Nevada Test Site

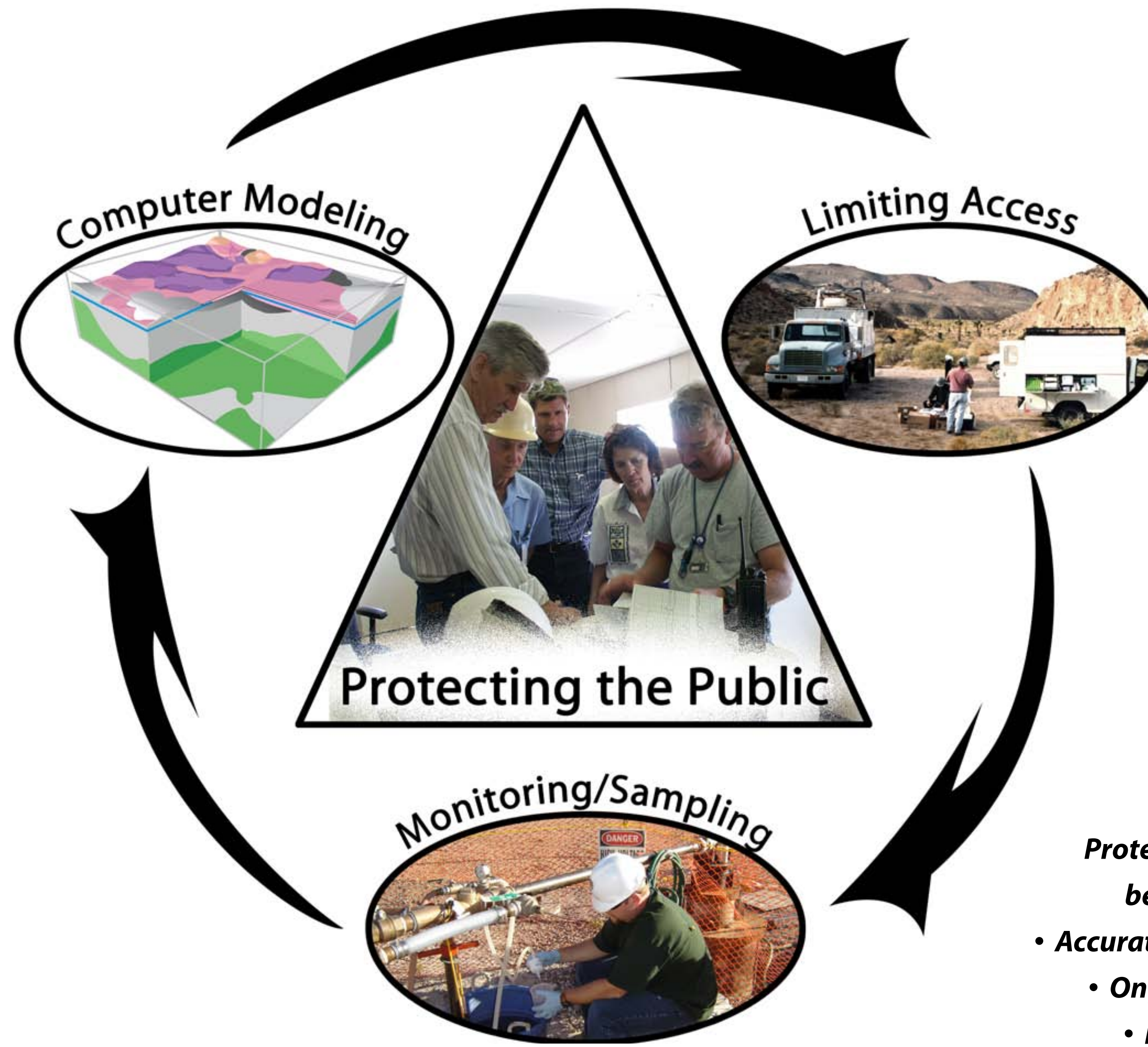
Protecting the Public

It is a top priority to determine the timing and location for potential groundwater contamination beyond Nevada Test Site boundaries.

- Nevada Test Site groundwater programs continuously research the potential for radiologically-contaminated groundwater to migrate beyond Nevada Test Site boundaries.
- This research includes calculating the ***probability*** (using computer modeling predictions) multiplied by the ***consequences*** of potential public exposure.

Probability x Consequences = Protecting the Public

- ***Probability*** uncertainty is reduced by gathering data (through sampling and other monitoring efforts on and off the Nevada Test Site) to improve and refine computer modeling.
- Sampling results are used in the computer model which predicts where contaminated groundwater can or will be found so that public access can be limited, thereby reducing the ***consequences*** of potential public exposure.



Protecting the public is best achieved by

- ***Accurate computer modeling***
- ***Ongoing monitoring***
- ***Limiting access***

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Radiation Facts

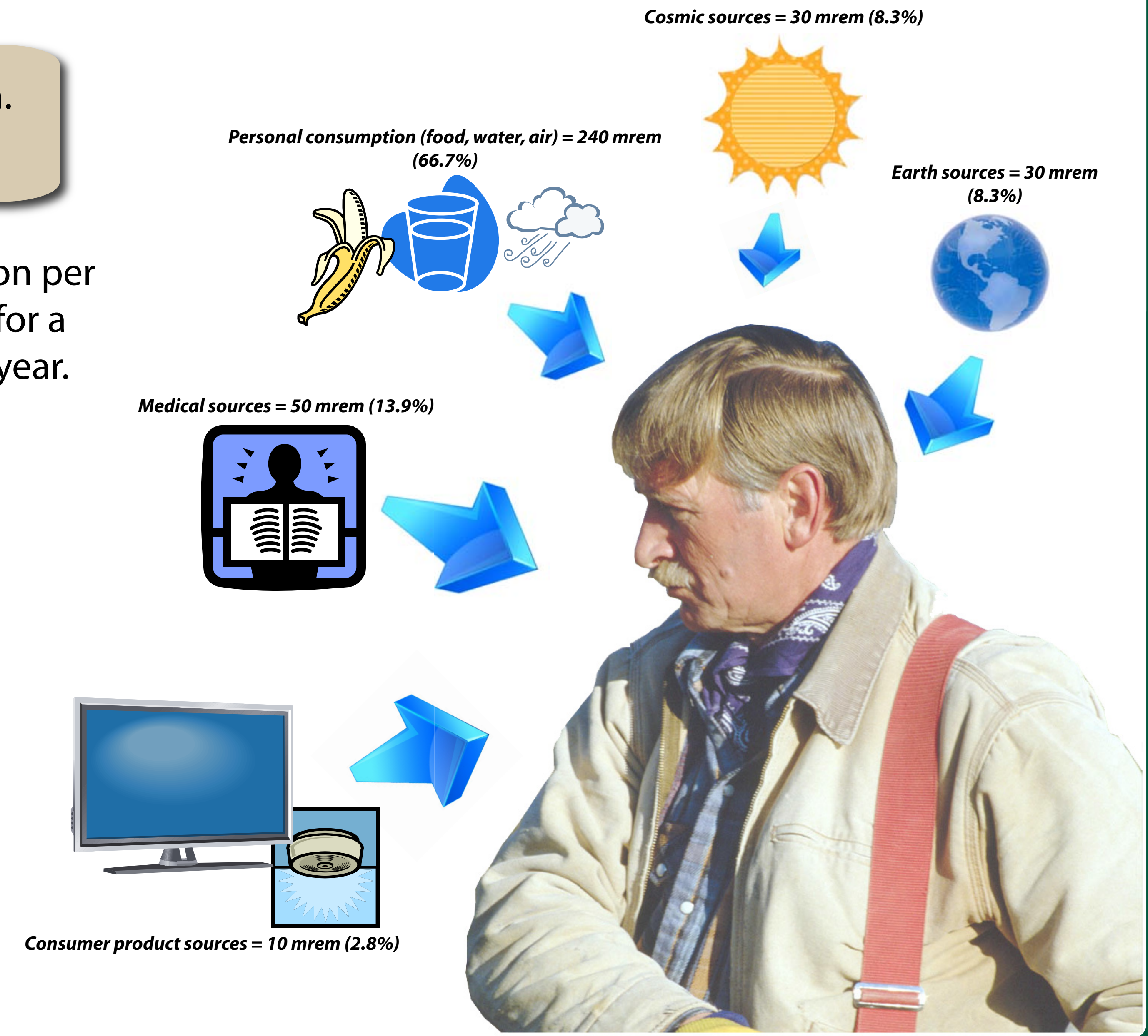
Radiation occurs naturally in the environment.

Average Annual Radiation Source and Dose

Rem measures the biological damage, or "dose" of radiation.
A ***millirem*** (mrem) is one one-thousandth of a rem.

The average person receives approximately 360 mrem of radiation per year from all sources. The maximum legal radiation dose limit for a person whose profession permits exposure is 5,000 mrem per year.

U.S. Environmental Protection Agency maximum contaminant level (MCL) for beta particle and photon radioactivity (e.g., tritium) in drinking water = 4 mrem per year



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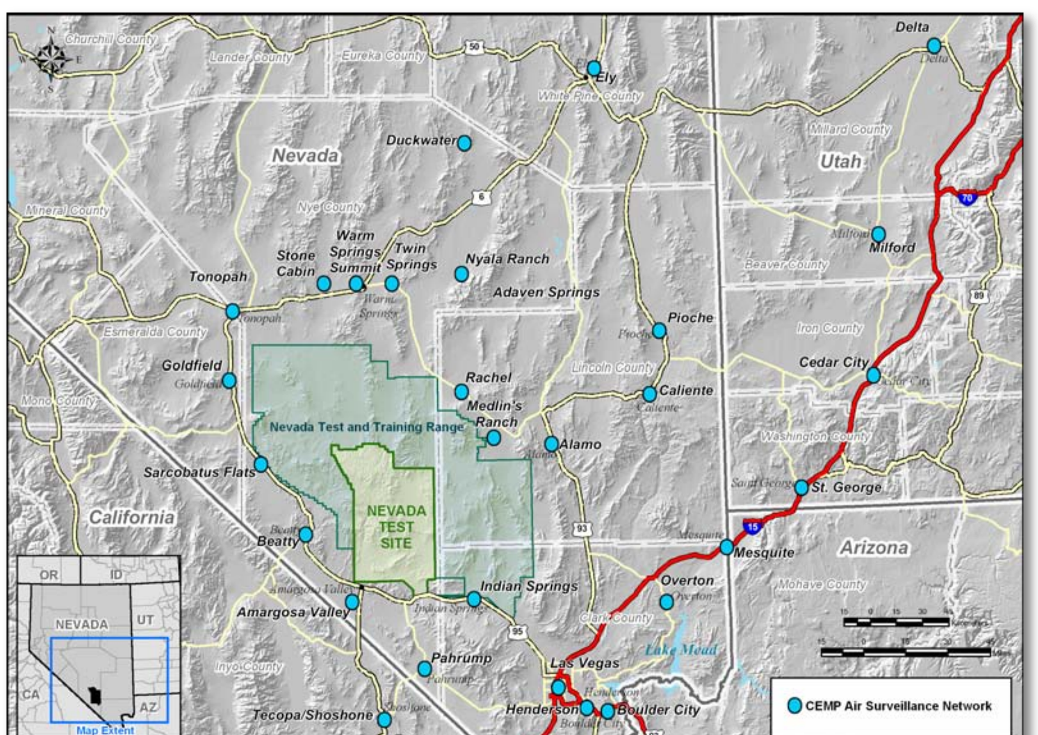
Community Environmental Monitoring Program (CEMP)

To date, tritium from historic underground nuclear tests has not been detected in the groundwater supply of any community surrounding the Nevada Test Site.

The CEMP samples the water supply yearly at each community hosting a CEMP station to test for the presence of man-made radioactivity. CEMP analyzes the samples for tritium because it is the most common radioactive contaminant at the Nevada Test Site and it moves most rapidly in groundwater.



CEMP monitoring test results are available at www.cemp.dri.edu

- CEMP's network of monitoring stations use instruments to detect airborne radiation (if present) and record weather data. This information is available real-time on the CEMP web site at www.cemp.dri.edu.
- Private citizens operate CEMP monitoring stations in Nevada, Utah, and California communities and ranches that surround and are downwind of the Nevada Test Site.
- Desert Research Institute administers the CEMP.
- CEMP is funded by the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office.

Tritium Results from CEMP Water Tests in Picocuries per liter (pCi/L)

Location	2007	2006	2005	2004	2003	2002	2001
Adaven Springs*	9.7	22.6	20	12	16	15	
Alamo^	-6.4	<1	<1	<1	<1	2	7
Amargosa Valley^	6.4	<1	<1	<1	3	<1	3
Beatty^	3.2	<1	<1	<1	<1	2	3
Boulder City*	19.3	35.4	24	29	35	27	34
Caliente^	3.2	<1	8	7	5	8	12
Cedar City^	6.4	<1	3	<1	<1	<1	1
Delta^	3.2	6.4	<1	2	<1	<1	1
Duckwater^	6.4						
Ely*	16.1	9.7	<1				
Goldfield^	3.2	<1	<1	<1	5	<1	<1
Henderson*	32.2	16.1	24	27	27	26	34
Indian Springs^	3.2	9.7	<1	<1	4	5	2
Las Vegas^	12.9	3.2	<1	3	<1	1	<1
Medlin's Ranch*	3.2	<1	10	9	9	4	13
Mesquite^	0						
Milford^	0	12.9	1	<1	<1	<1	<1
Nyala Ranch^	-3.2	9.7	<1	<1	<1	<1	
Overton^	12.9	6.4	<1	3	2	<1	1
Pahrump^	0	3.2	<1	<1	2	<1	1
Pioche^	0	6.4	<1	2	<1	4	<1
Rachel^	-6.4	3.2	<1	<1	<1	1	<1
Sarcobatus Flats^	19.3	<1	<1	3	<1	<1	
Stone Cabin Ranch*	-6.4	<1	2	<1	3	2	
St. George*	22.6	9.7	8	<1	4	8	9
Tonopah^	9.7	<1	<1	<1	4	<1	<1
Twin Springs^	-9.7	3.2	<1	<1	<1	<1	

* Sample taken from spring or surface water.
^ Sample taken from well water.

The safe drinking water standard for tritium allows 20,000 pCi/L.

Source: Nevada Test Site Environmental Reports

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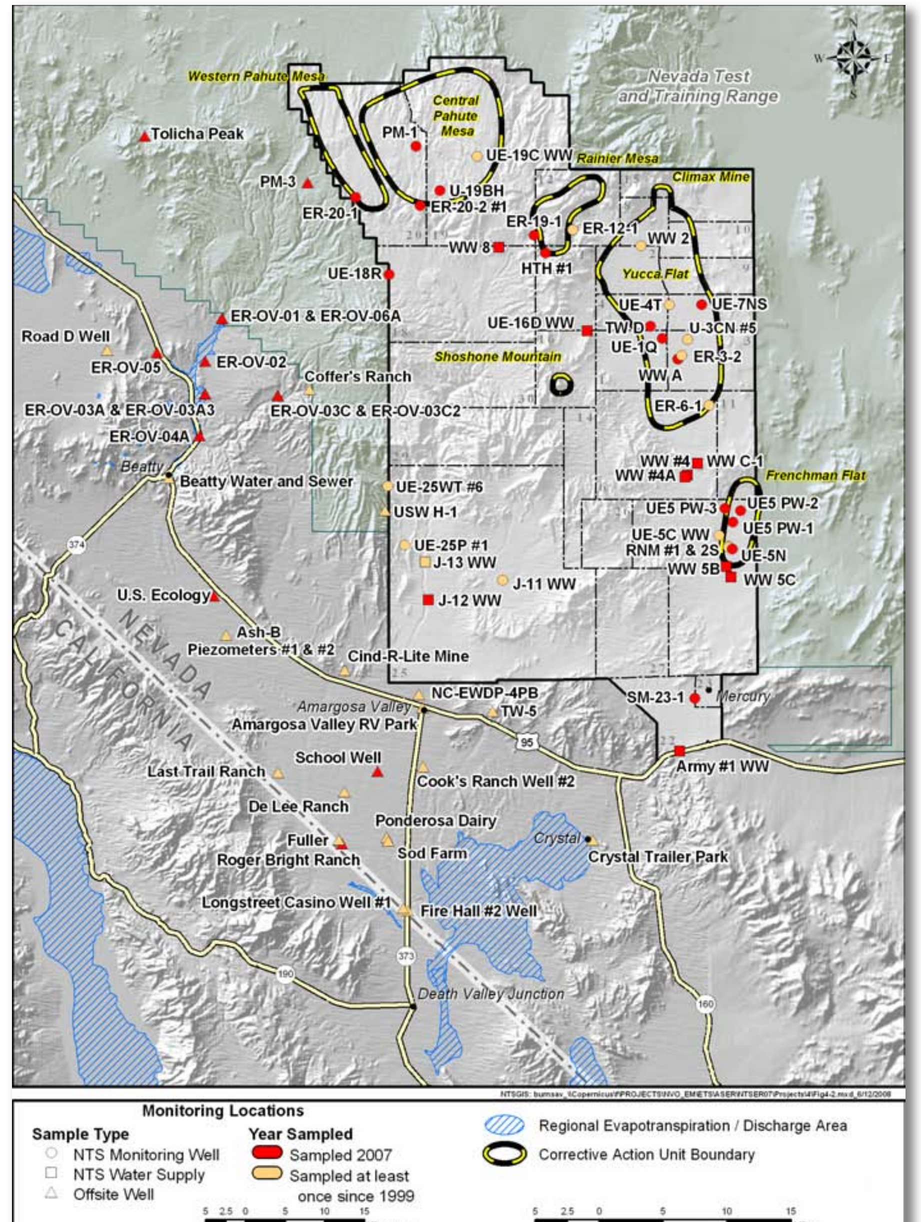
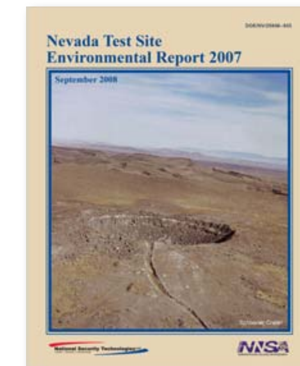
Routine Radiological Environmental Monitoring Program (RREMP)

To date, no man-made radioactivity from underground nuclear testing has ever been detected in any groundwater well located off the Nevada Test Site.

- Wells and springs on the Nevada Test Site are sampled to help identify the location of groundwater contamination.
- In areas where groundwater contamination has been located on the Nevada Test Site, wells and springs are monitored over time to determine if the level of radioactivity is increasing, decreasing or remaining the same.
- Groundwater wells and springs to the west and south of the Nevada Test Site are monitored to determine if any radioactivity has migrated off the Nevada Test Site into the public domain.





RREMP monitoring results are updated annually in the Nevada Test Site Environmental Report. This report is available at www.nv.doe.gov/library/publications/aser.aspx

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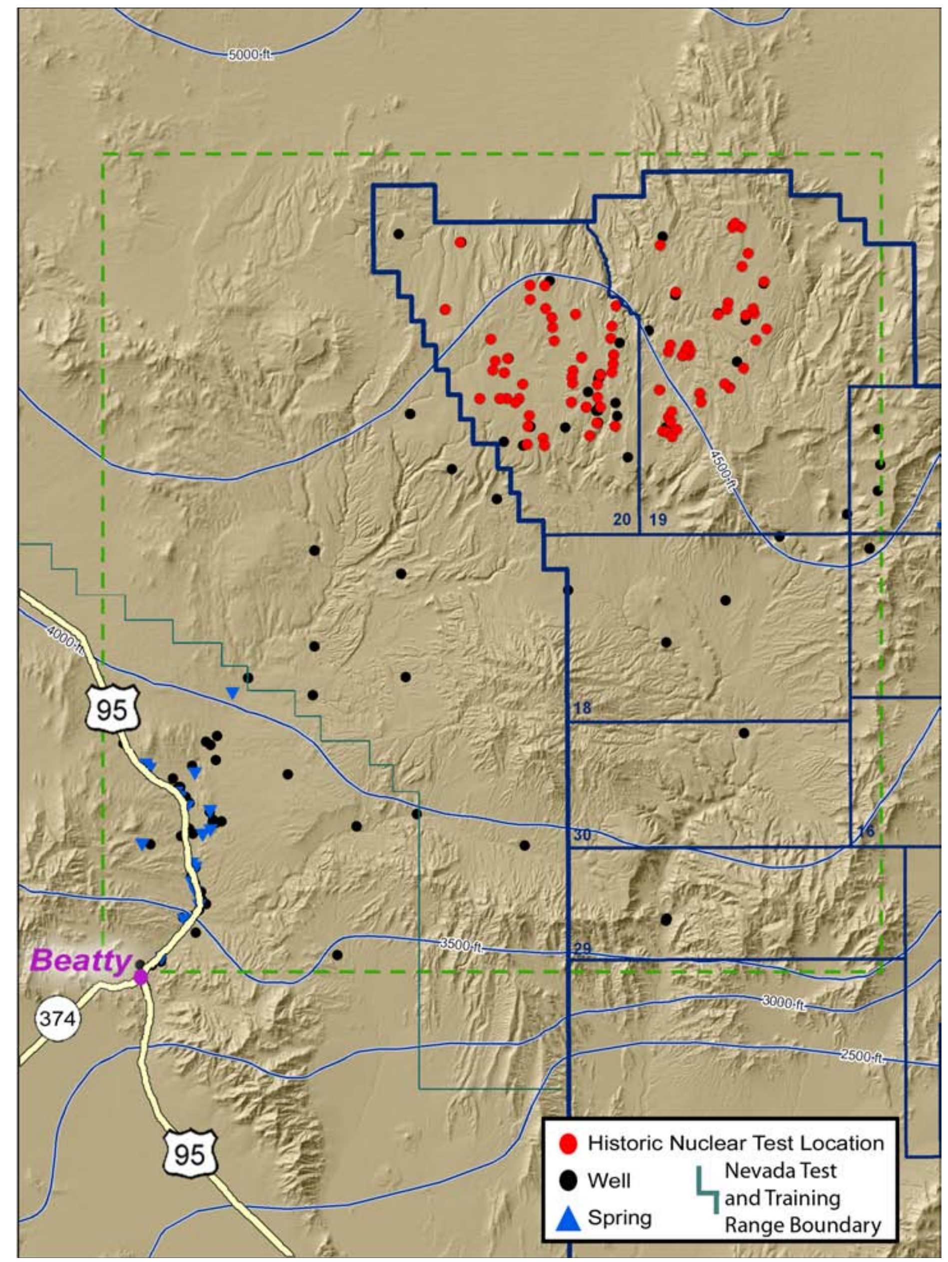
Modeling Pahute Mesa Groundwater Flow

Computer modeling depicts the Nevada Test Site Pahute Mesa groundwater to flow from north-northeast to south-southwest with a discharge point along Oasis Valley.

Computer models are a three-dimensional, mathematical representation of the important physical features within the flow system.

Pahute Mesa groundwater flow computer models were created from information obtained through well drilling, sampling, geophysical data collection, and research. Complex geologic alternatives are included in the models to account for uncertainties within the Nevada Test Site setting.

Flow Model Alternatives	Description
Raised Paleozoic	Raises the basement surface to highest plausible to focus flow in higher rocks.
Thirsty Canyon Lineament	Treats Thirsty Canyon Lineament as a continuous feature.
Deep Rooted Thrust	Considers Belted Range thrust to be more extensive resulting in a low permeability thrust sheet over most of the model.
Gravity Ridge	Aquifer units are truncated against older lower permeability rocks presumed to resist or hinder flow off Pahute Mesa.
Southeast Paleozoic	Changes Paleozoic carbonates into continuous sheet in southeastern area.
Silent Canyon Caldera Complex	Structurally uncoupled from basin and range faults. Circular caldera ring faults and collapse features. Faults do not extend to much depth.



- The flow models have been calibrated to approximate observed water levels in wells and discharge in springs.
- The flow models have also been demonstrated to approximate the natural chemical constituents in groundwater (such as chloride and sulfate) and how they change along flow paths.

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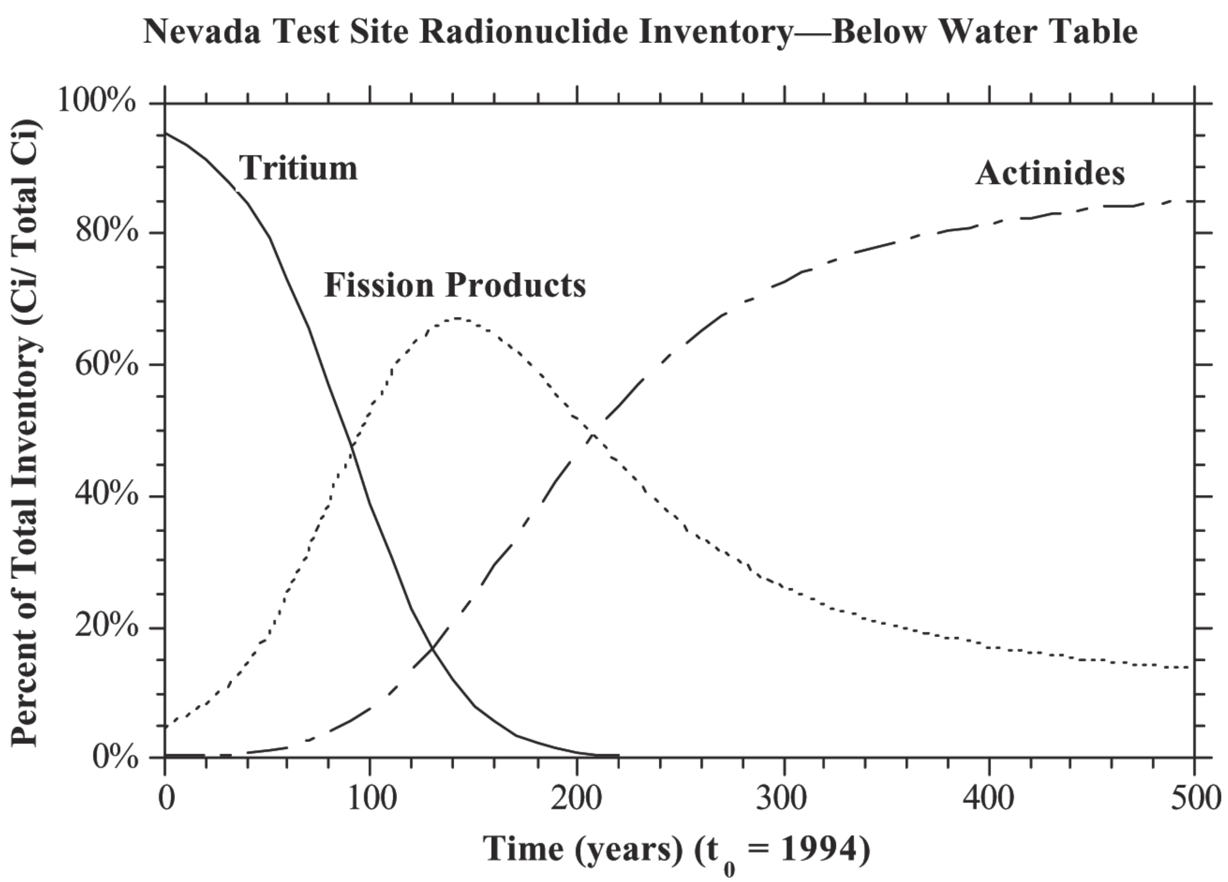
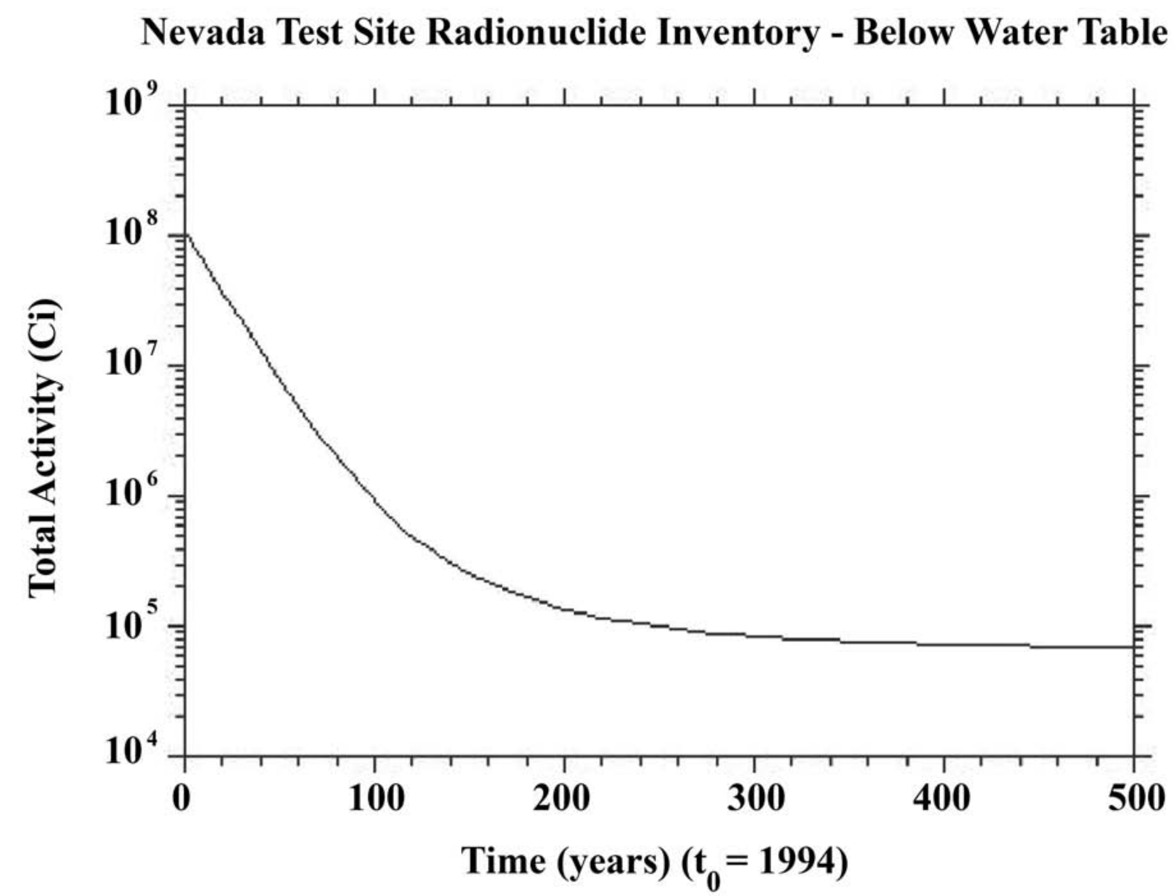
Modeling Source Term

"Source term" is an estimate of the amount of a contaminant released to the environment from a specific source (such as underground nuclear testing) over a certain period of time.

Source term models predict the amount and type of contaminants that will be found in the groundwater in the future.

At the Nevada Test Site, tritium currently dominates the inventory from underground testing, but is overtaken by fission products after approximately 100 years. After 200 years, actinides populate the majority of the remaining inventory. In roughly 200 years the total activity from radionuclides will decrease approximately three orders of magnitude from radioactive decay.





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Modeling the Movement of Contamination

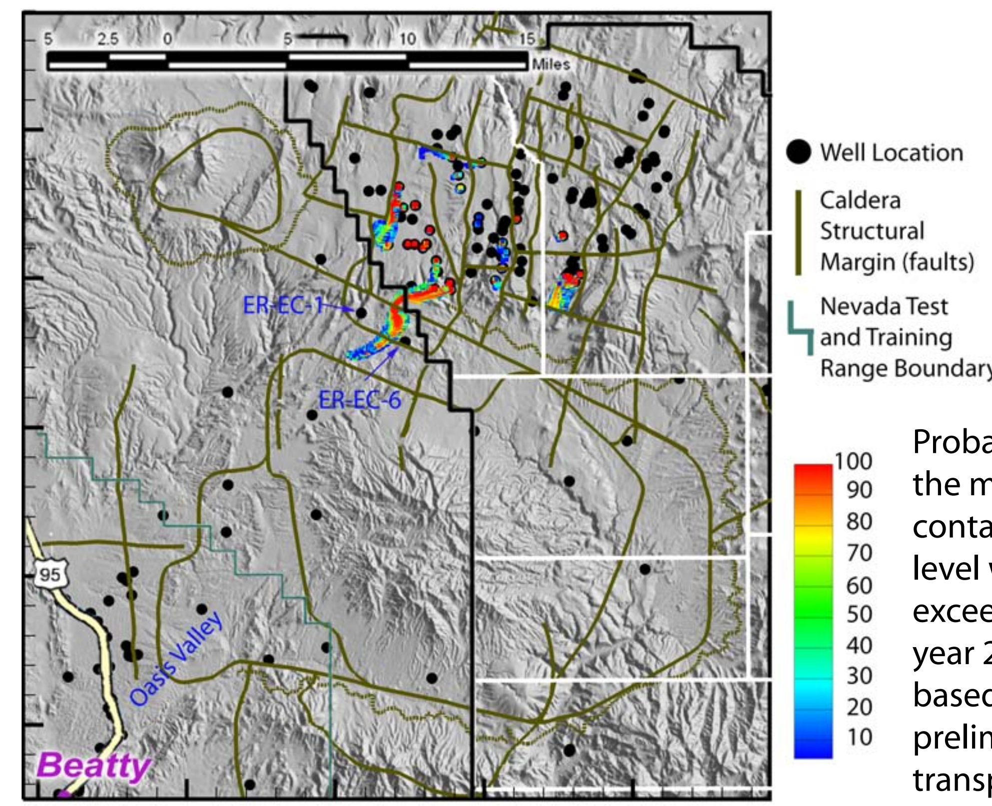
Estimating how quickly and how far potential contamination may move beyond Nevada Test Site boundaries is essential to implementing the appropriate protective measures.

The contaminant transport model simulates the movement of a variety of radiological contaminants through the groundwater, and predicts where contaminants will be found.

- Rate and distance parameters are applied to the flow model to predict how contaminants are transported over time.
- The transport model is developed using experimental results from laboratory and field tests of contaminant movement in aquifer material.
- Most well sampling results have not detected the presence of radionuclides, thereby posing challenges when comparing against predictions.

Safe Drinking Water Act maximum contaminant level for tritium is 20,000 pCi/L.

The transport model predicts that contamination above the maximum contaminant level for tritium should be present off the Nevada Test Site. However, no man-made radioactivity from underground nuclear testing has been detected in any samples drawn from groundwater wells located beyond Nevada Test Site borders.



Probability that the maximum contaminant level will be exceeded in year 2015, based on the preliminary transport model.

- Preliminary estimate of exceeding the maximum contaminant level 50 years after contamination occurred is depicted above (red is more and blue is less probable).
- Continued well drilling and data collection will improve and refine the transport models.

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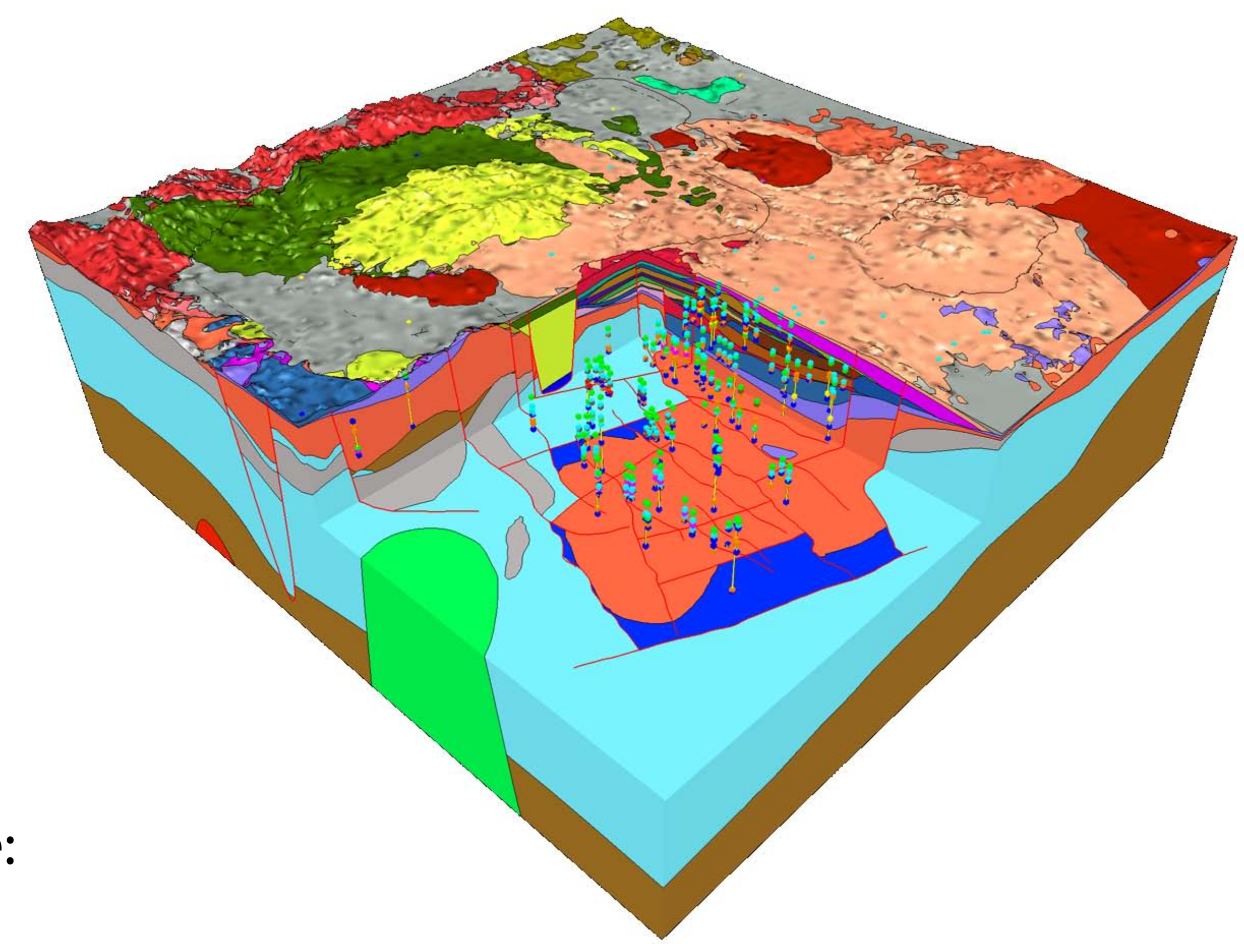
Complex Geology

Geology at the Nevada Test Site is diverse and complex.

The complexity of the sub-surface geology creates technical challenges for scientists to accurately determine where and how fast groundwater and contaminants migrate. The Underground Test Area Sub-Project works extensively to characterize the geology and represent the uncertainty of contaminant migration. The geologic models provide the initial framework for all Underground Test Area modeling.

The complex geologic features of Pahute Mesa include:

- At least six Tertiary-age calderas
- Basin-and-range normal faults
- Mesozoic-age thrust faults
- Granite bodies intruded through a basement of highly deformed sedimentary rocks



Pahute Mesa Geologic Model

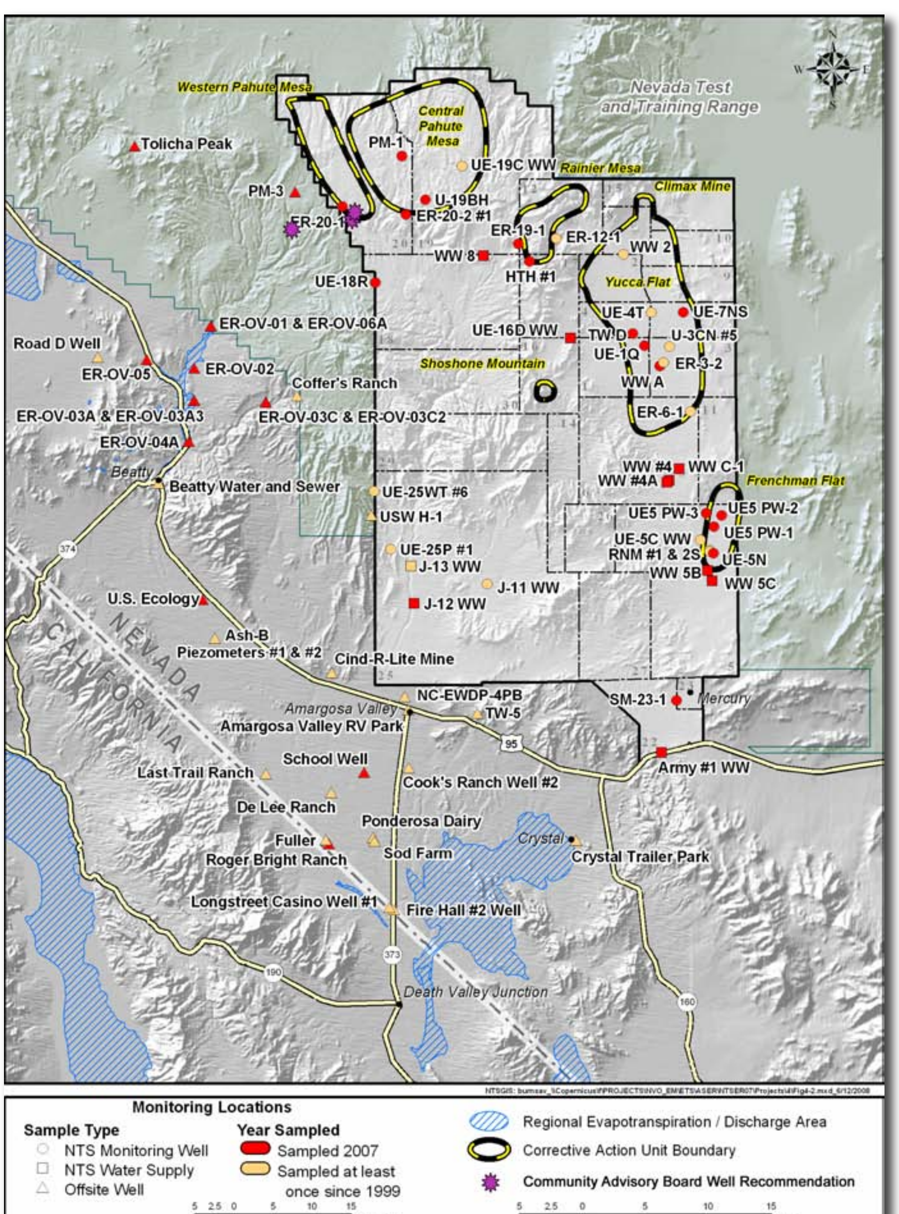
Each color represents rocks with distinct hydrogeologic properties.

Nevada Test Site
Community Advisory Board

Current and past CAB members reside in Beatty, Amargosa Valley, Pahrump, and Las Vegas.

The Community Advisory Board (CAB) is made up of Southern Nevada residents and is federally-chartered to provide recommendations to the Environmental Management Program at the Nevada Test Site.

In 2002, the U.S. Department of Energy asked the CAB to site the location of a groundwater well that would be used to gain data for the Underground Test Area Sub-Project. In 2006, after four years of extensive research, the CAB recommended three groundwater wells on and near Pahute Mesa. The U.S. Department of Energy begins in May 2009 with the drilling of a CAB recommended well.



Community Advisory Board members tour an Underground Test Area drill site (ER-16-1) on the Nevada Test Site.

A Community Advisory Board meeting held in Las Vegas, NV.

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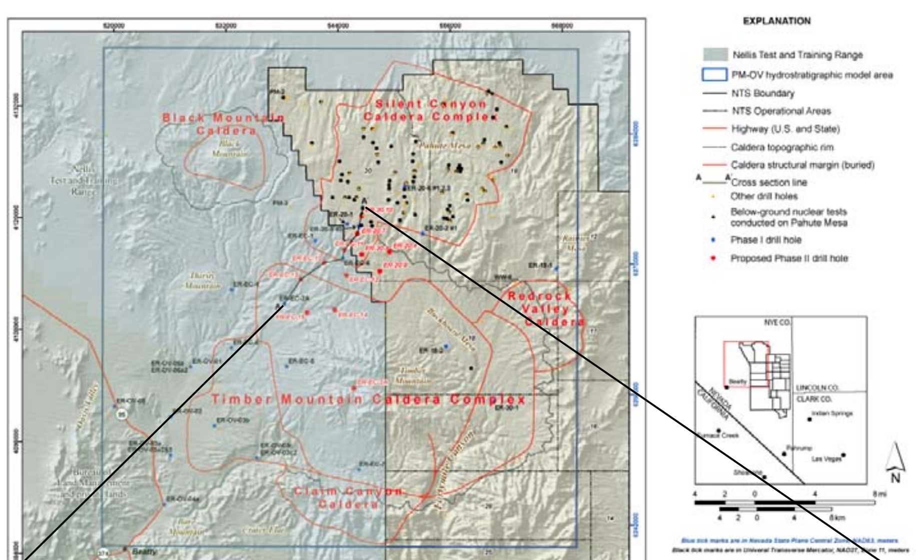
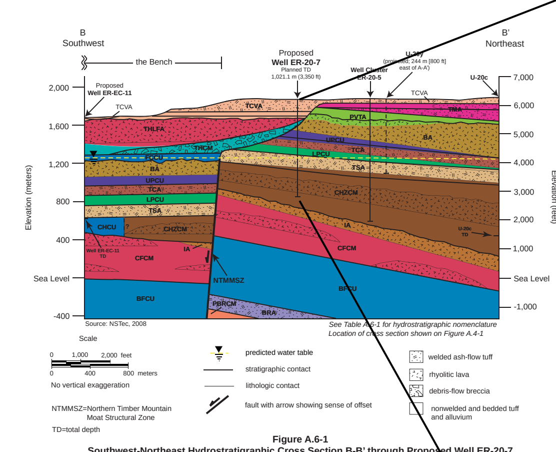
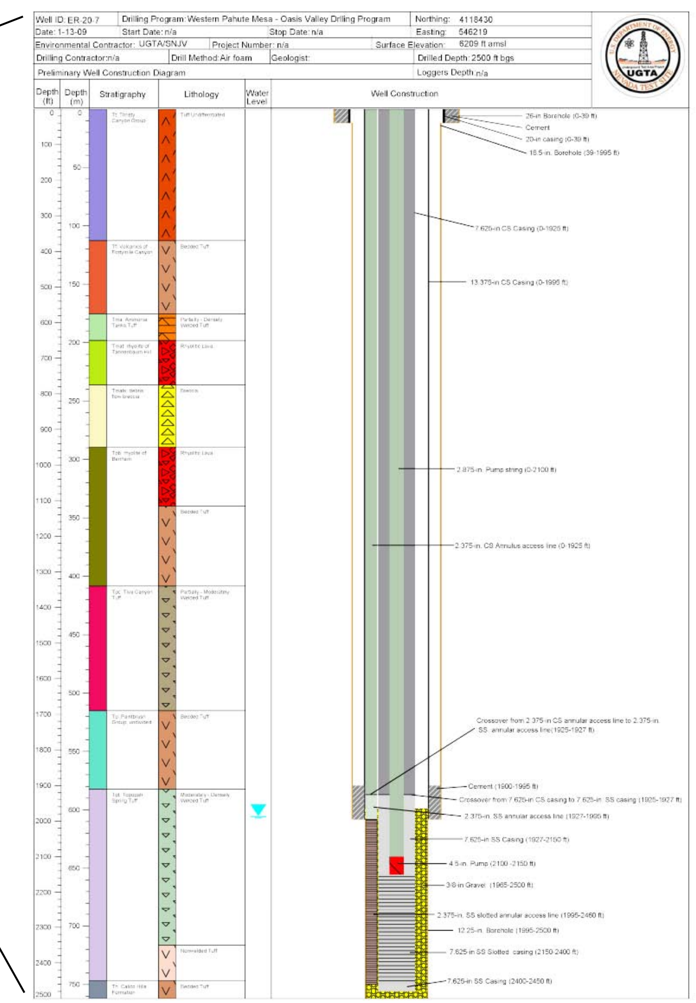
Groundwater Well Drilling

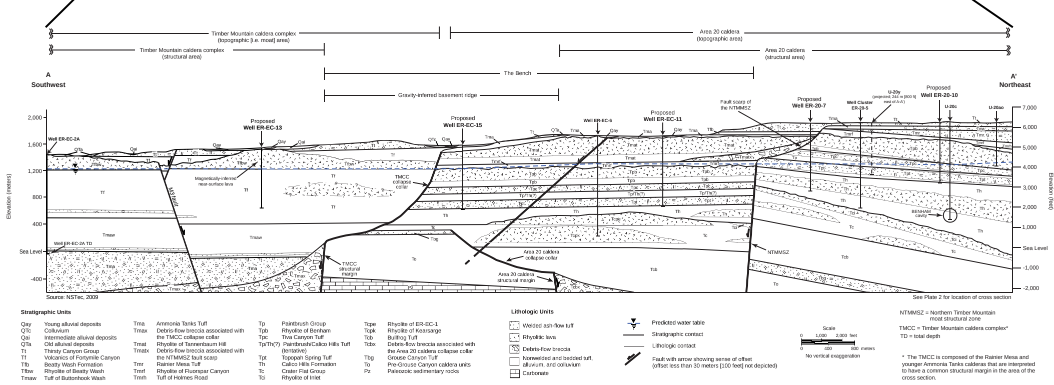
Wells are drilled to collect geologic and aquifer data, which is used in computer models to predict groundwater movement and contaminant boundaries.

- Pahute Mesa drilling begins in May 2009.
- Nine wells are planned to be drilled over the next four years.
- Wells will be drilled from 2,500 to 3,700 feet deep. Each well costs approximately $5 - $7 million.
- The Nevada Test Site Community Advisory Board (CAB) recommended three well locations.
- The first well drilled will be a CAB-recommended well.









Drilling UGTA well ER-16-1

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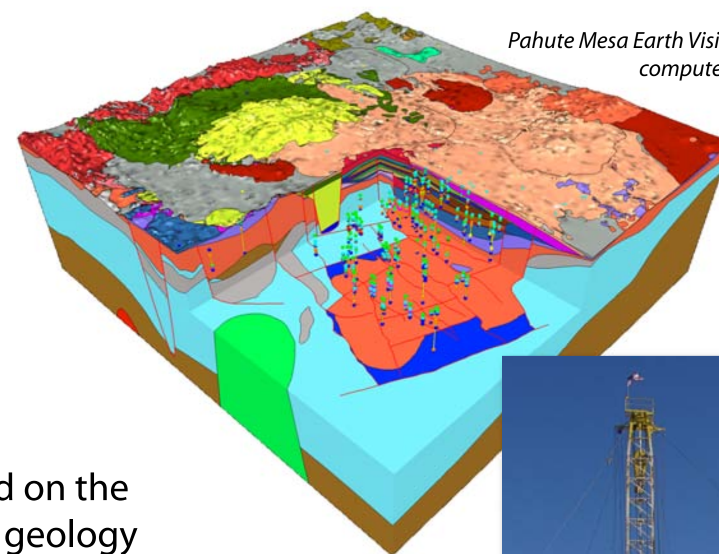
Underground Test Area (UGTA) Sub-Project

828 underground nuclear tests were conducted on the Nevada Test Site from 1951 to 1992. Some of the tests occurred near or below the water table, resulting in groundwater contamination.

UGTA Sub-Project staff are responsible for evaluating the impact of historic nuclear tests on groundwater resources and studying the extent of contaminant migration.

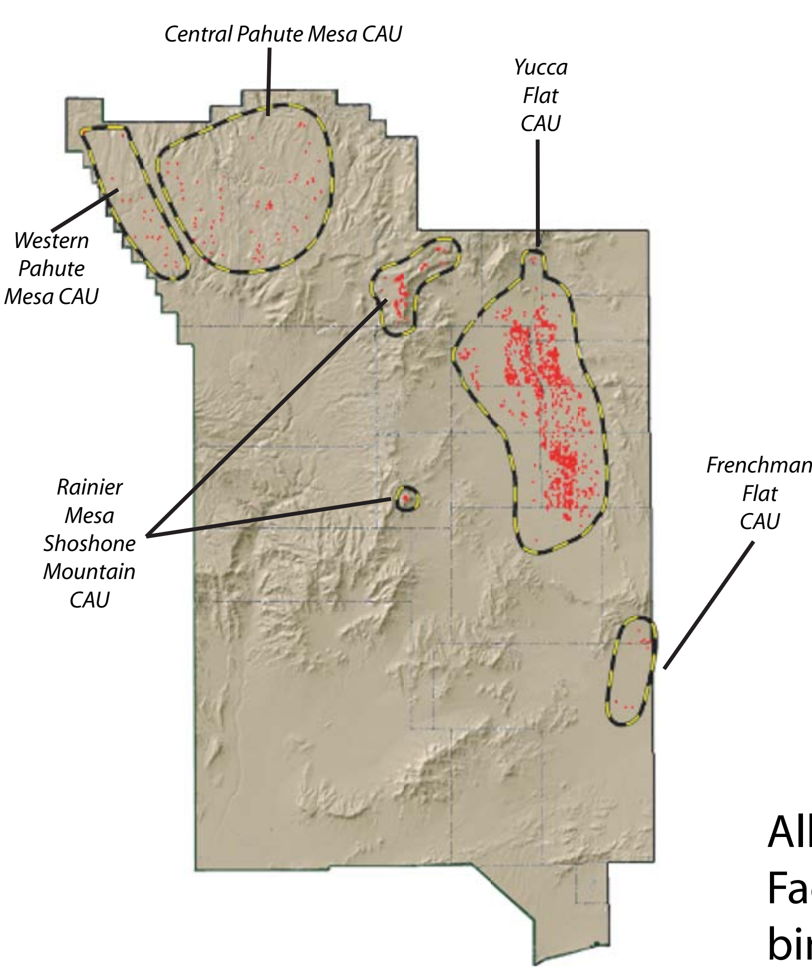


Pahute Mesa Earth Vision three-dimensional computer model

The UGTA Approach:

- Organized into five Corrective Action Units (CAUs)
- A CAU is a grouping of Corrective Action Sites (CASs), based on the locations of historic underground nuclear tests and similar geology
- Each CAU is analyzed and evaluated
- Wells are drilled to collect field data (samples)
- Field data is used to create three-dimensional computer models
- Models are used to estimate groundwater flow and transport parameters
- Models are the preferred decision tools for predicting current and future location of contamination
- Monitoring of groundwater is used to evaluate model predictions and ensure compliance with regulatory requirements

UGTA well ER-2-1 during mobilization on Yucca Flat



UGTA Corrective Action Unit (CAU) Boundaries

DOE staff works with other organizations in a collaborative approach to understand the nature and extent of groundwater contamination:

- *Lawrence Livermore National Laboratory*
- *Los Alamos National Laboratory*
- *Desert Research Institute*
- *United States Geological Survey*
- *State of Nevada*
- *National Security Technologies*
- *Stoller-Navarro Joint Venture*

All activities are conducted in accordance with the Federal Facility Agreement and Consent Order (FFACO), a legally binding document agreed to by the State of Nevada, the U.S. Department of Energy, and the U.S. Department of Defense.

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