ERRATA SHEET

Issue Date: July 2013

The Following Corrections Apply to: *Nevada National Security Site Environmental Report Summary 2011*

DOE Document Number: DOE/NV/25946--1604-SUM

Document Date: September 2012

The corrections shown below have been made in the subject document.

Page 18, middle column, first complete paragraph, first sentence:	117.427 changed to **121.427**
Page 18, middle column, first complete paragraph, second to last sentence:	117 changed to **121**
Page 18, table at bottom of page, Tritium (^3H) value:	117 changed to **121**

DOE/NV/25946--1604-SUM

Nevada National Security Site Environmental Report Summary 2011

September 2012

National Nuclear Security Administration

National Security Technologies LLC
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The information presented in this document is explained in greater detail in the ***Nevada National Security Site Environmental Report 2011*** (DOE/NV/25946--1604). A compact disc of this document is included on the back inside cover. This document can also be downloaded from the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office at **http://www.nv.energy.gov/library/publications/aser.aspx**.

For more information about the Nevada National Security Site Environmental Report, contact **Pete Sanders** at **(702) 295-1037** or **sanders@nv.doe.gov**.

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

By:

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Disclaimer

Front cover photograph ...

Geologist Sig Drellack on Pahute Mesa collecting fracture data for input to groundwater flow and transport models for the Underground Test Area Activity. View is westward.

Front cover photo insets *(clockwise)* ...

Environmental scientists Melissa Cabble and Matt Weaver sampling water for radiological analysis at the E-Tunnel containment ponds in Area 12 of the NNSS.

Radiological technician Patrick O'Brien surveying for radiation in Area 25 of the NNSS prior to plant sampling for radiological analysis.

Environmental scientists Martin Cavanaugh and Terry Sonnenburg sampling soil for radiological analysis at the North Las Vegas Facility.

Back cover photograph …

Drill rig crew running pipe into the borehole at the Underground Test Area Characterization Well ER-EC-13 southwest of Area 20 on the Nevada Test and Training Range.

Nevada National Security Site Environmental Report Summary 2011

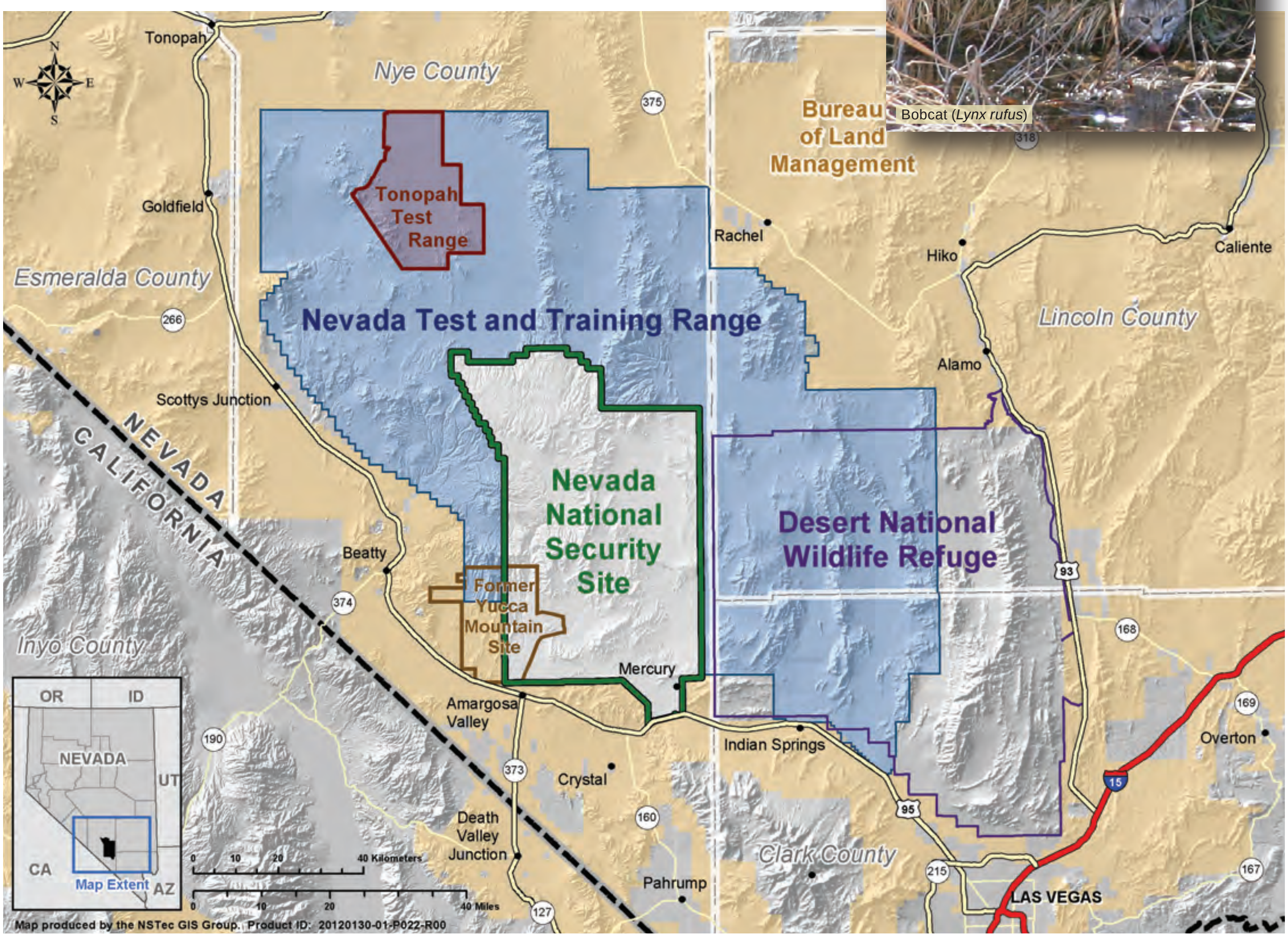
The U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) directs the management and operation of the Nevada National Security Site (NNSS). NNSA/NSO prepares the *Nevada National Security Site Environmental Report* (NNSSER) to provide the public an understanding of the environmental monitoring and compliance activities that are conducted on the NNSS to protect the public and the environment from radiation hazards and from nonradiological impacts.

The NNSSER is a comprehensive report of environmental activities performed at the NNSS and offsite facilities over the previous calendar year. It is prepared annually to meet the requirements and guidelines of the U.S. Department of Energy (DOE) and the information needs of NNSA/NSO stakeholders. This summary provides an abbreviated and more readable version of the NNSSER. It does not contain detailed descriptions or presentations of monitoring designs, data collection methods, data tables, the NNSS environment, or all environmental program activities performed throughout the year.

The reader is provided with an electronic file of the full NNSSER and of *Attachment A: Site Description* (see attached compact disc on the inside back cover). The reader may obtain a hard copy of the full NNSSER as directed on the inside front cover of this summary report.

The NNSS is currently the nation's unique site for ongoing national security–related missions and high-risk operations. The NNSS is located about 65 miles northwest of Las Vegas. The approximately 1,360-square-mile site is one of the largest restricted access areas in the United States. It is surrounded by federal installations with strictly controlled access, as well as by lands that are open to public entry.


Bobcat (*Lynx rufus*)



NNSS History

Between 1940 and 1950, the area now known as the NNSS was part of the Las Vegas Bombing and Gunnery Range. In 1950, the NNSS was established as the primary location for testing the nation's nuclear explosive devices. Such testing took place from 1951 to 1992.

Tests conducted through the 1950s were predominantly atmospheric tests. These involved a nuclear explosive device detonated while either on the ground surface, on a steel tower, suspended from tethered balloons, dropped from an aircraft, or placed on a rocket. Several tests were categorized as "safety experiments" and "storage-transportation tests," involving the destruction of a nuclear device with non-nuclear explosives. Some of these tests resulted in dispersion of plutonium in the test vicinity. One of these test areas, Project 57, lies just north of the NNSS boundary on the Nevada Test and Training Range (NTTR). Other tests, involving storage transportation, were conducted at the north end of the NTTR (Double Tracks) and on the Tonopah Test Range (TTR) (Clean Slates I, II, and III). All nuclear device tests are listed in *United States Nuclear Tests, July 1945 through September 1992* (U.S. Department of Energy, Nevada Operations Office, 2000, DOE/NV--209, Rev. 15).

The first underground test, a cratering test, was conducted in 1951. The first totally contained underground test was in 1957. Testing was discontinued during a moratorium that began October 31, 1958, but was resumed in September 1961 after tests by the Union of Soviet Socialist Republics began. Beginning in late 1962, nearly all tests were conducted in sealed vertical shafts drilled into Yucca Flat and Pahute Mesa or in horizontal tunnels mined into Rainier Mesa. From 1951 to 1992, a total of 828 underground nuclear tests were conducted at the NNSS. Approximately one-third of these tests were detonated below or in the water table.

Five earth-cratering (shallow-burial) tests were conducted over the period of 1962 through 1968 as part of the Plowshare Program, which explored peaceful uses of nuclear explosives. The first and highest yield Plowshare crater test, Sedan, was detonated at the northern end of Yucca Flat on the NNSS. The second-highest yield crater test was Schooner, located in the northwest corner of the NNSS. Mixed fission products, tritium, and plutonium from these tests were entrained in the soil, ejected from the craters, and deposited on the ground surrounding the craters.

Other nuclear-related experiments at the NNSS included the Bare Reactor Experiment–Nevada series in the 1960s. These tests were performed with a 14-million electron volt neutron generator mounted on a 1,527-foot steel tower used to conduct neutron and gamma-ray interaction studies on various materials and to assess radiation doses experienced by the nuclear bomb survivors of Hiroshima and Nagasaki. In addition, from 1959 through 1973 a series of open-air nuclear reactor, nuclear engine, and nuclear furnace tests were conducted in Area 25, and a series of tests with a nuclear ramjet engine were conducted in Area 26. The tests released mostly gaseous radioactivity (radio-iodines, radio-xenons, radio-kryptons) and some fuel particles. These releases resulted in negligible deposition on the ground.

NNSS - Continental Test Site

After the end of World War II, the United States tested nuclear weapons at Bikini Atoll and Enewetak in the Marshall Islands of the Central Pacific.

In June 1950, with the outbreak of hostilities in Korea and U.S. relations with the Soviet Union continuing to deteriorate, the search began for a continental test site to overcome the difficulties with remoteness and security experienced with testing in the Pacific. The final choices included Dugway Proving Ground–Wendover Bombing Range in western Utah, Alamogordo–White Sands Guided Missile Range in south-central New Mexico, and a North Site and a South Site on the Las Vegas Bombing and Gunnery Range in southern Nevada.

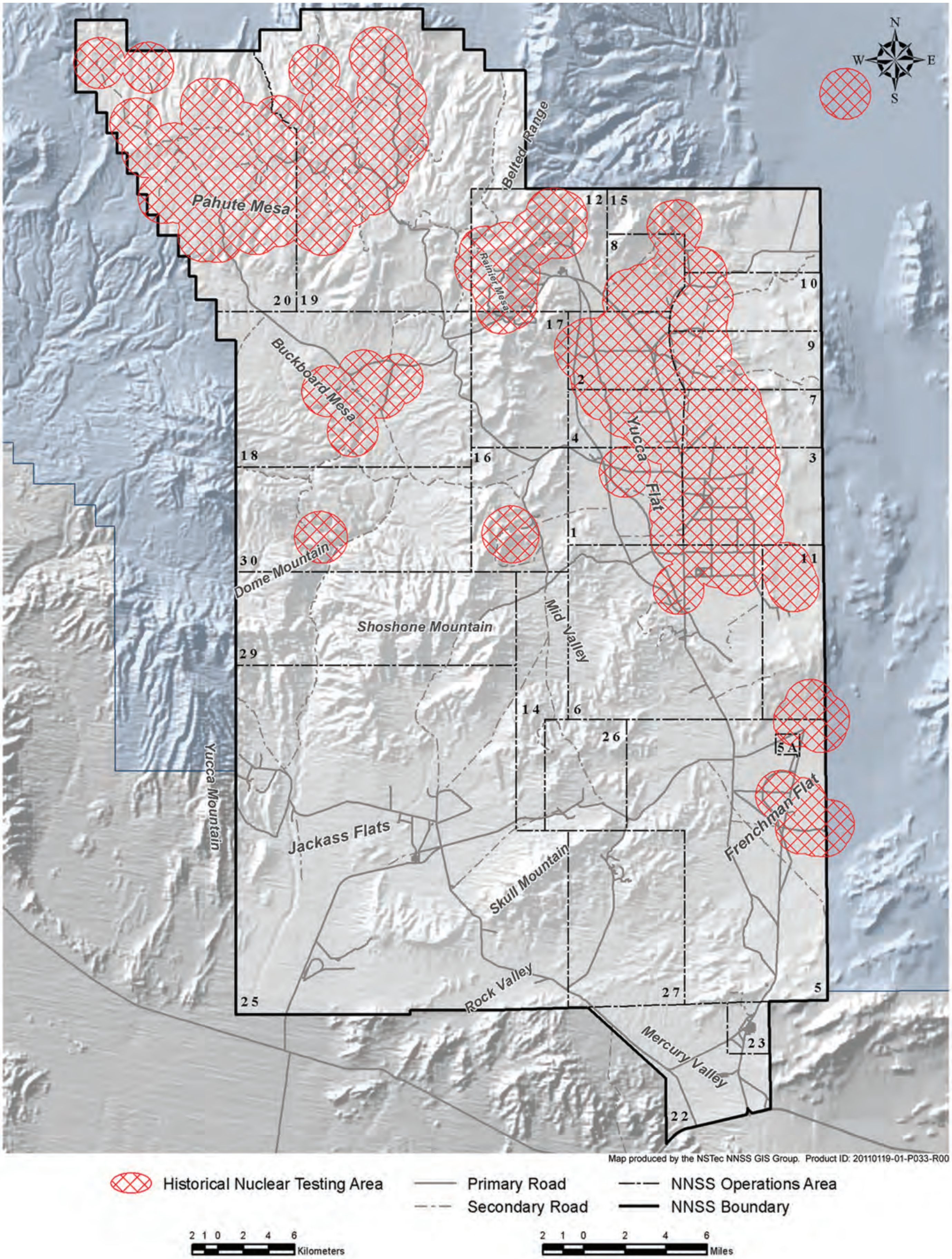
On December 18, 1950, President Truman approved the recommendations of Los Alamos testing officials and the Atomic Energy Commission, christening the South Site on the Las Vegas Bombing and Gunnery Range as the nation's continental test site. It was called the Nevada Proving Ground.

On January 27, 1951, an Air Force B-50D bomber dropped a 1-kiloton yield nuclear bomb over Frenchman Flat. It was the world's tenth nuclear detonation and was the first test at the newly established Nevada Test Site (NTS).

On September 23, 1992, the last underground nuclear test was conducted on the NTS, after which Congress imposed a moratorium on nuclear weapons testing. Since 1951, a total of 100 atmospheric and 828 underground nuclear weapons tests have been conducted at the NTS.

On August 23, 2010, the NTS was renamed the Nevada National Security Site to reflect the diversity of nuclear, energy, and homeland security activities conducted at the site.

Source: T. R. Fehner and F. G. Gosling, 2000. *Origins of the Nevada Test Site*, DOE/MA-0518, History Division, Executive Secretariat, Management and Administration, U.S. Department of Energy.



Historical Nuclear Testing Areas on and adjacent to the NNSS

The NNSS Now

Los Alamos, Lawrence Livermore, and Sandia National Laboratories are the principal organizations that sponsor and implement experimental programs at the NNSS. The three major NNSS missions include National Security/Defense, Environmental Management, and Nondefense. During the conduct of all missions and their programs, NNSA/NSO complies with applicable environmental and public health protection regulations and strives to manage the land and facilities at the NNSS as a unique and valuable national resource. In 2011, National Security Technologies, LLC (NSTec), was the Management and Operations contractor accountable for the successful execution of work and ensuring that work was performed in compliance with environmental regulations.

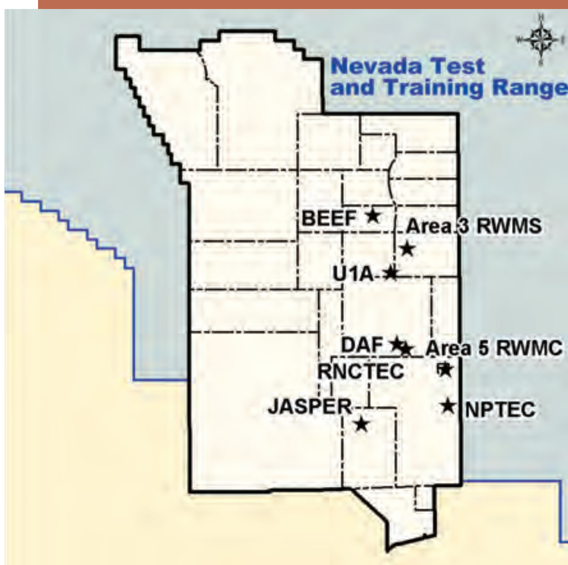
NNSS activities in 2011 continued to be diverse, with the primary goal to ensure that the existing U.S. stockpile of nuclear weapons remains safe and reliable. Other NNSS activities included weapons of mass destruction first responder training; the controlled release of hazardous material at the Nonproliferation Test and Evaluation Complex (NPTEC); remediation of legacy contamination sites; characterization of waste destined for the Waste Isolation Pilot Plant in Carlsbad, New Mexico, or the Idaho National Laboratory in Idaho Falls, Idaho; disposal of low-level and mixed low-level radioactive waste; and environmental research. Facilities that support the National Security/Defense mission include the U1a Facility, Big Explosives Experimental Facility (BEEF), Device Assembly Facility (DAF), Joint Actinide Shock Physics Experimental Research (JASPER) Facility, and the Radiological/Nuclear Countermeasures Test and Evaluation Complex (RNCTEC). Facilities that support the Environmental Management mission include the Area 5 Radioactive Waste Management Complex (RWMC) and the Area 3 Radioactive Waste Management Site (RWMS), which has been in cold standby since 2006.

NNSS Missions and Their Programs

National Security/Defense

Stockpile Stewardship and Management Program – Conducts high-hazard operations in support of defense-related nuclear and national security experiments.

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs – Provides support facilities, training facilities, and capabilities for government agencies involved in emergency response, nonproliferation technology development, national security technology development, and counterterrorism activities.



Work for Others Program – Provides support facilities and capabilities for other agencies/organizations involved in defense-related activities.

Environmental Management

Environmental Restoration Program – Characterizes and remediates the environmental legacy of nuclear weapons and other testing at the NNSS and NTTR locations, and develops and deploys technologies that enhance environmental restoration.

Waste Management Program – Manages and safely disposes of low-level waste and mixed low-level waste received from DOE- and U.S. Department of Defense (DoD)-approved facilities throughout the U.S. and wastes generated in Nevada by NNSA/NSO. Safely manages and characterizes hazardous and transuranic wastes for offsite disposal.

Nondefense

General Site Support and Infrastructure Program – Maintains the buildings, roads, utilities, and facilities required to support all NNSS programs and to provide a safe environment for NNSS workers.

Conservation and Renewable Energy Programs – Operates the pollution prevention program and supports renewable energy and conservation initiatives at the NNSS.

Other Research and Development – Provides support facilities and NNSS access to universities and organizations conducting environmental and other research unique to the regional setting.

The Legacy of NNSS Nuclear Testing

Approximately one-third of the 828 underground nuclear tests on the NNSS were detonated below or in the water table, resulting in radioactive contamination of groundwater in some areas. In addition, the 100 atmospheric nuclear tests conducted on the NNSS and numerous nuclear-related experiments resulted in radioactive contamination of surface soils, materials, equipment, and structures, mainly on the NNSS. The NNSA/NSO Environmental Management mission was established to address this legacy contamination. Within Environmental Management, the Environmental Restoration Activity is responsible for remediating contaminated sites, and the Waste Management Activity is responsible for safely managing and disposing of radioactive waste.

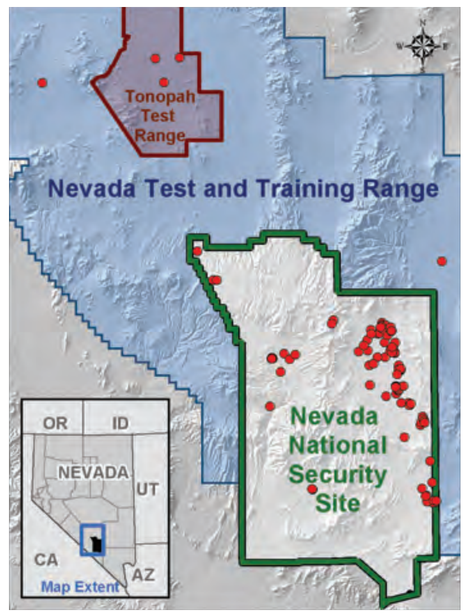
The Federal Facility Agreement and Consent Order (FFACO) between the State of Nevada, DOE, and DoD identifies corrective action units (CAUs), which are groupings of corrective action sites (CASs) that delineate areas of historical contamination. The FFACO establishes corrective actions and schedules for the remediation and closure of CASs. Approximately 3,000 CASs have been identified, many of which have already been remediated and/or closed. The public is kept informed of Environmental Management activities through periodic newsletters, exhibits, and fact sheets, and Environmental Management provides the opportunity for public input via the Nevada Site Specific Advisory Board, consisting of 15–20 citizen volunteers from Nevada.

Curie (Ci) is the traditional measure of radioactivity based on the observed decay rate of 1 gram of radium. One curie of radioactive material will have 37 billion disintegrations in 1 second.

Numerous man-made and naturally occurring radionuclides occur on the NNSS. The radionuclides produce ionizing radiation in the form of alpha particles, beta particles, and gamma

Continued on Page 8 ...

Legacy Contamination



Locations of Soil Contamination on and off the NNSS

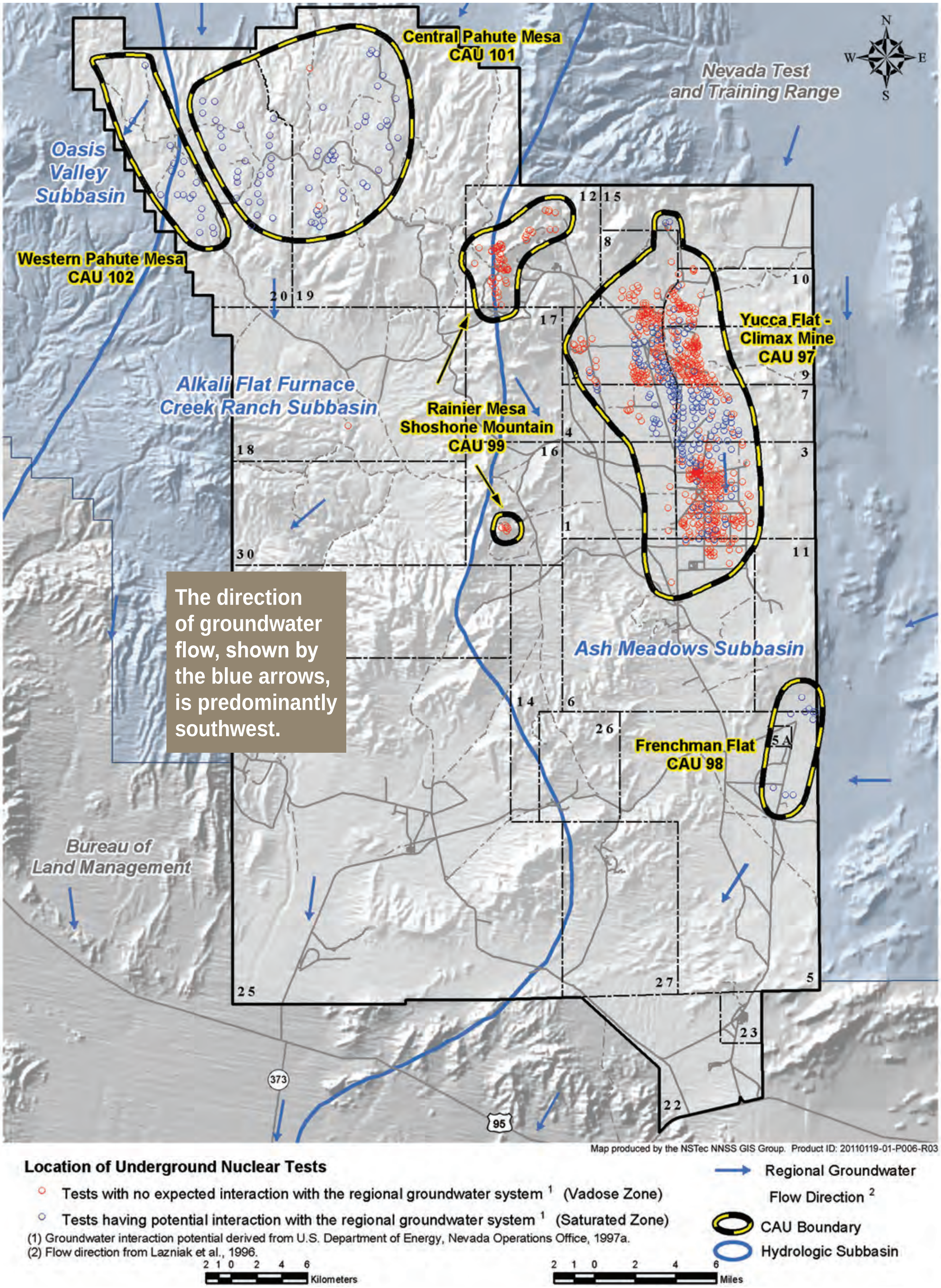
Groundwater — **The total amount of radiation remaining below the groundwater table is approximately 40 to 60 million Ci, based on the most recent estimate, which incorporates corrections for radioactive decay since the last underground test in 1992. The areas of known and potential groundwater contamination on the NNSS due to underground nuclear testing are called Underground Test Area (UGTA) CAUs. The corrective action strategy is to identify contaminant boundaries for these UGTA CAUs and to implement an effective long-term monitoring system.**

Soil — **Radioactively contaminated surface soils directly resulting from nuclear weapons testing exist at approximately 100 sites on and around the NNSS. Corrective actions for these sites range from removal of soil to closure in place with restricted access controls, such as fencing and posting. In 2011, 21 sites on the NNSS were closed. The TTR and NTTR sites require negotiation with the State of Nevada and the U.S. Department of Defense. As of December 31, 2011, 39 sites have been approved by the State for closure in accordance with the FFACO.**

Air — **Airborne radioactive contamination from the resuspension of contaminated soils at legacy sites and from current activities is monitored continuously on and off the NNSS. Since the cessation of atmospheric nuclear testing, the annual amounts of radiation released into the air from the NNSS have ranged from 48 to 2,200 Ci for tritium, 0.0018 to 0.40 Ci for plutonium, and 0.039 to 0.049 Ci for americium. In air measured in communities surrounding the NNSS, emissions from the NNSS cannot be distinguished from background airborne radiation.**

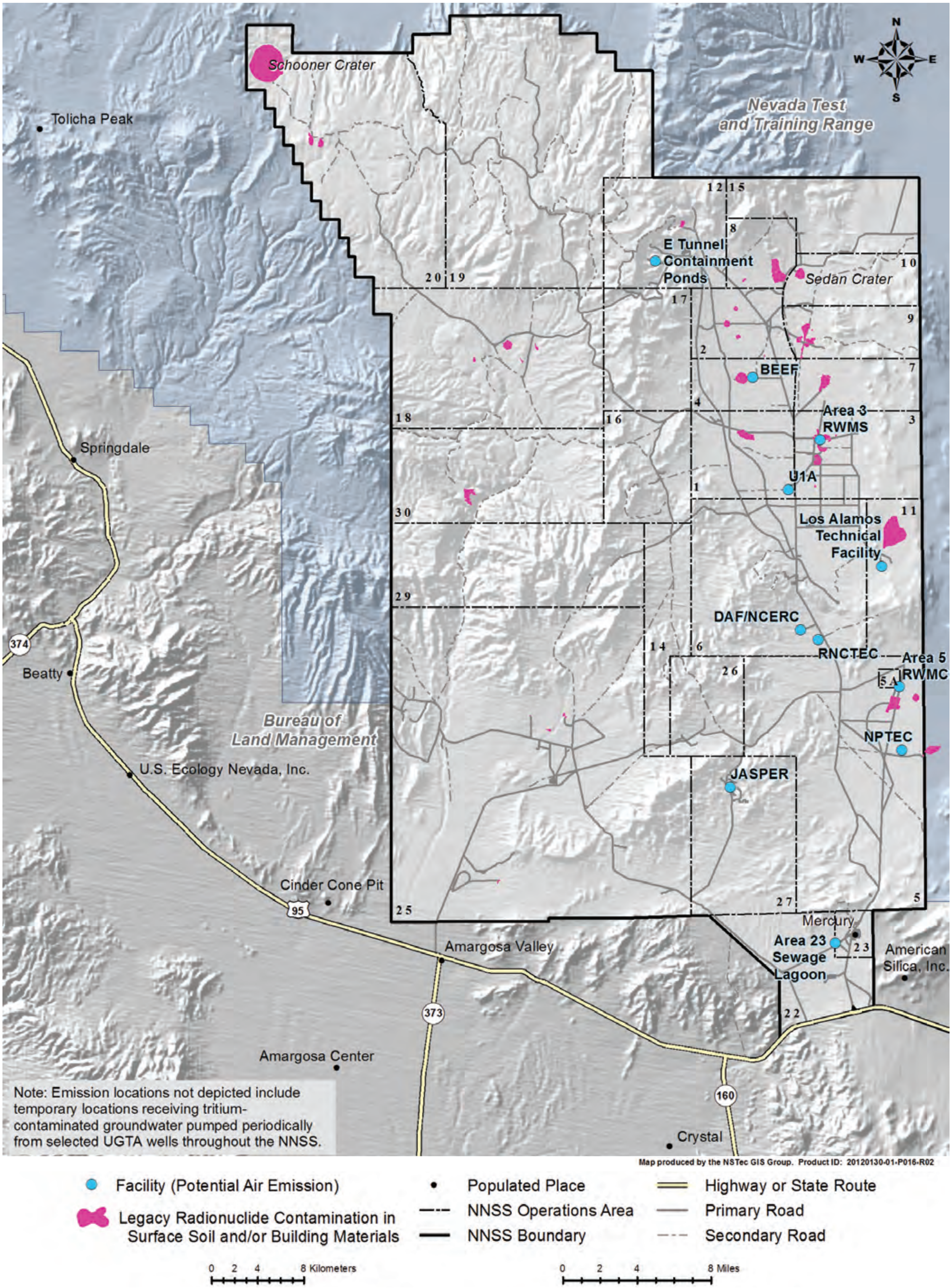
Structures/Materials — **There are approximately 1,850 sites where facilities, equipment, structures, and/or debris were contaminated by historical nuclear research, development, and testing activities. Corrective actions may include the removal and disposal of debris, site excavation, decontamination and decommissioning, or closure in place. In 2011, 35 sites were closed, and 38 were investigated and/or remediated as progress towards closure. As of December 31, 2011, 1,814 sites have been approved by the State for closure in accordance with the FFACO.**

Waste Disposal — **Low-level and mixed low-level radioactive wastes have been generated by historical nuclear research, development, and testing activities and environmental cleanup activities. From the 1960s, when waste disposal began, through December 31, 2011, nearly 1.55 million cubic yards of waste have been safely disposed at the Area 3 and Area 5 RWMSs. The estimated cumulative radioactivity of all wastes at the time of disposal is 15.4 million Ci. The radioactive content of the waste decays over time, however, at a varied rate depending on the radionuclide.**



The direction of groundwater flow, shown by the blue arrows, is predominantly southwest.

Areas of Potential Groundwater Contamination on the NNSS



Sources of Radiological Air Emissions on the NNSS

The Legacy of NNSS Nuclear Testing
... continued from Page 5

rays, which are emitted from the unstable radionuclides as they decay to form more stable atoms. Almost all human exposure to ionizing radiation (82% in the United States) comes from natural sources that include cosmic radiation from outer space, terrestrial radiation from materials like uranium and radium in the earth, and naturally occurring radionuclides in food, water, and the aerosols and gases in the air we breathe. Man-made sources and applications of ionizing radiation in our everyday life include smoke detectors, X-rays, CT scans, and nuclear medicine procedures. For people living in areas around the NNSS, less than 2% of their total radiation exposure is attributable to past nuclear testing or to current NNSS activities.

Forms of Radiation

Alpha particles are heavy, positively charged particles given off by some decaying atoms. Alpha particles can be blocked by a sheet of paper. Atoms emitting alpha particles are hazardous only if they are swallowed or inhaled.

Beta particles are electrons or positrons (positively charged electrons) ejected from the nucleus of a decaying atom. More penetrating than alpha radiation, beta particles can pass through several millimeters of skin. A sheet of aluminum only a fraction of an inch thick will stop beta radiation. Beta particles can damage skin but are most hazardous if the beta-emitting atoms are swallowed or inhaled.

Gamma rays are waves of pure energy similar to X-rays, light, microwaves, and radio waves. Gamma rays are emitted by certain radionuclides when their nuclei transition from a higher to a lower energy state. They can readily pass into the human body. They can be almost completely blocked by about 40 inches of concrete, 40 feet of water, or a few inches of lead. Gamma rays can be both an external and internal hazard.

X-rays are a more familiar form of electromagnetic radiation, usually with a limited penetrating power, typically used in medical or dental examinations. Television sets, especially color, give off soft (low-energy) X-rays; thus, they are shielded to greatly reduce the risk of radiation exposure.

Neutrons are uncharged heavy particles contained in the nucleus of every atom heavier than ordinary hydrogen. They induce ionization only indirectly in atoms that they strike, but they can damage body tissues. Neutrons are released, for example, during the fission (splitting) of uranium atoms in the fuel of nuclear power plants. They can also be very penetrating. In general, efficient shielding against neutrons can be provided by materials containing hydrogen, such as water. Like gamma rays, neutrons are both an external and internal hazard.

Radionuclides Detected on the NNSS

	Name*	Abbreviation	Primary Type(s) of Radiation	Major NNSS Source
Man-Made	Americium-241	^{241}Am	Alpha, gamma	In soil at and near legacy sites of aboveground nuclear testing. Detected in soil and air.
	Cesium-137	^{137}Cs	Beta, gamma	
	Plutonium-238	^{238}Pu	Alpha	
	Strontium-90	^{90}Sr	Beta	
	Cobalt-60	^{60}Co	Gamma	In soil at and near legacy sites of aboveground nuclear testing. Detected in soil.
	Europium-152	^{152}Eu	Gamma	
	Europium-155	^{155}Eu	Gamma	
	Plutonium-239+240	$^{239+240}Pu$	Alpha	In soil at and near legacy sites of plutonium dispersal experiments. Detected in soil and air.
	Tritium	^{3}H	Beta	In groundwater in areas of underground nuclear tests, in surface ponds used to contain contaminated groundwater, in soil at nuclear test locations, in waste packages buried in pits at waste management sites. Detected in groundwater and air.
Naturally Occurring	Beryllium-7	^{7}Be	Gamma	Produced by interactions between cosmic radiation from the sun and the earth's upper atmosphere. Detected in air.
	Potassium-40	^{40}K	Beta, gamma	Naturally occurring in the earth's crust. Detected in groundwater, soil, and air.
	Radium-226	^{226}Ra	Alpha, gamma**	
	Thorium-232	^{232}Th	Alpha**	
	Uranium-234***	^{234}U	Alpha**	
	Uranium-235***	^{235}U	Alpha, gamma**	
	Uranium-238***	^{238}U	Alpha**	

*The number given with the name of the radionuclide is the atomic mass number, which is the total number of protons and neutrons in the nucleus of the atom. Atoms with the same number of protons are the same element; atoms of the same element with different mass numbers are called isotopes of one another. Plutonium and uranium each have several radioactive isotopes that are detected on the NNSS.

**Some progeny or daughter radionuclides produced by the natural decay of this radionuclide would emit alpha, beta, or gamma radiation as well.

***These uranium isotopes, though of natural origin, can also be detected at specific NNSS locations where man-made depleted uranium has been released during experiments, resulting in an alteration of the relative amounts of each isotope.

Understanding Radiation Dose

Dose is a generic term to describe the amount of radiation a person receives. The energy deposited indicates the number of molecules disrupted. The energy the radiation deposits in tissue is called the absorbed dose. The units of measure of absorbed dose are the rad or the gray. The biological effect of radiation depends on the type of radiation (alpha, beta, gamma, or X-ray) and the tissues exposed. A measure of the biological risk of the energy deposited is the dose equivalent. The units of dose equivalent are called rems or sieverts. In the NNSSER, the term dose is used to mean dose equivalent measured in rems. A thousandth of a rem is called a millirem, abbreviated as mrem.

An average person in the United States receives about 310 mrem each year from natural sources and an additional 310 mrem from medical procedures and consumer products. Whether or not there is a "safe" radiation dose equivalent is a controversial subject. Because the topic has yet to be settled scientifically, regulators take a conservative approach and assume that there is no such thing as a 100% safe dose equivalent. It is believed that the risk of developing an adverse health effect (such as cancer) is proportionate to the amount of radiation dose received.

Characterizing soil contaminants at CAU 374, Danny Boy, an atmospheric nuclear test location in Area 18

Many human activities increase our exposure to radiation over and above the average background radiation dose of 310 mrem per year. These activities include, for example, uranium mining, airline travel, and operating nuclear power plants. Regulators balance the benefit of these activities with the risk of increasing radiation exposures above background and, as a result, set dose limits for the public and workers specific to these activities. DOE has set the dose limit to the public from exposure to DOE-related nuclear activities to 100 mrem/yr. This is the same public dose limit set by the U.S. Nuclear Regulatory Commission (NRC) and recommended by the International Commission on Radiological Protection and the National Commission on Radiological Protection and Measurements. The NRC has set the dose limit for radiation workers to 5,000 mrem/yr. There are no common or agreed-upon dose limits for workers or the public across industries, states, or countries.

Dose — The amount of radiation a person receives.

Absorbed dose — The energy the radiation deposits in tissue, where the energy deposited indicates the number of molecules disrupted. The units of measure of absorbed dose are the rad or the gray.

Dose equivalent — A measure of the biological risk of the energy deposited in tissue, which depends on the type of radiation (alpha, beta, gamma, or X-ray) and the tissues exposed. The units of measure of dose equivalent are called rems or sieverts.

Common Doses to the Average American

Source/Activity	**Average Dose/Year** (or as noted)
5-hour jet plane ride	3 mrem/5 hours
Building materials	4 mrem
Chest X-ray	8 mrem
Cosmic	30 mrem
Soil	35 mrem
Internal to our body	40 mrem
Mammogram	138 mrem
Radon gas	200 mrem
CT scan	2,500 mrem
Smoking 20 cigarettes/day	5,300 mrem to a smoker's lung
One cancer treatment	5,000,000 mrem to the tumor

Source: http://hss.energy.gov/HealthSafety/WSHP/radiation/Radiation-final-6-20.pdf, as accessed on March 25, 2010

Monitoring NNSS Radiation and Pathways of Exposure to the Public

The release of man-made radionuclides from the NNSS has been monitored since the first decade of atmospheric testing. After 1962, nuclear tests were conducted only underground, greatly reducing the radiation exposure in the areas surrounding the NNSS. Underground nuclear testing nearly eliminated atmospheric releases of radiation but resulted in the contamination of groundwater in some areas of the NNSS. After the 1992 moratorium on nuclear testing, radiation monitoring focused on detecting airborne radionuclides that are resuspended with historically contaminated soils on the NNSS and on detecting man-made radionuclides in groundwater.

There are three pathways in this dry desert environment by which man-made radionuclides from the NNSS might reach the surrounding public:

Air Transport Pathway – Members of the public may inhale or ingest radionuclides that are resuspended by the wind from contaminated sites on the NNSS. However, such resuspended radiation measured off and on the NNSS is much lower than natural background radiation in all areas accessible to the public.

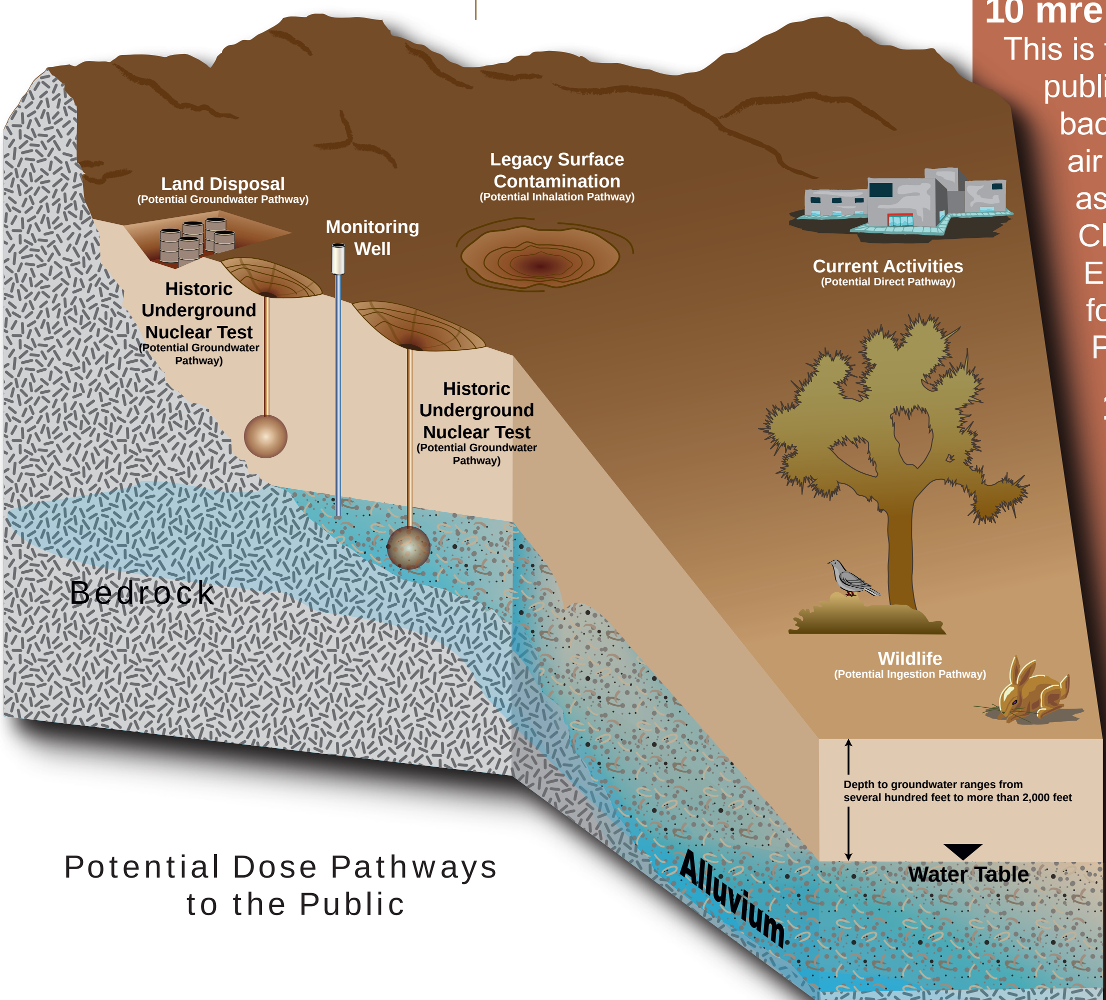
Ingestion Pathway – Members of the public may ingest game animals that have been exposed to contaminated soil or water on the NNSS, have moved off the NNSS, and have then been hunted.

Groundwater Pathway – Based on monitoring data, drinking contaminated groundwater is currently not a possible pathway for public exposure, given the restricted public access to the NNSS and the location of known contaminated groundwater on and off the NNSS. No man-made radionuclides have been detected in drinking water sources monitored off the NNSS, and no drinking water wells on the NNSS have measurable levels of manmade radionuclides. Radioactively contaminated groundwater was discovered in a characterization well on NTTR just west of the NNSS boundary in 2009 *(see Page 12)*. This well is not a source of drinking water.

Public Dose Limits for NNSS Radiation

10 mrem/yr —
This is the dose limit to the public (above natural background) from just the air transport pathway, as specified by the Clean Air Act National Emission Standards for Hazardous Air Pollutants (NESHAP).

100 mrem/yr —
This is the dose limit to the public (above natural background) from all possible pathways combined, as specified by DOE O 458.1, “Radiation Protection of the Public and the Environment.”



Potential Dose Pathways to the Public

Estimated 2011 Radiation Dose to the Public from NNSS Operations

Inhalation – Compliance with radiation dose limits to the general public from the air transport pathway is demonstrated using air sampling results from six onsite "critical receptor" sampling stations, which were approved by the Environmental Protection Agency (EPA) in 2001. The radionuclides detected at four or more of the NNSS critical receptor samplers were ^{241}Am, ^{134}Cs, ^{137}Cs, ^{238}Pu, $^{239+240}$Pu, $^{233+234}$U, $^{235+236}$U, ^{238}U, and ^{3}H. The cesium is believed to be solely from the Fukushima Daiichi nuclear power plant event in March 2011. Uranium in NNSS surface soils has generally been attributed to naturally occurring uranium.

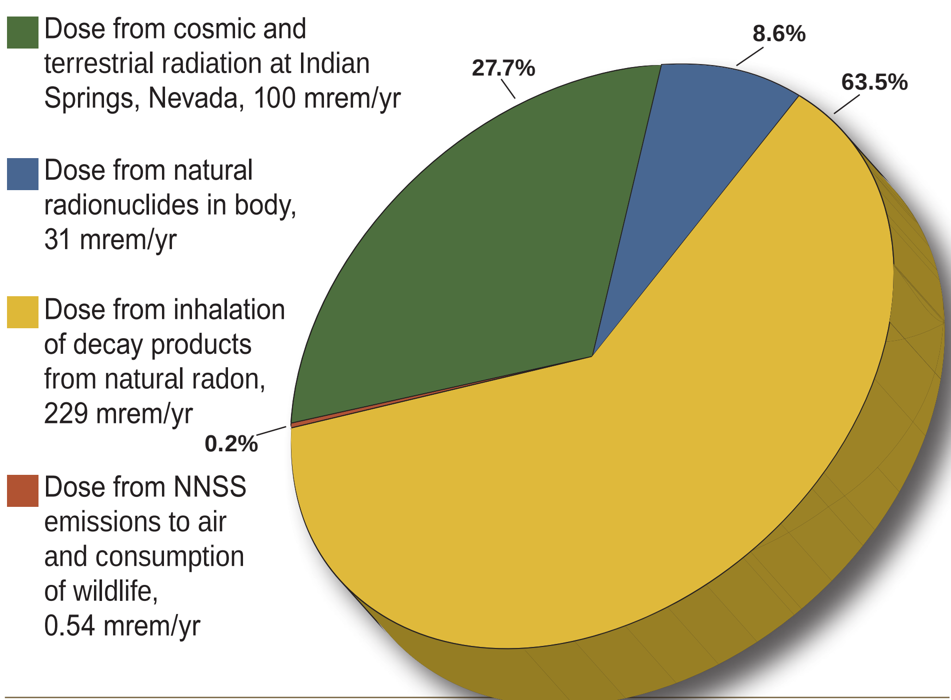
As in previous years, the 2011 data from the six critical receptor samplers show that the NESHAP dose limit to the public of 10 mrem/yr was not exceeded. The Schooner critical receptor station, in the far northwest corner of the NNSS, had the highest concentrations of radioactive air emissions; an individual residing at this station would experience a dose from air emissions of 1.22 mrem/yr. A more realistic estimate of the maximum dose to a member of the offsite public would be to use the air sampling results from the Gate 510 sampler in the far southwest corner of the NNSS, which is closest to the nearest populated place, Amargosa Valley. A person residing at the Gate 500 station would experience a dose from air emissions of 0.07 mrem/yr.

Ingestion – NNSS game animals include pronghorn antelope, mule deer, chukar, Gambel's quail, mourning doves, cottontail rabbits, and jackrabbits. Small game animals from different contaminated NNSS sites are trapped each year and analyzed for their radionuclide content. These results are used to construct worst-case scenarios for the dose to hunters who might consume these animals if the animals moved off the NNSS.

In 2011, two jackrabbits were captured at T2 in Area 2 where four nuclear weapons tests were conducted on the surface of the site from 1952 to 1957. Opportunistic tissue samples of eight mule deer and one bighorn sheep, which were accidently killed on roads or killed by mountain lions, were also collected. Man-made radionuclides were found in both of the jackrabbits and in only one of the mule deer. The estimated dose to a hunter from eating 20 jackrabbits or one mule deer similar to those sampled in 2011 is about 0.30 mrem. Another dose estimate can be calculated by assuming an individual in 1 year consumes one game animal of each species that has been sampled over the past 10 years on the NNSS and by assuming they all contain the average radionuclide concentrations found in each species. This dose estimate would be 0.47 mrem/yr.

Direct Exposure – No members of the public are expected to receive direct gamma radiation that is above background levels as a result of NNSS operations. Areas accessible to the public, such as the main entrance gate, had direct gamma radiation exposure rates comparable to natural background rates from cosmic and terrestrial radiation.

Percents of Total Dose to the Public from Natural Background Sources and from the NNSS



2011 Dose to the Public from All Pathways

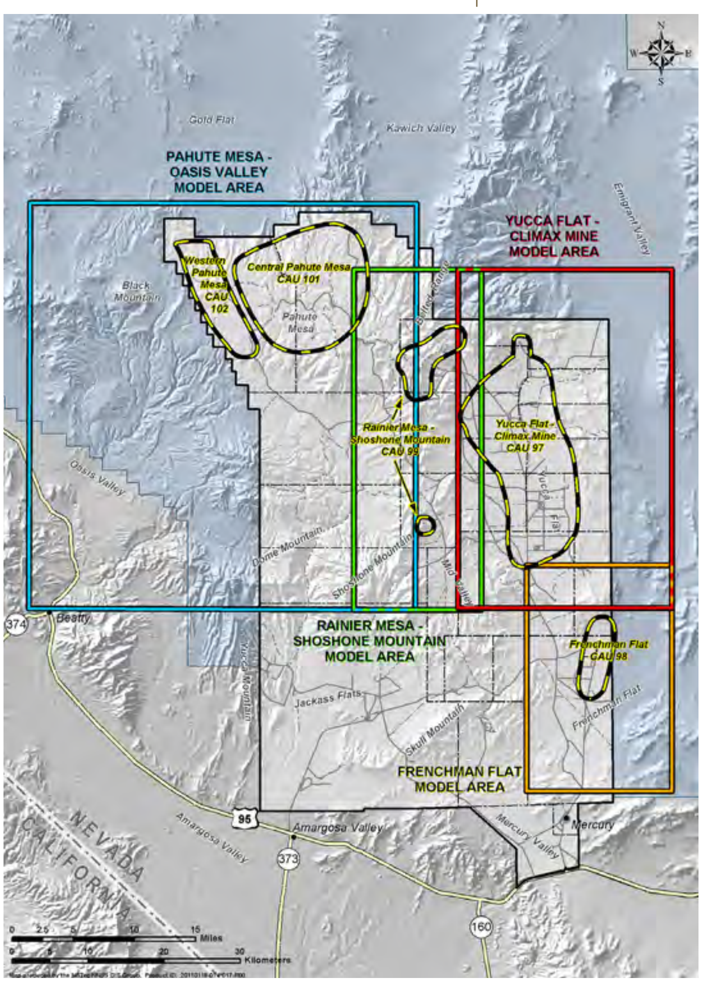
0.54 mrem/yr — **This is the maximum dose to the public from inhalation, ingestion, and direct exposure pathways that is attributable to NNSS operations. It is well below the dose limit of 100 mrem/yr established by DOE O 458.1 for radiation exposure to the public from all pathways combined. This total dose estimate is indistinguishable from natural background radiation experienced by the public residing in communities near the NNSS.**

Groundwater Investigations and Modeling

The UGTA Activity (formerly known as the UGTA Sub-Project) gathers data to characterize the groundwater aquifers beneath the NNSS and adjacent lands. The data are used to develop hydrogeologic models for the CAUs and the larger UGTA model areas that will predict the groundwater movement and transport of radiological contaminants from the CAUs. Closure of the UGTA CAUs under the FFACO will involve long-term groundwater monitoring because cost-effective technologies have not been developed to effectively remove or stabilize the radiological contaminants produced during historical underground nuclear testing.

Pahute Mesa–Oasis Valley Model Area – A Phase II hydrogeologic field investigation for this model area was initiated in 2009. Twelve sites for new Phase II wells were proposed and prioritized. The top ten of the twelve sites were selected for drilling with the available resources. Four wells were drilled in 2009 (three on the NNSS and one on the NTTR) and four were drilled in 2010 on the NTTR. No new wells were drilled in 2011, but two Pahute Mesa Phase II wells will be drilled in 2012 (ER-20-11 and ER-EC-14). All Phase II well locations were selected to yield the maximum amount of information to support groundwater flow and contaminant transport modeling. Some may also be used as long-term groundwater monitoring wells.

One Environmental Restoration mission is to identify contaminant boundaries for the UGTA CAUs and then implement an effective long-term monitoring system, which will protect the public from exposure to groundwater contaminated by historical underground nuclear testing.



Location of UGTA Activity CAUs and Model Areas

Within this model area, Well ER-EC-11 on the NTTR was found to have 13,180 picocuries per liter (pCi/L) of tritium when it was sampled in October 2009. This was the first offsite well in which radionuclides from underground nuclear testing activities at the NNSS have been detected. This finding was not unexpected because the flow and transport model for the area, published in 2009, predicts that tritium contamination above the Safe Drinking Water Act limit of 20,000 pCi/L should be present off the NNSS *(see figure on next page)*. In 2010, a deeper zone of the well was sampled, and no tritium was detected because the aquifer sampled in 2010 is isolated from the overlying contaminated aquifer by a confining unit, which does not readily conduct water. Well ER-EC-11 was not sampled in 2011. The well is located approximately 2,350 feet west of the NNSS boundary and approximately 2 miles from the nearest underground nuclear tests BENHAM and TYBO conducted in 1968 and 1975, respectively.

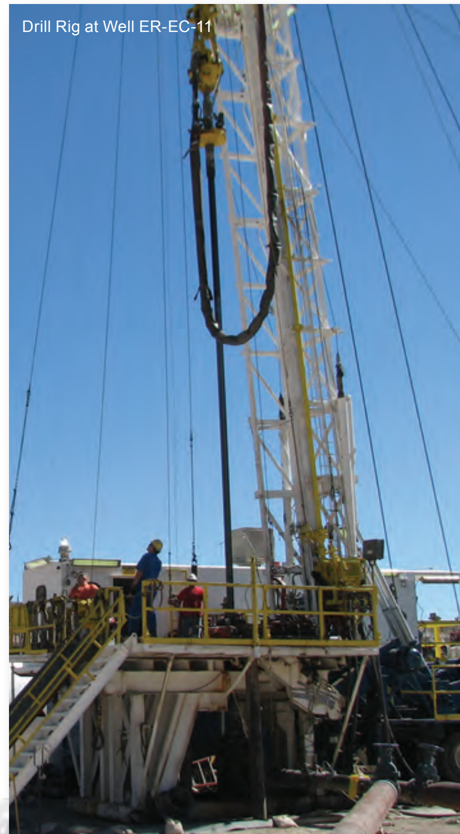
In May 2010 and July 2011, the NNSA/NSO monitoring well, PM-3, located 2 miles west of the NNSS border on NTTR *(see Page 15)*, was sampled, and tritium was detected at low levels (<64 pCi/L). Hydrogeologic data west of the NNSS are sparse, and thus groundwater flow predictions at the location of PM-3 are uncertain. Currently there are several developing hypotheses to explain the occurrence of tritium at PM-3. A sampling activity is planned for the summer of 2012. Results from a more comprehensive suite of water analyses of 2012 samples are expected to provide the necessary information to identify the source of the tritium. Well sample analyses to date have not detected the presence of man-made radionuclides farther downgradient of Pahute Mesa in any of the 11 nearby UGTA wells on the NTTR (ER-EC-1, -2A, -4, -5, -6, -7, -8, -12, -13, -15, and ER-20-4).

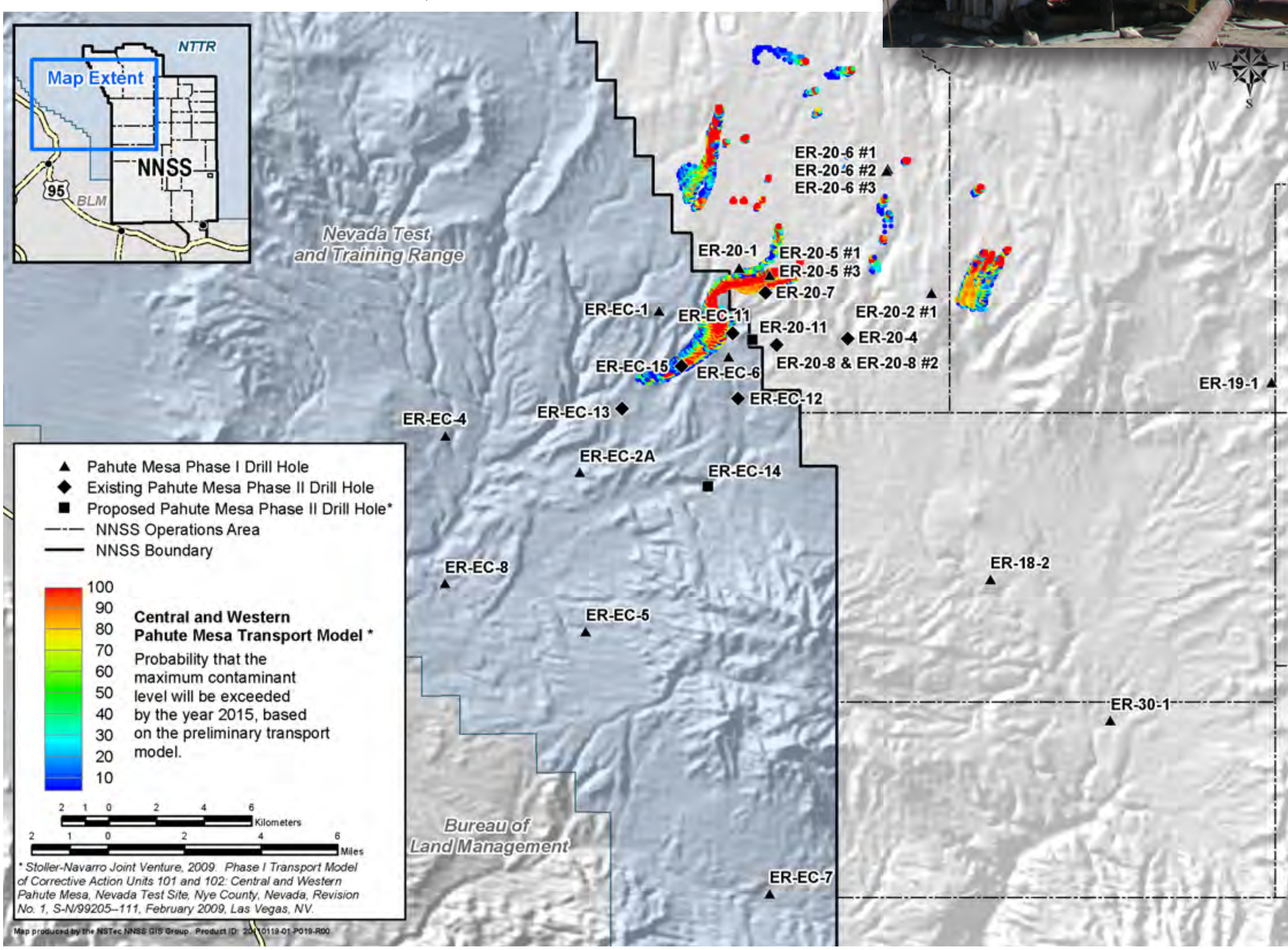
In May 2011, NNSA/NSO gave a third public presentation of the model predictions and the current state of knowledge of contaminant migration off the NNSS at the Beatty Community Center in Beatty, Nevada.

Frenchman Flat Model Area – A well drilling and completion criteria document for two new wells within this model area, ER-5-5 and ER-11-2, was prepared in 2011. The new wells will provide data needed to evaluate the Frenchman Flat CAU flow and transport models, which were reviewed and accepted by the Nevada Division of Environmental Protection in 2010. The results of a surface magnetometer survey conducted in 2010 by the U.S. Geological Survey (USGS) in northern Frenchman Flat were used in 2011 to help site the wells to be used for model evaluation and/or long-term monitoring.

Rainier Mesa–Shoshone Mountain Model Area – Work continued in 2011 on developing the source-term model for the Rainier Mesa–Shoshone Mountain CAU. Also, work continued on building the groundwater flow and transport model for the CAU and flow and transport models for the N-Tunnel and T-Tunnel areas within the CAU.

Yucca Flat–Climax Mine Model Area – Work continued in 2011 on developing the source-term model and the flow and transport models for the Yucca Flat–Climax Mine CAU. Several supplemental analyses regarding the flow and transport properties of faults, groundwater recharge, and the hydrologic source term were started in 2011 to enhance the CAU models.


Drill Rig at Well ER-EC-11



Results of Phase I Central and Western Pahute Mesa Transport Modeling

Offsite Radiological Monitoring of Groundwater

NNSA/NSO's comprehensive Routine Radiological Environmental Monitoring Plan (RREMP) includes sampling and analysis of groundwater and natural springs off of the NNSS. The purpose of monitoring is to detect man-made radionuclides in wells that are downgradient from the UGTA CAUs and that penetrate an aquifer. Monitoring is also conducted to verify that offsite wells and springs used by the public for drinking water do not contain man-made radionuclides due to NNSS past or present activities.

The RREMP monitoring well network includes existing onsite and offsite wells drilled in support of nuclear testing or other site missions. Sometimes new monitoring wells are added to the network. UGTA Activity characterization wells that are no longer needed by the Activity are added if they are not hot wells (i.e., if their tritium levels are less than 400,000 pCi/L). The RREMP and its network of aquifer monitoring wells satisfy the Agreement in Principle with the State of Nevada in which NNSA/NSO has agreed to implement "an appropriate monitoring plan for groundwater on and adjacent to the NNSS." It is important to note that the RREMP network of monitoring wells is not designed to meet the requirements of the FFACO for a long-term monitoring network for the closure of UGTA CAUs.

In 2011, NNSA/NSO sampled for the presence of tritium in five offsite private/community water supply wells, ten offsite non-potable NNSA/NSO wells, and three offsite springs used as water supplies. NNSA/NSO also sampled for man-made gamma-emitting radionuclides and gross alpha and gross beta radioactivity in the majority of these wells and springs *(see map on Page 15).*

Offsite water supply wells and springs are also monitored for the presence of tritium by the independent Community Environmental Monitoring Program (CEMP), which is coordinated by the Desert Research Institute (DRI) of the Nevada System of Higher Education under contract with NNSA/NSO. The CEMP provides the public with these data as part of a non-regulatory public informational and outreach program. In 2011, the CEMP offsite water sampling locations included 21 wells, 3 surface water supply systems, and 4 springs located in selected towns and communities within 240 miles of the NNSS *(see map on Page 16).*

Offsite water supply samples collected by NNSA/NSO and the CEMP had levels of tritium either below laboratory background levels or at very low detectable levels (<30 pCi/L). The highest detectable levels (22.2 and 22.7 pCi/L) were in CEMP surface water samples from Boulder City and Henderson, Nevada, respectively, which originated from Lake Mead. The detectable levels represent residual tritium persisting in the environment that originated from global atmospheric nuclear testing.

Range in Groundwater Tritium Levels Measured off the NNSS in 2011	
Offsite Supply Wells	-7.8 to 4.8 pCi/L
Offsite Springs/Surface Waters	-5.2 to 22.7 pCi/L
Offsite NNSA/NSO Monitoring Wells	-16.5 to 63.2 pCi/L

Note: Negative numbers indicate measured levels below measured natural background levels (see Section 1.8.13 of the full NNSSER report for a discussion of negative numbers).

In the offsite non-potable wells, tritium was detected in samples from two depths of the RREMP monitoring well, PM-3, which ranged from 19.5 pCi/L of tritium at the 1,994-foot depth to 63.2 pCi/L at the 1,560-foot depth. These concentrations are far lower than the EPA limit for drinking water of 20,000 pCi/L. As mentioned on Page 12, sampling and more extensive analyses are planned for the summer of 2012 to help identify the source of the tritium.

No samples from offsite springs or wells contained any man-made gamma-emitting radionuclides.

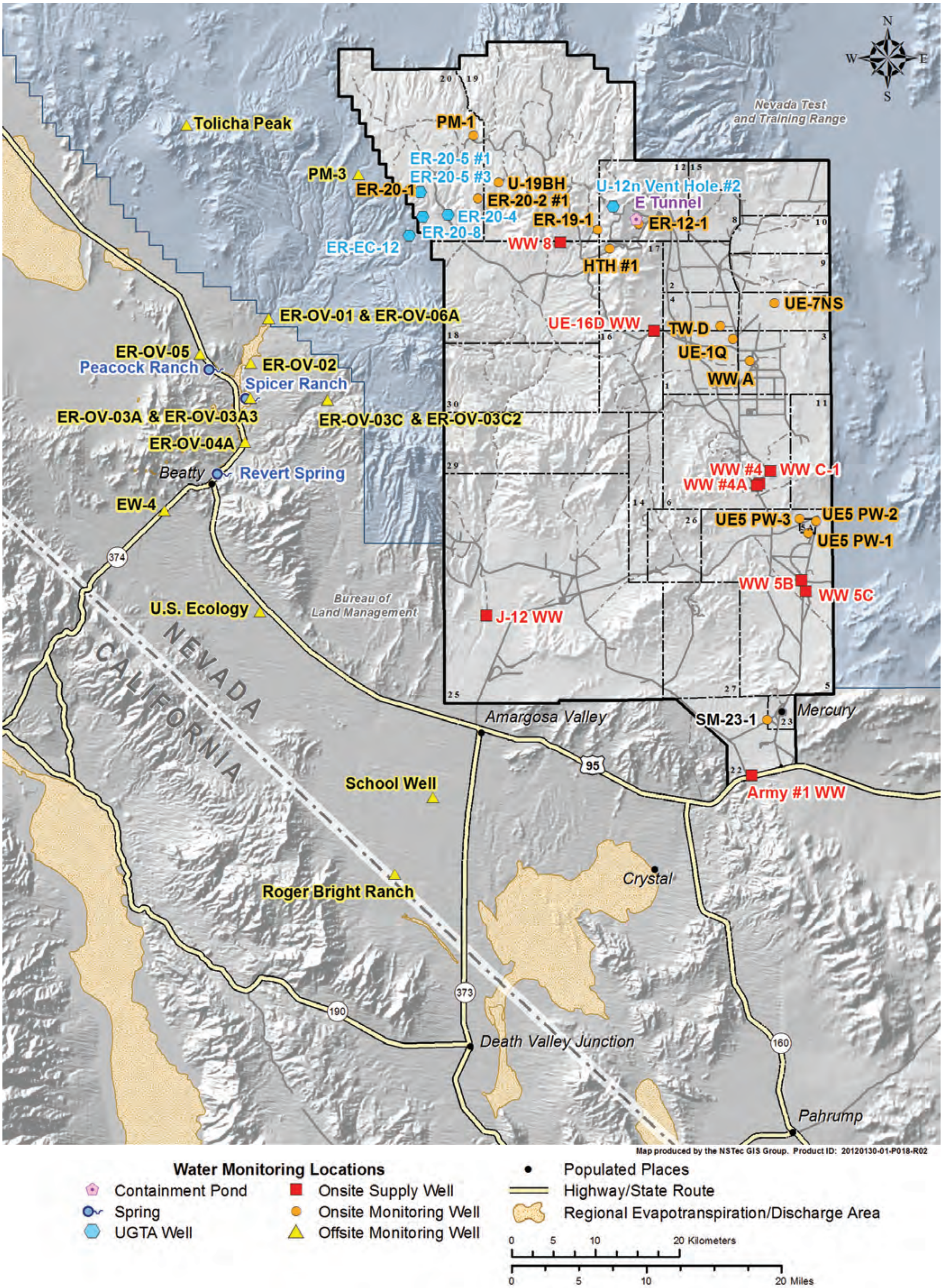
The majority of the offsite non-potable monitoring wells, which NNSA/NSO sampled for gross alpha and gross beta radioactivity, all had detectable gross alpha and/or gross beta activity consistent with levels anticipated from natural sources. All levels were less than the EPA limits set for drinking water (15 pCi/L for gross alpha and 50 pCi/L for gross beta).

Onsite Radiological Monitoring of Groundwater

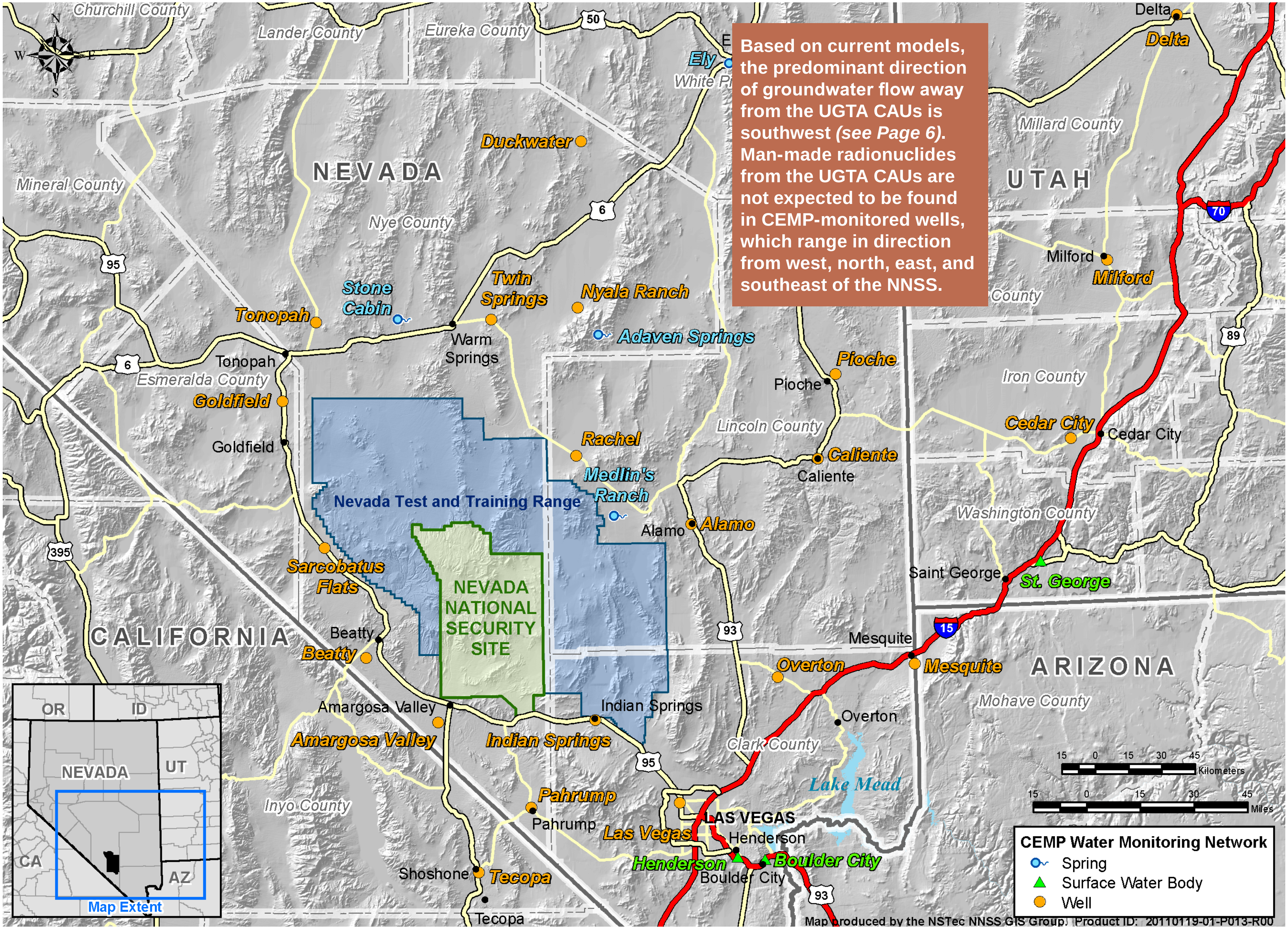
Radioactivity in onsite groundwater and surface waters of the NNSS is monitored annually in order to (1) ensure that NNSS drinking water is safe, (2) determine if permitted facilities on the NNSS are in compliance with permit discharge limits for radionuclides, (3) estimate radiological dose to onsite wildlife using natural and man-made water sources, and (4) determine if groundwater is being protected from disposed radioactive wastes at the Area 3 and Area 5 RWMSs.

In 2011, 5 potable water supply wells, 4 non-potable/inactive water supply wells, 14 monitoring wells, and 1 tritiated water containment pond system were sampled *(see map on Page 15).* All samples were monitored for tritium. All water supply wells and 7 of the 14 onsite monitoring wells were also monitored for gross alpha and

Continued on Page 17 ...



2011 NNSA/NSO Water Monitoring Locations



2011 CEMP Water Monitoring Locations

gross beta radioactivity and for man-made gamma-emitting radionuclides.

NNSS Water Supply Wells

The 2011 data continue to indicate that underground nuclear testing has not impacted the NNSS drinking water supply network. None of the onsite water supply wells had detectable concentrations of tritium or any man-made gamma-emitting radionuclides. The gross alpha and gross beta radioactivity detected in potable water supply wells represent the presence of naturally occurring radionuclides and did not exceed EPA drinking water limits in any of the five active potable supply wells.

NNSS Monitoring Wells

Some migration of radionuclides from the underground test areas to NNSS monitoring wells has occurred, although the migration distances appear to be very short. Three onsite monitoring wells (PM-1, UE-7NS, and WW A) had detectable concentrations of tritium ranging from 63.8 to 329 pCi/L, all well below the drinking water limit of 20,000 pCi/L. Each of these wells is located within 0.6 miles of a historical underground test. Tritium concentrations in these wells have been decreasing in recent years; the estimated rates of decrease since 1999 range from 5.4% to 11.7% and are consistent with the natural decay rate of tritium. In 2011, all the other onsite monitoring wells sampled had tritium levels below detection.

Range in Groundwater Tritium Levels Measured on the NNSS in 2011

Onsite Supply Wells	-13.9 to 16.2 pCi/L
Onsite Monitoring Wells	-14.2 to 329* pCi/L

*Three onsite monitoring wells had detectable levels of tritium; all three are within 1 kilometer (0.6 miles) of underground nuclear tests.

Note: Negative numbers indicate measured levels below measured natural background levels (see Section 1.8.13 of the full NNSSER report for a discussion of negative numbers).

No man-made gamma-emitting radionuclides were detected in the 14 monitoring wells sampled in 2011. The majority of those monitoring well samples measured for gross alpha and gross beta had detectable levels, which are likely from natural sources. One of the monitoring wells (ER-19-1) had gross beta activity above the EPA drinking water limit.

Containment Ponds

A series of five constructed ponds collect and hold water discharged from E-Tunnel in Area 12 where nuclear testing was conducted in the past. The water is perched groundwater that has percolated through fractures in the tunnel system. Monitoring of the effluent waters from E-Tunnel is conducted to determine if radionuclides or other contaminants exceed the allowable contaminant levels regulated under a state water pollution control permit. Tritium concentrations in tunnel effluent waters in 2011 were lower than the permit limit.

The E-Tunnel containment ponds are fenced and posted with radiological warning signs. Given that the ponds are available to wildlife, game animals are periodically sampled to assess the potential radiological dose to humans via ingestion of game animals exposed to these ponds and to evaluate the radiological impacts to wildlife.

No drinking water wells on the NNSS contained detectable tritium or man-made gamma-emitting radionuclides.


Great Basin collared lizard *(Crotaphytus bicinctores)*

Tritiated water is also pumped into sumps during studies conducted by the UGTA Activity *(see Page 12)*. If the tritium level exceeds 400,000 pCi/L in water that is purged from an UGTA well during drilling and or sampling operations, the contaminated water is pumped from the wells and diverted to lined sumps (containment ponds) for evaporation, as required by the State. During 2011, water containing tritium was pumped from four drill holes. Water from one of the wells, ER-20-5 #1, was contained in a sump and had a tritium concentration of 30,100,000 pCi/L. Well ER-20-5 #1 intercepts a contaminant plume consisting almost entirely of tritium believed to originate from the TYBO and BENHAM underground test areas, which are about 913 feet and 4,291 feet away from ER-20-5 #1, respectively.


Desert bighorn sheep *(Ovis canadensis nelsoni)*

2011 Monitoring Results for E-Tunnel Effluent Waters

Parameter	Permit Limit (pCi/L)	Average Measured Concentration (pCi/L)
Tritium	1,000,000	461,000
Gross Alpha	35	10
Gross Beta	100	4

Monitoring Radioactive Air Emissions and Direct Radiation

NNSS radioactive emissions are monitored to determine the public dose from inhalation *(shown on Page 11)* and to ensure compliance with the NESHAP under the Clean Air Act. A network of 19 air sampling stations and a network of 109 thermoluminescent dosimeters (TLDs) are located throughout the NNSS *(see map on Page 19)*. NNSS air sampling stations monitor tritium in water vapor, man-made radionuclides, and gross alpha and beta radioactivity in airborne particulates. The TLD stations monitor direct gamma radiation exposure.

Radioactive emissions are also monitored at stations in selected towns and communities within 240 miles of the NNSS by the CEMP. A network of 29 CEMP stations is used *(see map on Page 20)*. The CEMP stations monitor gross alpha and beta radioactivity in airborne particulates using low-volume particulate air samplers, penetrating gamma radiation using TLDs, gamma radiation exposure rates using pressurized ion chamber (PIC) detectors, and meteorological (MET) parameters using automated weather instrumentation.

Man-Made Radionuclides at NNSS Air Sampling Stations

Several man-made radionuclides were detected at NNSS air sampling stations in 2011: ^{241}Am, ^{134}Cs, ^{173}Cs, ^{3}H, ^{238}Pu, and $^{239+240}$Pu. None, however, exceeded concentration limits established by the Clean Air Act. The highest average levels of ^{241}Am, ^{238}Pu, and $^{239+240}$Pu were detected at Bunker 9-300 in Area 9, located within an area of known soil contamination from past nuclear tests. The highest average level of tritium was detected at Schooner, site of the second-highest yield Plowshare cratering experiment on the NNSS, where tritium-infused ejecta surrounds the crater. The detectable levels of ^{134}Cs and ^{137}Cs are attributable to releases from the Fukushima Nuclear Power Plant in March 2011.

The total amounts of man-made radionuclides that were emitted to the air from all sources on the NNSS in 2011 was estimated to be 121.427 Ci. In 2011, these sources included contaminated soils at Schooner and Sedan craters, Area 3 and Area 5 RWMSs, and legacy sites; contaminated groundwater held in containment ponds or lagoons; and tests conducted at the BEEF and NPTEC. Over the past 10 years, total emissions have ranged from 121 to 625 Ci for tritium, 0.039 to 0.049 Ci for ^{241}Am, and 0.24 to 0.39 Ci for $^{239+240}$Pu. Emissions of ^{238}Pu are estimated to have remained consistent at about 0.050 Ci over the same time frame.

Man-Made Radionuclides at Offsite Air Sampling Stations

No airborne radioactivity related to any NNSS operations was detected at the CEMP stations during 2011. No man-made gamma-emitting radionuclides were detected.

Range in Average Concentrations of Man-Made Radionuclides in Air Samples on the NNSS in 2011 Attributable to NNSS Operations

Radionuclide	Concentration (10^{-15} µCi/mL)[a] Limit[b]	Lowest Average	Highest Average
^{241}Am	1.9	0.004	0.093
^{3}H	1,500,000	100	166,000
^{238}Pu	2.1	0.002	0.009
$^{239+240}$Pu	2.0	0.003	0.581

(a) The scale of concentration units for radionuclides shown in the table has been standardized to 10^{-15} microcuries per milliliter (µCi/mL). This scale may differ from those reported in detailed radionuclide-specific data tables in the NNSSER.

(b) The concentration established by NESHAP as the compliance limit.

Estimated Quantity of Man-Made Radionuclides Released into the Air from the NNSS in 2011 (in Curies)

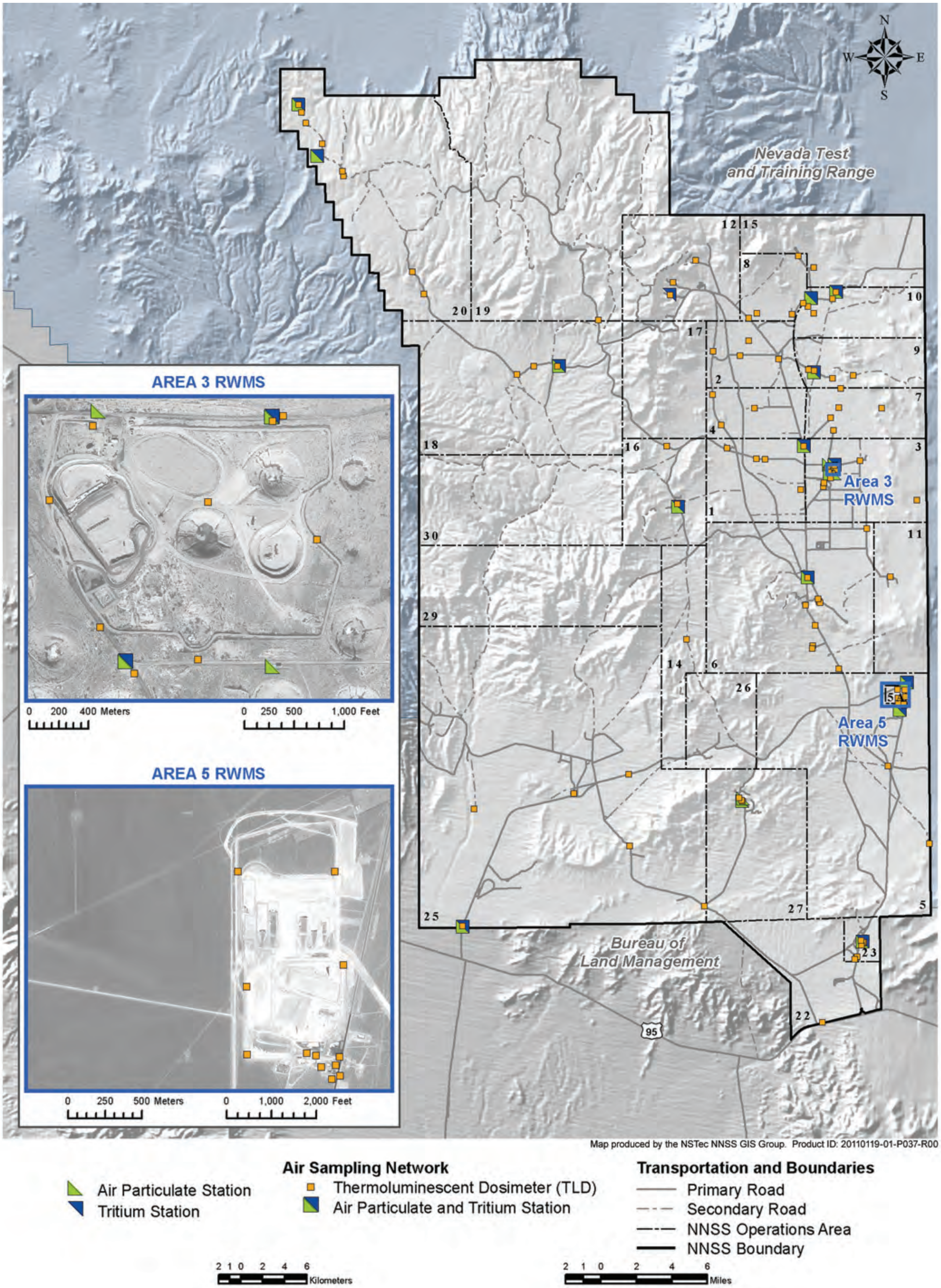
Tritium (^{3}H)	Americium (^{241}Am)	Plutonium (^{238}Pu)	Plutonium ($^{239+240}$Pu)	Depleted Uranium (DU)
121	0.047	0.050	0.29	0.040

Plutonium and americium sources are legacy sites of past nuclear testing on the NNSS where these radionuclides are in surface soils that can become re-suspended by wind.

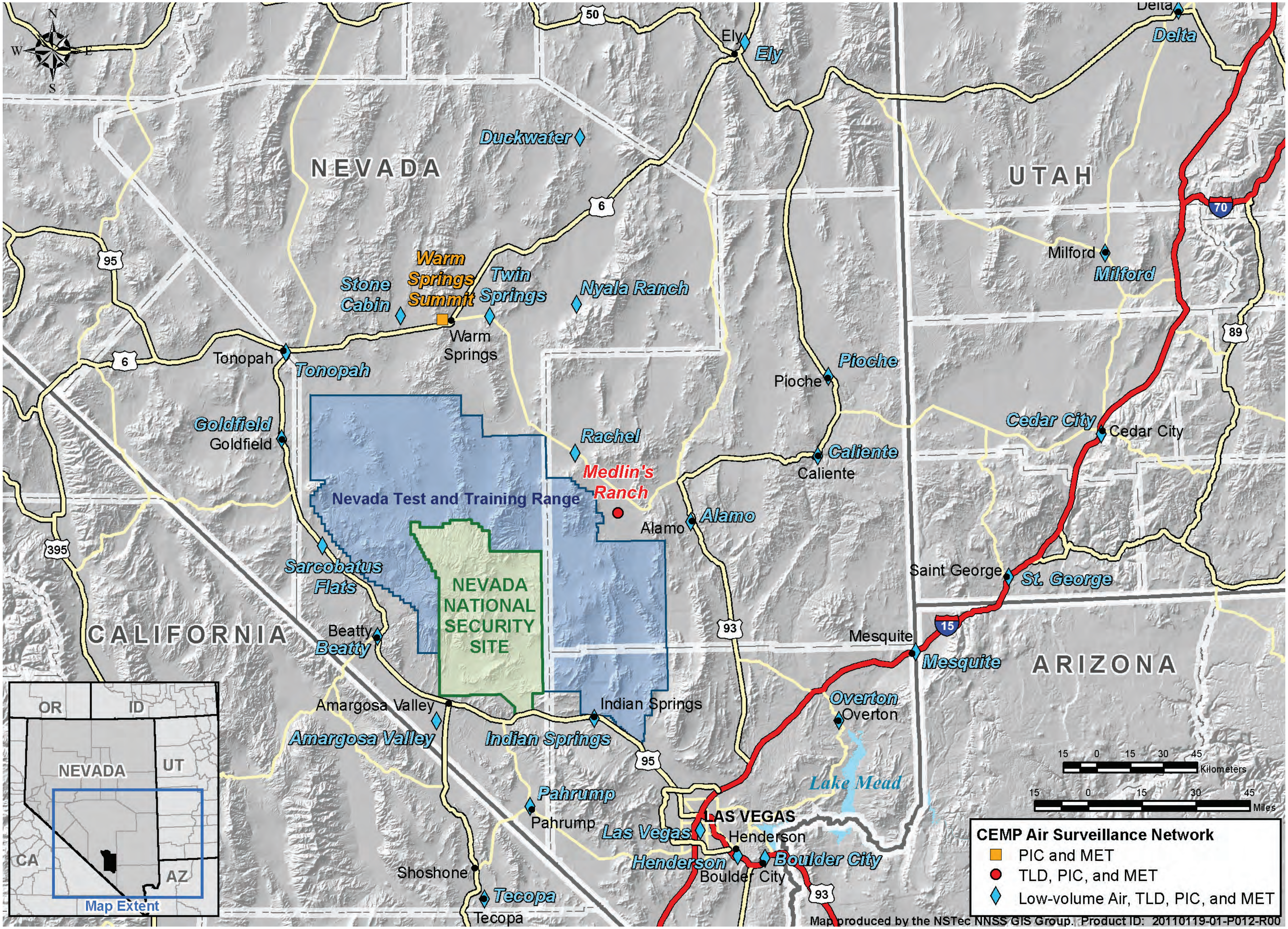
Air Monitoring in Response to Japan's Nuclear Reactor Accident

On March 21, 2011, the CEMP installed additional air samplers at the Las Vegas and Henderson stations to determine if radiological materials could be detected from the Fukushima Nuclear Power Plant in Japan that was damaged by the March 11, 2011, tsunami. Air samples were collected every 2 to 3 days for approximately 2 weeks for gamma spectroscopy analysis. Overall, the mean gross beta activity was about 20% higher at all stations, mainly due to the presence of ^{134}Cs, ^{137}Cs, and iodine-131 (^{131}I). The Clean Air Act's average annual exposure limits to these radionuclides were not exceeded.

Analysis results and a discussion of the non-significant public health risk posed to Nevadans by this accident can be found at http://www.cemp.dri.edu/japan_response.html.



2011 NNSS Air Sampling Network



2011 CEMP Air Surveillance Network

Range in Average Direct Radiation Measured in 2011 on and off the NNSS		
Location	**Elevation Above Sea Level** (feet)	**Radiation Exposure** (mR/yr)
NNSS - Schooner TLD station	5,660	600
NNSS - 35 Legacy Site TLD stations (includes Schooner)	3,077–5,938	238
Warm Springs Summit, Nevada CEMP PIC station	7,570	172
Twin Springs, Nevada CEMP PIC station	5,146	174
NNSS - 16 Waste Operation TLD stations	3,176–4,021	139
NNSS - 10 Background TLD stations	2,755–5,938	119
St. George, Utah CEMP PIC station	2,688	91
Pahrump, Nevada CEMP PIC station	2,639	72
NNSS Mercury Fitness Track TLD station	3,769	61

Gamma Radiation Exposure

Ten NNSS TLD stations are located where radiation effects from past or present NNSS operations are negligible, and therefore measure only natural background levels of gamma radiation from cosmic and terrestrial sources. In 2011, the mean measured background level from the ten stations was 119 milliroentgens per year (mR/yr). This is well within the range of variation in background levels observed in other parts of the U.S. of similar elevation above sea level. Background radiation varies not only by elevation but by the amounts of natural radioactive materials in soil and rock in different geographic regions.

The highest estimated mean annual gamma exposure measured at a TLD station on the NNSS was 600 mR/yr at Schooner, one of the legacy Plowshare sites on Pahute Mesa. The lowest was 61 mR/yr in Mercury at the fitness track. The mean annual gamma exposure at 16 TLD locations near the Area 3 and Area 5 RWMSs was 139 mR/yr, and at the 35 TLD locations near known legacy sites (including Schooner), it was 238 mR/yr.

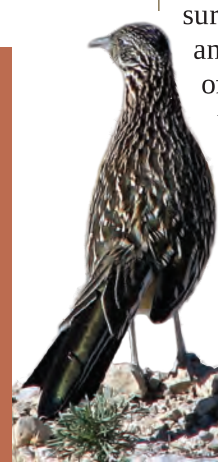
The CEMP offsite TLD and PIC results remained consistent with previous years' background radiation levels and are also well within the range of variation in background levels observed in other parts of the U.S. and with the 119 mR/yr level measured on the NNSS. The highest total annual gamma exposure measured off site, based on the PIC detectors, was 174 mR at Twin Springs, Nevada (at 5,146 feet elevation). The lowest offsite rate, based on the PIC detectors, was 72 mR at Pahrump, Nevada (at 2,639 feet elevation).

Average Background Radiation of Selected U.S. Cities (Excluding Radon)		
City	**Elevation Above Sea Level** (feet)	**Radiation** (mR/yr)
Denver, CO	5,280	164.6
Wheeling, WV	656	111.9
Rochester, NY	505	88.1
St. Louis, MO	465	87.9
Portland, OR	39	86.7
Los Angeles, CA	292	73.6
Fort Worth, TX	650	68.7
Richmond, VA	210	64.1
New Orleans, LA	39	63.7
Tampa, FL	0	63.7

Source: http://www.wrcc.dri.edu/cemp/Radiation.html, as accessed on June 26, 2012

2011 NNSS Background Gamma Radiation

119 mR/yr — This is the mean background radiation measured at 10 TLD stations in areas isolated from past and present nuclear activities.



Greater Roadrunner
(Geococcyx californianus)

Nonradiological Monitoring of Air and Water

Great Basin skink *(Eumeces skiltonianus)*

Estimated Quantity of Pollutants Released into the Air from NNSS Operations in 2011

Criteria Air Pollutants:	Tons
Particulate Matter[(a)]	2.41
Carbon Monoxide	3.70
Nitrogen Oxides	16.15
Sulfur Dioxide	1.20
Volatile Organic Compounds	1.68
Hazardous Air Pollutants (HAPs)	0.04

(a) Particulate matter equal to or less than 10 microns in diameter

Nonradioactive Air Emissions

The release of air pollutants is regulated on the NNSS under a Class II air quality operating permit. Class II permits are issued for "minor" sources where annual emissions must not exceed 100 tons of any one "criteria pollutant," or 10 tons of any one of the 189 "hazardous air pollutants" (HAPs), or 25 tons of any combination of HAPs. Common sources of such air pollutants on the NNSS include particulates from construction, aggregate production, surface disturbances, fugitive dust from driving on unpaved roads, fuel-burning equipment, open burning, fuel storage facilities, and chemical release and detonation tests.

An estimated 25.14 tons of criteria air pollutants and 0.04 tons of HAPS were released on the NNSS in 2011. The majority of the emissions were nitrogen oxides from diesel generators. No emission limits for any air pollutants were exceeded.

Nonradiological Monitoring of Drinking Water and Wastewater

NNSA/NSO operates a network of six permitted wells that comprise three permitted public water systems on the NNSS that supply the drinking water needs of NNSS workers and visitors. NNSA/NSO also hauls potable water to work locations at the NNSS that are not part of a public water system. Monitoring results for 2011 indicated that water samples from the three public water systems and from the potable water hauling trucks met the National Primary and Secondary Drinking Water Standards.

Industrial discharges on the NNSS are limited to the two operating sewage lagoon systems, Area 6 Yucca and Area 23 Mercury. Under the requirements of the state operating permit, liquid discharges to these sewage lagoons were tested quarterly in 2011 for biological oxygen demand, pH, and total suspended solids. All sewage lagoon water measurements were within permit limits.

The discharge water from the E-Tunnel complex is sampled annually under a state water pollution control permit for 14 nonradiological contaminants, which are mainly metals. In 2011, no contaminants were detected at levels that exceeded permit limits.

NNSS Drinking Water

The public water systems that supply drinking water to NNSS workers and visitors meet all National Primary and Secondary Drinking Water Standards.

Sampling well water

Cleanup and Closure of Corrective Action Sites

The Environmental Restoration Activity takes corrective actions at sites on the NNSS, the NTTR, and the TTR that have been impacted by atmospheric and underground nuclear tests conducted from 1951 to 1992. The activity is responsible for approximately 3,000 CASs in Nevada. The CASs may be contaminated with radioactive and/or nonradioactive wastes. The FFACO, as amended, describes the strategy that will be employed to plan, implement, and complete environmental corrective actions. The State of Nevada is a participant throughout the closure process, and the Nevada Site Specific Advisory Board (NSSAB) is kept informed of the progress made. The NSSAB is a formal volunteer group of interested citizens and representatives who provide informed recommendations to NNSA/NSO's EM Program.

Industrial Site CASs are facilities and land that may have become contaminated as a result of activities conducted in support of nuclear testing, and include disposal wells, inactive tanks, contaminated waste sites, inactive ponds, muck piles, spill sites, drains and sumps, and ordnance sites. In 2011, 35 Industrial Sites CASs were closed, and 38 CASs were investigated and/or remediated as progress towards closure. Only 45 CASs remain to be closed.

Soil Site CASs are where nuclear tests have resulted in extensive surface and/or shallow subsurface contamination. The soils may contain contaminants including radioactive materials, oils, solvents, heavy metals, as well as contaminated instruments and test structures used during testing activities. Corrective actions range from removal of soil to closure in place with restricted access controls. In 2011, 21 Soil Site CASs were closed on the NNSS. There are 89 CASs that remain to be closed.

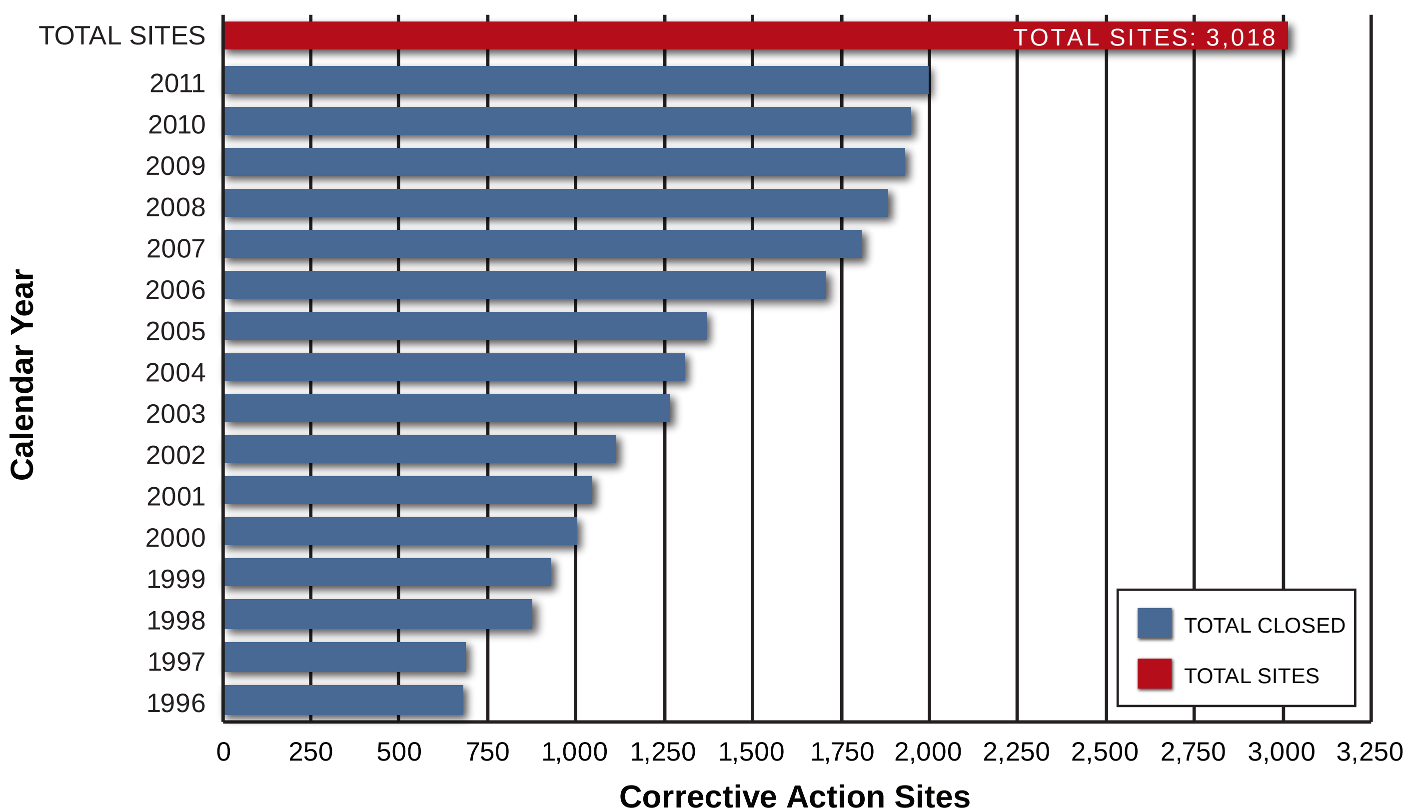
UGTA CASs include 878 sites of underground nuclear tests where the tests have resulted or might result in local or regional impacts to groundwater resources *(see Pages 12 and 13).*

Restoration Progress under FFACO

In 2011, 56 CASs were closed and all 2011 FFACO cleanup and closure activity milestones were met. The majority of the remaining CASs are UGTA CASs for which closure in place with long-term monitoring is the corrective action.

Nevada National Security Site

Corrective Action Site Closures



Cultural Resources

The historical landscape of the NNSS contains archaeological sites, buildings, structures, and places of importance to American Indians and others. These are referred to as "cultural resources." NNSA/NSO requires that NNSS activities and programs comply with all applicable cultural resources regulations and that such resources on the NNSS be monitored. The Cultural Resources Management program is implemented by DRI to meet this requirement.

DRI archaeologists completed archival research for 37 proposed projects in 2011 and completed surveys of 1,603 acres for 21 of the projects. Eighteen field surveys and 3 historical evaluations identified 55 sites, 41 of which are prehistoric, 13 are historic, and 1 is both. U12n Tunnel was determined to be eligible for the National Register of Historic Places (NRHP). Historical evaluations were conducted for the U16a Tunnel complex and the U15a and U15e shafts. Final reports and other NRHP eligibility determinations are pending for 15 projects. No mitigation actions to protect historic properties on the NNSS were required. DRI continued to maintain and manage the NNSS Archaeological Collection, which contains over 400,000 artifacts.

NNSA/NSO's American Indian Program conducts consultations with NNSS-affiliated American Indian tribes through the Consolidated Group of Tribes and Organizations (CGTO). In 2011, the CGTO's American Indian Writer's Subgroup completed final edits to tribal text for a dedicated appendix to the draft *Site-Wide Environmental Impact Statement (SWEIS) for the Nevada National Security Site and Offsite Locations in Nevada*. The CGTO also submitted formal comments relating to the SWEIS. In 2011, the CGTO requested an opportunity to meet with the NNSA Assistant Secretary of EM during a scheduled visit in Nevada. The meeting occurred on January 25, 2012, during which the CGTO Spokesperson provided the Assistant Secretary with an overview of the NNSA/NSO American Indian Program.

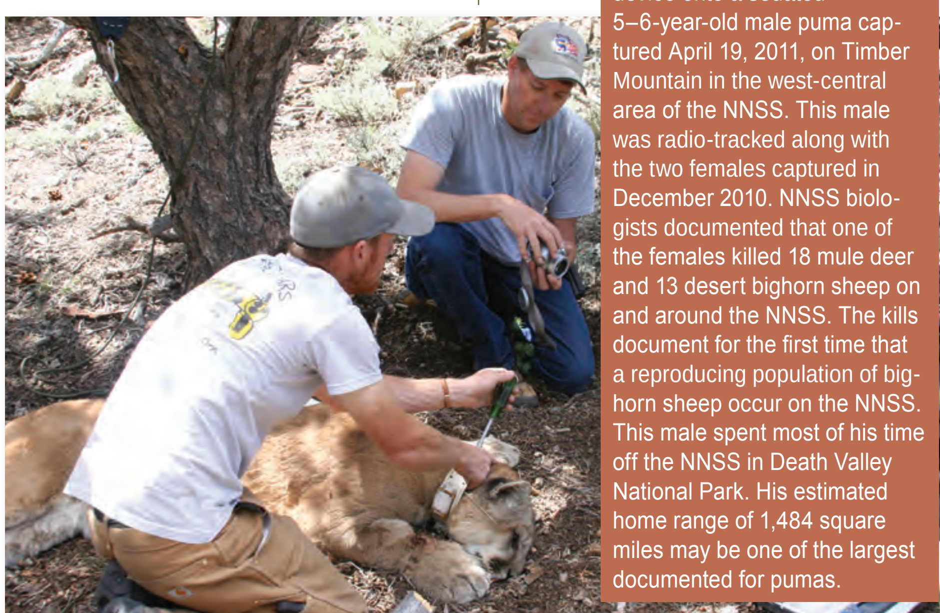
Ecological Monitoring and Endangered Species Protection

The Ecological Monitoring and Compliance (EMAC) Program provides ecological support for activities and programs conducted on the NNSS. Important species known to occur on the NNSS include 18 sensitive plants, 1 mollusk, 2 reptiles, over 250 birds, and 27 mammals. They are classified as important due to their sensitive, protected, and/or regulatory status with state or federal agencies.


Desert tortoise *(Gopherus agassizii)*

The desert tortoise is the only resident species on the NNSS that is protected under the Endangered Species Act and that can be adversely affected by NNSS activities. It is designated as a threatened species under the Act. Habitat of the desert tortoise is in the southern third of the NNSS. Activities conducted in desert tortoise habitat must comply with the terms and conditions of a Biological Opinion issued to NNSA/NSO by the U.S. Fish and Wildlife Service. In 2011, no desert tortoises were accidentally injured or killed at a project site, nor were any found, captured, or displaced from project sites. One desert tortoise was accidentally killed on a paved road in 2011, and nine were moved out of harm's way off of roads.

In 2011, biologists continued to monitor important species and biological resources on the NNSS that included sensitive plants, migratory birds, wild horses, mule deer, sensitive bats, the western red-tailed skink, and natural and man-made water sources. The collaborative effort with Dr. David Mattson of the USGS continued in 2011 to study the movements, habitat use, and food habits of pumas (mountain lions) on and around the NNSS. The goal is to capture and collar four pumas and track them for a year. A male puma was captured and radio-collared in April 2011. Two females had been captured and collared in December 2010. NNSS biologists are assisting USGS by collecting information on the puma's kills.


Biologists Brian Jansen and Derek Hall attach a tracking device onto a sedated 5–6-year-old male puma captured April 19, 2011, on Timber Mountain in the west-central area of the NNSS. This male was radio-tracked along with the two females captured in December 2010. NNSS biologists documented that one of the females killed 18 mule deer and 13 desert bighorn sheep on and around the NNSS. The kills document for the first time that a reproducing population of bighorn sheep occur on the NNSS. This male spent most of his time off the NNSS in Death Valley National Park. His estimated home range of 1,484 square miles may be one of the largest documented for pumas.

Environmental Management System

NNSA/NSO's Environmental Management System (EMS) is a business management practice that incorporates concern for environmental performance throughout the NNSS and its support facilities. The goal of the EMS is continual reduction of NNSA/NSO's impact on the environment. The EMS is designed to meet the requirements of the globally recognized International Organization for Standardization (ISO) 14001:2004 Environmental Management Standard. In 2008, the EMS obtained ISO 14001:2004 certification. Annual audits are required to maintain an EMS registration, and recertification audits of the entire EMS occur every 3 years. In 2011, an EMS recertification audit determined that NNSA/NSO remains in conformance with the ISO 14001: 2004 Standard.

Site-specific EMS objectives and targets are developed on a fiscal year (FY) schedule (October 1 through September 30). In FY 2011, the EMS objectives included:

- Reduce energy use.
- Increase use of renewable fuels.
- Decrease use of petroleum-based fuels.
- Reduce water usage.
- Purchase products that meet environmentally preferable purchasing standards.
- Reduce fugitive emissions of ozone depleting substances/gases.
- Protect groundwater quality through borehole plugging.
- Meet site remediation corrective action schedule deadlines established under the FFACO.
- Help NNSA meet DOE complex-wide site sustainability goals.

The targets set for these objectives are tracked by the various responsible operational groups and reported quarterly to an Executive Leadership Council. Some EMS targets mirror the sustainable environmental stewardship goals established by DOE *(see Pages 26 and 27)*.

The Energy Management Program was formed to specifically reduce the use of energy and water in NNSA/NSO facilities and to advance the use of solar and other renewable energy sources. In December 2011, the Energy Management Program developed the FY 2012 NNSA/NSO Site Sustainability Plan, which reports the current status and planned actions toward meeting DOE's sustainability goals. Thus far, the Energy Management Program is on track to meet the majority of the DOE long-term goals *(see Pages 26 and 27)*.

The Pollution Prevention and Waste Minimization Program helps to reduce the volume and toxicity of waste that must be disposed. In 2011, 133.1 tons of hazardous waste were diverted from disposal by recycling and reuse. The largest proportion of this reduction in waste came from shipments of used oil and lead acid batteries to offsite vendors for recycling.

More than 836 tons of solid waste were diverted from landfills and either recycled or reused in 2011. Most of these materials were mixed paper, cardboard, cans, and plastic sent off site for recycling, and ferrous and nonferrous metal sold as scrap for recycling.

GHG emissions targeted for reduction are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. For setting and tracking DOE emission reduction goals, they are classified depending on their source:

Scope 1 — direct emissions from sources owned or controlled by a federal agency.

Scope 2 — direct emissions resulting from the generation of electricity, heat, or steam purchased by a federal agency.

Scope 3 — emissions from sources not owned or directly controlled by a federal agency but related to agency activities.

Through implementation of the EMS and efforts of the Energy Management Program, NNSA/NSO is helping DOE to meet their nation-wide goal of reducing greenhouse gas (GHG) emission by 28% by the year 2020 when compared to FY 2008 emissions. This goal is for Scope 1 and Scope 2 GHG emissions.

FY 2011 Status of Environmental and Sustainability Objectives

Energy Efficiency and Management

- Energy intensity (energy use per square foot of building space) was 28.64% below the FY 2003 baseline – the goal is 30% reduction by FY 2015.
- 94% of buildings or processes are metered for electricity and 100% are metered for natural gas – exceeded the goal of 90% for electricity by October 2012 and 90% for natural gas by October 2015.
- Two cool roofs (solar reflective/thermal resistant) were installed. Cool roofs currently cover 28.9% of the gsf of all NNSA/NSO buildings.
- Through the purchase of renewable energy credits and by using photovoltaic and wind turbines that generate 0.5% of the power produced on site, NNSA/NSO met the goal of having 7.5% of its power on the NNSS come from renewable sources.

Water Efficiency and Management

- Water intensity (gallons used per total gross square feet [gsf] of facility space) was 31.4% below the FY 2007 baseline – exceeded the goal of 26% reduction by FY 2020.
- Non-potable water production (used to estimate consumption) was 15% above the FY 2010 baseline due to end point leaks that are scheduled for repair in FY 2012 – the goal is 20% reduction by FY 2020.

Fleet Management

- Use of alternative fuel was 132% above the FY 2005 baseline – exceeded the goal of 60% increase in FY 2011.
- Use of petroleum was 46% less than the FY 2005 baseline – exceeded the goal of 12% reduction in FY 2011.
- 53.5% of light duty vehicle acquisitions were alternative fuel vehicles, less than the goal of 75%. All other light duty vehicles acquired were hybrid electric.
- Fleet inventory is 9.7% less than FY 2005 baseline – the goal is 15% reduction by FY 2015.
  - Fleet inventory was reduced 1% from FY 2010, below the 4% reduction goal.

High Performance Sustainable Buildings (HPSBs)

- 4.4% of buildings larger than 5,000 gsf are compliant with the Guiding Principles for Federal Leadership in HPSB design – the goal is to have 15% of such buildings compliant by FY 2015.
- The Nevada Support Facility building, located at the North Las Vegas Facility (NLVF), achieved Energy Star certification in FY 2011, and an application was submitted for the building to also receive Leadership in Energy and Environmental Design (LEED) certification. LEED Gold certification was awarded in August 2012.

U.S. GREEN BUILDING COUNCIL LEED USGBC

Pollution Prevention and Waste Minimization

- ▶ 35.3% of non-hazardous solid waste generated at NNSA/NSO facilities was diverted from landfills through recycling – the goal is 50% by the end of FY 2015.
- ▶ Use of bio-based janitorial supplies was increased 50% from FY 2010, meeting the EMS goal.
- ▶ Chemical purchase requisitions and projects were reviewed and approved to help reduce the sources of waste and pollutants and to increase the use of acceptable alternative chemicals and processes.
- ▶ All subcontracts were revised to include the requirement to meet NNSA Environmentally Preferable Purchasing standards, meeting the EMS goal.
- ▶ Most food wastes at the NNSS are collected and taken to a local Native American tribe for composting.

Greenhouse Gas (GHG) Emissions

- ▶ Annual inventory of Scope 1 and 2 GHG emissions (excluding "fugitive" or uncontrolled/unintentional emissions) was 17% below the FY 2008 baseline – the goal is 28% reduction by FY 2020. Fugitive emissions will be inventoried for tracking in FY 2012.
- ▶ Annual inventory of Scope 3 GHG emissions (excluding fugitive emissions) was 83% below the FY 2008 baseline – exceeded the goal of 13% reduction by FY 2020. Work will progress in FY 2012 towards quantifying fugitive emissions.
- ▶ Reduced fugitive GHG emissions by draining refrigerant from 62 chillers and training personnel in the capture of sulfur hexafluoride gas during maintenance of high-voltage electric systems.

Electronic Stewardship and Data Centers

- ▶ 100% of the 2,100 leased computers are Electronic Product Environmental Assessment Tool (EPEAT) registered and Energy Star qualified.
- ▶ Leased computers began to be replaced with leased thin client terminals that reduce energy use by 85%.
- ▶ Power meters were installed in data centers in Building C-1 at the NLVF and in Building 23-725 at Mercury to begin monitoring power utilization effectiveness (PUE). The goal is a maximum annual weighted average PUE of 1.4 for the data centers by FY 2015.
- ▶ All leased computer equipment contracts require that returned equipment and parts be refurbished, reused, or recycled through a company certified by the International Association of Electronic Recyclers.

Innovation

- ▶ A behavior-based energy awareness program was developed along with a character icon called The Green Reaper to promote the program.
- ▶ The energy usage of an NNSS building was monitored for 12 months after its exterior was painted with an insulated paint additive. Monitoring was completed and indicated minimal energy use reduction (1%–2%).

Summary of NNSA/NSO's Compliance with Major Federal Statutes in 2011

Environmental Statute or Order and What It Covers	2011 Status
Atomic Energy Act (through compliance with DOE O 435.1, "Radioactive Waste Management"): Management of low-level waste (LLW) and mixed low-level waste (MLLW) generated or disposed on site	33,532 tons of radioactive wastes, which included LLW, MLLW, and asbestiform LLW, were received and disposed on site and were within permit limits for volume and weight; vadose zone and groundwater monitoring continued to verify that disposed LLW and MLLW are not migrating to groundwater or threatening biota or the environment.
Clean Air Act: Air quality and emissions into the air from facility operations	Onsite air sampling stations detected man-made radionuclides at levels comparable to previous years and well below the regulatory dose limit for air emissions to the public of 10 mrem/yr. The estimated dose from all 2011 NNSS air emissions to the maximally exposed individual (MEI) is 0.07 mrem/yr. Nonradiological air emissions from permitted equipment and facilities were all below emission and opacity limits.
Clean Water Act: Water quality and effluent discharges from facility operations	All domestic and industrial wastewater systems and groundwater monitoring well samples were within permit limits for regulated water contaminants and water chemistry parameters.
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)/Superfund Amendments and Reauthorization Act (SARA): Cleanup of waste sites containing hazardous substances	No NNSS cleanup operations are regulated under CERCLA or SARA; they are regulated under RCRA instead.
DOE O 458.1, "Radiation Protection of the Public and the Environment": Measuring radioactivity in the environment and estimating radiological dose to the public due to NNSA/NSO activities	RREMP monitoring of air, water, and direct radiation was conducted. The total annual dose to the MEI from all exposure pathways due to NNSA/NSO activities was estimated to be 0.54 mrem/yr, well below the DOE limit of 100 mrem/yr.
Emergency Planning and Community Right to Know Act (EPCRA): The public's right to know about chemicals released into the community	30,847 pounds (lb) of lead, 7,951 lb of mercury, and 5,048 lb of PCBs were disposed on site; 8,690 lb of lead were released as spent ammunition and 5.2 lb of lead were released to the air from the Mercury Firing Range. The amount of lead, mercury, and PCBs shipped off site for disposal or recycling totaled 101,650 lb, 0.02 lb, and 3.93 lb, respectively.
Endangered Species Act (ESA): Threatened or endangered species of plants and animals	Field surveys for 21 proposed projects were conducted; 4.68 acres of tortoise habitat were disturbed, and no tortoises were harmed at or displaced from project sites; one tortoise was killed accidentally on a road, and nine were moved off roads to safety. All actions were in compliance with permit requirements.
Federal Facility Agreement and Consent Order (FFACO): Cleanup of waste sites containing hazardous substances	All 2011 corrective action milestones under the FFACO were met. A total of 56 CASs were closed in accordance with State-approved corrective action plans.
Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA): Storage and use of pesticides and herbicides	Both restricted-use and nonrestricted-use pesticides were applied by State-certified personnel. Storage and use of pesticides were in compliance with federal and state regulations.
Migratory Bird Treaty Act (MBTA): Protecting migratory birds, nests, and eggs from harm	During biological surveys for proposed projects, no migratory bird nests, eggs, or young were found in harm's way. However, seven red-tailed hawks and two great horned owls were electrocuted by power lines, and a common poorwill was killed by a vehicle. Biologists and NNSS Power Support personnel identified ways to help mitigate raptor electrocutions and power equipment damage related to raptor nests and perches.
National Environmental Policy Act (NEPA): Evaluating projects for environmental impacts	The draft *Site-Wide Environmental Impact Statement for the Nevada National Security Site and Offsite Locations in Nevada* was released for public review in July 2011. Public meetings were held in September 2011 in various Nevada and Utah communities. It evaluates current and future NNSA/NSO operations in Nevada during the 10-year period beginning when the Record of Decision is published, which is estimated to be November 2012.
National Historic Preservation Act (NHPA): Identifying and preserving historic properties	Archival research for 37 projects was conducted; 669 acres were surveyed for 16 of the projects, and 1 historic site was identified. The historical U12n Tunnel complex in Area 12 was determined to be eligible for the National Register of Historic Places.
Resource Conservation and Recovery Act (RCRA): Generation, management, disposal of hazardous waste (HW) and MLLW and cleanup of inactive, historical waste sites	1,001 tons of MLLW were disposed of on site, 10.55 tons of HW were received for onsite storage, 6.06 tons of PCB wastes were shipped off site for disposal, and 34.66 tons of waste explosive ordnance were detonated on site. Groundwater monitoring of wells at the Area 5 RWMS confirmed that buried MLLW remains contained, and vadose zone monitoring and post-closure inspections of historical RCRA closure sites confirmed that buried HW remains contained.
Safe Drinking Water Act: Quality of drinking water	The concentrations of all regulated water contaminants in drinking water from the three permitted public water systems on the NNSS were below state and federal permit limits.
Toxic Substances Control Act (TSCA): Management and disposal of polychlorinated biphenyls (PCBs)	10 drums of fluorescent light ballasts containing PCBs and 17 drums of PCB-contaminated soil were shipped off site to permitted disposal and treatment facilities.

National Nuclear Security Administration

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