NEVADA NATIONAL NNSS SECURITY SITE

Welcome to the Groundwater Open House!

The Groundwater is Safe

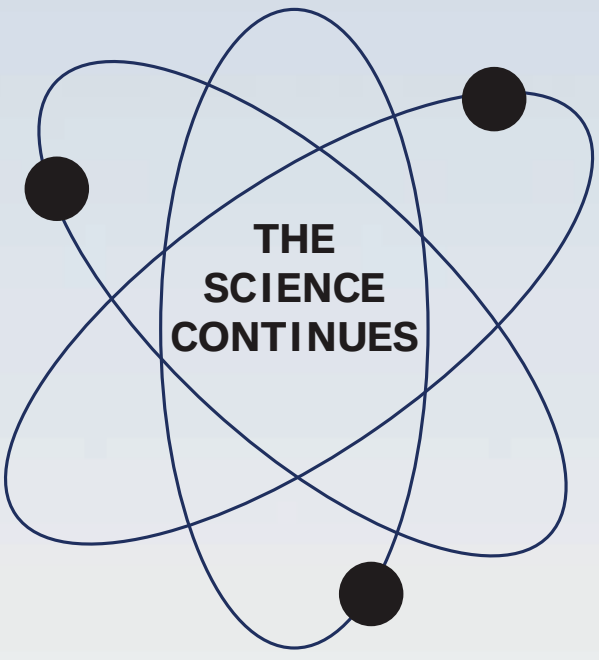
Public water supply is safe from the impacts of historic underground nuclear testing. Current research shows contaminated groundwater will **not** reach public water supplies.

To learn how we know, find posters marked with this symbol.

A Major Success

After decades of analysis, the Department of Energy, along with numerous scientists across the nation, have determined that there is no risk to the public from contaminated groundwater in Frenchman Flat.

Learn how the groundwater program at Frenchman Flat relates to your community by finding posters with this symbol.



The Science Continues

As part of a long-term monitoring program, ongoing scientific studies will continue into the future to identify where contaminated groundwater is located, in which direction it flows and its rate of movement.

Find the latest data on posters marked with this symbol.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office

Log No. 2016-094

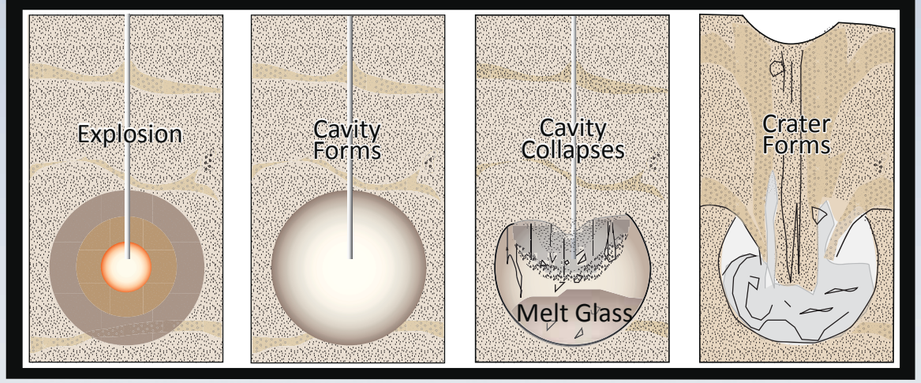
GWOH2016-1b

Historic Underground Nuclear Testing and Groundwater

What Occurred

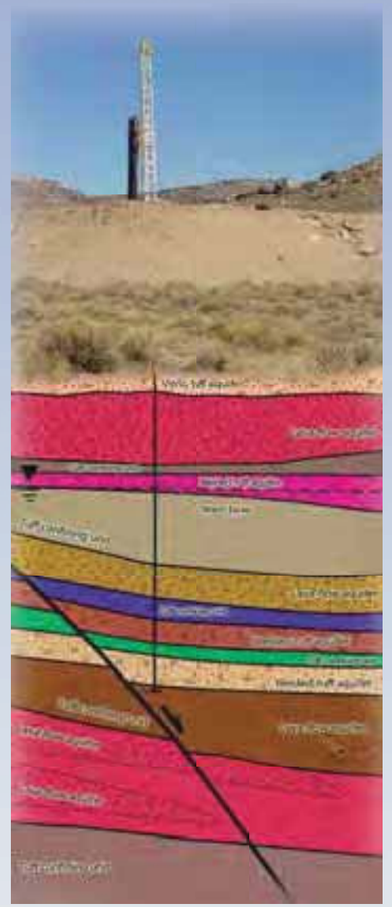
- 828 underground tests from 1951 to 1992
  - Up to 4,800 feet below the ground surface
  - One-third near, below, or in the water table
  - Some NNSS groundwater contains radionuclides
  - Radionuclides are also in melt glass or the rocks surrounding the underground cavities

Stages of an Underground Nuclear Test



An underground nuclear explosion vaporizes the surrounding rock, resulting in a cavity. As the remaining rock cools, melt glass forms and settles to the bottom of the cavity. This may lead to a collapse of the cavity which forms a depression on the surface, or a subsidence crater.

Important Factors



- Research focused on the next 1,000 years shows the contaminants in groundwater decay to safe levels long before reaching public water sources
- No practical technology for vast-scale contaminant removal
- The NNSS has extremely complex underground hydrogeology
- Radionuclides are located deep underground
- Not all tests had equal potential to release radionuclides into groundwater

Log No. 2016-094

GWOH2016-1d

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NNSS Groundwater Program Timeline

65 years of hydrogeologic data collection has contributed to a better understanding of the complex regional groundwater system.

This knowledge significantly enhances the decision-making process for resource allocations.

Evolution of the NNSS Groundwater Program:

1951 First Underground Nuclear Test

1989 Environmental Management Program Created

1992 Final Underground Nuclear Test

1996 Federal Facility Agreement and Consent Order (FFACO)

2009 First Groundwater Open House

2016 Frenchman Flat Closure Report

Pre-1989

- Scientific studies on radioactive releases in groundwater
- Significant data collected on geologic, geochemical, and hydrologic conditions
  - Data still used today

1989-1993

- Installation of groundwater characterization wells
- Preliminary definition of contaminant concentration, distribution, and variability
- Defined groundwater pathways that may allow contaminant migration
- Developed a preliminary risk assessment to define the risks associated with contaminants
- Evaluated potential remedial methodologies and their ability to reduce defined risks

1993-Present

- Drilling and sampling of characterization wells
- Data interpretation
- Computer modeling
- Identifying potential receptors and estimating potential risks
- Implementing a monitoring program to protect human health and the environment

Log No. 2016-094

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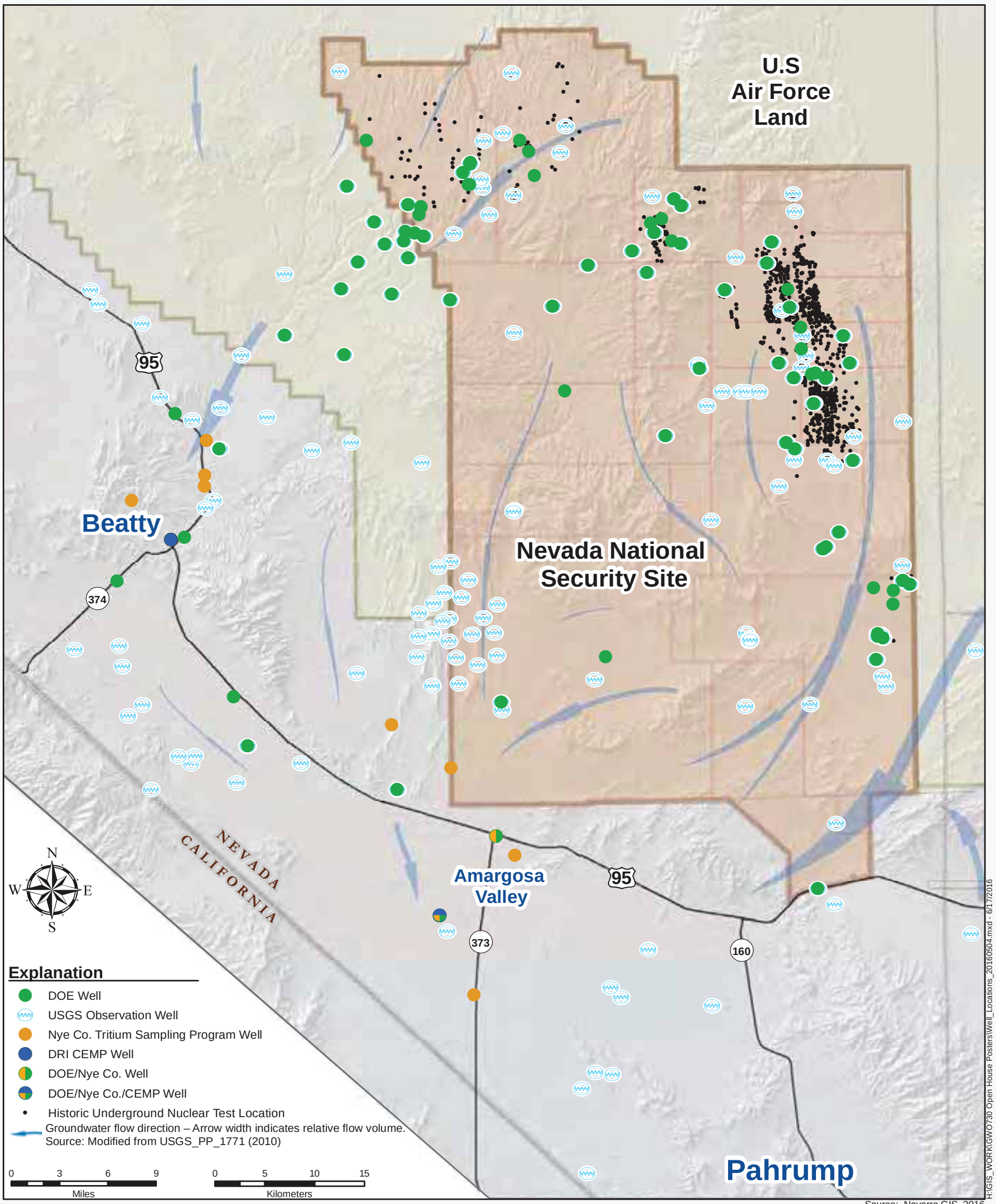
Wells Available for Sampling On and Near the NNSS



Source: Navarro GIS, 2016

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office

Log No. 2016-094

GWOH2016-2a

Groundwater "Ant Farm" Demonstration

- The general principles of groundwater flow and transport can be demonstrated visually in the Ant Farm
- The Ant Farm, although not truly representative of the hydrogeologic setting of the Nevada National Security Site, provides a sense of how groundwater behaves in nature

Groundwater Ant Farm Demonstration at Vanderburg Elementary School

Groundwater is water that has infiltrated from surface sources (rain/snow) and accumulated in the subsurface

- Groundwater moves through pore spaces and fractures in various types of geologic layers
  - Geologic layers range from near surface soils such as sands and gravels to deeper rock units such as limestones and volcanic rocks
- Groundwater moves within geologic layers at different rates and directions based on the geology, hydraulic properties (i.e., ability of water to flow through rock), and elevation of the water table.

GWOH2016-2d

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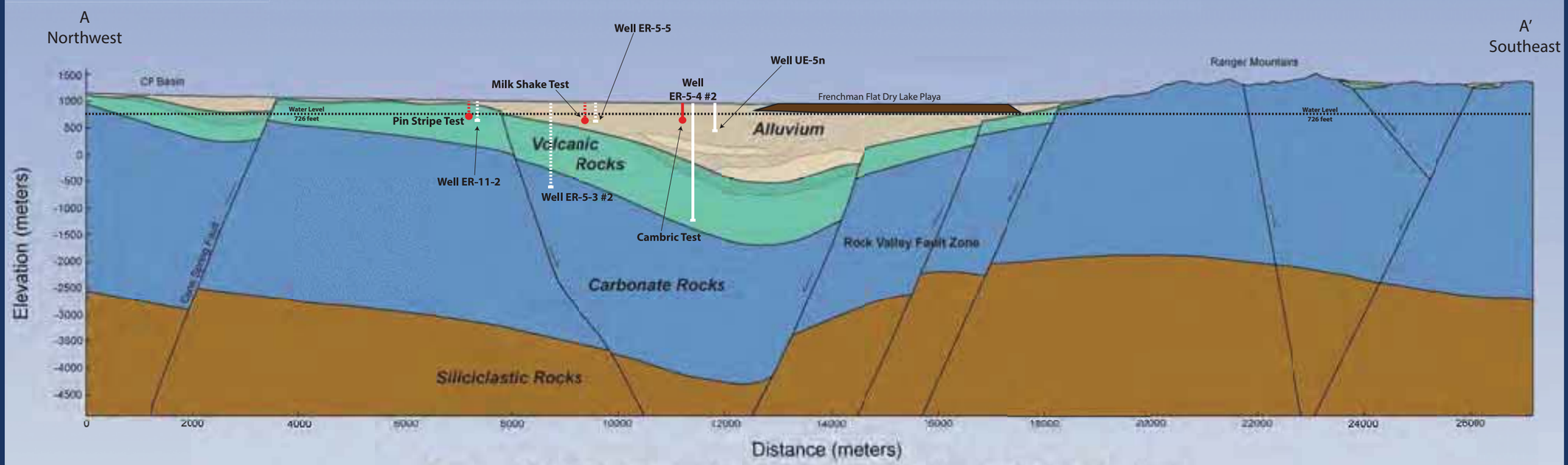
A Simplified Cross-Section of Frenchman Flat



Generalized Northwest - Southeast Geologic Cross Section

(Looking Northeast)

Total Depths:

Pin Stripe Test – 970 feet
Well ER-11-2 – 1,310 feet
Milk Shake Test – 870 feet
Well ER-5-3 #2 – 5,683 feet
Well ER-5-5 – 1,087 feet
Cambric Test – 970 feet
Well ER-5-4 #2 – 7,000 feet
Well UE-5n – 1,687 feet

Legend:

- Quaternary Playa Deposits
- Quaternary/Tertiary Alluvium
- Tertiary Volcanic Rocks
- Precambrian and Paleozoic Sedimentary Rocks
- Precambrian and Paleozoic Siliciclastic Rocks
- Aquifer: Rock units that are aquifers when they are below the water table

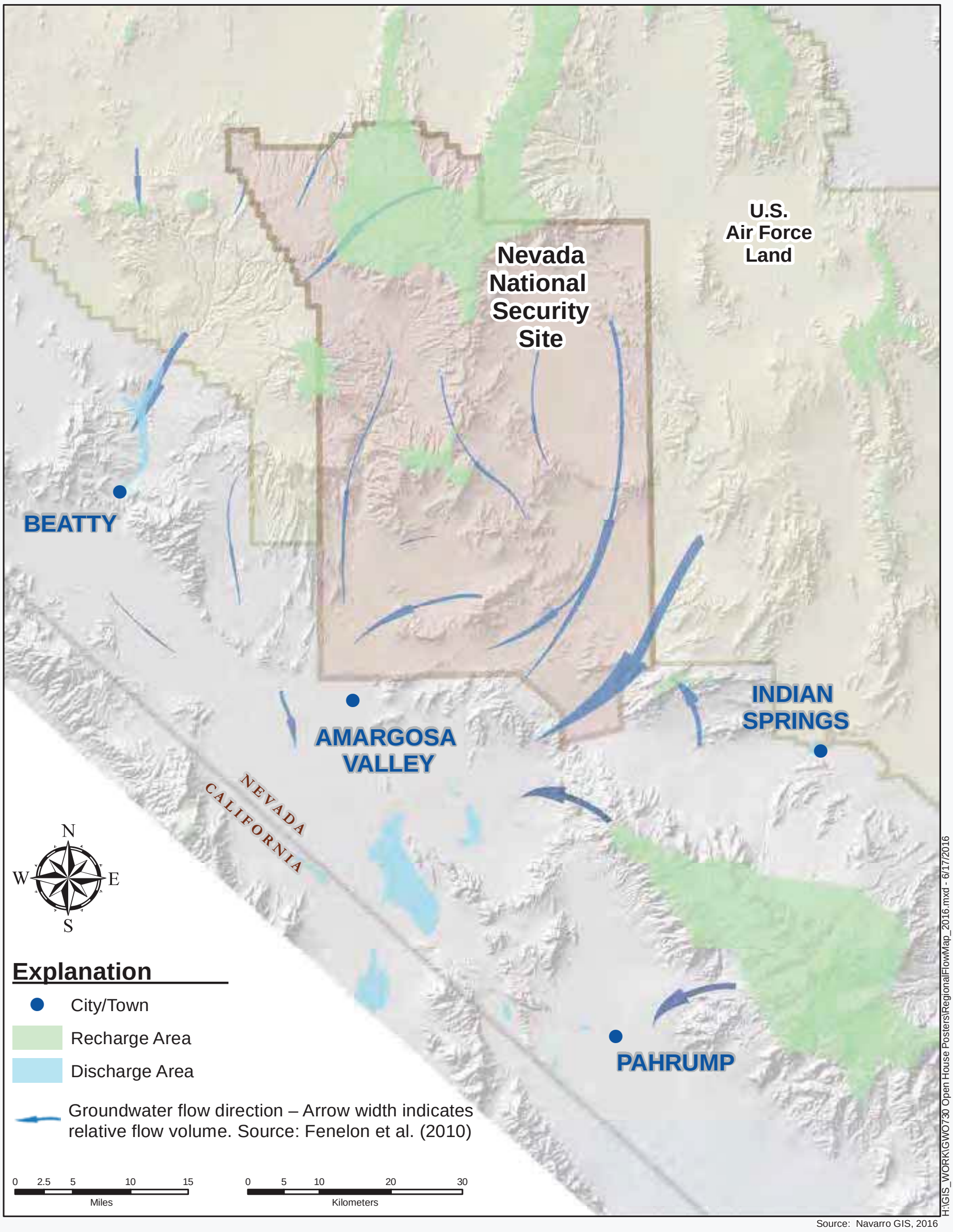
Log No. 2016-094

NEVADA NATIONAL NNSS SECURITY SITE

GWOH2016-3

Regional Groundwater Flow

Groundwater Flows from Recharge to Discharge Areas



Source: Navarro GIS, 2016

NEVADA NATIONAL NNSS SECURITY SITE

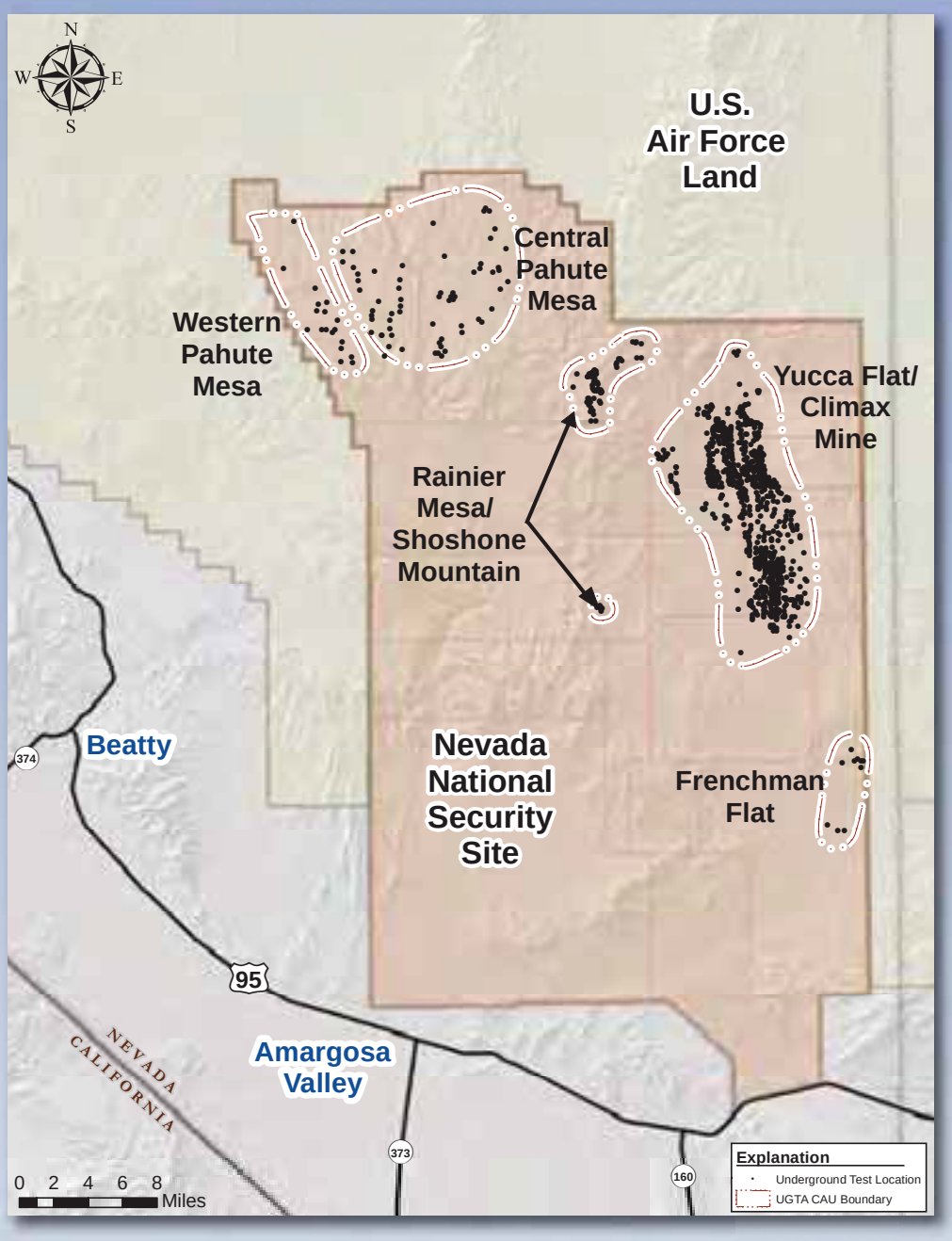
Federal Facility Agreement and Consent Order

Regulatory Strategy

Under a binding legal agreement, the State of Nevada Division of Environmental Protection must review and approve each stage of Nevada National Security Site groundwater characterization activities.

Investigation Stage

- Gather new data to enhance models developed for each of the historic underground nuclear test areas
- Review results: geology, hydrology, source term*, groundwater and transport models, modeling approach



Decision/Action Stage

- Develop a model evaluation plan to challenge and refine model forecasts
- Use model evaluation plan to identify locations for new wells or data collection activities
- Use data collected to support transition to long-term monitoring

Closure Stage (Long-Term Monitoring)

- Negotiate use restrictions and regulatory boundary
- Establish institutional controls and requirements
- Develop long-term monitoring program

NDEP

*Source term: the types and quantities of radionuclides released from an underground test

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*Federal Facility Agreement and Consent Order**

Regulatory Strategy

Legally-binding agreement between the State of Nevada; U.S. Department of Energy, Environmental Management; U.S. Department of Defense; and U.S. Department of Energy, Legacy Management

NDEP - State of Nevada Division of Environmental Protection

NNSA/NFO - U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office

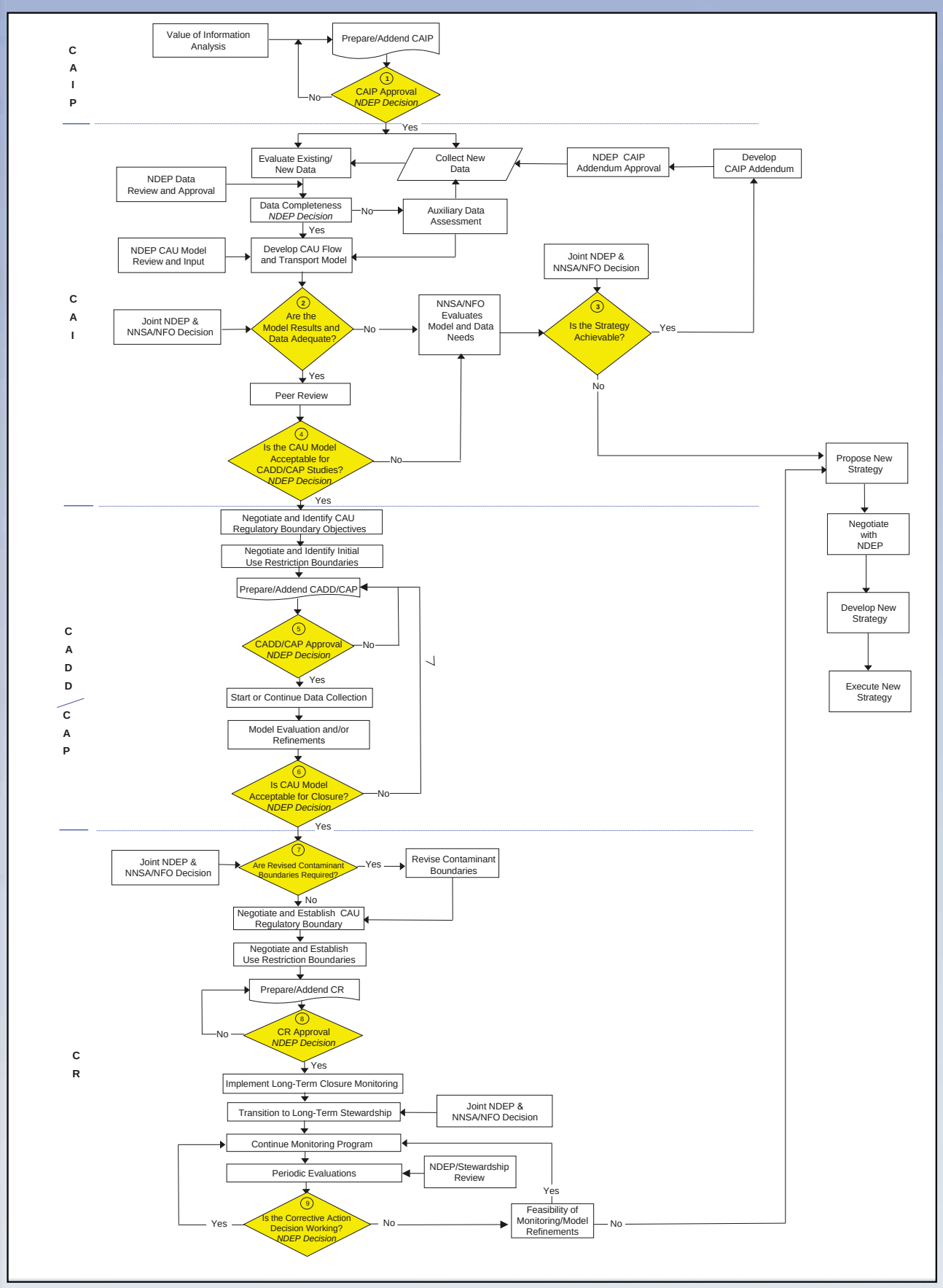
CAU - Corrective Action Unit: group of sites under investigation.

CAIP - Corrective Action Investigation Plan: looks at existing information from the weapons testing program, the regional flow model, and one-dimensional transport simulations to determine the best options for site characterization and prioritization

CAI - Corrective Action Investigation: uses the information from the CAIP stage to develop CAU-specific models of flow and transport, taking the uncertainty of each specific hydrogeologic setting into account--these models are then used to forecast contaminant boundaries for 1,000 years

CADD/CAP - Corrective Action Decision Document/Corrective Action Plan: includes developing and negotiating an initial regulatory boundary, developing monitoring programs for model testing and closure, and identifying institutional controls

CR - Closure Report: involves negotiating the final regulatory boundary for CAU closure; developing a closure report, which must be approved by NDEP; and developing and initiating a long-term monitoring program



***Also referred to as FFACO**

NDEP

GWOH2016-5a

Radiation Exposure and You

- Average person receives approximately 320 mrem* of radiation per year from exposure to various naturally-occuring and man-made sources
- Medical procedures (such as dental or chest x-rays) expose the average person to another 298 mrem (not illustrated below)
- Health effects (primarily cancer) have been demonstrated in humans at doses exceeding 5,000-10,000 mrem delivered at high dose rates; below this dose, estimation of adverse health effects is speculative

The Average Annual Dose of Radiation

Radon - 230 mrem

- Gas produced by natural breakdown of uranium in soil, rock and water
- Migrates through porous areas like the ground and the foundation of your house

The Human Body - 31 mrem

- Large portion of our radiation exposure comes from within our own bodies and the bodies of others near us
- Potassium-40 and other radioactive isotopes found in the air, water and soil are incorporated into the food we eat, then into body tissue
- Carbon-14, the same isotope used for carbon-dating in archaeology, is naturally-occurring in our bodies

Cosmic - 30 mrem

- High-energy gamma radiation that originates in outer space and filters through the Earth's atmosphere in the form of rays such as sunlight
- Cosmic radiation increases with altitude

Terrestrial - 19 mrem

- Soil, rock, and clay are examples of material deposits in the Earth that contain naturally radioactive materials like uranium and thorium
- Naturally radioactive materials are also present in construction materials

Consumer Products - 12 mrem

- Small amounts emitted from such household items as smoke detectors and televisions

Tritium - 4 mrem

- Drinking two liters of water each day for a year that contains 20,000 picocuries of tritium per liter (allowable limit under the Safe Drinking Water Act)
- Equivalent to drinking 193 gallons ($3^1/_2$ 55-gallon drums) of water contaminated with 20,000 picocuries per liter of tritium

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*mrem (millirem) is one one-thousandth of a rem which measures biological impact, or "dose" of radiation

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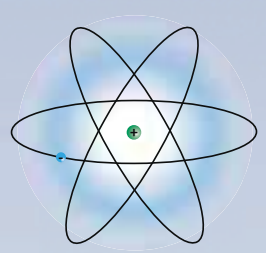
Understanding Tritium in Water

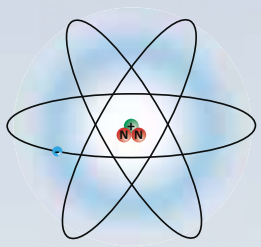
- Radioactive form of hydrogen with a half-life* of 12.3 years
- Decays to nearly zero within 200 years
- Naturally occurs in surface waters, such as Lake Mead, at 10 to 30 picocuries per liter
- Regulatory safety standard for drinking water is 20,000 picocuries per liter

In order for tritium contaminated water to be unsafe, a person would need to drink more than 193 gallons of water per year containing 20,000 picocuries of tritium per liter...which is approximately the same dose of radiation you would get during a typical commercial flight between Los Angeles and New York City.



Hydrogen Atom

One proton
No neutrons
One electron



Tritium Atom

One proton
Two neutrons
One electron

Why Analyze for Tritium?

More than 95% of the initial radionuclide inventory

Moves easily in groundwater

Many longer-lived radionuclides, such as plutonium, are slow moving or immobile

Unless increased levels of tritium are observed, other longer-lived radionuclides will not be present

*Half-life refers to the amount of time it takes for a radioactive substance to lose half of its radioactivity.

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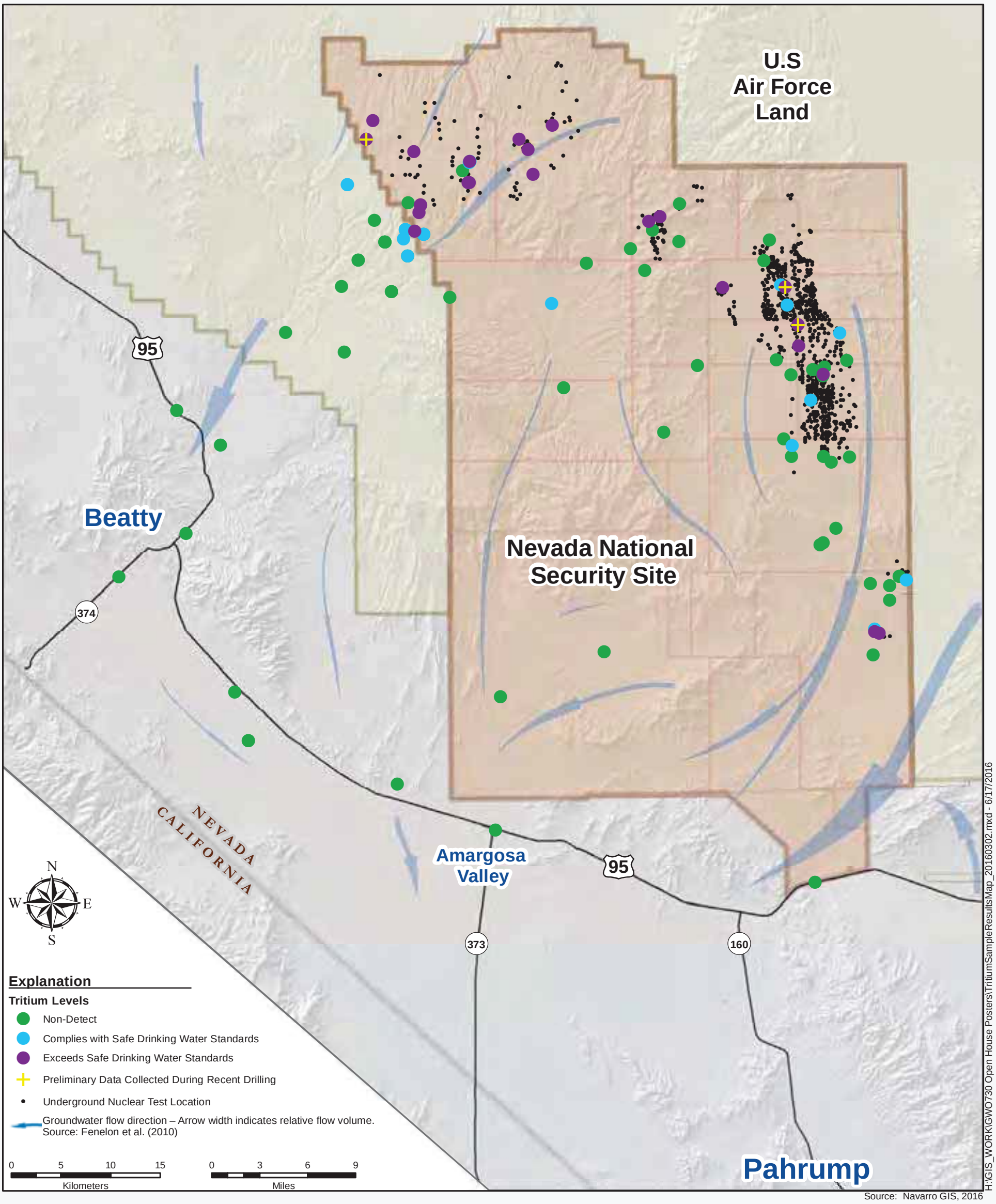
Tritium Results for DOE Sampled Wells

Calculations show tritium in the groundwater from underground nuclear tests will decay to nearly zero in 200 years



Source: Navarro GIS, 2016

Note: Some wells are selected for sampling based on previous laboratory analyses (e.g., presence of radionuclides) and modeling results (e.g., well is along a flow path).

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office

Log No. 2016-091

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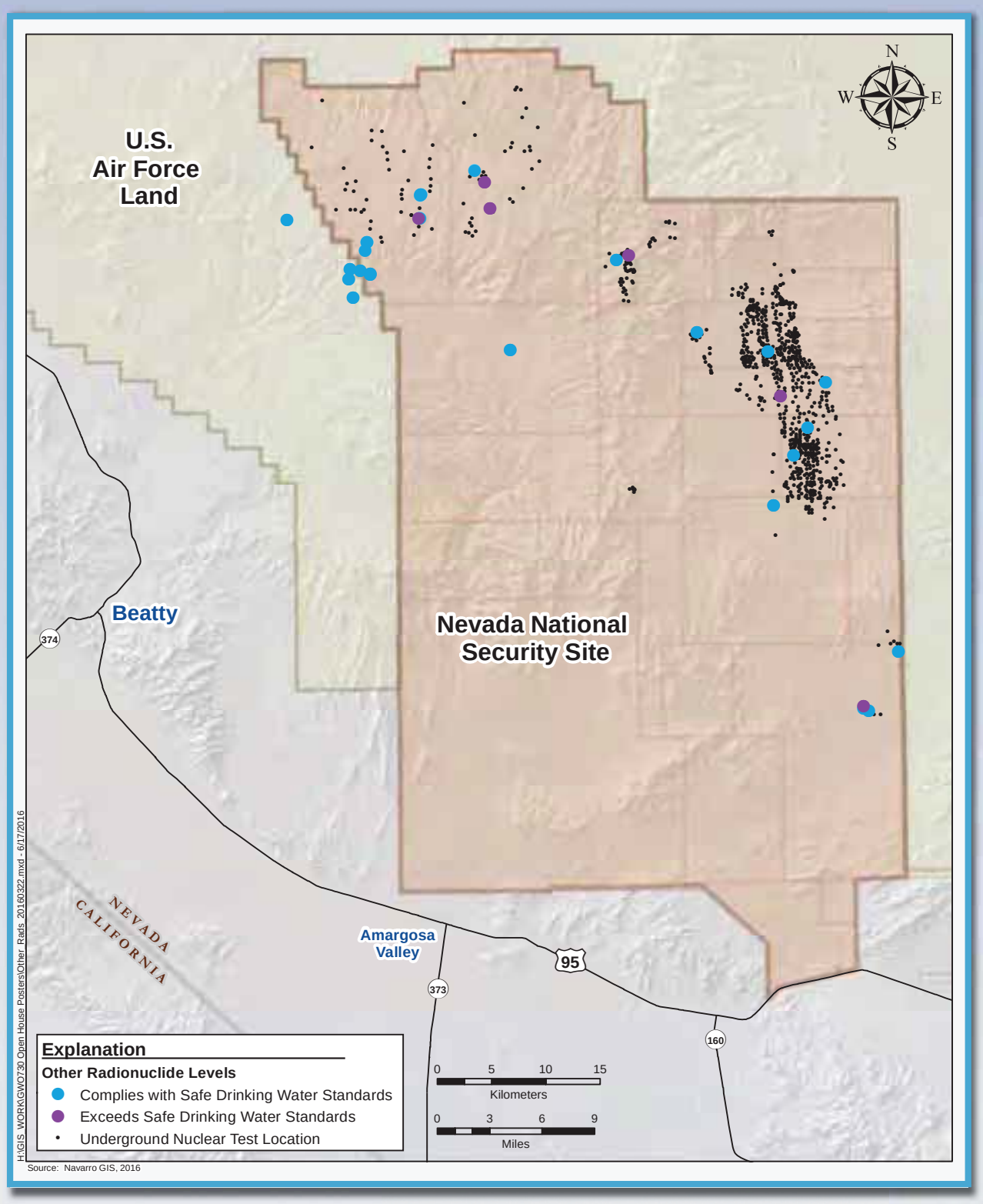
Sampling Results for Other Radionuclides

- **No radionuclides from underground nuclear testing have been detected on publicly accessible land**
- **Radionuclides other than tritium that were produced by historic underground nuclear testing have been detected at extremely low levels (less than 0.1% of safety standards) in water samples collected on U.S. Air Force land**
- **Radionuclides other than tritium have only been found in excess of Safe Drinking Water standards in wells close to a nuclear test cavity on the NNSS**

Many of the radionuclides produced by nuclear tests are relatively immobile

- 29 radionuclides are trapped in the melt glass formed by the detonation of the underground nuclear device
- Tritium, carbon, iodine, chlorine, technetium are mobile in most subsurface environments
- Cesium and strontium are mobile in some subsurface environments
- Plutonium is transported a limited distance on small particles
- Samples are analyzed for other radionuclides once tritium has been detected through standard analyses



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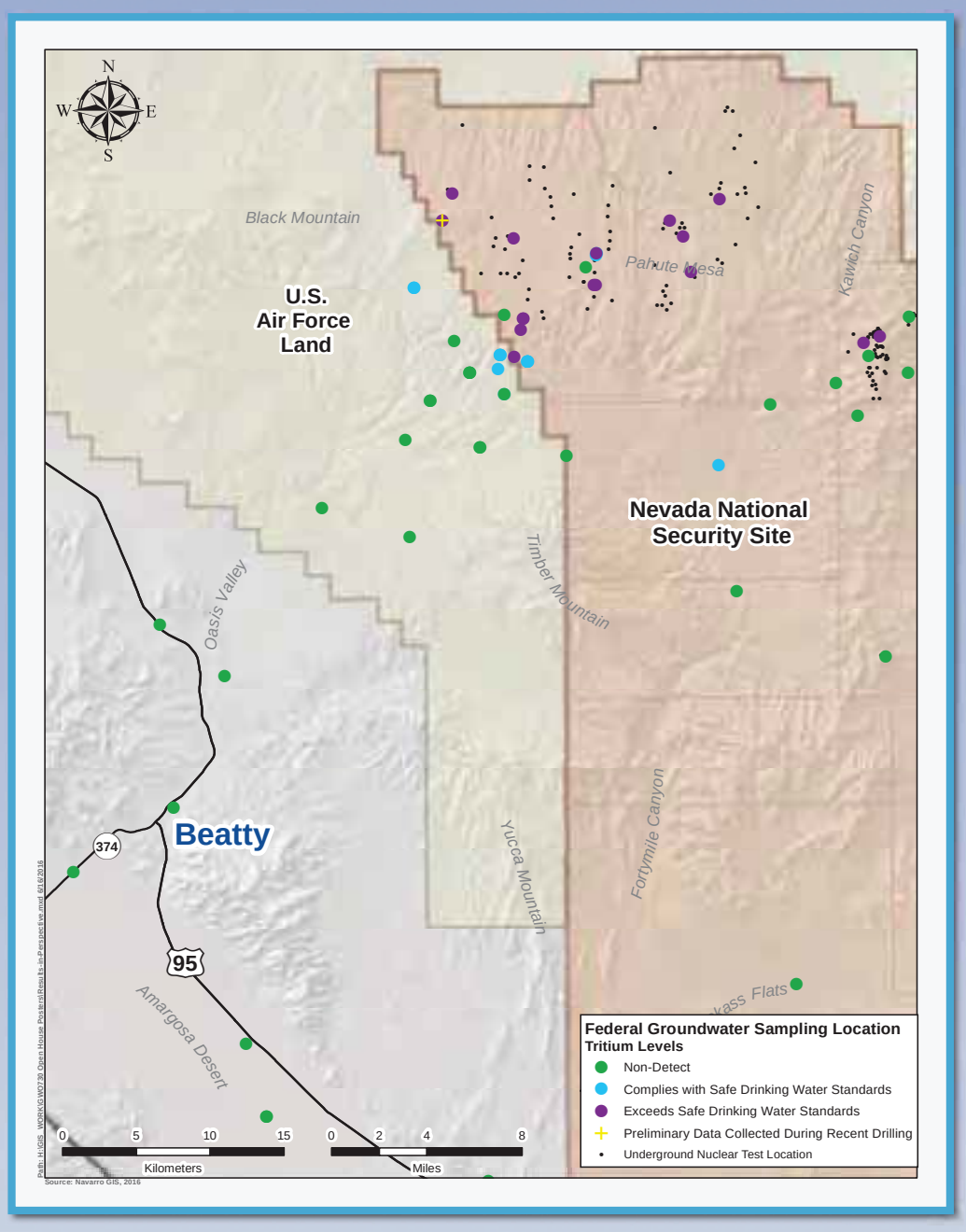
Putting Results in Perspective

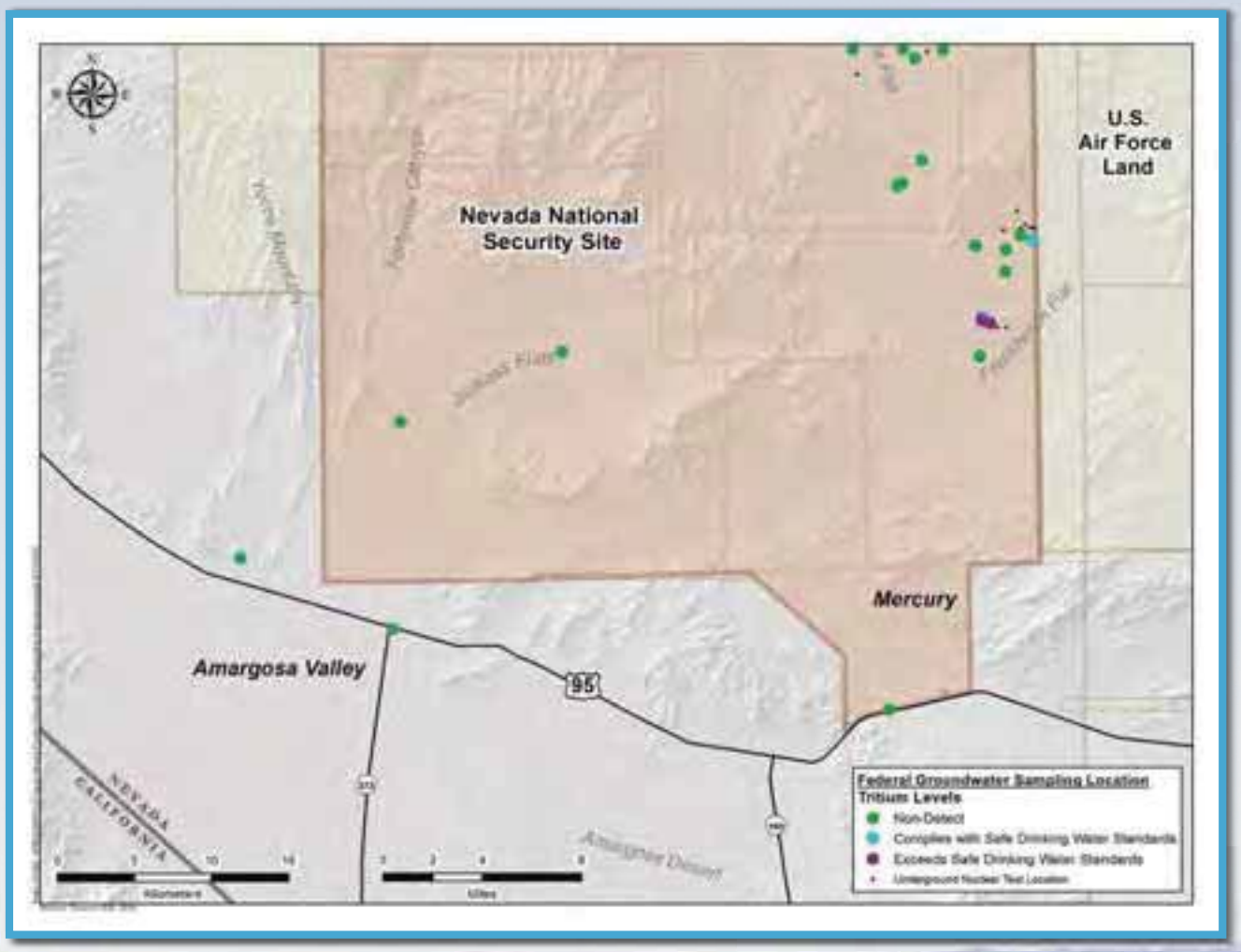
Pahute Mesa

- Based on conservative, scientific calculations and sampling results, it will take at least 100 years for tritium to reach the closest public land boundary
  - In approximately 100 years, the concentration of tritium is estimated to be in compliance with safety standards at the closest public land boundary
  - In approximately 200 years, the concentration of tritium will be nearly zero at the closest public land boundary



Frenchman Flat

- Contaminated groundwater is not expected to leave the Frenchman Flat basin
  - Modeling indicates that radionuclides in groundwater will travel less than 1 mile in 1,000 years



Protecting the Public

- No public access to contaminated groundwater
  - Large area of federally-controlled land provides buffer zone
- Evolving and conservative computer models provide forecasts to continually inform sampling strategies
- Ongoing monitoring serves as a means for early detection and confirmation/validation of modeling forecasts

GWOH2016-7a

A Success Story
Frenchman Flat Groundwater Characterization

Frenchman Flat

- Ten underground nuclear tests
  - Conducted between 1965 and 1971
  - Nine in alluvium and one in a volcanic unit
  - Nine detonated above but near the water table, each less than 20 kilotons
  - One test (less than one kiloton) detonated below the water table
  - Represent a small fraction (0.1%) of the radionuclides deposited underground at the Nevada National Security Site

Log No. 2016-XXX

Log No. 2016-XXX

Frenchman Flat
Timeline

1999–2000
- State approved Phase I investigation plan
- Models developed based on investigations performed since the early 1950s
- Internal and external peer reviews recommended additional investigations

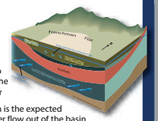
2001–2010
- State approved Phase II investigation plan
- Assessed contaminant movement between geologic layers to the lower carbonate aquifer
- Five wells drilled and tested
- Models updated based on new hydrogeologic, geochemical, and geophysical data
- Results published in more than 30 peer reviewed reports
- External peer review team recommended progressing to model evaluation

2011–2014
- Initial use-restriction boundaries and regulatory boundary objective identified
- Two wells drilled and tested
- Surface-magnetic surveys developed
- Models refined
- State approved transition to long-term monitoring

Log No. 2016-xxx

What We Know

- Groundwater flow is extremely slow
- Groundwater flow is to the south–southeast in the alluvial and volcanic aquifers and to the southwestward in the lower carbonate aquifer



- Rock Valley fault system is the expected pathway of groundwater flow out of the basin
- Contaminated groundwater is not forecasted to reach the Rock Valley fault system within 1,000 years

- Majority of contamination is tritium, which will decay below safety standards within 200 years
- Results indicate other radionuclides do not exceed safety standards, except where trapped in the test cavities
- Contaminated groundwater expected to remain near the tests

Log No. 2016-xxx

Boundaries

What is a Contaminant Boundary?

Groundwater within this boundary may exceed the safety standards at some time within 1,000 years

- Safety standard for tritium is 20,000 picocuries per liter
- Boundary is developed based on modeling studies of groundwater flow and radionuclide transport

What is a Use-Restriction Boundary?

Boundaries defining the areas that require institutional controls to restrict access to potentially contaminated groundwater

- Based on contaminant boundaries
- Use-restrictions are associated with the deep subsurface
- Drilling, pumping, and other activities require authorization in this area

***Regulatory boundary objective** is to protect water resources down gradient of the Rock Valley fault system from radionuclide contamination*

What is a Regulatory Boundary?

Boundaries that provide protection for the public and the environment from the effects of radionuclide contamination

- 1,000-year contaminant boundaries are well within the regulatory boundary
- If radionuclides reach this boundary, a plan must be submitted to the State to ensure water resources down gradient are protected

Log No. 2016-xxx

Long-Term Monitoring
The First Five Years

Groundwater Sampling and Analysis
- Sample six wells annually

Water-Level Measurements
- Measure groundwater levels in 16 wells quarterly to verify conditions have not changed

Frenchman Flat Long-Term Monitoring Network

Frenchman Flat Long-Term Water-Level Monitoring Network

Institutional Controls
- Monitor annually to verify that use-restriction boundaries effectively restrict access to contaminated groundwater

Monitoring Network Maintenance
- Annually inspect monitoring networks to verify well functionality and effectiveness

Documenting and Assessing Results
- Report results annually
- Verify consistency of groundwater quality and water levels with model assumptions and boundaries
- Confirm effectiveness of institutional controls
- Evaluate strategy for protecting human health and the environment

Log No. XXXX-XXX

Long-Term Monitoring
After Five Years

Routine Monitoring
- Provides a baseline for future evaluation
- Establishes thresholds/triggers for assessing protection of public health
- Determines the optimal path forward

Periodic Evaluations
- Assess current land use restrictions, processes and procedures to ensure the protection of human health and the environment
- Consider any new land use applications that may affect the long-term monitoring strategy
- Ensure water level data are consistent with the conceptual model and whether sampling results are consistent with model predictions

Log No. XXXX-XXX

Implementing protections for the health and safety of the public and environment

Extensive Investigations and Characterization of Subsurface Environment → Scientific Understanding of Contamination Extent and Movement → Monitoring and Restricted Access in Perpetuity

A Look Ahead
Frenchman Flat Sets the Stage for Advancing Other Groundwater Investigation Areas

- New processes and methodologies developed
  - Regulatory process refined to best support modeling, monitoring, and institutional controls strategy
  - Peer review processes (external and internal committees of experts) established to provide confidence that the strategy is protective of the public and environment
  - State-of-the-art methodologies developed and applied by a highly technical team of experts from numerous scientific organizations

- Transitioning Frenchman Flat provides an invaluable experience for understanding the necessary balance of modeling, monitoring, and institutional control that is protective of public health and the environment

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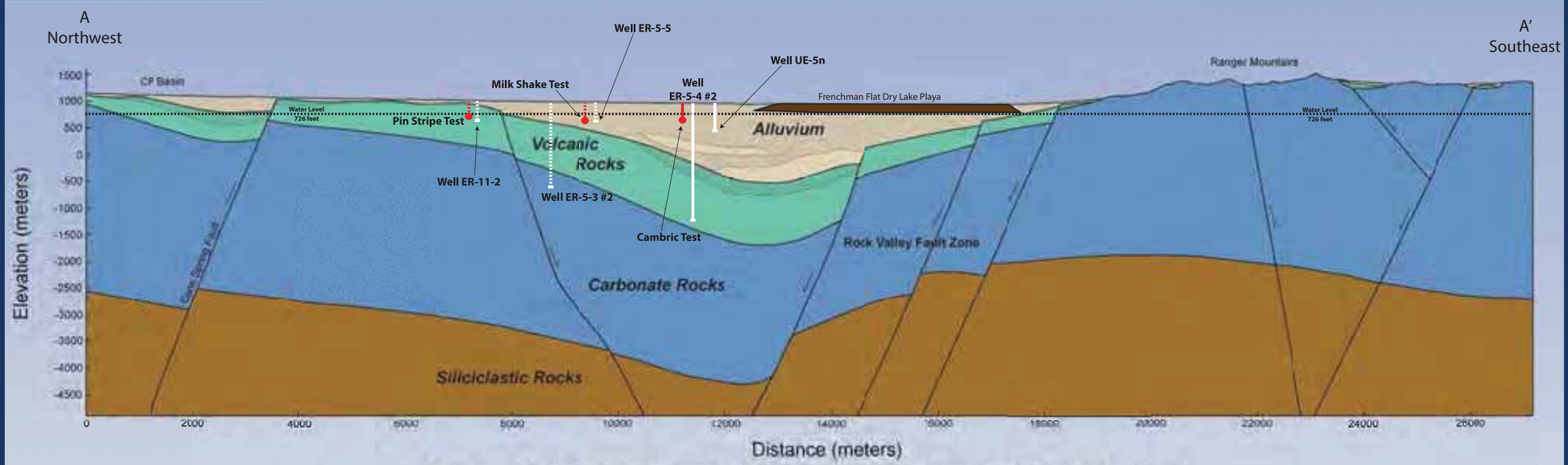
GWOH2016-7b

A Simplified Cross-Section of Frenchman Flat



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Log No. 2016-094

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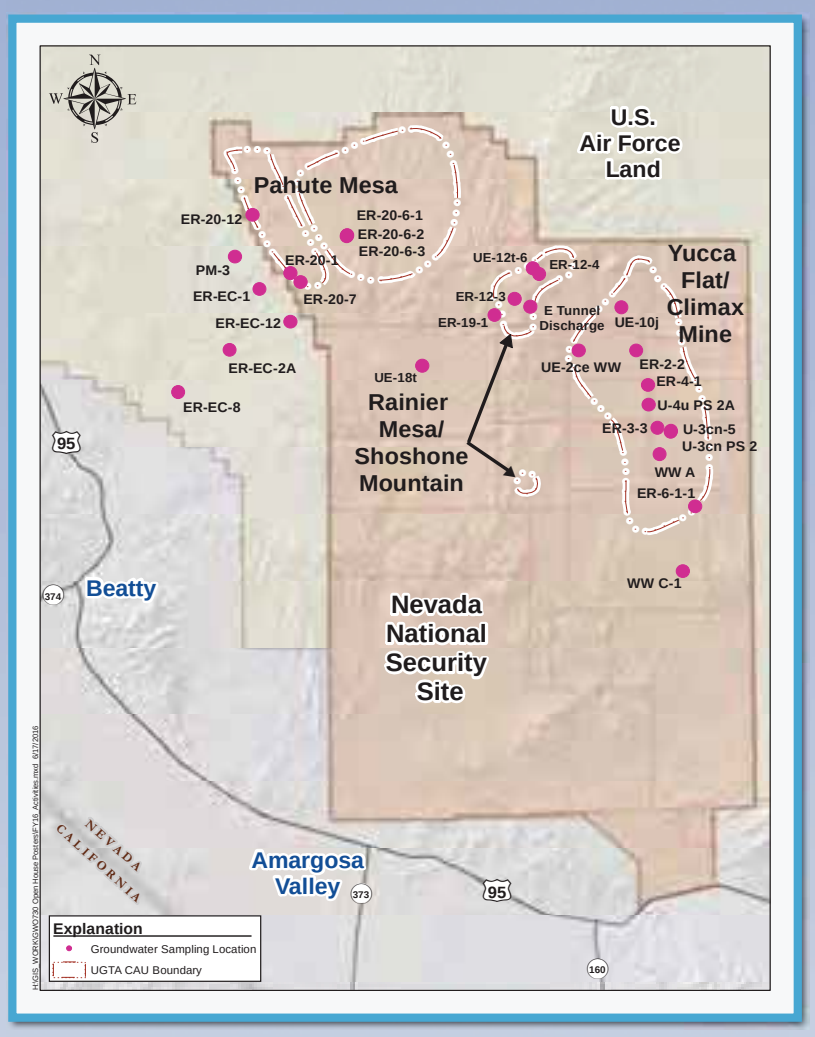
Recent & Upcoming Activities

Scientists continually collect and analyze data to enhance knowledge of the complex subsurface environment.



Pahute Mesa

- Drilled, tested and sampled a new well (ER-20-12) to gather information for defining the western portion of the flow system
- Compiling and analyzing site data
- Incorporating properties of the rocks, observed groundwater conditions, and water quality observations into a framework needed to build a computer model of the subsurface Pahute Mesa environment
- Enhancing understanding of radionuclide movement in groundwater based on analysis of the subsurface conditions near the nuclear tests

Rainier Mesa/Shoshone Mountain

- Developed plan to address State-approved Alternative Modeling Strategy
  - Considers alternative scenarios for radionuclide movement in groundwater
  - Recognizes isolated groundwater system
- Planning for an external peer review

Yucca Flat/Climax Mine

- Drilled three new wells in 2016 (ER-2-2, ER-3-3 and ER-4-1) to compare and improve conceptual models and collect new data
  - Preliminary analysis of samples shows no tritium in the lower carbonate aquifer
  - Data collected supports that models are conservative and protective of public health and safety
- Completing reconciliation of external peer review comments
  - Drilling results further support information presented to peer review panel

Continue Sampling and Water-Level Monitoring

Water-level monitoring at various wells on or near the NNSS, and groundwater sampling proposed at the following wells:

Pahute Mesa

- ER-20-12 (2016)
- ER-EC-2A (2016)
- ER-EC-8 (2016)
- ER-EC-1 (2016)
- ER-EC-12 (2016)
- PM-3-1 (2016)
- PM-3-2 (2016)
- ER-20-6-1 (2017)
- ER-20-6-2 (2017)
- ER-20-6-3 (2017)
- ER-20-1 (2017)
- ER-20-7 (2017)
- ER-EC-12 (2017)

Rainier Mesa

- UE-12t-6 (2017)
- ER-19-1 (2017)
- ER-12-3 (2017)
- ER-12-4 (2017)
- UE-18t (2017)
- E-Tunnel Discharge (2017)

Yucca Flat/Climax Mine

- ER-6-1-1 (2016)
- UE-10j (2016)
- U-3cn PS 2 (2016)
- U-4u PS 2A (2016)
- WW C-1 (2017)
- U-3cn-5 (2017)
- UE-2ce WW (2017)
- WW-A (2017)

GWOH2016-9

Poster Exhibited & Staffed by Nevada Site Specific Advisory Board

U.S. Department of Energy

NSSAB

Nevada Site Specific Advisory Board

...citizens working together on environmental issues

What is the NSSAB?

A group of southern Nevada stakeholders providing recommendations to the Department of Energy on cleanup activities at the Nevada National Security Site

Meetings

- All Full Board meetings are open to the public
- While usually held in Las Vegas, Full Board meetings may be held throughout southern Nevada

Member Responsibilities

- Attend Full Board meetings
- Review materials with timely response
- Commit approximately 10 hours per month
- No technical experience is required

Waste Offloading

Waste Management

Groundwater Sampling

NSSAB Well Visit

Soil Monitoring

Industrial Sites Cleanup

Well Development and Testing

NSSAB Outreach

Phone
702-630-0522

Email
NSSAB@nnsa.doe.gov

Website
www.nv.energy.gov/NSSAB

Areas of Focus

The NSSAB makes recommendations on specific cleanup activities at the Nevada National Security Site

Budget
...reviews and prioritizes funding for cleanup projects

Groundwater
...issues related to groundwater contamination, characterization, drilling and modeling

Industrial Sites
...issues related to decontaminating and disposing of obsolete buildings and facilities

Soils
...cleanup standards used to remediate surface soil contaminated by historic nuclear testing

Transportation/Waste
...issues related to transportation of hazardous and radioactive waste and waste disposal activities

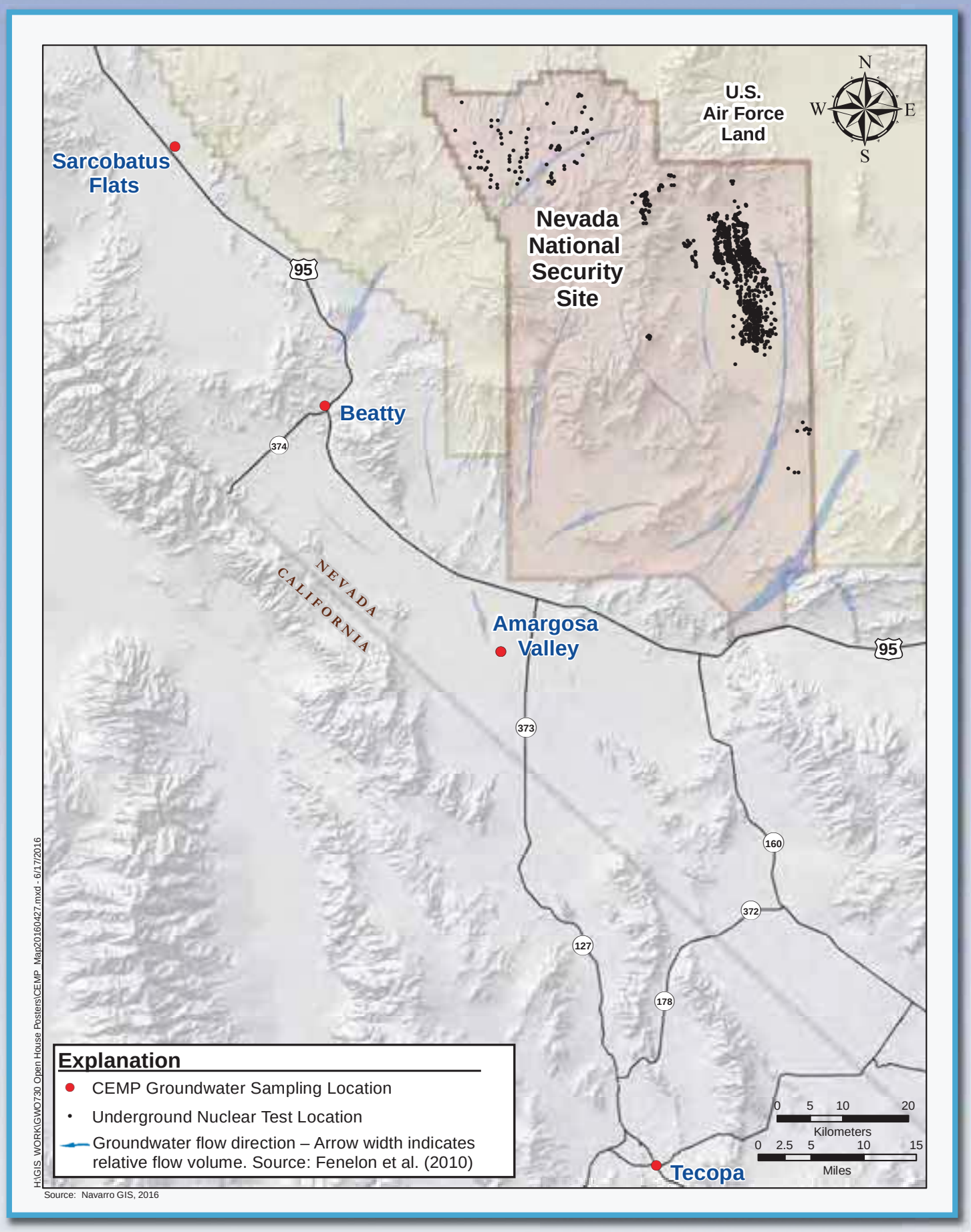
Membership
...recruits new members

Outreach
...increases public awareness of the NSSAB

NEVADA NATIONAL NNSS SECURITY SITE

Community Environmental Monitoring Program (CEMP) - Groundwater Sampling

CEMP focuses on groundwater monitoring down gradient of the NNSS



- CEMP provides off-site radiological monitoring in communities surrounding the NNSS
  - Radionuclides from underground testing have never been detected in water supplies serving CEMP communities
- U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office provides funding for DRI to administer the program
- CEMP provides a hands-on role for public stakeholders
- Water sampling results available at **www.cemp.dri.edu** and posted on bulletin boards at local CEMP stations (red dots on map)

DRI Desert Research Institute

Nye County Tritium Sampling and Monitoring Program

Nye County Nuclear Waste Repository Project Office

Introduction

The Nye County Nuclear Waste Repository Office (NWRPO) was awarded a five-year Defense Environmental Cleanup Program grant from the United States Department of Energy (DOE), in 2015. The purpose of the grant is to conduct groundwater monitoring and test for tritium in water from wells downgradient of the Nevada National Security Site (NNSS), formerly the Nevada Test Site. The grant resulted in the creation of the Nye County Tritium Sampling and Monitoring Program (TSaMP). In 2015, the TSaMP worked in conjunction with the Community Environmental Monitoring Program (CEMP) to select and sample 10 "core wells" located downgradient of the NNSS, and in the general areas of Beatty, Lathrop Wells, and Amargosa Valley. For the remaining four years of the grant (2016 - 2019), the TSaMP will continue to sample the 10 "core wells" plus an additional 10 wells, for a total of 20 wells each year. These 10 additional wells may change year-to-year depending on priorities and recommendations made by the Community Environmental Monitors.

Map showing the general area (blue oval) of the Nye County Tritium Sampling And Monitoring Program (TSaMP). The TSaMP focus is on areas downgradient (south) and off of the NNSS. Triangles are locations of CEMP stations in communities surrounding and downwind of the Nevada National Security Site (NNSS) that monitor the airborne and groundwater environments for manmade radioactivity. The CEMP is a collaborative effort of the Department of Energy's National Nuclear Security Administration Nevada Field Office (NNSA/NFO) and the Desert Research Institute (DRI) of the Nevada System of Higher Education. Map is from the CEMP Website at: (www.cemp.dri.edu).

2015 Sampling

The TSaMP wells are all downgradient of the Nevada National Security site (NNSS), formerly the Nevada Test Site (NTS), and were sampled to determine if radionuclides from underground nuclear testing are present in wells off of the NNSS. Water samples were collected between December 7th and December 21st, 2015. Five of the wells (GWE- OV-1, GWE-OV-2, GWE-8PA, EWDP-13P, and EWDP-24P) are owned by Nye County and were installed by the Nye County Nuclear Waste Repository Project Office (NWRPO) as either Early Warning Drilling Program (EWDP) wells south of Yucca Mountain, or as part of the more extensive Groundwater Evaluation Program (GWE). The Nye County monitoring wells do not have dedicated pumps and were sampled using a portable positive displacement pump after purging at least 3 well volumes from each well (16 to 163 gallons). This process ensured that the resultant samples were representative of local groundwater conditions. The five remaining community wells (Amargosa Elementary School, Amargosa Valley RV Park, Beatty Water and Sanitation (W04), Northwest Academy, and Baileys Hot Springs) are either operating domestic or municipal wells and were sampled from the dedicated pump discharge. These wells were purged prior to sampling to insure that representative water samples were obtained. Standard water quality parameters (pH, temperature, electrical conductivity) were also collected from all ten wells. Locations of the TSaMP wells were chosen based on groundwater flow paths off of the NNSS, proximity of wells to downgradient communities and recommendations provided by Community Environmental Monitors (CEM's). CEM's are trained local citizens that manage the Community Environmental Monitoring Program (CEMP) stations.

2015 Sampling Results

All 10 "core samples" had tritium levels below the detection limits of 278 or 313 picocuries per liter (<278 pCi/ L or <313 pCi/L) depending on the sample. Samples were analyzed using the standard tritium analysis method (unenriched) by Radiation Safety Engendering, Inc. in Chandler Arizona. Tritium is a radioactive form of hydrogen with a half-life of 12.3 years. Tritium is sampled for in the water because it is one of the most abundant radionuclides generated by an underground nuclear test, and because it is a constituent of the water molecule itself, it is also one of the most mobile. (NNSS Environmental Report 2014) -See http://www.nv.energy.gov/library/publications/aser.aspx . The Safe Drinking Water Act (SDWA) limit for tritium in drinking water is 20,000 pCi/L. This limit is also referred to as the maximum contaminant level (MCL). **Picocurie** (pCi) is a term that scientists use to describe how much radiation and, therefore, how much tritium, is in the water. A picoCurie is one-trillionth of a Curie, and 1 pCi/L is the amount of radioactive material in 1 liter of a gas or liquid that will produced 0.037 disintegrations per second.

Public Outreach

Under the DOE grant, Nye County (TSaMP) is responsible for providing public outreach and providing sampling methodology, data, and quality check results to the DOE . To meet these goals the TSaMP ran two articles in the Pahrump Valley Times (December 18th 2015 and April 29th 2016), supplied sampling results to the DOE to be includes in the 2015 Nevada National Security Site Environmental Report, and authored subsection 5.1.2 *"Nye County Tritium Sampling and Monitoring Program"* of the report. Nye County also conducted a tour on December 18th 2015, for the Nevada Site Specific Advisory Board and Community Environmental Monitors, to some of the TSaMP well locations and demonstrated sampling equipment and work procedures. Nye County has also been making an effort to participate in public outreach events such as the annual DOE Groundwater Open House.

Locations Sampled by DOE

The area to the northeast of the town of Beatty NV is of particular interest to tritium monitoring since tritium was detected in Well ER-EC-11, a DOE characterization well, just west of Pahute Mesa, where 85 nuclear tests were conducted between 1965 and 1992. The well is locate on the Nevada Test and Training Range (NTTR), 2,350 feet west of the NNSS boundary, and approximately 23 miles Northwest of Beatty. The tritium level in ER-EC-11 was at 10,600 pCi/L when sampled in 2009 which is below the Safe Drinking Water Act limit of 20,000 pCi/L. In a recent email from the Department of Energy it was stated "based on our monitoring observations at Wells ER-EC-11 and ER-EC-6 we do not expect tritium concentrations above the MCL near Beatty, NV. These data indicate it will be more than 250 years before measureable tritium will arrive" – Bill Wilborn (Underground Test Area (UGTA) Activity Lead- personal communications – April 2016).

Map shows the location of the 10 TSaMP "core wells" sampled in 2015. Colors assigned to each well indicates the tritium detection limit of the sample (see map - Explanation). Note: All results of samples taken in 2015 were below the reported detection limit. The TSaMP focus areas is downgradient and along the south and southwest borders of the NNSS and NTTR. Locations in gray indicate other Nye County wells that may be sampling in the future (remaining years of the grant (2016 - 2019).

All 2015 TSaMP tritium sampling results were below the detection limits of 278 or 313 picocuries per liter (<278 pCi/ L or <313 pCi/L). The bottom three samples (gray) are quality assurance samples – two field duplicates and one filed blank as required by NWRPO Technical Procedure TPN-11.8 *"Groundwater Sampling and Analysis for the Nye County Tritium Sampling And Monitoring Program",* and Work Plan WP-11 *"Groundwater Chemistry Sampling and Analysis".*

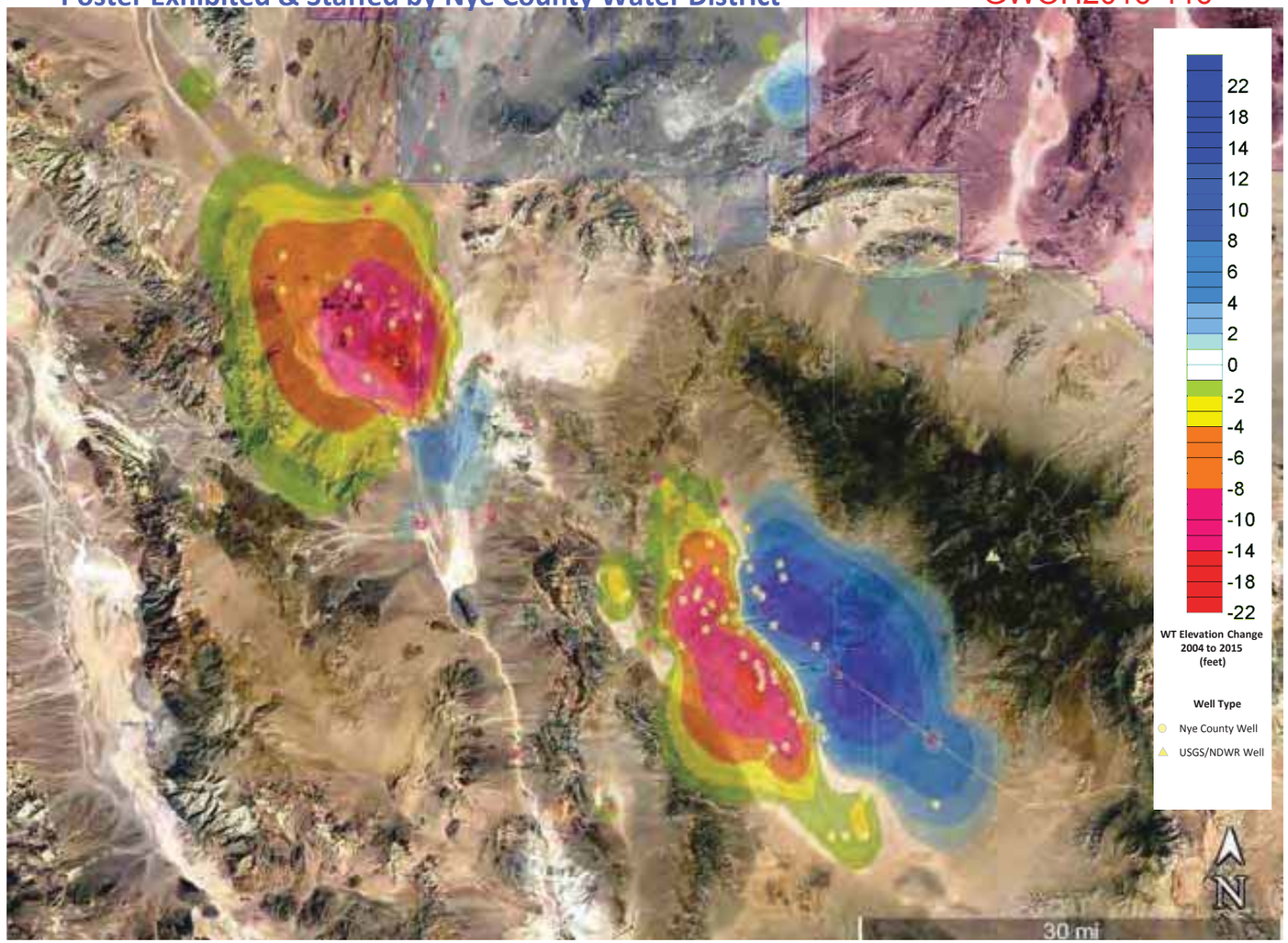
Examples of Nye County TSaMP commitment to public outreach are two articles ran in the Pahrump Valley Times, authoring of subsection 5.1.2 *"Nye County Tritium Sampling and Monitoring Program"* in the Nevada National Security Site Environmental Report - 2015 (in progress), and hosting a tour for the Nevada Site Specific Advisory Board and Community Environmental Monitors.

Map showing location of well ER-EC-11 and tritium concentration, as a percentage of the Safe Drinking Water Act Maximum Contamination Level (limit of 20,000 pCi/L). Map also shows other locations and tritium concentrations sampled by the DOE- NNSA/NFO water sampling network. Note: Black arrows indicate relative intensity and flow directions of groundwater flowing off of the NNSS. Map is from the Nevada National Security Site Environmental Report - 2014

Water Level Trends In Southern Nye County - 2015 Update (Sept.-2004 to Sept.-2015)

Poster Exhibited & Staffed by Nye County Water District

GWOH2016-11c



Poster Exhibited & Staffed by Nevada Division of Water Resources

GWOH2016-12

NEVADA DIVISION OF WATER RESOURCES

(aka NEVADA STATE ENGINEER'S OFFICE)

WHAT WE DO

WATER RIGHTS (SURFACE AND GROUNDWATER)

- APPROPRIATIONS
- REALLOCATION
- MONITORING

WATER AVAILABILITY (PERENNIAL YIELD)

ADJUDICATIONS

DAM SAFETY

FLOODPLAIN MANAGEMENT

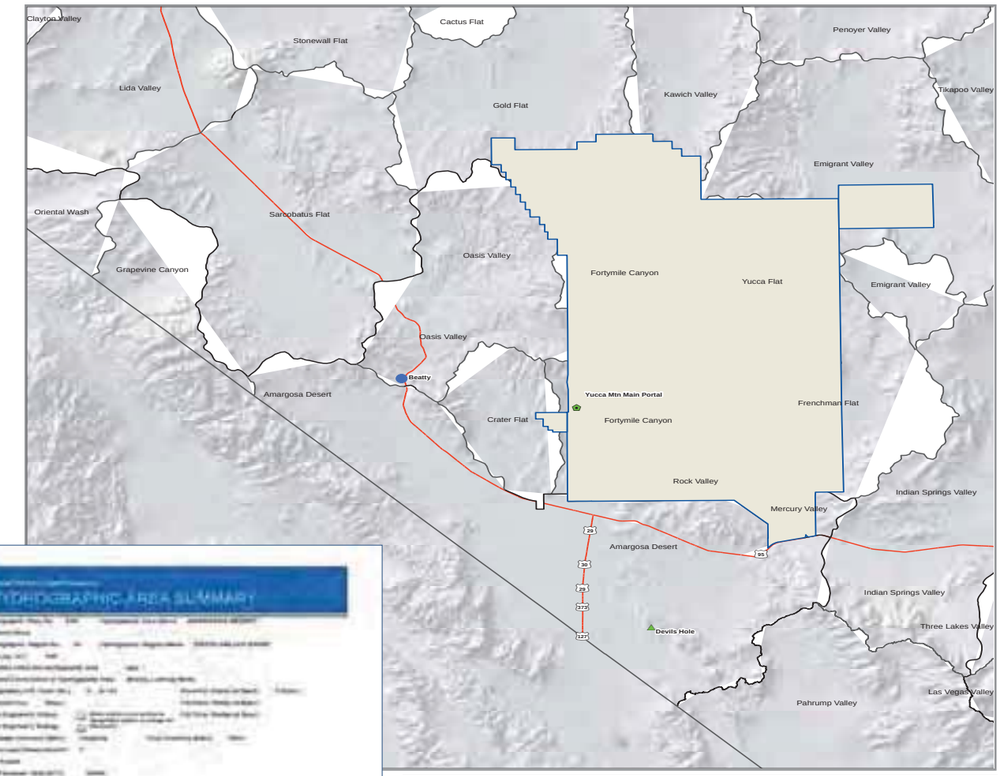
WELL DRILLING REGULATIONS

Nevada water law is based on two fundamental concepts: prior appropriation and beneficial use. Prior appropriation (also known as "first in time, first in right") allows for the orderly use of the state's water resources by granting priority to senior water rights. This concept ensures the senior uses are protected, even as new uses for water are allocated.

All water may be appropriated for beneficial use as provided in Chapters 533 and 534 of the Nevada Revised Statutes. Irrigation, mining, recreation, commercial/industrial and municipal uses are examples of beneficial uses, among others.

Department of Conservation and Natural Resources
Office of the State Engineer
Division of Water Resources
901 S. Stewart St.
Carson City, NV 89701

Jason King, P.E.
State Engineer



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WATER RIGHTS ALLOCATIONS IN THE BEATTY AREA BASINS

HYDROGRAPHIC BASIN	PERENNIAL YIELD (acre feet)	EXISTING APPROPRIATIONS (acre feet)
Mercury Valley		0
Rock Valley		0
Fortymile Canyon - Jackass Flats	24,000	17
Fortymile Canyon - Buckboard Mesa	(These basins have a	0
Oasis Valley	combined perennial yield)	1,296
Crater Flat		681
Amargosa Desert		26,297
Grapevine Canyon	400	12
Oriental Wash	150	237
Lida Valley	350	259
Sarcobatus Flat	3,000	3,395
Stonewall Flat	100	12
Gold Flat	1,900	391
Kawich Valley	2,200	23
Emigrant Valley - Groom Lake Valley	2,800	12
Emigrant Valley - Papoose Lake Valley	10	0
Yucca Flat	350	0
Frenchman Flat	100	0
Indian Springs Valley	500	1,390
Pahrump Valley	20,000	58,436

http://water.nv.gov/

NEVADA NATIONAL NNSS SECURITY SITE

Sign Up for the Upcoming Nevada National Security Site Groundwater Tour

Proposed Date: Wednesday, November 2, 2016

Join Us for a Groundwater-Focused Tour*

Core Library

Well Development, Testing and Sampling at Well ER-3-3

Rainier Mesa Tunnel and Overlook Discussion of Modeling Strategy

If you are interested in attending, please complete the form at this station, and we will contact you with more details.

*Featured stops are subject to change.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office

NEVADA NATIONAL NNSS SECURITY SITE

Expanding Our Understanding of Groundwater

The Nevada Field Office continues to gather information that expands our scientific knowledge on the location, type, quantity, direction of movement, and rate of radionuclide movement in groundwater. Key steps involve:

Identifying Information

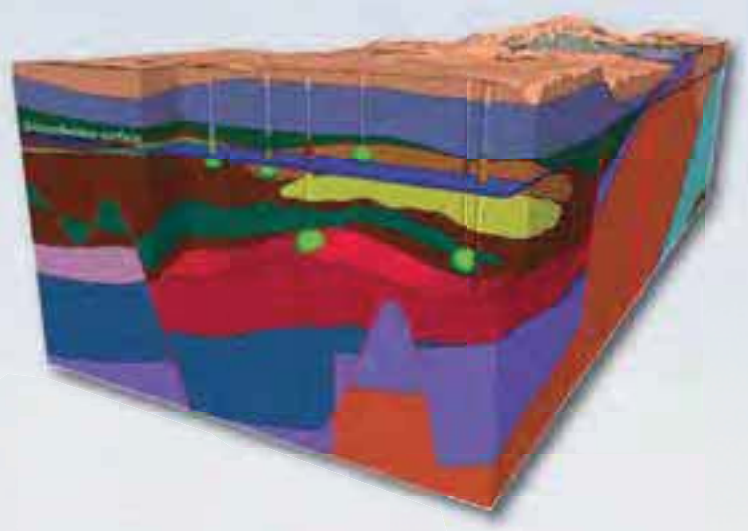
- Geology
- Hydrology
- Groundwater chemistry
- Concentration of radionuclides

Gathering Information

- Well drilling and construction
- Aquifer testing and water-level monitoring
- Water sample collection

Analyzing Information

- Computer simulations (modeling) of hydrogeology and groundwater flow and contaminant transport



Computer model of Nevada National Security Site subsurface

NEVADA NATIONAL NNSS SECURITY SITE

Why Computer Modeling?

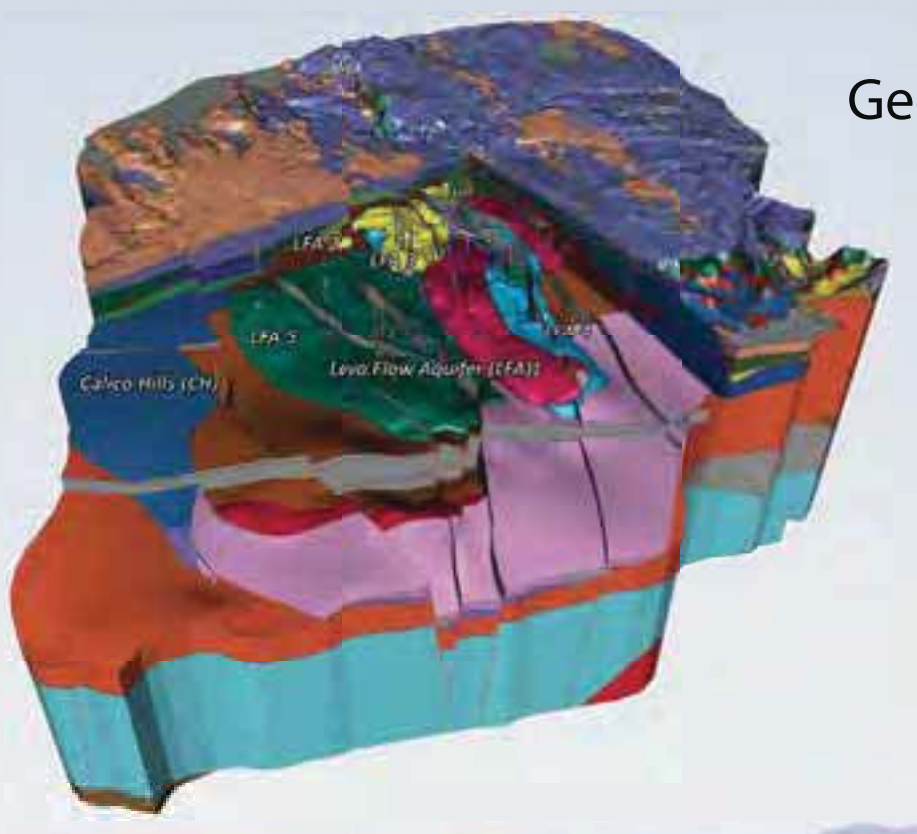
Creates three-dimensional representations of otherwise inaccessible subsurface

Provides flexibility for integrating available data

Helps forecast where contamination is moving and how fast

Allows for uncertainty and sensitivity analysis

Provides basis for regulatory compliance and risk decisions



Geologic Model

NEVADA NATIONAL NNSS SECURITY SITE

Poster Exhibited & Staffed by Desert Research Institute

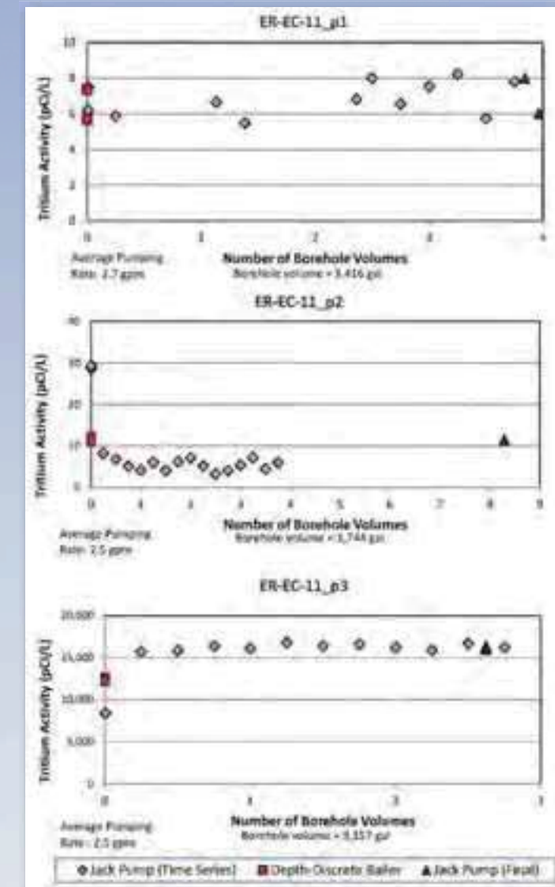
GWOH2016-14c

Evaluation of Sampling Technology

Alternative technologies can be used to collect water samples. Scientists are working to determine which technology produces the best samples while keeping costs as low as possible

Bailers are economical and easy to use but cannot purge a well.

Submersible pumps and Jack pumps (shown) are industry standards but are expensive to install, difficult to move, and require substantial power to operate.



Bailed samples (red squares) from the unpumped well can be similar to pumped samples (tan diamonds and blue triangles) depending upon the degree of interaction between the well and surrounding groundwater.

Bailer: A hollow tube connected to a valve that allows you to acquire a few liters of sample from any depth within the well.

Purge: Remove a sufficient amount of water from the well to ensure samples are representative of water in the surrounding aquifer.

If you would like high-resolution versions of the posters, please include the poster number(s) which are located on the upper right corner of each poster and submit your request to envmgt@nnsa.doe.gov