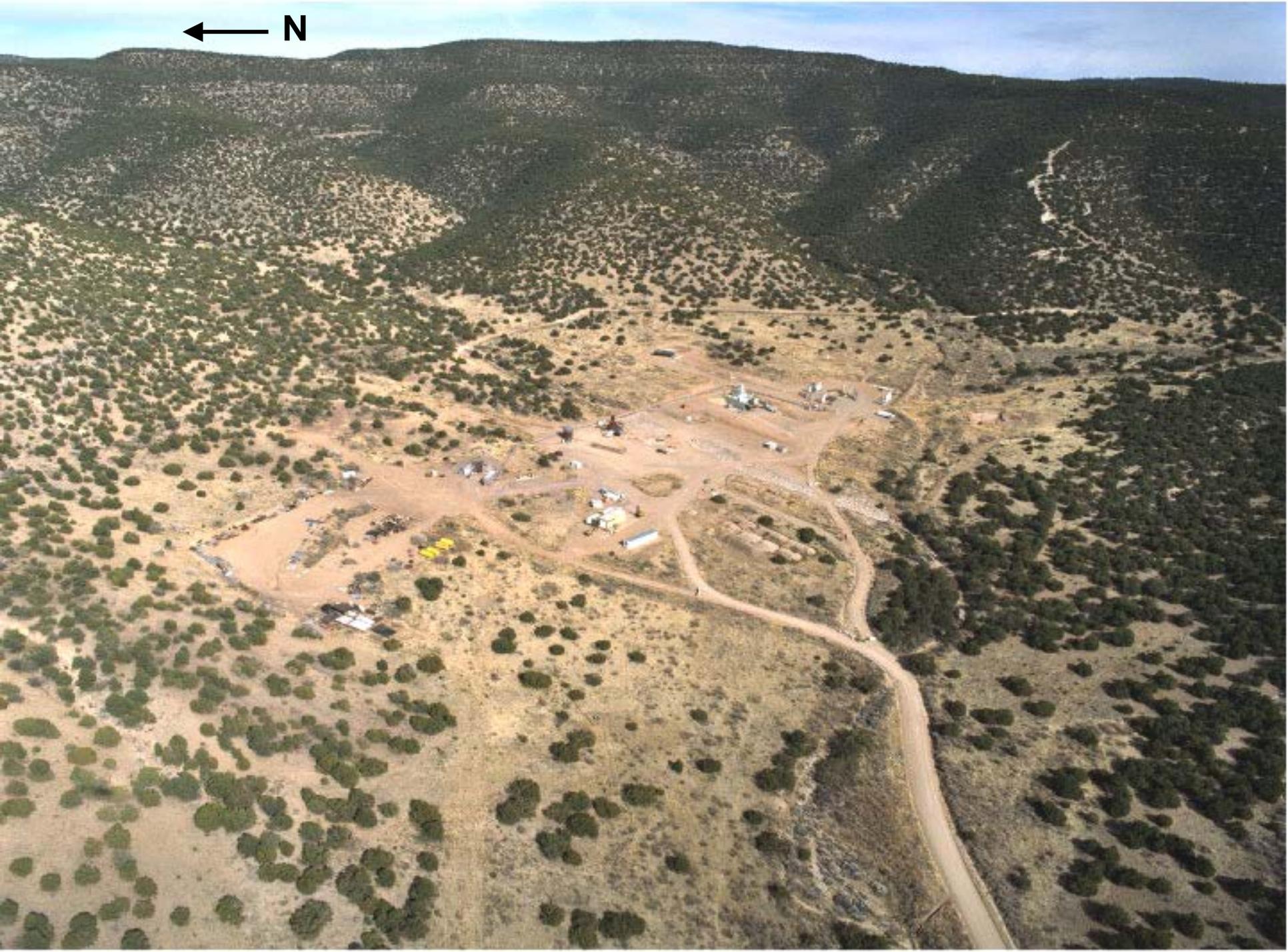


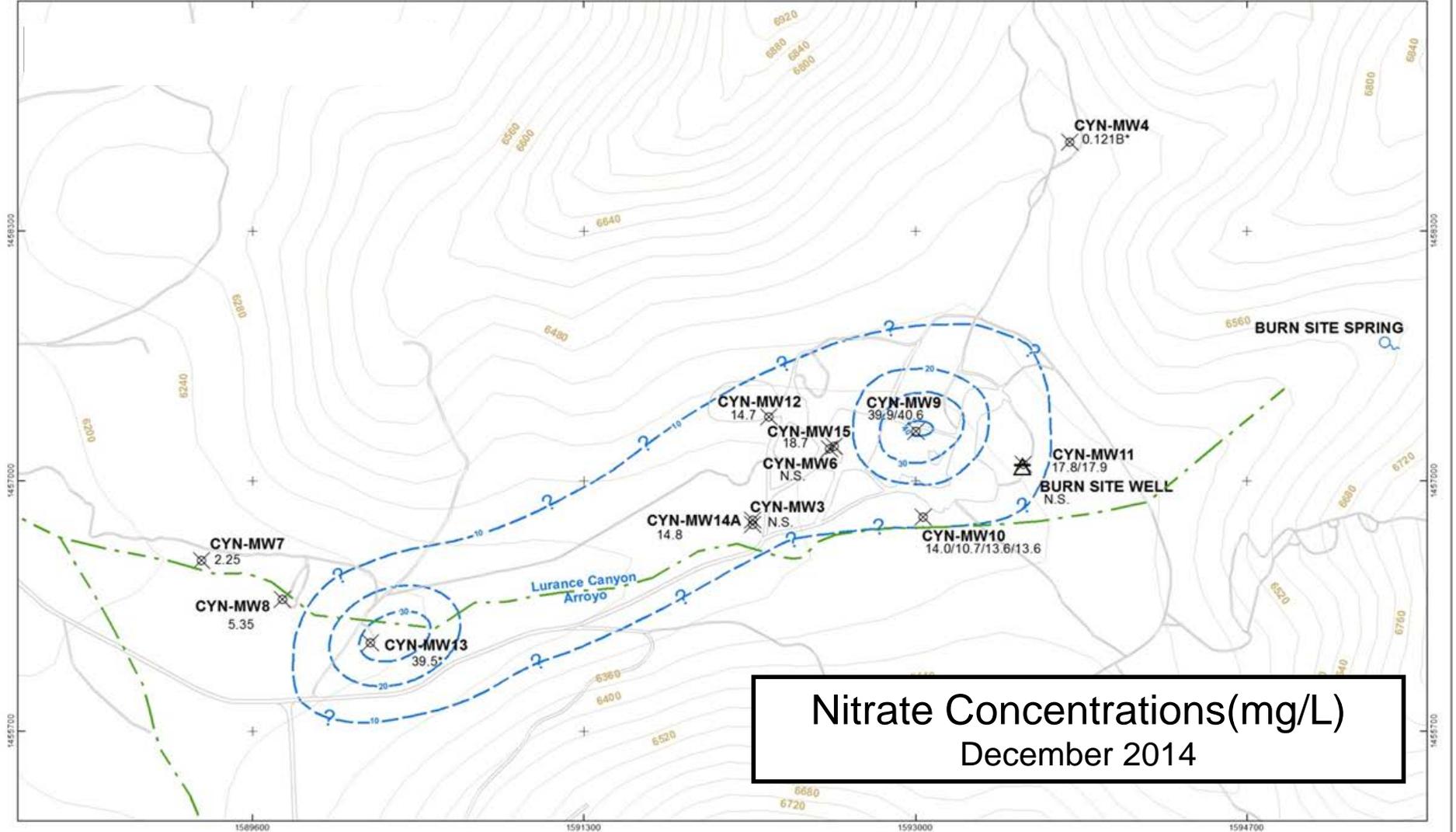
# Burn Site GW AOC

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- GW occurs in fractured bedrock
- Depth to GW varies from 108 to 326 ft. below surface
- GW contains nitrate (NO<sub>3</sub>), up to 42 ppm (reg. standard 10 ppm)
- GW in one monitoring well contains perchlorate ~ 4 ppb (no reg. standard)
- Currently conducting weight-of-evidence process to determine origin of nitrate
- Weight-of-evidence process includes aquifer pumping test

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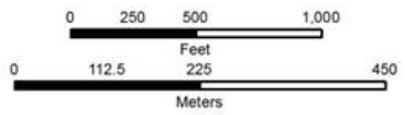




**Legend**

- Groundwater Monitoring Well, with December 2014, Nitrate plus Nitrite Concentrations (mg/L). N.S. denotes not sampled. \*Asterik denotes June 2014 sample.
- Production Well (non-potable)
- Concentration Contour (mg/L) (dashed where inferred; queried where uncertain)
- Spring
- Unpaved Road
- Arroyo
- 40-ft. Contour

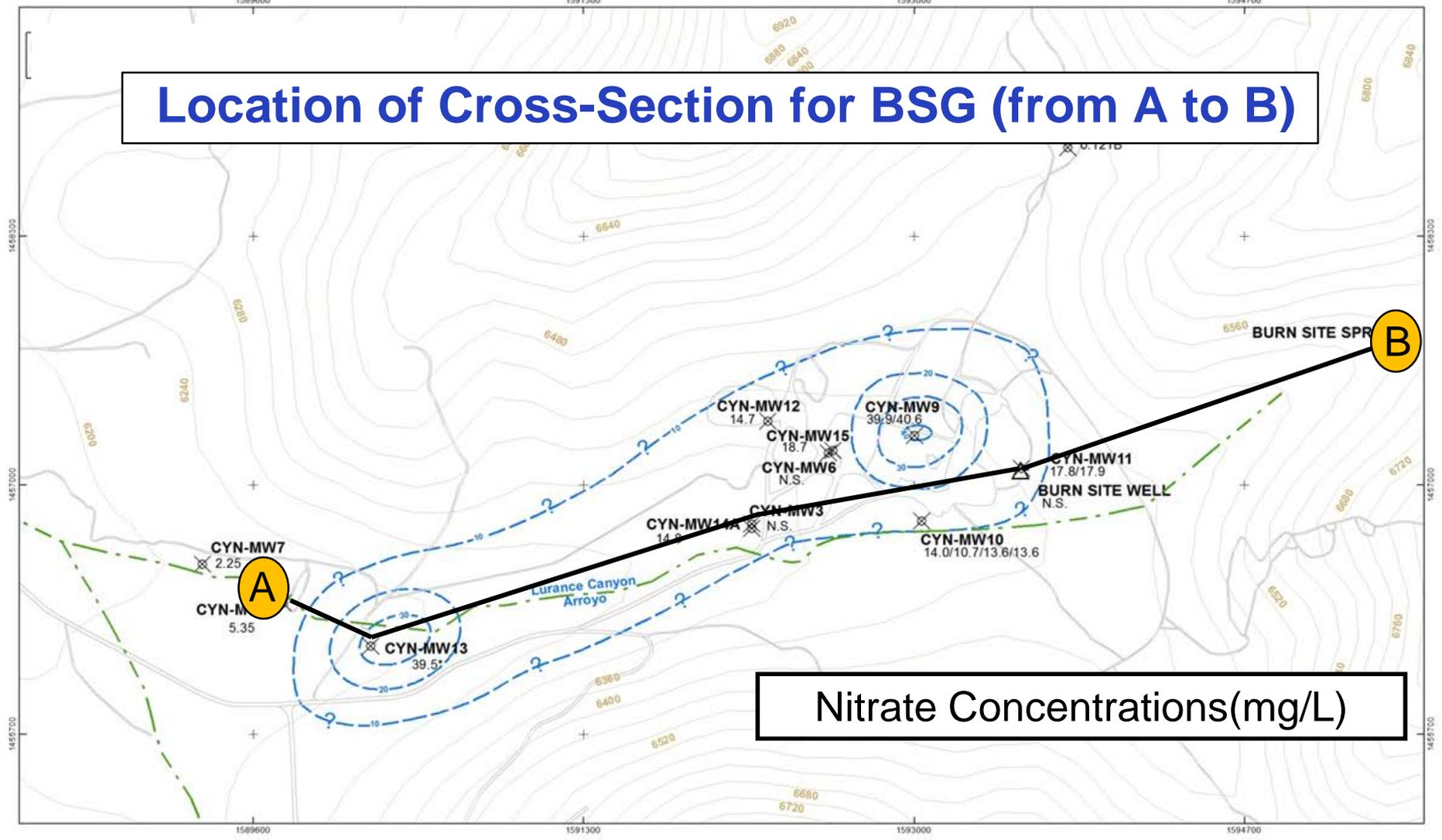
Sandia National Laboratories, New Mexico  
Environmental Geographic Information System



New Mexico State Plane Central Zone, 1983  
1988 North American Vertical Datum



# Location of Cross-Section for BSG (from A to B)

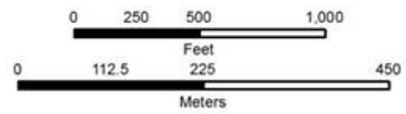


## Nitrate Concentrations(mg/L)

### Legend

- Groundwater Monitoring Well, with December 2014, Nitrate plus Nitrite Concentrations (mg/L). N.S. denotes not sampled. \*Asterik denotes June 2014 sample.
- Spring
- Unpaved Road
- Arroyo
- Production Well (non-potable)
- 40-ft. Contour
- Concentration Contour (mg/L) (dashed where inferred; queried where uncertain)

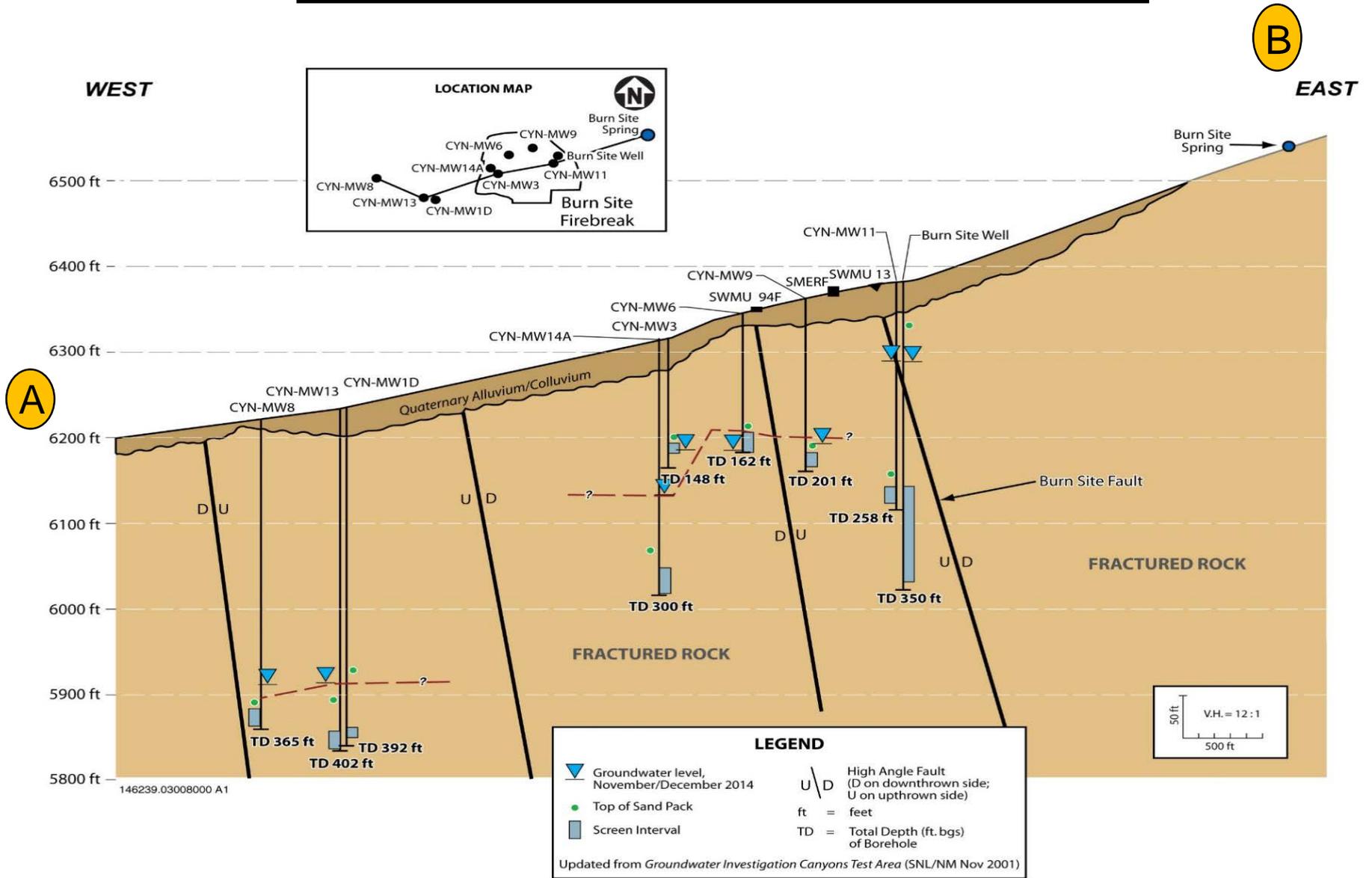
Sandia National Laboratories, New Mexico  
Environmental Geographic Information System



New Mexico State Plane Central Zone, 1983  
1988 North American Vertical Datum



# Simplified Cross-Section (from A to B)





# Burn Site GW AOC

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- As part of weight-of-evidence process, submitted Aquifer Pumping Test Work Plan to NMED
- NMED approved Pumping Test Work Plan on June 23, 2016
- Conducted Pumping Test during week of March 13, 2017
  - 12 hour step-down pumping test & 24 hour constant rate pumping test
- Currently analyzing data

# Conducting Aquifer Pumping Test





## Remaining 9 ER Sites

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- 6 Soil sites (five plus one)
- 3 Groundwater Areas of Concern (AOCs)

  - Burn Site



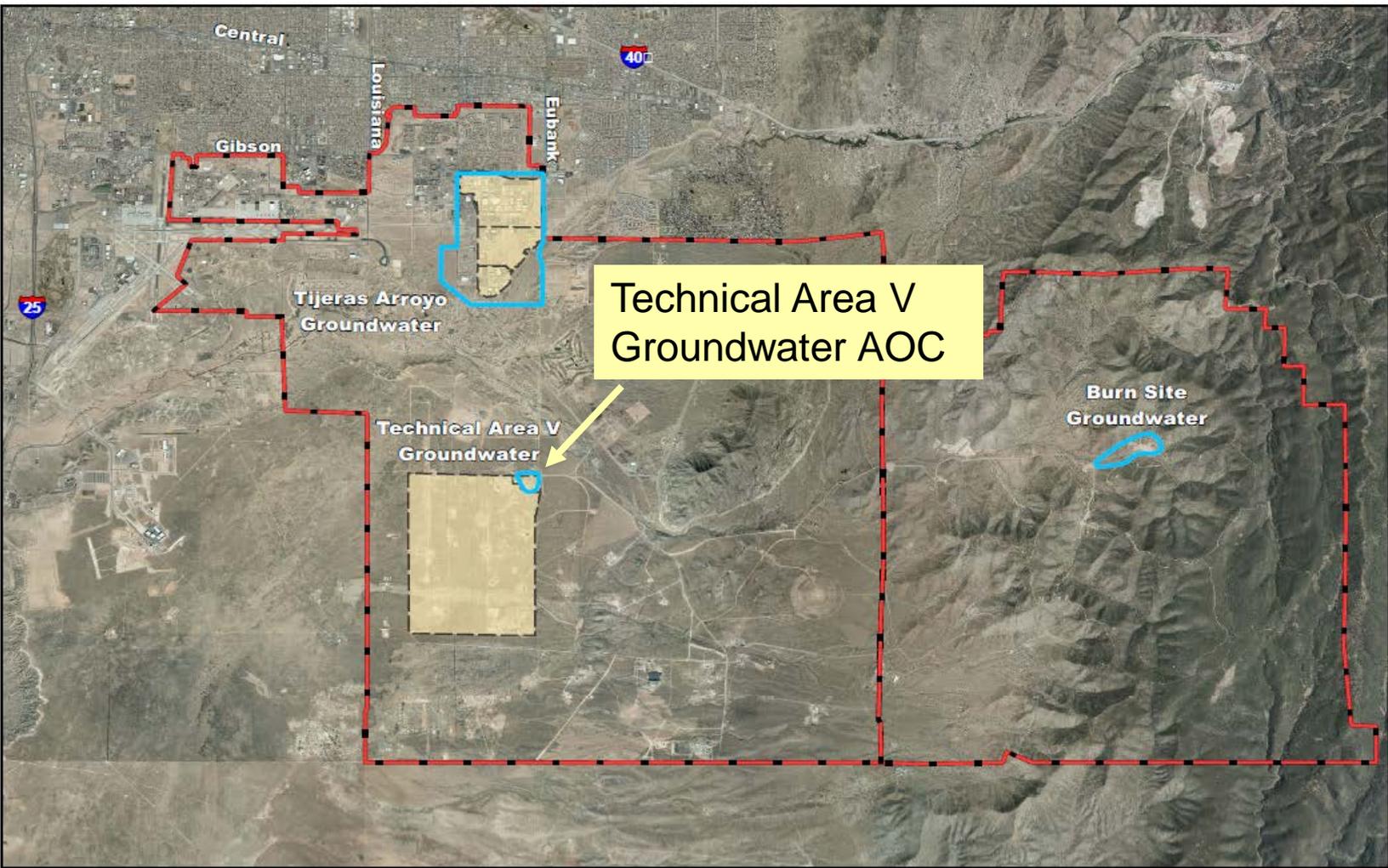


  - Technical Area V

  - Tijeras Arroyo



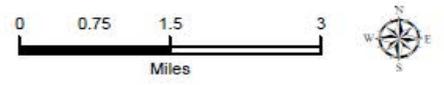
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Technical Area V  
Groundwater AOC

**Legend**

-  Groundwater Area of Investigation
-  SNL Technical Area
-  KAFB boundary





## Technical Area-V GW AOC

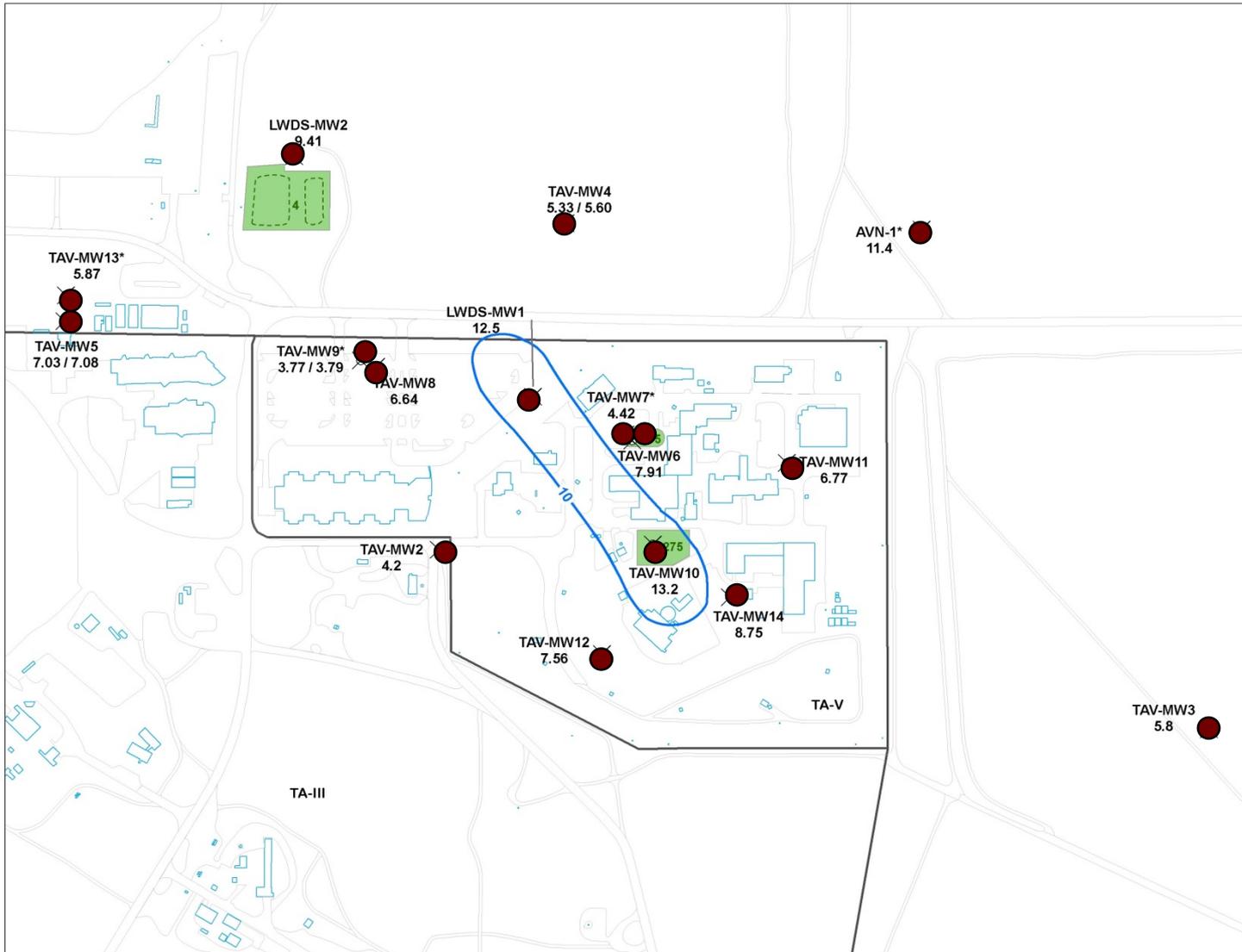
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- Technical Area V Groundwater (TAVG) AOC is 35 acres (0.05 sq. mi.)
- Current monitoring well network of 16 wells including three deep wells
- Regional GW occurs 500 ft. below surface in clays/silts/sands
- Contaminated with nitrate and trichloroethylene (TCE)
  - Nitrate: up to 14 ppm (regulatory standard is 10 ppm)
  - Trichloroethylene (TCE): up to 19 ppb (regulatory standard is 5 ppb)
  - Low concentrations & Plume is not moving



# Nitrate Distribution in Groundwater at TA-V

## December 2015

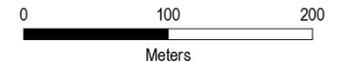
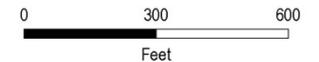


### Legend

- Monitoring well, with November/December 2015 Nitrate plus Nitrite concentrations (mg/L)
- Isoconcentration contour (mg/L)
- Road, paved and unpaved
- Building / structure
- Inactive impoundment boundary
- Solid Waste Management Unit (SWMU)
- Technical Area (TA) boundary

Note:

\* Wells AVN-1, TAV-MW7, TAV-MW9, and TAV-MW13 are completed below the water table, and were not contoured.

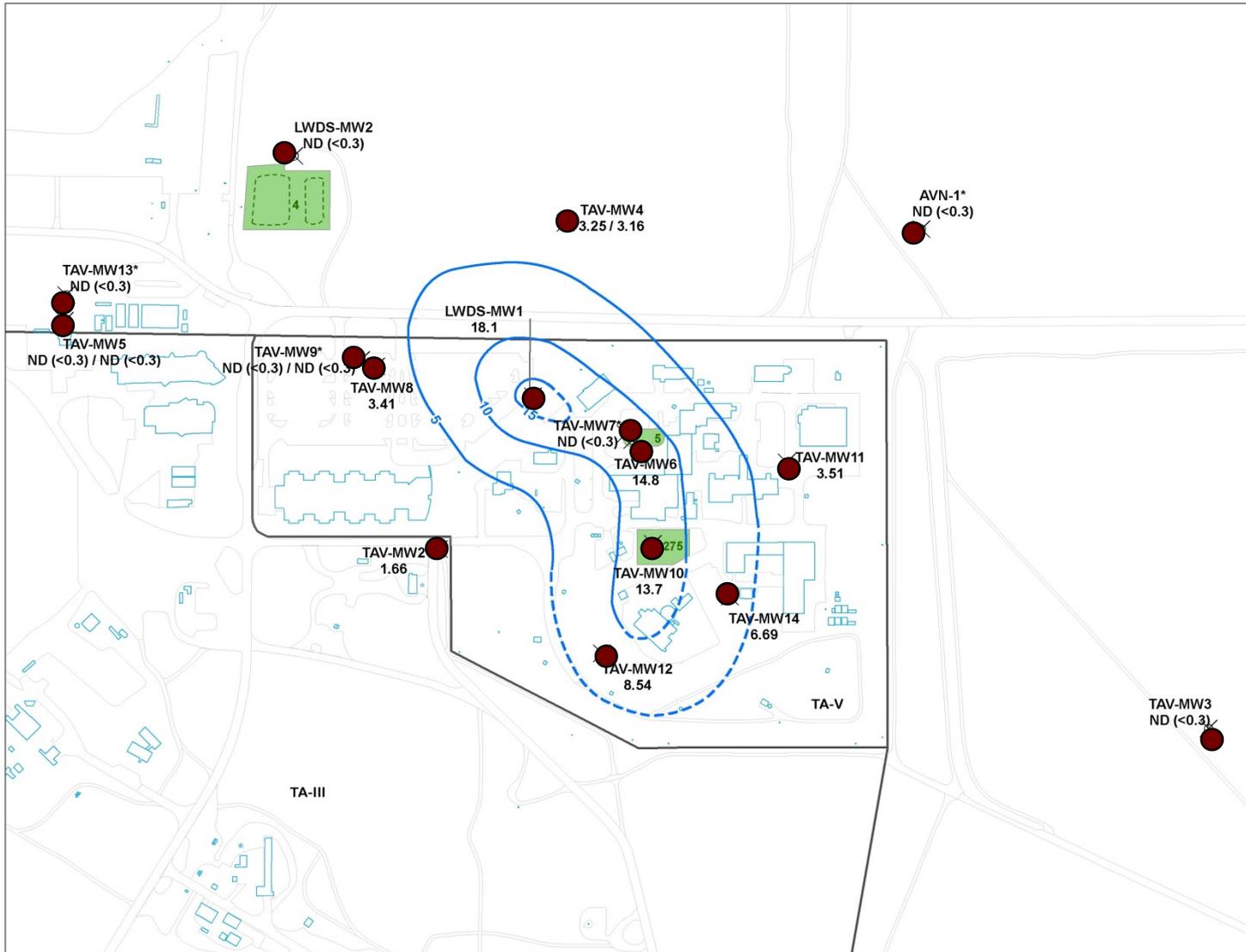


SNL EGIS ORG.4142

New Mexico State Plane Central Zone, 1983 North American Vertical Datum

SNL, EGIS Dept 4142 ce16516 3-16-16 / mb13135

# TCE Distribution in Groundwater at TA-V December 2015



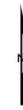
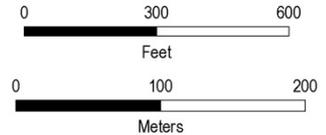
## Legend

- Monitoring well, with November/December 2015 Trichloroethene concentrations (µg/L)
- Isoconcentration contour (µg/L), dashed where inferred
- Road, paved and unpaved
- Building / structure
- Inactive impoundment boundary
- Solid Waste Management Unit (SWMU)
- Technical Area (TA) boundary

## Notes:

\* Wells AVN-1, TAV-MW7, TAV-MW9, and TAV-MW13 are completed below the water table, and were not contoured.

ND = not detected, method detection limit indicated in parentheses.



Sandia National Laboratories SNL EGIS ORG.4142

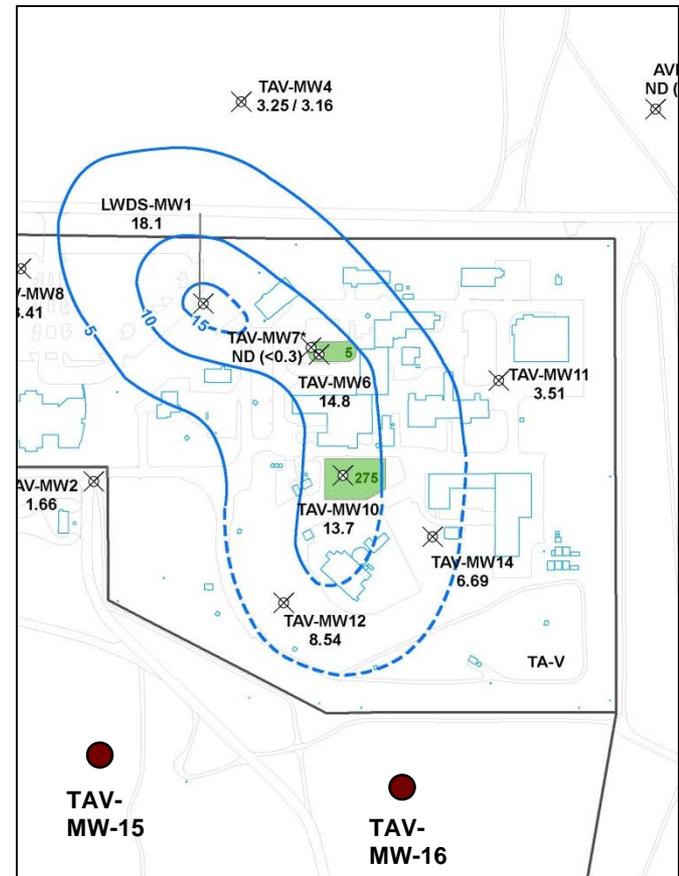
New Mexico State Plane Central Zone, 1983  
1988 North American Vertical Datum

SNL, EGIS Dept 4142 ce16515 3-16-16 / mb13135

# Installed Two New Monitoring Wells



- Installed 2 new monitoring wells to better define plume
- Completed: January 2017
- Now network 18 monitoring wells





# Path forward: a Phased Treatability Study of In-Situ Bioremediation of GW

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- “Treatability Study” is to test the effectiveness of in-situ bioremediation technology at site
  - “In-Situ” means to treat the contamination in place
  - “Bioremediation” means we will use biological processes to remediate the groundwater
- “Phased” means the study will be conducted in steps



# Simple Explanation of In-Situ Bioremediation of Groundwater

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- Injection wells will be used to supply substrate solution to the groundwater. Substrate solution contains bacteria, with “food” and nutrients for bacteria. Bacteria will break down nitrate and TCE into nontoxic substances.



# Animation of Bioremediation

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# What is Substrate Solution to be Injected?

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- Potable water containing:
  - Food for bacteria
  - Nutrients for bacteria
  - Bacteria that use TCE as food
  - Inert tracer



# How In-Situ Bioremediation Should Work

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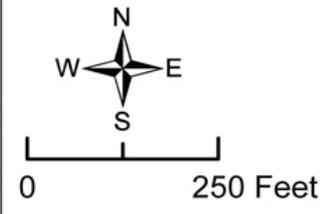
- After injection, expect 2 processes to occur, one after the other:
  - Process 1 – injected food & nutrients will cause existing bacteria to grow, and consume nitrates & oxygen dissolved in groundwater – groundwater becomes anaerobic (limited oxygen)
  - Process 2 - in anaerobic groundwater: injected food & nutrients & our bacteria (*dehalococcoides mccartyi*) consume TCE
- Injected bacteria (*dehalococcoides mccartyi*)
  - Naturally occurring, not genetically modified
  - Not toxic to humans
  - Only live in oxygen-free GW, can not live in surrounding GW



# Phased Treatability Study

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- Phase I - Pilot Test
  - Install injection well
  - Injection volume is 3,700 gallons
  - Performance monitoring for 6 months
- Phase I - Full-Scale Injection at the first injection well
  - Injection volume is 530,000 gallons for 60 ft radius
  - Performance monitoring for 2 years for rebound
- Phase II Full-Scale Injection at second & third injection wells
  - Install 2 more injection wells
  - Injection volume is 530,000 gallons each
  - Monitor 2 years



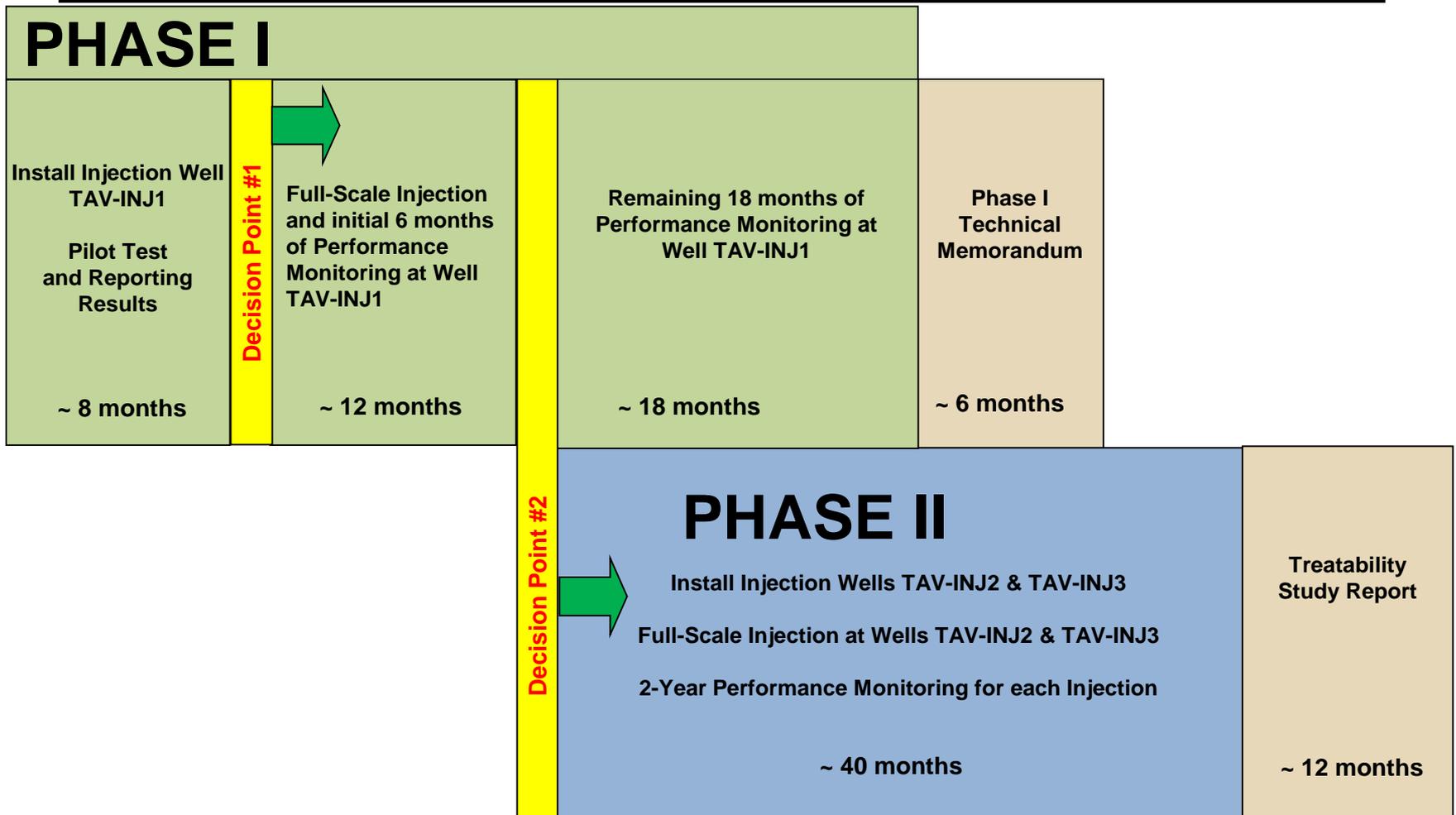
- Groundwater wells**
- Plume monitoring
  - ISB performance monitoring
- Proposed wells**
- Plume monitoring
  - ISB injection

**Legend**

- Inferred isoconcentration contour dashed where uncertain
- TCE (ug/L) (October 2013)
- Nitrate (mg/L) (October 2013)
- Anticipated radius of influence for gravity injection of ISB substrate

Note: \* = Well screened in deeper zone; concentrations not used for contouring.

# Treatability Study Flow Chart with Activities & Estimated Durations





# Status: Work Plan and Discharge Permit

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- Treatability Study Work Plan approved by NMED *Hazardous Waste Bureau* - May 2016
- Discharge Permit from NMED is required to inject substrate solution into groundwater
- Discharge Permit Application submitted to NMED *Groundwater Quality Bureau* - July 2016
- Draft Discharge Permit posted by NMED on March 3, 2017 for Public Comment
- Public Comment period closes May 11, 2017



**New Mexico Environment Department –  
Ground Water Quality Bureau**

Notice is hereby given pursuant to 20.6.2.3108.G NMAC, the following Groundwater Discharge Permit applications have been proposed for approval. To request additional information or to obtain a copy of a draft permit, contact the Ground Water Quality Bureau in Santa Fe at (505) 827-2900. Draft permits may also be viewed on-line at <https://www.env.nm.gov/gwb/NMED-GWQB-PublicNotice.htm>

DP-1845 - Sandia National Laboratories/New Mexico: James Todd, Assistant Manager for Engineering, proposes to discharge up to 20,000 gallons per day (gpd) of impacted groundwater to be received and treated utilizing an In-Situ Bioremediation system. Three injection wells will be installed via air-rotary with the casing-hammer method. The wells are to be installed are TAV-INJ1, TAV-INJ2, and TAV-INJ3. Groundwater will be extracted and be mixed with substrate solution components and then gravity-fed into injection wells along with biodegradation bacteria. During the full-scale injection, each daily injection will be followed with approximately 100 gallons of chase water consisting of unamended potable water deoxygenated by sparging with argon gas. Potential contaminants associated with this type of discharge include Trichloroethene (TCE) and Nitrate. The facility is located on Kirtland Air Force Base, approximately one mile southwest of the intersection of Pennsylvania Ave and TA-111V of, in Section 20, T09N, R04E, Bernalillo County. Groundwater beneath the site is at a depth of approximately 503.37 feet and has a total dissolved solids concentration of approximately 423 milligrams per liter. NMED permit contact: Kellie Jones at (505) 827-2949 or [kellie.jones@state.nm.us](mailto:kellie.jones@state.nm.us)

This draft permit was previously published on March 3, 2017. This notification is to extend the public comment period for an additional 30-day period.



## Remaining 9 ER Sites

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- 6 Soil sites (five plus one)
- 3 Groundwater Areas of Concern (AOCs)

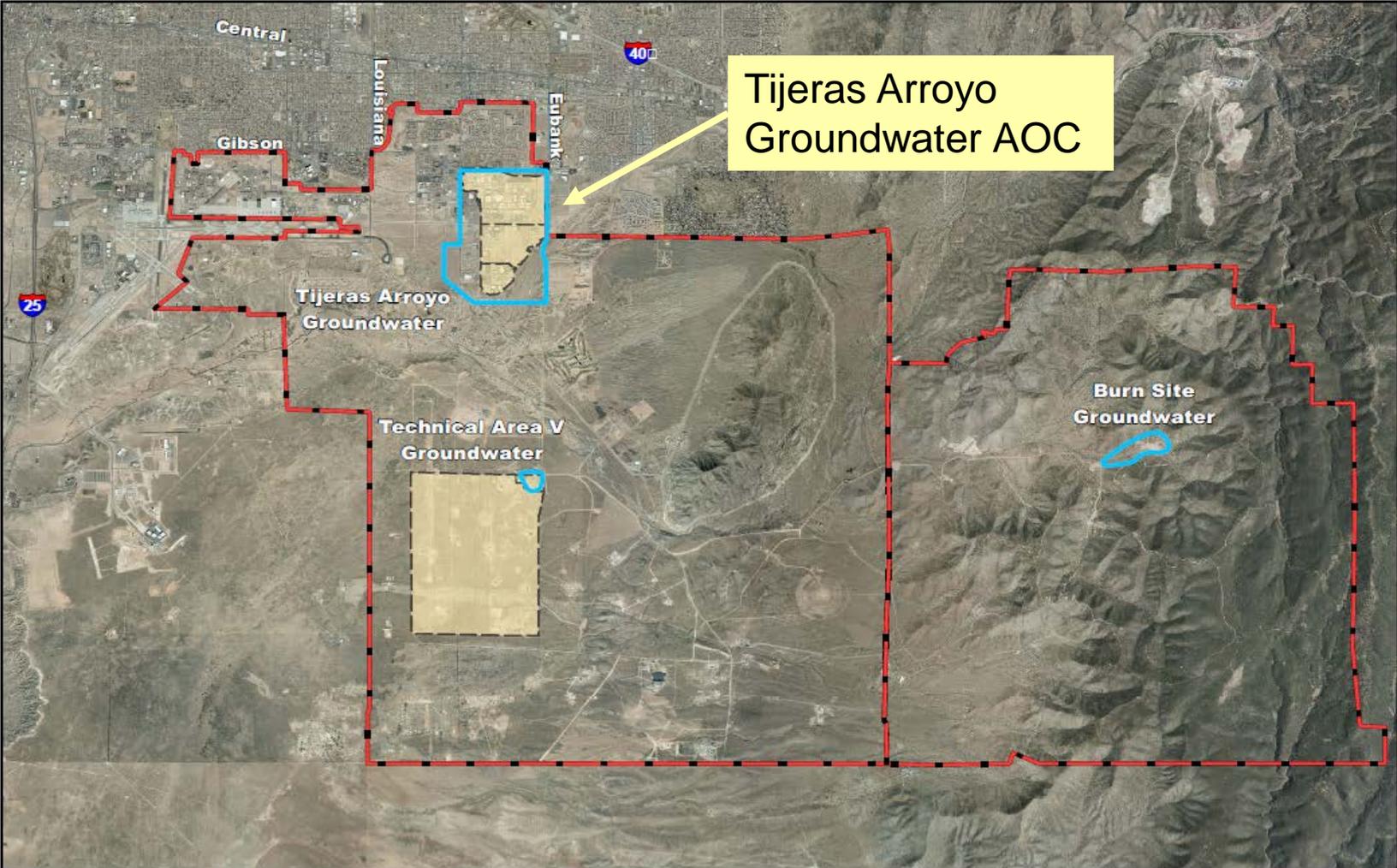
  - Burn Site

  - Technical Area V

  - Tijeras Arroyo



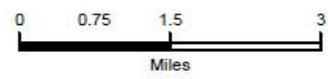
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Tijeras Arroyo  
Groundwater AOC

**Legend**

- Groundwater Area of Investigation
- SNL Technical Area
- KAFB boundary





# Tijeras Arroyo Groundwater AOC

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- Tijeras Arroyo Groundwater (TAG ) AOC is 1.8 sq. mile
- There are currently 27 Sandia National Laboratories (SNL) monitoring wells in TAG AOC
- Based on data from SNL and KAFB monitoring wells:
  - Regional aquifer at ~500 ft in clays/silts/sands
  - “Perched” GW ~ 200 ft above regional aquifer in silts/sands

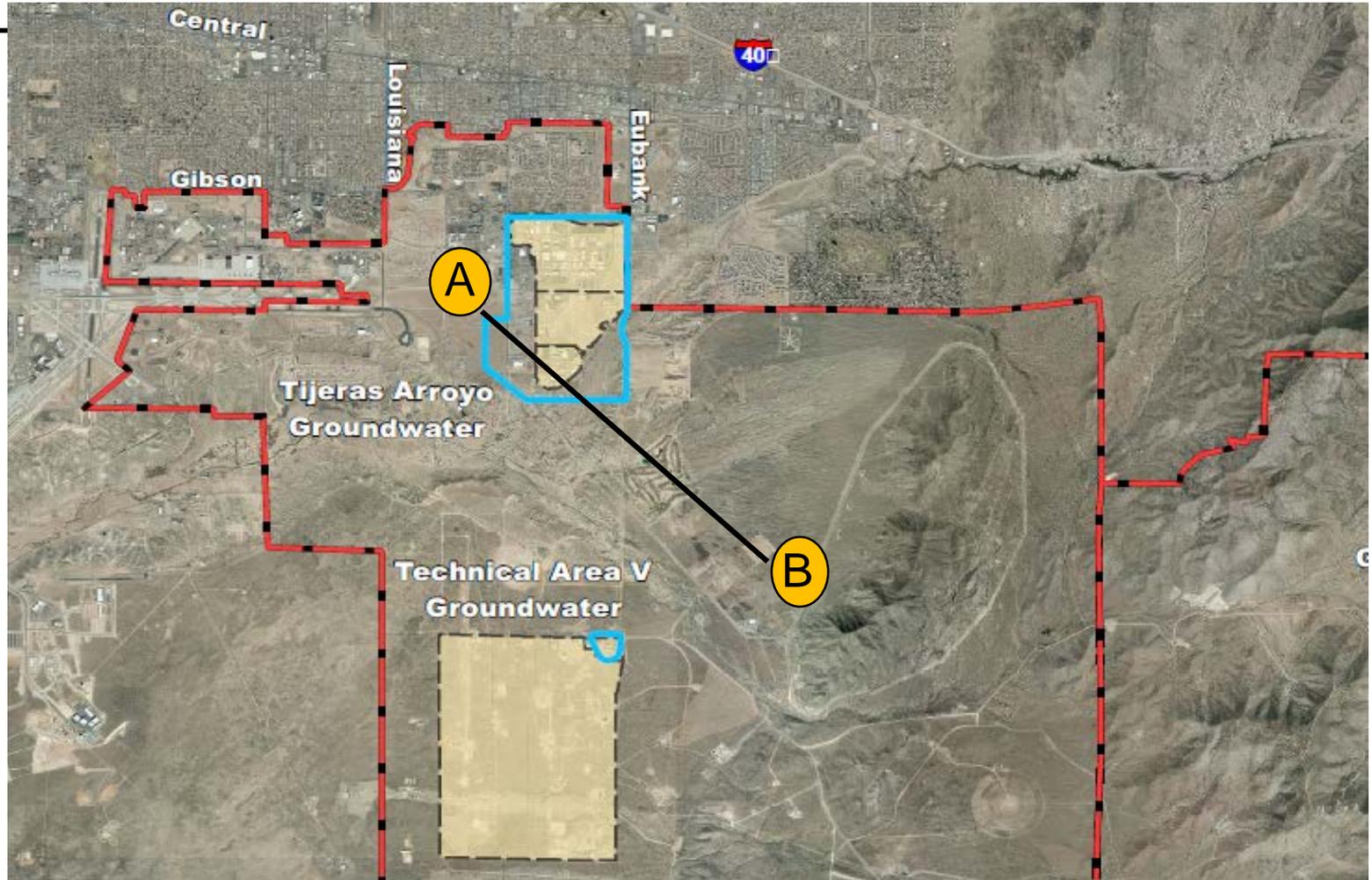


# Perched Groundwater in Tijeras Arroyo Groundwater AOC

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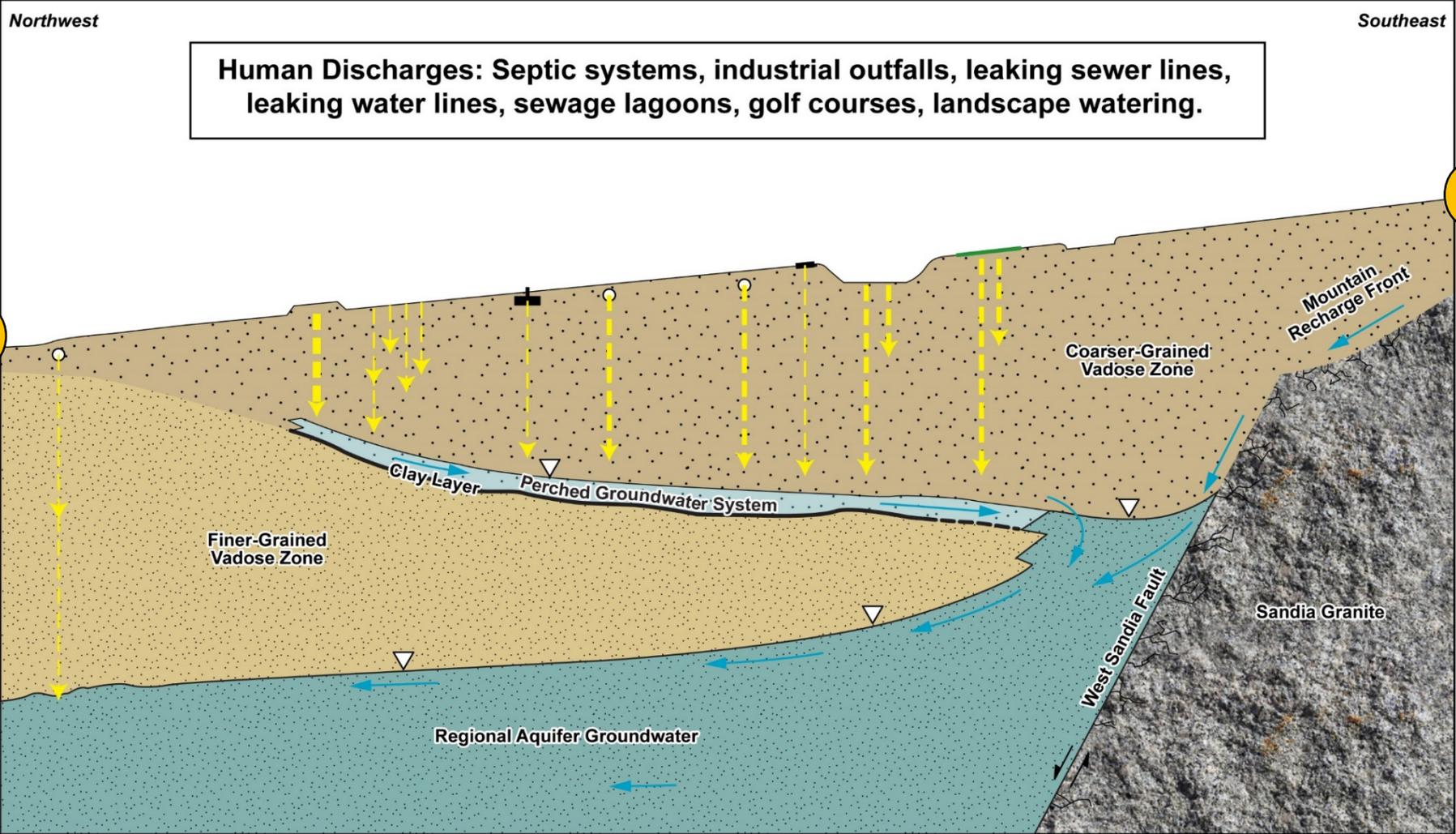
- Perched GW is from natural sources & human activities
- Examples of human activities releasing water to subsurface
  - SNL's old acid waste line outfall (1948-1974)
  - SNL's TA-II Septic Systems (1948 to 1992)
  - KAFB sewage impoundments (1966 - 1987)
  - Major breaks in large City/County sewer line (1994, 2003 & 2013)
  - Leaks in sewer and water lines
  - Landscape watering
- Perched GW thin seam of GW 10 to 20 ft. thick in SNL's AOC
- No drinking water wells in perched GW
- Human discharges have decreased and perched GW in SNL's AOC is drying out

# Location of Conceptual Model Cross-Section of TAG (from A to A)

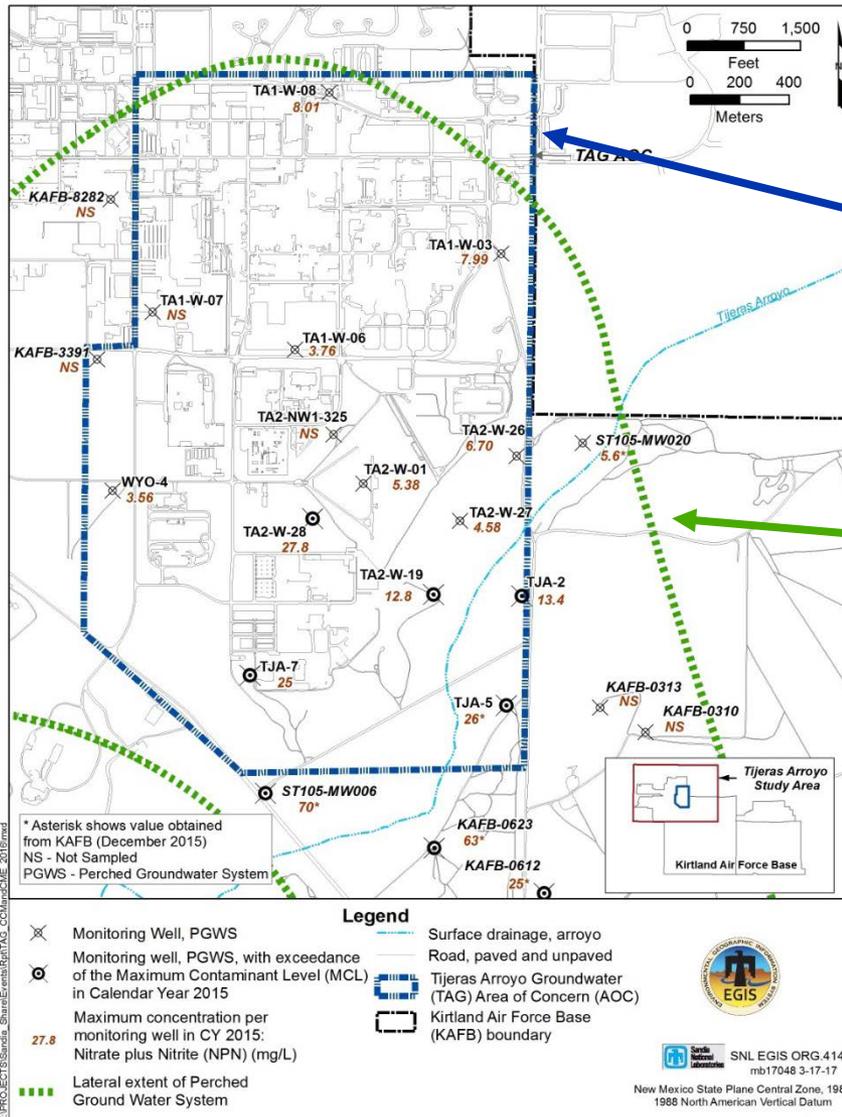


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# Conceptual Model Cross-Section of TAG (from A to B)



# Extent of Perched Groundwater



Area of Concern (inside blue line)

Perched Groundwater (inside green line)

# 20+ Year Record of Declining Water Levels in Perched Groundwater





# Nitrate Levels

## October 2015

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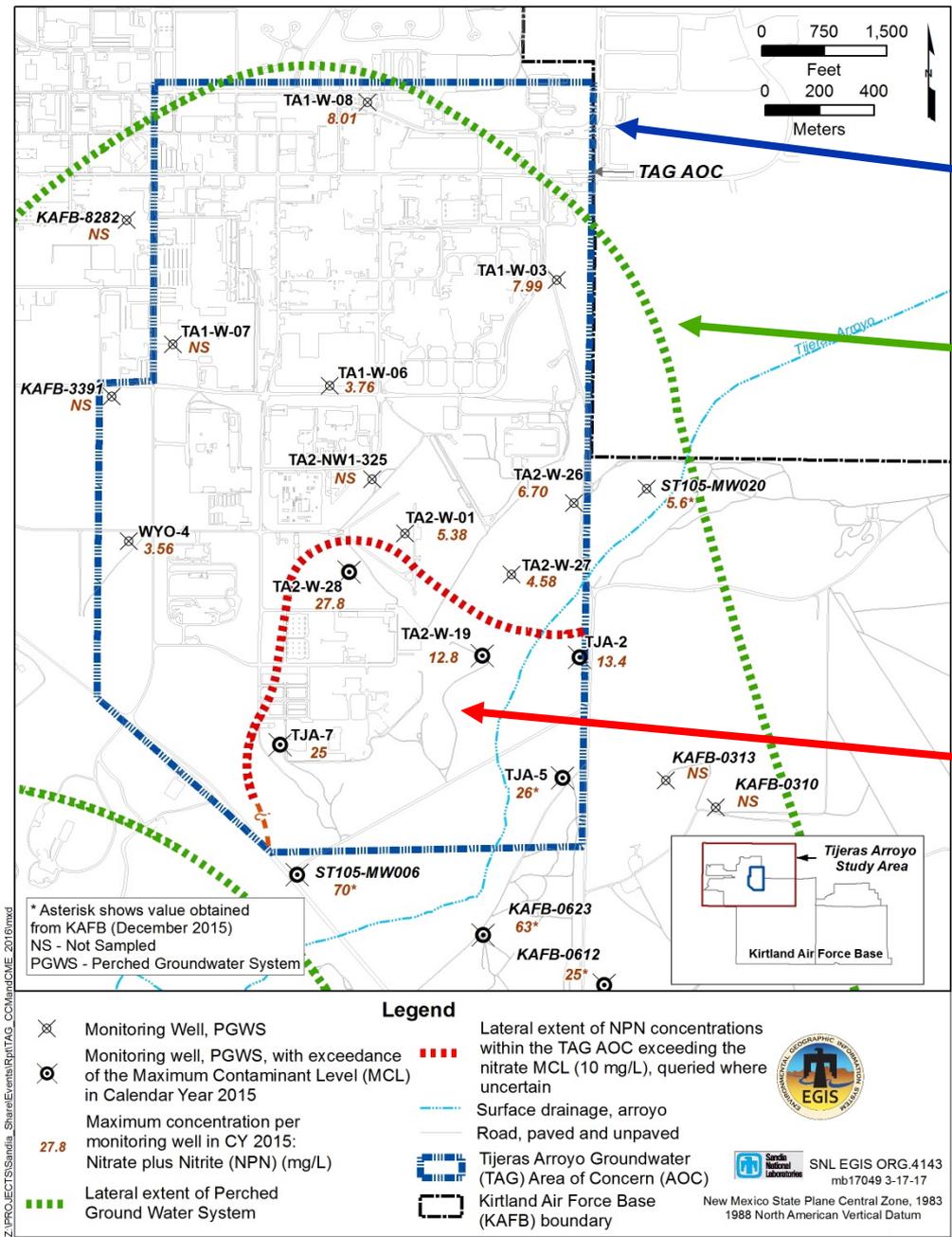
	Nitrate maximum, mg/L
Drinking Water Standard	10 mg/L
Perched	27.8 mg/L maximum
Regional Aquifer	9.4 mg/L maximum (except the extreme SE corner)



# Nitrate Contamination of Tijeras Arroyo Groundwater AOC

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- Within the 1.8 sq. mi. AOC, ~ 0.35 sq. mi. of perched GW is contaminated with nitrate above the drinking water standard
- Within the 1.8 sq. mi. AOC, regional GW does not contain nitrate above the drinking water standard (except extreme SE corner)
- Updated Corrective Measures Evaluation Report sent to NMED on November 30, 2016
- Awaiting NMED review



Area of Concern (inside blue line)

Perched Groundwater (inside green line)

Area of Nitrate Contamination (inside red line)

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Sandia National Laboratories  
SNL EGIS ORG.4143  
mb17049 3-17-17  
New Mexico State Plane Central Zone, 1983  
1988 North American Vertical Datum



# Summary of Progress of Sandia's ER Operations

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- Completed required corrective actions at 6 soil sites and requested modification of Permit for Corrective Action Complete status
- At Burn Site GW AOC, conducted aquifer pumping test and evaluating results
- At TA-V, installed 2 new monitoring wells and planning a Phased Treatability Study for In-situ Bioremediation of contaminated groundwater
- Submitted Corrective Measures Evaluation Report for contaminated groundwater at Tijeras Arroyo GW AOC



## More Information & Questions

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- On-line information ER documents hosted by NMED - <http://www.nmenv.state.nm.us/HWB/snlperm.html>
- On-line collection of ER documents hosted by UNM's Lobo Vault - <http://digitalrepository.unm.edu/snl/>
- Annual Groundwater Monitoring Report for Sandia Labs - [http://www.sandia.gov/news/publications/environmental\\_reports/index.html](http://www.sandia.gov/news/publications/environmental_reports/index.html)
- Send email questions to - [envinfo@sandia.gov](mailto:envinfo@sandia.gov)