5.0 WATER SURVEILLANCE ACTIVITIES

The Nevada Test Site (NTS) has a history of underground nuclear testing and continues to operate radioactive waste storage sites, environmental restoration sites, and a hazardous material testing facility. Groundwater surveillance is particularly important because of the potential for groundwater contamination from some of these activities and the scarcity of water supplies in this desert region. The water surveillance program includes a combination of effluent controls, groundwater protection, monitoring, restoration, and permit compliance. Groundwater quality monitoring is conducted both onsite and offsite by Bechtel Nevada (BN) for the Routine Radiological Environmental Monitoring Plan (RREMP) and the U.S. Environmental Protection Agency's (EPA's) Radiation & Indoor Environments National Laboratory-Las Vegas (R&IE-LV) for the Long Term Hydrological Monitoring Program (LTHMP). In 1999, there was a transition from the LTHMP to the RREMP (DOE 1998a). Results from both programs are reported for 1999.

Groundwater quantity monitoring continues to be conducted by the U.S. Geological Survey (USGS) and BN. No significant water level changes were detected associated with groundwater pumping, and water usage on the NTS continued to decline. The NTS potable water supply system continues to be free of any detectable man-made radionuclides.

The Nevada Environmental Restoration Project (ERP) goals are to safeguard the public's health and safety and to protect the environment. This involves the assessment and cleanup of contaminated sites and facilities to meet standards required by federal and state environmental laws. In 1996, the U.S. Department of Energy Nevada Operations Office (DOE/NV) formalized an agreement with the state for implementing corrective actions based on public health and environmental considerations in a cost-effective and cooperative manner. Investigation and cleanup activities continued on the NTS and the adjacent Nellis Air Force Range. Particular emphasis was directed at the Pahute Mesa, and Oasis Valley (adjacent offsite) areas.

Beginning in 1999, activities at non-NTS sites in other states including the two in Central Nevada (SHOAL and FAULTLESS sites) will not be reported in the NTS Annual Site Environmental Report (ASER). These monitoring and remedial activities will be addressed in separate reports (e.g. the "Annual Water Sampling and Analysis Calendar Year 1999", Davis 1999, available from R&IE-LV). The term "offsite" in this ASER will refer to adjacent, or proximal areas to the NTS. Also included in this ASER are the administratively related North Las Vegas Facility (NLVF) and the Remote Sensing Laboratory (RSL) at Nellis Air Force Base in North Las Vegas.

5.1 WATER MONITORING PROGRAM INFORMATION

Water monitoring activities conducted in the past on the NTS and related facilities involve surveillance of surface and groundwaters, drinking water systems, sewage treatment ponds, and actions protective of groundwater resources. During 1999, the sampling of onsite surface waters (reservoirs and natural springs) was terminated in accordance with the "Routine Radiological Environmental Monitoring Plan", published in December 1998 (DOE 1998a). The past concentrations of radionuclides in the reservoirs have consistently been below the Derived Concentration Guides (DCGs), and the supply wells, the source of water for the reservoirs, are routinely sampled. Likewise, the radionuclide concentrations in samples of spring water have also been consistently below the DCGs, and none of the onsite springs are hydrologically connected to the aquifers that may have been radioactively contaminated by underground nuclear tests.

REGULATORY DRIVERS FOR ONSITE ENVIRONMENTAL MONITORING

DOE Order 5400.1, "General Environmental Protection Program," establishes environmental protection program requirements, responsibilities, and authorities for DOE operations. These mandates require compliance with applicable federal, state, and local environmental protection regulations. Other DOE directives applicable to environmental monitoring include DOE Order 5400.5, "Radiation Protection of the Public and the Environment"; and DOE/EH-0173T, "Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance." Nevada Administrative Code (NAC) 445A.453 - 445A.459 “Public Water Systems” provides standards for sampling and monitoring of potable water systems.

WATER EFFLUENT MONITORING

Radiologically contaminated water continued to be discharged from E Tunnel in Rainier Mesa (Area 12) despite efforts to seal that tunnel. A grab sample was collected quarterly from the tunnel's effluent discharge point and from the tunnel's containment pond. These samples were analyzed for tritium (^{3}H), gross alpha, gross beta, ^{238}Pu, $^{239+240}Pu$, and gamma emitters. In addition, one quarterly sample was analyzed for ^{90}Sr, and one quarterly sample was analyzed for ^{137}Cs. Tritium was the radionuclide most consistently detected at the tunnel sites. Other radionuclides were detected at lower concentrations. Flow data obtained from the Defense Threat Reduction Agency (formerly the Defense Special Weapons Agency) were used to calculate the total volume discharged. Annual average radioactivity concentrations were calculated from the quarterly measurements. From these, the total amount of radioactivity in the effluent was obtained.

Seven new wells were drilled in the vicinity of the NTS during 1999 (one onsite and six offsite, located just west of the NTS). Water pumped from the wells during drilling and to obtain characterization water samples was discharged into lined and/or unlined containment ponds depending upon proximity to source areas (e.g., on Pahute Mesa). No man-made radionuclides were detected in the drilling or predevelopement characterization fluids produced from these wells.

WATER ENVIRONMENTAL MONITORING

Environmental monitoring was conducted onsite throughout the NTS and the near offsite area. Groundwater samples were routinely collected at preestablished locations and analyzed for radioactivity.

Water samples were collected from selected potable tap water points, water supply wells, monitoring wells, sewage lagoons, and containment ponds. The frequency of collection and types of analyses done for these types of samples are shown in Tables 5.1, 5.2, 5.3, and 5.4. Sampling locations are shown on Figures 5.1 (supply wells), 5.2 (surface water), and 5.3 (monitoring wells).

5.2 NTS HYDROLOGICAL MONITORING PROGRAMS

Until implementation of the LTHMP in 1972, monitoring of ground and surface waters was done by the U.S. Public Health Service,

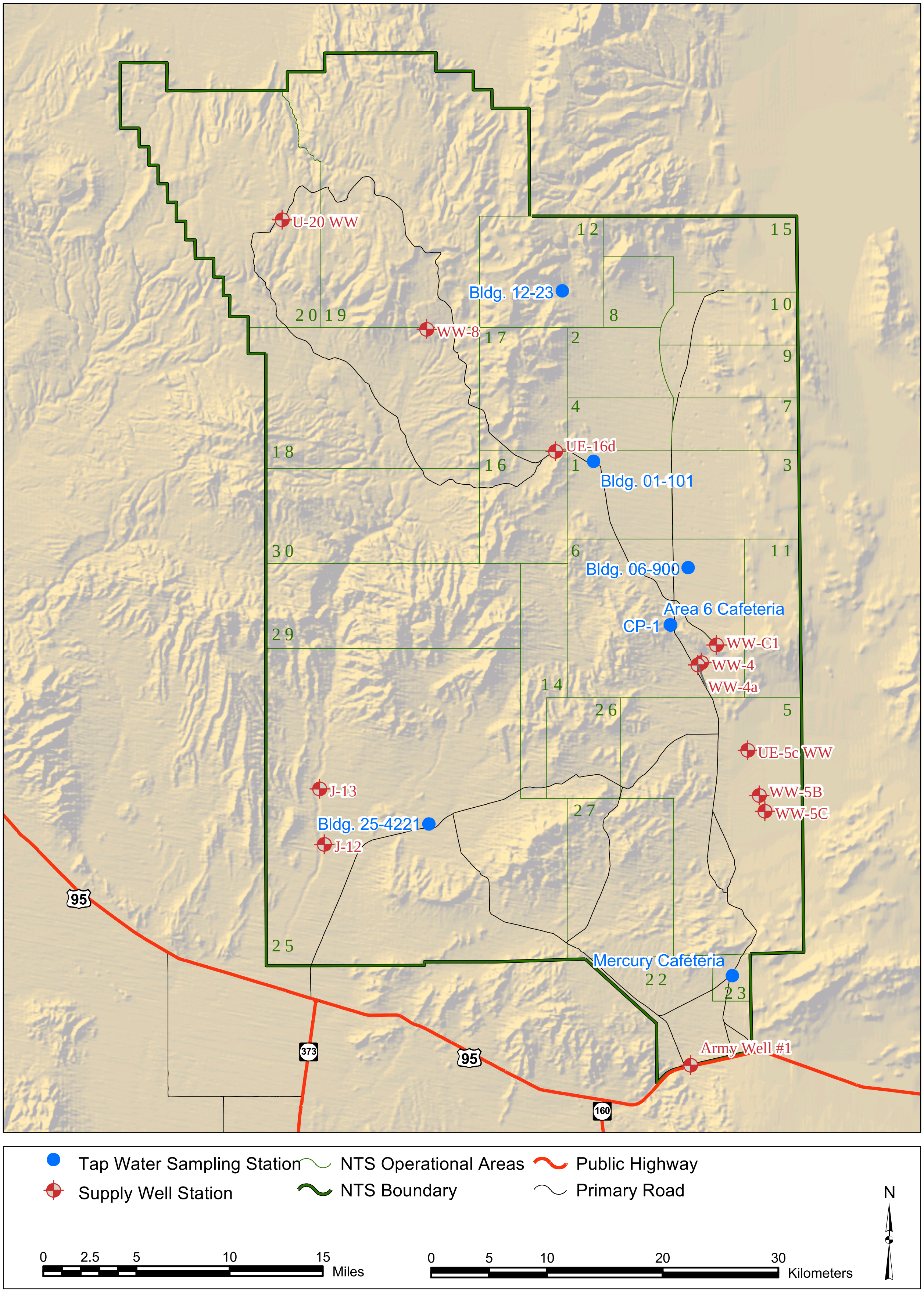

Figure 5.1 Supply Well and Potable Water Sampling Stations on the NTS - 1999

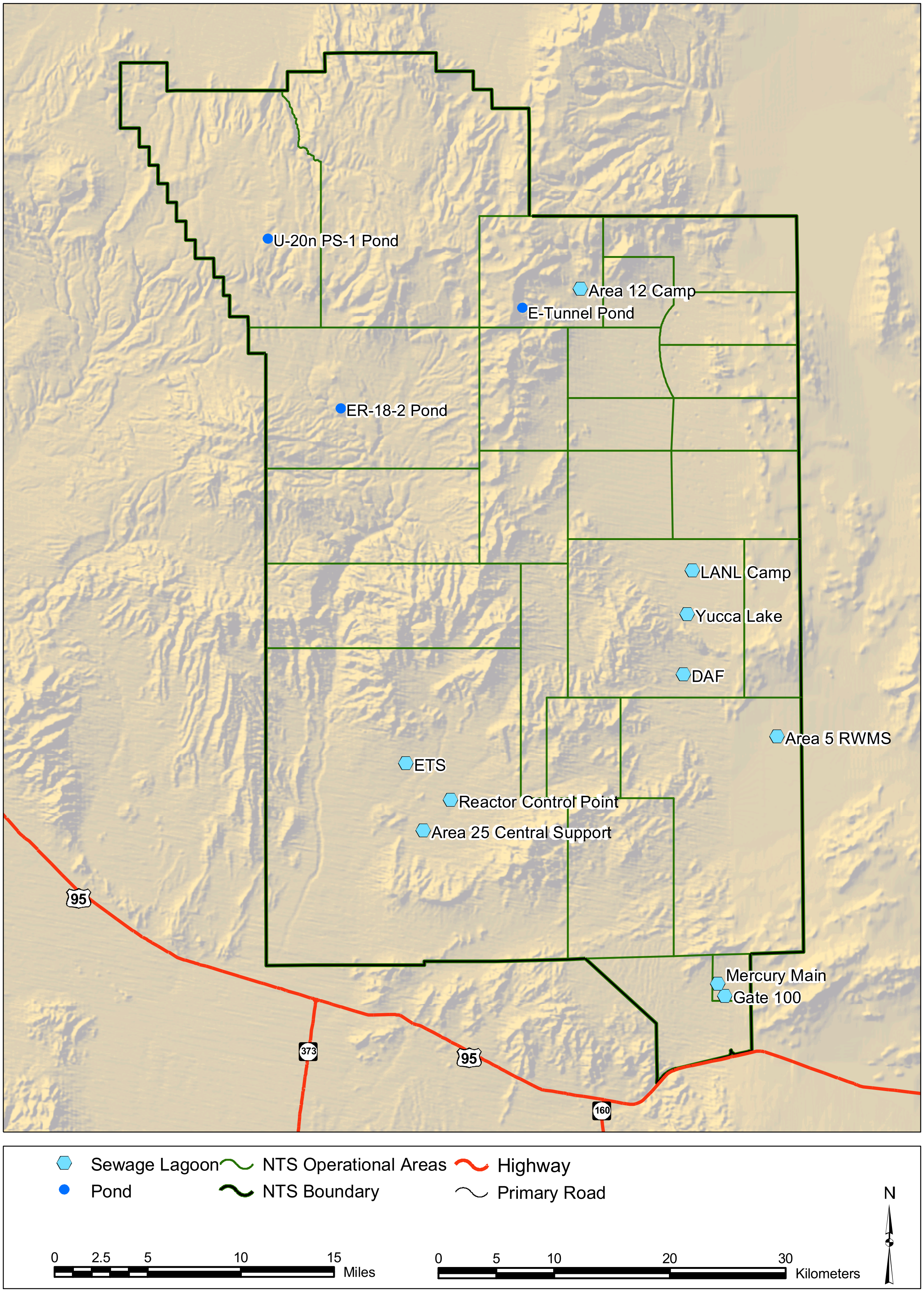

Figure 5.2 Surface Water Sampling Locations on the NTS - 1999

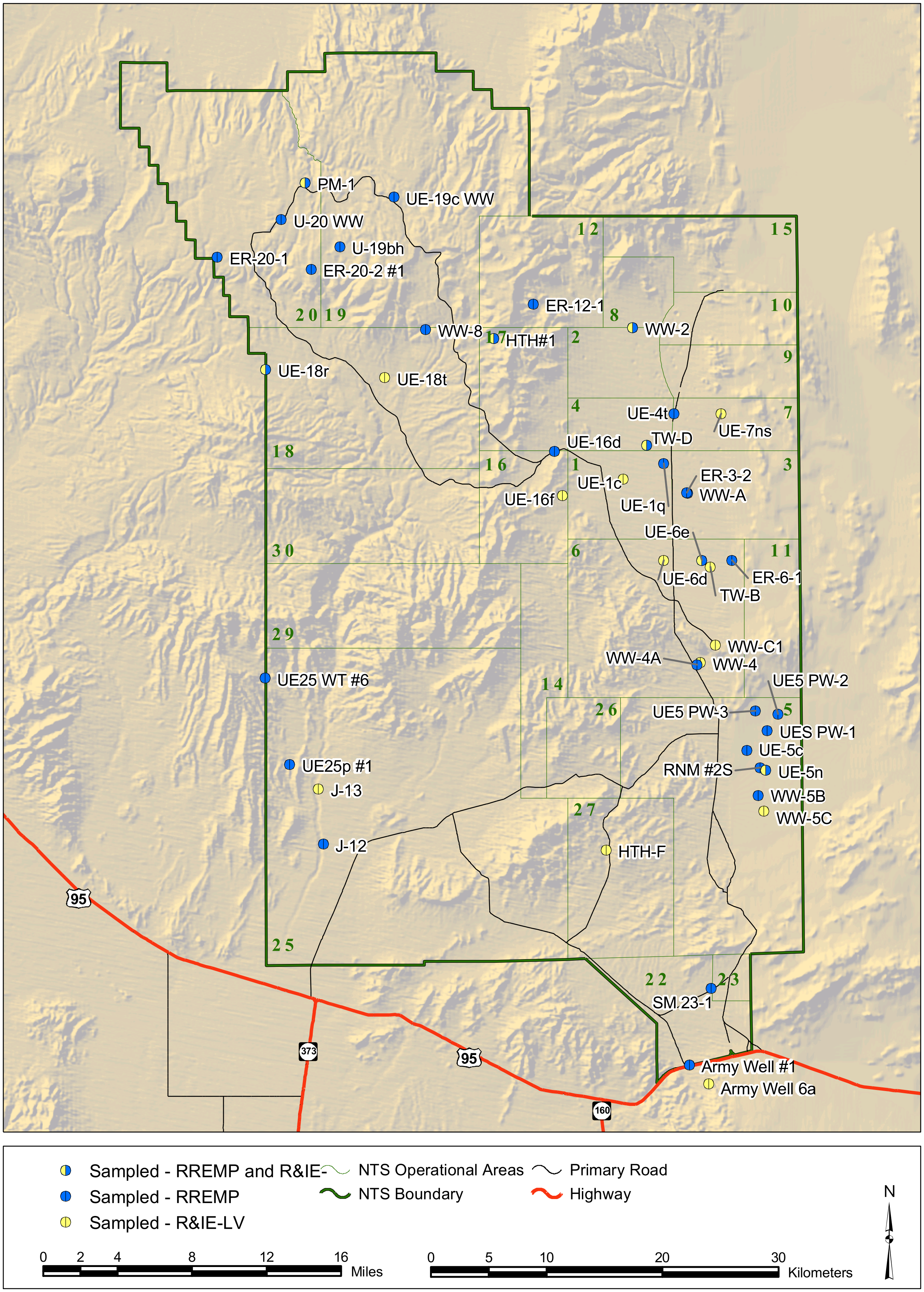

Figure 5.3 NTS Groundwater Radiological Monitoring Sites (RREMP, R&IE-LV) - 1999

the USGS, and the U.S. Atomic Energy Commission contractor organizations. The EPA's R&IE-LV has been responsible for operation of the LTHMP. In 1998, BN was tasked by the DOE/NV to establish and manage the NTS RREMP, a single integrated and comprehensive monitoring program. In 1999, there was a transition from the LTHMP to the RREMP (DOE 1998a). A brief summary of each program is provided below.

LONG-TERM HYDROLOGICAL MONITORING PROGRAM (LTHMP)

The EPA's R&IE-LV is responsible for operation of the LTHMP, including sample collection, analysis, and data reporting. The LTHMP consists of routine radiological monitoring, analysis, and reporting of samples collected from specific wells on the NTS and of wells, springs, and surface waters in the offsite area around the NTS.

The present R&IE-LV sampling locations on the NTS, or immediately outside its borders on federally owned land are shown in Figure 5.3. All sampling locations are selected by DOE and primarily represent potable water supplies. R&IE-LV samples onsite wells without pumps and, for quality assurance purposes, collects samples from some potable wells sampled by BN. In 1999, a total of 21 onsite wells was sampled in support of the LTHMP. All samples were analyzed by gamma spectrometry and for tritium.

Summaries of the 1999 sampling results for the onsite sampling program are provided in Section 5.5.

SAMPLING AND ANALYSIS PROCEDURES

The procedures for the analysis of water samples, used by EPA’s R&IE-LV, are described by Johns et al., 1979 and are summarized in Table 5.1. These include gamma spectral analysis and radiochemical analysis for tritium. The procedures are based on a standard methodology for the stated analytical procedures. Two methods for tritium analysis were performed; these were conventional and electrolytic enrichment. The samples were initially analyzed for tritium by the conventional method followed by enrichment analysis if the results were less than 800 pCi/L (30 Bq/L). In late 1995, it was decided that only 25 percent of the samples would be analyzed by the electrolytic enrichment method. The samples selected for enrichment are from locations that are in position to show possible migration. Two 500-mL glass bottles and a 1-gal plastic container are filled at each sampling location. At the sample collection sites, the pH, conductivity, water temperature, and sampling depth are measured and recorded when the sample is collected. For wells with operating pumps, the samples were collected at the nearest convenient outlet. If the well has no pump, a truck-mounted sampling unit is used. With this unit, it is possible to collect 3-L samples from wells as deep as 1,800 m (5,900 ft).

When these locations were sampled for the first time, the samples were analyzed for ^{89,90}Sr, ^{238}Pu, $^{239+240}$Pu, and uranium isotopes in addition to the analyses mentioned above. The 500-mL samples were analyzed for tritium and the 1-gal sample from each site was analyzed by gamma spectrometry.

GROUNDWATER NEAR THE NEVADA TEST SITE

Water sampling around the NTS is conducted by R&IE-LV under an interagency agreement with DOE to ensure the radiological safety of public drinking water supplies, and representative water sources of rural residents and, where suitable, to monitor any migration of radionuclides from the NTS. This water monitoring is conducted within the LTHMP. R&IE-LV personnel routinely collect and analyze water samples from locations in the offsite areas surrounding the NTS. Due to the scarcity of surface waters in the region, most of the samples are groundwater, collected from existing wells. Samples from specific locations are collected monthly, biannually, annually, or biennially in accordance with a preset schedule. Many drinking water supplies used by the offsite population are represented in the LTHMP samples. A total of 23 offsite wells and springs were sampled by the R&IE-LV in support of the LTHMP during 1999. Figure 5.4 is a map of the locations sampled.

ROUTINE RADIOLOGICAL ENVIRONMENTAL MONITORING PLAN

Environmental monitoring has been conducted on and near the NTS by the DOE, through various agencies, for over forty years. Environmental measurements were made at first to determine the extent of contamination for the protection of operations and workers. Later, monitoring was expanded as needed to comply with state and federal regulations and permit requirements, and to address stakeholder issues regarding radiation contamination as a result of DOE activities. The DOE recently conducted a review of environmental monitoring at the NTS, taking into consideration all the media being monitored (air, vadose zone, water, and biota) by several different organizations, and as a result redesigned the entire program. The resulting RREMP is a single integrated and comprehensive monitoring program.

BN was tasked by the DOE/NV to establish and manage the NTS RREMP. Among the existing environmental monitoring programs incorporated into the RREMP are the LTHMP, and environmental monitoring operations by single programs or agencies, including the USGS, EPA, Joint Testing Organization, the DOE/NV Underground Testing Area (UGTA) project, and others. The RREMP remains a multi-organizational program; however, the RREMP provides for centralized management and reporting. Goals of the RREMP initiative include optimizing efficiency and reducing duplication, thereby minimizing costs while continuing to meet all regulatory, health and safety, and environmental obligations.

SURFACE WATER SAMPLING SITES

The surface water sample locations in the RREMP on the NTS include the E Tunnel containment ponds and nine sewage lagoons (Figure 5.2). Offsite locations include 12 natural springs. The criteria for selection was based on the monitoring objectives described in Section 1.3.1 of the RREMP (DOE 1998a). Water sources were selected for monitoring if they had the potential for exposing the public, onsite biota, or the environment to significant levels of radionuclides, or if they required monitoring under an existing State discharge permit.

All surface water samples are analyzed for tritium and gamma emitters. At selected locations and, at all new locations where a hydrochemical baseline does not exist, the analysis are expanded to include gross beta and gross alpha emissions, tritium (by the enrichment method), ^{238}Pu, $^{239+240}$Pu, and ^{90}Sr. In addition, flow rate at the springs, at the time of the sampling, will be measured, if feasible.

Surface water from onsite containment ponds and sewage lagoons will be sampled and analyzed quarterly for all contaminants listed above except ^{90}Sr, which will be checked only once a year. Offsite spring water will be sampled and analyzed for tritium semiannually, triennially, or annually depending upon proximity to the NTS and relation to groundwater flow paths. The initial samples at new locations will be analyzed for a wider suite of radioactive contaminants, including tritium (by the enrichment method), as well as standard water properties such as hydrogen ion concentration (pH), and conductivity, and hydrochemistry (alkalinity, bicarbonate, and principal anions/cations) to establish a

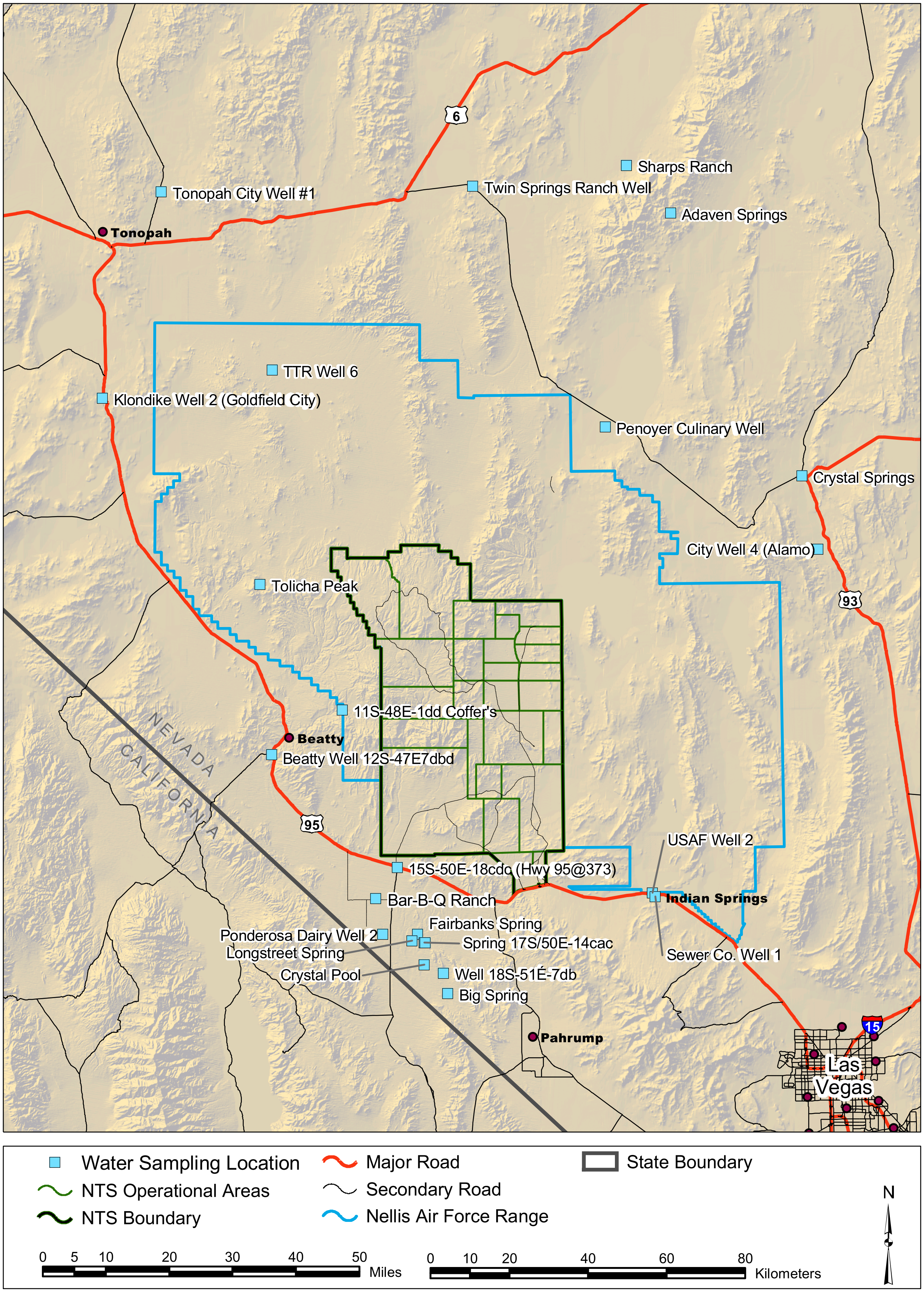

Figure 5.4 Wells and Springs Outside the NTS Included in the LTHMP - 1999

baseline. This sampling plan is summarized in Table 5.3. Sampling will not occur as scheduled if there is insufficient water at a site (e.g., the springs) to obtain a sample.

GROUNDWATER SAMPLING

Unless regulatory changes in permit conditions occur, the parameters and the action levels for the monitoring of the water supply wells and the permitted facilities on the NTS will remain the same. The parameter of interest for the routine radiological monitoring of groundwater is tritium. The action level for tritium is 10 percent of the drinking water standard. The standard method for tritium analysis, which can detect tritium at concentrations as low as 300 to 700 pCi/L, will be used at most wells. However, for wells in the southwestern offsite areas (Oasis Valley), and selected wells within corrective action units (CAUs), the enriched-tritium analysis method is used because tritium levels as low as 10 pCi/L can be detected with this method. Analyzing for tritium at all other offsite wells by the standard method is a cost-effective means of satisfying the program objectives. All wells will be sampled for the additional parameters as shown in Table 5.3.

Other water properties (e.g., pH, specific conductivity, principal anions and cations, etc.) will be measured at selected wells at the same time water samples for radiological analysis are collected. For example, at new monitoring wells which do not have previously established baseline data, water chemistry data will be collected during the first year of sampling. Also, at selected wells, it may be necessary to measure other water quality characteristics to confirm certain assumptions of radionuclide migration models for groundwater (e.g., confirm the existence of colloidal transport). These other properties are shown in Table 5.3 (see Type IV Analysis).

Sampling frequency for the wells in the proposed network will differ: water supply wells and wells near source areas will be sampled more frequently, and wells without established background data will be sampled more frequently for one year. Sampling frequencies of the wells are summarized in Table 5.3. The onsite groundwater monitoring wells included in the RREMP are shown in Figures 5.1 (onsite supply), and 5.3 (onsite monitoring wells).

DRINKING WATER CONSUMPTION ENDPOINTS

The drinking water network at the NTS consists of four separate systems, with seven consumption endpoints. Ten potable supply wells feed the four drinking water systems (Table 5.4). As a check on any effect the water distribution system might have on water quality, the seven water system endpoints (tap water) are sampled on a monthly (pre-fiscal year [FY] 1997), quarterly or annually (FY 1997) basis. No test-related radionuclides have been detected to date.

To support RREMP objectives and to demonstrate compliance with relevant regulations (e.g., Safe Drinking Water Act [SDWA], DOE Order 5400.5, and Nevada Revised Statutes 445A.361), the seven drinking water systems endpoints will continue to be sampled according to the schedule presented in Table 5.4. Distribution systems located within, or traversing, the historical testing areas will be sampled more frequently (quarterly), while the other systems will be sampled on an annual basis. The tap water samples will be analyzed annually for gamma emitters, gross alpha, gross beta, tritium (enriched method), ^{238}Pu, $^{239-240}$Pu, and ^{90}Sr.

ANALYTICAL PROCEDURES

Water samples collected for the RREMP are analyzed by BN's Analytical Services Laboratory. Analytical procedures used for water samples are briefly described here and also presented in Table 5.1. A 500-mL aliquot was taken from the water sample, placed in a plastic bottle, and counted for gamma activity with a germanium detector. A 2.5-mL aliquot was used for ^{3}H analysis by liquid scintillation counting. An 800-mL aliquot was evaporated to 15 mL, transferred to a stainless steel counting planchet, and evaporated to dryness after the addition of a wetting agent. Alpha and/or beta analyses were accomplished by counting the planchet samples for 100 minutes in a gas-flow proportional counter.

Tritium enrichment analyses were done on samples from the water supply wells by concentrating the volume and tritium content of a 250-mL sample aliquot to 10 mL by electrolysis of a basic solution and analyzing a 5-mL portion of the concentrate by liquid scintillation counting.

The ^{226,228}Ra concentrations were determined from low-background gamma spectrometric analyses of radium sulfate precipitates. The samples were prepared by adding a barium carrier and ^{225}Ra tracer to 800 mL of a sample, precipitating the barium and radium as a sulfate, separating the precipitate, and analyzing it by counting for 500 minutes in a low-level gamma spectroscopy facility.

The radiochemical procedure for plutonium was similar to that described in Chapter 4. Alpha spectroscopy was used to measure any ^{238}Pu, $^{239+240}$Pu, and the ^{242}Pu tracer present in the samples.

5.3 GROUNDWATER PROTECTION PROGRAM

HYDROGEOLOGY OF THE NTS

The NTS has three general water-bearing units: the lower carbonate aquifer, volcanic aquifers, and valley-fill aquifers. The water table occurs variably in the latter two units, while groundwater in the lower carbonate aquifer occurs under confined conditions. The depth to the saturated zone is highly variable, but is generally at least 210 m (approximately 690 ft) below the land surface (e.g. in Frenchman Flat) and is often more than 457 m (approximately 1,500 ft) (e.g. in Yucca Flat). The hydrogeologic units at the NTS occur in three groundwater subbasins in the Death Valley Groundwater Basin (see Chapter 2, Figure 2.7, for a diagram of these systems). The actual subbasin boundaries are poorly defined, but what is known about the basin hydrology is summarized below.

Groundwater beneath the eastern part of the NTS is in the Ash Meadows Subbasin and discharges along a spring line in Ash Meadows, south of the NTS (Waddell et al., 1984). Most of the western NTS is in the Alkali Flat-Furnace Creek Subbasin, with discharges occurring by evapotranspiration at Alkali Flat and by spring flow near Furnace Creek Ranch (Laczniak et al., 1996).

Groundwater beneath the far northwestern corner of the NTS may be in the Oasis Valley Subbasin, which discharges by evapotranspiration in Oasis Valley. Some underflow from the subbasin discharge areas probably travels to springs in Death Valley. Regional groundwater flow is from the upland recharge areas in the north and east toward discharge areas in Ash Meadows and Death Valley, southwest of the NTS. Because of large topographic changes across the area and the importance of fractures to groundwater flow, local flow directions may be radically different from the regional trend (Laczniak et al., 1996).

NTS AREAS OF POSSIBLE GROUNDWATER CONTAMINATION

In 1996, DOE/NV confirmed the location of 828 underground tests at the NTS that are included in areas of possible groundwater contamination as indicated on Figure 5.5. Approximately one third (259) of these tests were at or below the water table (DOE 1996b). The principal by-products from these tests were heavy metals and a wide variety of radionuclides with differing half-lives and decay products. Detonations within, or near, the regional water table have contaminated the local groundwater with

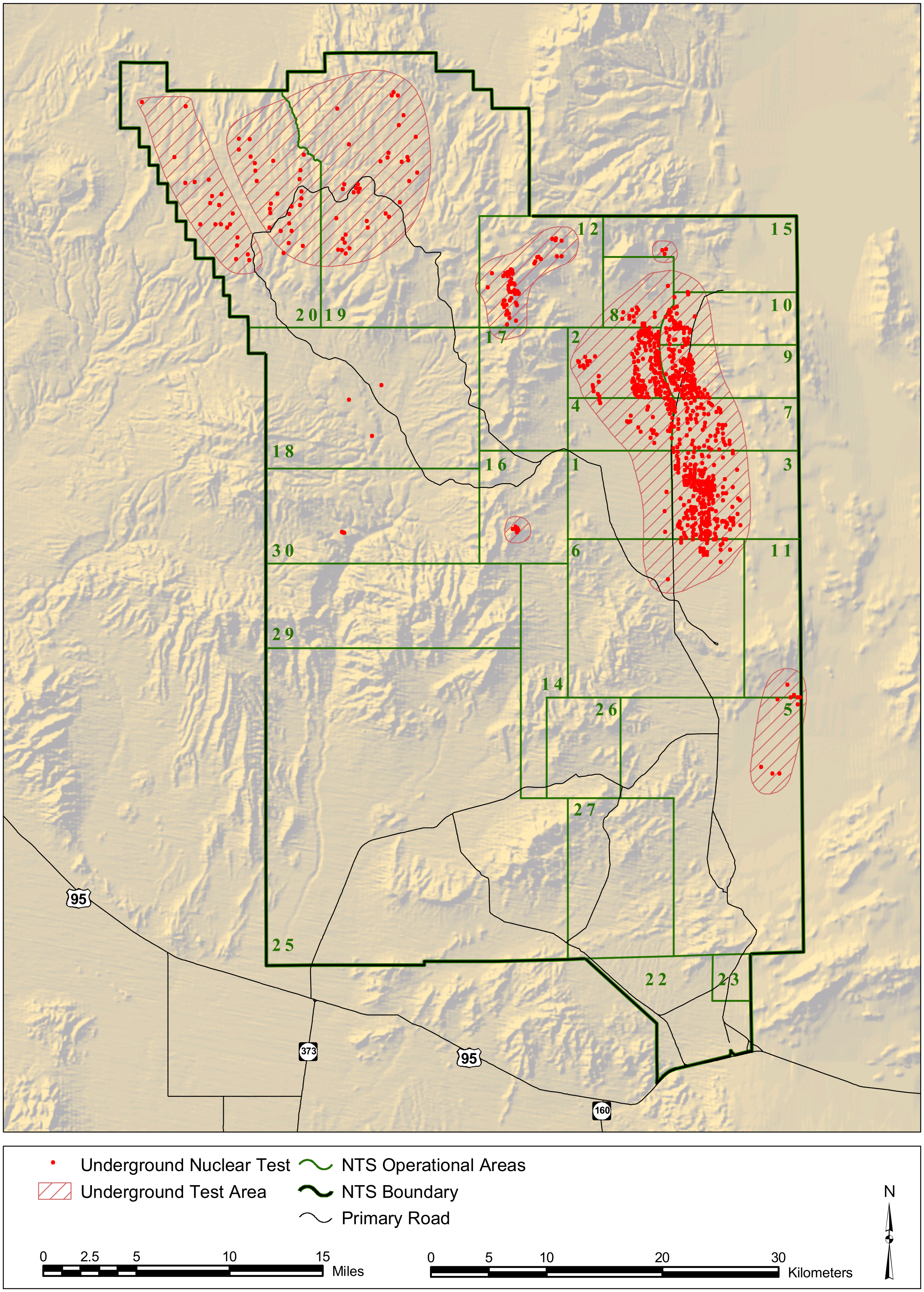

Figure 5.5 Areas of Potential Groundwater Contamination on the NTS

over 60 radionuclides, totaling 300 million curies, being in or near the water table with tritium being the most abundant (DOE 1996c).

Surface activities associated with underground testing and other NTS activities such as disposal of low-level radioactive waste (LLW) and mixed wastes, spill testing of hazardous liquefied gaseous fuels, and transport of radioactive materials, also pose potential soil and groundwater contamination risks. The types of possible contaminants found on the surface of the NTS include radionuclides, organic compounds, metals, and residues from plastics, epoxy, and drilling muds. A wide variety of surface facilities, such as former injection wells, leach fields, sumps, waste storage facilities, tunnel containment ponds and muck piles, and storage tanks, may have contaminated the soil and shallow unsaturated zones of the NTS. The known sites are categorized by type and listed in Appendices II, III, and IV of the Federal Facility Agreement and Consent Order (FFACO) (FFACO 1996), agreed to by the DOE, U.S. Department of Defense (DOD), and Nevada Division of Environmental Protection (NDEP). The great depths to groundwater and the arid climate mitigate the potential for mobilization of surface and shallow subsurface contamination. However, contaminants entering the carbonate bedrock from Rainier Mesa tunnel ponds, contaminated wastes injected into deep wells, underground tests near the water table, and wastes disposed of into subsidence craters have the potential to reach groundwater.

ACTIVITIES PROTECTIVE OF GROUNDWATER

DOE/NV has instituted a policy regarding protection of the environment. This policy states: “A principal objective of the DOE/NV policy is to assure the minimization of potential impacts on the environment, including groundwater, from underground testing.” An ongoing program to monitor and assess the effectiveness of groundwater protection efforts will be enhanced so that resources are allocated based on current understanding of the effectiveness of groundwater protection programs. Groundwater protection activities contained within DOE/NV programs are described below.

STORM WATER RUN-OFF

Storm water, at the NTS, primarily follows the natural terrain and after a large storm will temporarily collect on low spots, including dry lake beds (playas). With the great depth to groundwater at the NTS, this occasional pooling of storm-water runoff presents no hazard to groundwater.

Storm water surveys were conducted on the NTS in March 1999. The U.S. Army Corps of Engineers provided data and maps gathered in October 1998 that indicated areas which could potentially contribute storm water to waters of the United States.

DOE/NV and contractor personnel teamed to conduct a thorough regulatory and physical assessment of storm water conditions to determine the need for National Pollution Discharge Elimination System permitting related to “discharges associated with industrial activity.” Of primary concern were activities located in the Frenchman and Yucca Lake drainages.

In a letter to the NDEP, Bureau of Federal Facilities (May 1999), the DOE/NV noted that evidence gathered substantiates and supports the position that there are no industrial activities at the NTS that impact waters of the United States.

WASTE MINIMIZATION AND POLLUTION PREVENTION AWARENESS PROGRAM

The Waste Minimization and Pollution Prevention Awareness Program is designed to reduce waste generation and possible pollutant releases to the environment, thus increasing the protection of employees and the public. All DOE/NV contractors and NTS users who exceed the EPA criteria for small-quantity generators have established implementation plans in accordance with DOE/NV requirements. Contractor programs ensure that waste minimization activities are in accordance with federal, state, and local environmental laws and regulations and DOE Orders. A discussion of 1999 activities is given in Chapter 6.

There are three closed-loop recirculating steam cleaning units that are used to clean equipment prior to servicing. These units not only minimize the water that is needed to operate, but also prevent the wastewater from running onto the ground and potentially contaminating the soil. Potential contaminants (primarily hydrocarbon materials) are instead captured in a filter and properly disposed of or recycled.

WASTE TREATMENT, STORAGE, AND DISPOSAL

DOE/NV currently operates disposal facilities in Areas 3 and 5 at the NTS for LLW generated by DOE and the DOD facilities. All hazardous wastes generated at the NTS are stored at a Hazardous Waste Accumulation Site in Area 5 until shipped offsite to EPA-approved commercial disposal facilities.

Since both the RWMS-3 and RWMS-5 disposal sites contain mixed as well as LLW waste, they are subject to Hazardous Waste regulations dictated by the Resource Conservation and Recovery Act (RCRA). In accordance with Title 40 Code of Federal Regulations (CFR) 265 - Subpart F (CFR 1984), operators of interim status treatment, storage, and disposal facilities for hazardous waste are required to collect quarterly samples for one year from one upgradient and three downgradient wells for characterization of groundwater quality. However, the lack of a hydraulic gradient in the uppermost aquifer makes it difficult to define upgradient and downgradient directions around RWMS-5 (BN 2000a). There are three groundwater monitoring wells surrounding the RWMS-5. In a letter from NDEP to DOE/NV, dated February 24, 1994, NDEP stated that there was no need to install additional wells pending future data on the groundwater gradient, thereby effectively substituting the three pilot wells for the standard four RCRA wells. At the RWMS-3, there are no facility-specific groundwater monitoring wells, because NDEP has approved the request for a groundwater monitoring waiver. At RWMS-5, sampling protocols for characterization and detection data collection were based on the RCRA Groundwater Monitoring Technical Enforcement Guidance Document (EPA 1986). Groundwater elevation was measured prior to each sampling event. The first collections of these characterization data were performed in 1993. Subsequent semi-annual sampling was continued through 1999 (BN 2000a), and results were statistically compared with the initial characterization data. No chemical or radiological constituents attributable to the DOE's weapons testing or waste disposal activities have been detected. The uppermost aquifer meets current water quality standards for drinking water sources. The analyses performed are shown in Table 5.5. Groundwater monitoring results for 1999 can be found in "1999 Annual Data Report: Groundwater Monitoring Program Area 5 Radioactive Waste Management Site" (BN 2000a).

At the NTS there are three nonhazardous waste landfills that have state of Nevada Operating Permits. The permitting process considers groundwater protection at these locations. At the Area 23 Class II Municipal and Industrial Solid Waste Disposal Site, there is no groundwater monitoring well. However, Well SM-23-1 described below is considered (informally) by the state as a supplement to vadose zone monitoring (VZM) at the landfill.

VADOSE ZONE MONITORING

A VZM strategy is being implemented at the RWMSs in conjunction with groundwater monitoring at RWMS-5, in support of the RWMS-5 and RWMS-3 Performance Assessments (PAs), and as proof of concept. VZM offers many advantages over groundwater monitoring including:

- providing critical assessment of facility performance.

- detecting potential problems long before the groundwater resource would be impacted.

- allowing corrective actions to be made early.
- differentiating the source of contamination (UGTA versus RWMS).

- eliminating the need to retrofit monitoring on existing waste cells using nearby sites.

- considerably less expensive than groundwater monitoring.

The primary objective of RWMS VZM is to support the assumptions made in the PAs and to measure water movement through the vadose zone. In addition, DOE Orders 5820.2A (DOE 1988) and 435.1 (435.1 will replace 5820.2A) require that monitoring provide data to evaluate the performance of a waste management operation.

The RWMS VZM strategy is to directly measure the water balance for an entire facility. This is accomplished by use of, meteorological data to measure precipitation and to calculate potential evapotranspiration (ET); weighing lysimeters to measure actual ET; neutron logging through access tubes; and automated soil water sensors to measure actual soil water content and water potential changes with time and over a large spatial coverage. This strategy provides an accurate estimate of downward drainage through the facilities and therefore, potential recharge. Based on the initial results of this strategy, as well as other work (Tyler et al., 1996), there is essentially zero recharge to the groundwater under current conditions at the RWMS-3 and RWMS-5, and all precipitation is effectively returned to the atmosphere by plant transpiration and soil evaporation (BN 2000b).

Soil water content is monitored at Pits 1 through 5 at RWMS-5 and is monitored under the U-3ah/at, U-3ax/bl, and U-3bh disposal units at RWMS-3. At the RWMS-5, monitoring is conducted using neutron moisture meters in access tubes penetrating the operational cover (approximately 8 ft), the waste zone (20 - 30 ft), and the vadose zone below the pit floor. No wetting fronts were observed to pass through the operational covers at the RWMS-5 in 1999. At the RWMS-3, soil water content monitoring is conducted in cased boreholes angled under the U-3ah/at and U-3ax/bl disposal units, and in cased boreholes drilled directly into the floor of the U-3bh disposal unit. Soil water content below the RWMS-3 remained unchanged in 1999.

Installation of automated VZM systems was initiated in 1998 with water content sensors (Total Domain Reflectometry Probes) buried beneath the floors of Pit 3 and 5 at the RWMS-5. Sensors for measurement of water content were installed in the operational cover of Pit 3 in 1999 to provide data on waste cell cover performance.

WELLHEAD RECONSTRUCTION AND WELL REHABILITATION

There was no wellhead rehabilitation work in 1999. However, all of the wells associated with the state permitted drinking water distribution systems at the NTS have been inspected by the state and meet current wellhead protection regulations.

SEWAGE LAGOON COMPLIANCE

State Water Pollution Control Permit GNEV93001 requires that one of four methods of groundwater protection be established at active sewage lagoons on the NTS by January 31, 1999. The four acceptable groundwater protection methods identified in the permit include groundwater monitoring, VZM, engineered liner installation, and hydrogeological site characterization.

In February and June of 1999, the Area 23 monitoring well sampling results were all below the limits listed in Appendix III of the general permit (GNEV93001).

5.4 ENVIRONMENTAL RESTORATION PROGRAM (ERP)

The Nevada ERP was begun in the late 1980s to address contamination resulting primarily from nuclear weapons testing and related support operations. The goals of the project are to safeguard the public's health and safety and to protect the environment. This involves the assessment and cleanup of contaminated sites and facilities to meet standards required by federal and state environmental laws. Approximately 828 sites used for historic underground nuclear tests will be investigated, along with areas where more than 100 aboveground tests were conducted. Additionally, 1,500 other sites that were used for support operations will potentially require environmental remediation.

The DOE/NV is working closely with representatives of the state of Nevada to ensure compliance with applicable environmental regulations. The 1996 FFACO provides a mechanism for implementing corrective actions based on public health and environmental considerations in a cost-effective and cooperative manner. It also establishes a framework for identifying, prioritizing, investigating, remediating, and monitoring contaminated DOE sites in Nevada. The FFACO's corrective action requirements supersede some portions of the NTS RCRA Permit issued in May 1995. Investigations and remediations follow a strategy for investigation and remediation outlined in Appendix VI, Corrective Action Strategy, of the FFACO. The strategy is based on four steps: (1) identifying corrective action sites, (2) grouping the sites into corrective action units, (3) prioritizing the units for funding and work, and (4) implementing investigations or actions as applicable. The sites are broadly organized into underground test area sites, industrial sites, soil sites, and off sites. Information related to investigation and cleanup activities as it relates to groundwater protection follows.

UNDERGROUND TESTING AREA (UGTA) SITES

The goals of the UGTA project include evaluating the nature and extent of contamination in groundwater due to underground nuclear testing and establishing a long-term groundwater monitoring network. As part of the UGTA project, scientists are developing computer models to predict groundwater flow and contaminant migration within and near the NTS. To develop and test these models it is necessary to collect geologic, geophysical, and hydrologic data from new and existing wells to define groundwater migration pathways, migration rates, and quality.

In 1999, the UGTA Project initiated a hydrogeologic investigation well drilling program in the Western Pahute Mesa - Oasis Valley (WPM-OV) area of Nye County, Nevada (International Technology [IT] 1998). The goal of the WPM-OV program is to collect subsurface geologic and hydrologic data in a large, poorly characterized area down-gradient from Pahute Mesa, where underground nuclear tests were conducted, and up-gradient from groundwater discharge and withdrawal sites in Oasis Valley northeast of Beatty, Nevada (Figure 5.6). Data from these wells will allow for more accurate modeling of groundwater flow and radionuclide migration in the region. Some of the wells may also function as long-term monitoring wells.

Seven new wells were drilled under this program during 1999 (one onsite and six offsite, located just west of the NTS). Preliminary (predevelopement) groundwater characterization samples were collected from each of these wells. No man-made radionuclides were detected in these wells.

POST-SHOT WELLS ("HOT WELLS")

Accomplishments of the UGTA project in 1999 also include the sampling of three post-shot/cavity wells: U-4u PS#2A, U-19v PSlds, and U-20n PS#1ddh. These

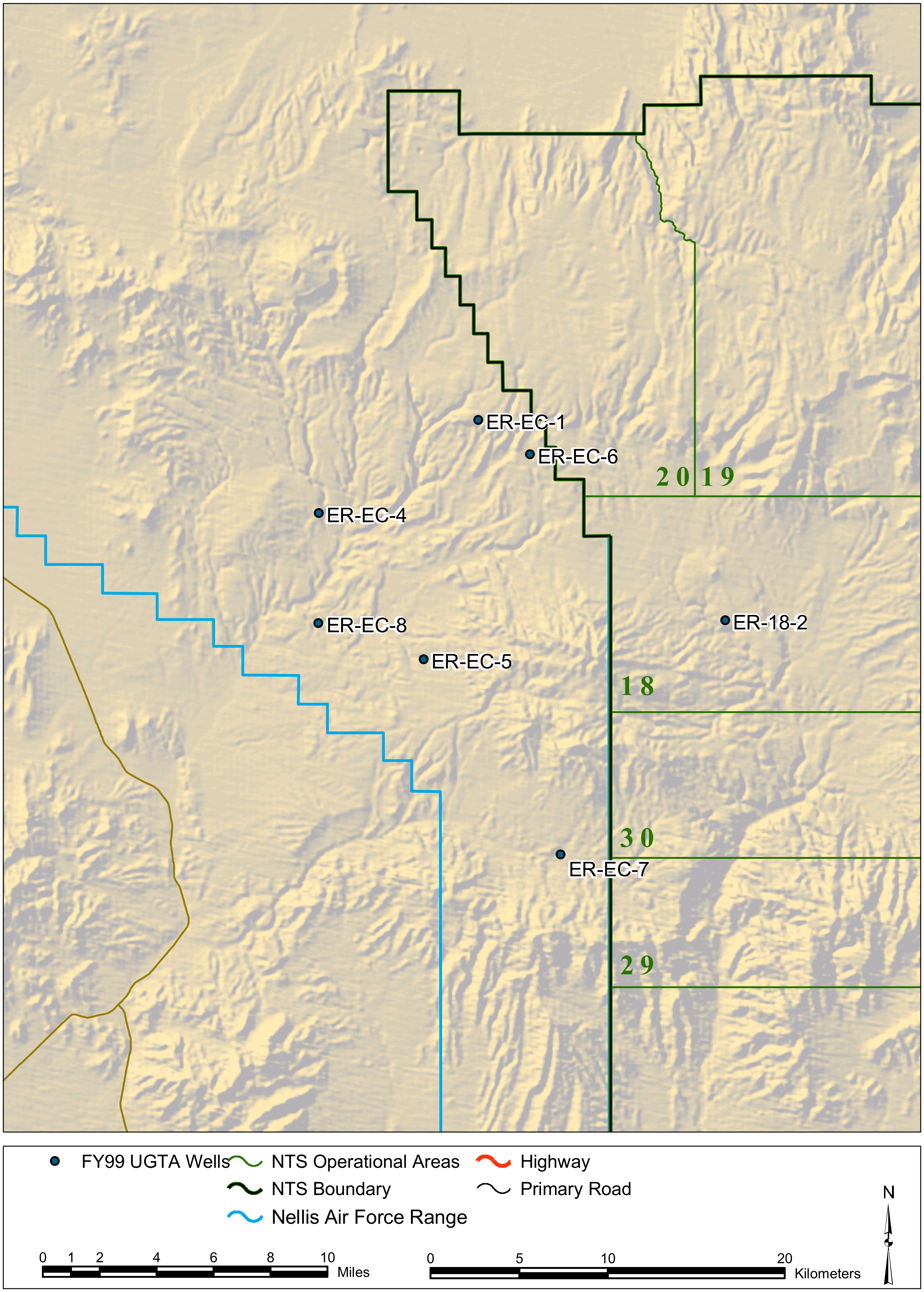

Figure 5.6 Locations of UGTA Wells - 1999

wells access cavities from the underground nuclear tests DALHART, ALMENDRO, and CHESHIRE, respectively. In general, preliminary results show expected levels of contamination for post-shot wells. Final laboratory analytical results for U-19v PSlds and U-4u PS#2A are pending (at time of publication), so only U-20n PS#1ddh is discussed below.

A multi-agency team consisting of personnel from the USGS, Los Alamos National Laboratory (LANL), and Lawrence Livermore National Laboratory (LLNL) collected fluid samples at U-20n PS#1ddh using a downhole sampling pump. The well accesses the test cavity via perforated 5.5 inch casing. During sample collection, field parameters, including temperature, pH, and conductivity were measured. Samples were then analyzed for ^{3}H, ^{14}C, gross alpha and gross beta (see Table 5.7).

U-20n PS#1ddh was drilled to support studies of radionuclide migration from the cavity/chimney region of the CHESHIRE underground test that was conducted on Pahute Mesa in February of 1976. Radionuclide migration studies at this site have been intermittent since 1976. Samples collected from the lower zone of U-20n PS#1ddh present a unique opportunity to analyze cavity fluids.

The results of this sampling effort at U-20n PS#1ddh will support the DOE's continuing efforts to create a long-term monitoring program for wells in or near underground nuclear test cavities. The program objectives are to characterize the hydrologic source term and evaluate the decay and potential migration of radionuclides through monitoring at or near the source.

MISCELLANEOUS STUDIES

Radionuclides in water samples were variously analyzed by IT, LLNL, Desert Research Institute (DRI), and LANL. Additional information and analytical results for 1999 studies will be reported by the respective organizations during 2000.

LLNL continues to investigate the occurrence, distribution, and potential mobility of radionuclides in the sub-surface through investigation of archival post-shot debris. Static leaching experiments of glass and crystalline samples were continued to elucidate controls on the solubility of radionuclides.

These and other related studies conducted by LLNL in 1999 in support of DOE's Hydrologic Resources Management Program and UGTA are reported in Smith et al., 2000.

INDUSTRIAL SITES AND DECONTAMINATION AND DECOMMISSIONING

ABANDONED UNDERGROUND STORAGE TANKS

The NTS underground storage tank (UST) program continues to meet regulatory compliance schedules. Details of this program are discussed in Chapter 3.

5.5 WATER SURVEILLANCE PROGRAM RESULTS

The analytical results obtained for water samples collected onsite and from the adjacent offsite area are described in this Section. Only a few samples from wells proximal to underground nuclear tests contained detectable concentrations of radionuclides. No detectable man-made radionuclides were detected offsite. Table 5.6 lists the routine sampling locations where well water samples contained activity levels greater than 0.2 percent of the National Primary Drinking Water Standards.

ONSITE WATER MONITORING RESULTS

RADIOACTIVITY IN SURFACE WATER

Surface water sampling at the NTS was conducted at three containment ponds (Well ER-18-2, post shot well U-20n PS#1ddh, and the E Tunnel ponds), one tunnel effluent (E Tunnel), and nine sewage lagoons. The locations of these sources are shown in Figure 5.2. When water was available and the weather permitted, a grab sample was taken and analyzed in accordance with Tables 5.2 (general summary) and 5.3 (RREMP).

The annual average for each radionuclide analyzed in surface waters is presented in Table 5.7, along with the results from analysis of tunnel effluents. The results from gamma spectrometry were non-detectable for all sample locations, except for samples from the E Tunnel effluent and related containment pond.

With the exception of the E Tunnel and U-20n PS#1ddh containment ponds, no annual average concentration in surface waters was found to be statistically different from any others at the 5 percent significance level.

RESERVOIRS AND SPRINGS

These surface waters (water well reservoirs and natural springs) were eliminated from the environmental monitoring program in accordance with the RREMP that was developed in 1998.

CONTAINMENT PONDS

Due to the sealing of the tunnels at the close of 1993, liquid effluents ceased at all tunnels except E Tunnel. The E Tunnel containment ponds were fenced and posted with radiological warning signs. During each sampling, a grab sample was taken from the E Tunnel containment pond and at the effluent discharge point. The samples were analyzed for ^{3}H, ^{90}Sr, ^{238}Pu, $^{239+240}Pu$, gross alpha, gross beta, and gamma activity in accordance with the schedule in Tables 5.2 and 5.3 (RREMP). The annual averages of these analyses from the two sampling locations are listed in Table 5.7.

The effluent from characterization Well ER-18-2 and purge water from source-term Well U-20n PS#1ddh in Areas 18 and 20 respectively, was discharged into lined containment ponds. No radioactivity related to man-made radionuclides was detected at Well ER-18-2 (BN 2000c; IT 1999). The total liquid discharged at U-20n PS#1ddh was measured (approximately 37,850 liters [10,000 gallons]). By multiplying that volume by the average concentration of ^{3}H in collected samples (see Table 5.7), the total amount of ^{3}H discharged may be calculated.

SEWAGE LAGOONS

Samples were collected quarterly during 1999 from the nine sewage lagoons on the network. Each of the lagoons is part of a closed system used for evaporative treatment of sanitary waste. The lagoons are located in Areas 5, 6, 12, 22, 23, and 25. The annual gross beta concentration averages for all lagoons ranged from 20.0 to 43.5 x 10^{-9} µCi/mL (0.74 to 1.6 Bq/L). No radioactivity was detected above the Minimum Detectable Concentrations (MDCs) for ^{3}H, ^{90}Sr, ^{238}Pu, or $^{239+240}Pu$ (Table 5.7). No test-related radioactivity was detected by gamma spectrometric analyses, except for ^{137}Cs, which was found at a concentration of 1.2 x 10^{-9} µCi/mL in one sample collected at the DAF Sewage Lagoon on April 22, 2000. A second sample collected on April 29, 2000, and analyzed by gamma spectrometry, was found to contain no test-related radioactivity.

RADIOACTIVITY IN SUPPLY WELLS AND DRINKING WATER

The principal water distribution system on the NTS is potentially the critical pathway for ingestion of waterborne radionuclides. Consequently, the water distribution system is sampled and evaluated frequently. The NTS water system consists of 13 supply wells, 10 of which supply potable water to onsite distribution systems. The drinking water is pumped from the wells to the points of consumption. The supply wells were sampled on a quarterly basis. Drinking water is sampled at taps on the end-points of the distribution systems to provide a constant check of the radioactivity and to allow end-use activity comparisons to the radioactivity of the water in the supply wells. In this section, analytical results are presented from samples taken at the 12 supply wells (Well C was inactive during 1999).

Each well was sampled and analyzed as noted in the schedule in Tables 5.2 and 5.3. As a cross check on the comparability of analyses by BN and EPA's R&IE-LV on water well samples, several wells were sampled by both organizations. The results of these analyses, listed in Table 5.8, showed reasonably good agreement.

The locations of the supply wells are shown in Figure 5.1. Water from these wells (10 potable and 2 nonpotable) was used for a variety of purposes during 1999. Samples were collected from those wells which could potentially provide water for human consumption. These data were used to help document the radiological characteristics of the NTS groundwater system. The sample results are maintained in a database so that long-term trends and changes can be studied.

Table 5.9 lists the drinking water sources with corresponding system endpoints, and Table 5.10 lists the potable and nonpotable supply wells and their respective radioactivity averages. No test-related radionuclides were detected by gamma spectrometry. Included in Table 5.10 are the median MDCs for each of the measurements for comparison to the concentration averages for each location. For various operational reasons, samples could not be collected from all locations every sampling period.

As a check on any effect the water distribution system might have on water quality, samples were taken from seven water distribution system end-points (tap water samples). To ensure that all of the water available for consumption was being considered, each drinking water system was identified. The drinking water network at the NTS consists of four drinking water systems. The components of the four systems are shown in Table 5.9. These systems, fed by ten potable supply wells (in 1999), are the source of the water for the seven end-points. Table 5.11 lists the annual concentration averages for all of the analyses performed on tap water samples. No test-related radionuclides were detected.

GROSS BETA

As shown in Table 5.10, the gross beta concentration averages for all of the supply wells were above the median MDC of the measurement. The highest average gross beta activity occurred at Well C-1 and was 1.3×10^{-8} µCi/mL (0.48 Bq/L), which was 4.4 percent of the DCG for ^{40}K and 33 percent of the DCG for ^{90}Sr based upon 4 mrem effective dose equivalent (EDE) per year. In earlier reports (Scoggins 1983; 1984), it was noted that the majority of gross beta activity was attributable to naturally occurring ^{40}K. All concentration averages were comparable to those reported in 1998.

As in previous years, the gross beta concentration averages for all tap water samples were above the median MDC of the measurements. The highest annual average of 10.3×10^{-9} µCi/mL (0.38 Bq/L) occurred in the Area 23 Cafeteria, similar to the supply well water. The annual EDE is also equivalent to that from the supply well water.

TRITIUM

As shown in Table 5.10, the average tritium concentrations at all supply wells was below the average MDC of the measurement (note that the MDC was 14.7×10^{-9} µCi/mL, based on tritium enrichment analysis).

The annual average tritium concentrations in tap water samples, as shown in Table 5.10, were all less than the median MDC of 14.7×10^{-9} µCi/mL. The tritium concentrations for all end-point water samples, which were also determined by a tritium enrichment method, are expected to be lower than the MDC, since the levels of tritium in the potable supply wells were below the median tritium enrichment MDC of 14.7 x 10^{-9} µCi/mL (0.54 Bq/L). These MDC values are 0.019 percent of the drinking water DCG adjusted to a 4 mrem (0.04 mSv) EDE.

PLUTONIUM

All supply well water samples analyzed for ^{238}Pu and $^{239+240}$Pu had concentrations below the MDCs of about 2.7 x 10^{-12} µCi/mL, which are about 2.0 percent of their respective DCGs adjusted to a 4 mrem EDE per year. Table 5.10 lists the concentration averages of these nuclides for each location.

The annual averages of $^{239+240}$Pu and ^{238}Pu for each tap water sample were below the median MDC of the measurements, which were both less than 2 percent of the 4 mrem DCG. These isotopes are not normally detected in drinking water.

GROSS ALPHA

In accordance with the National Primary Drinking Water Regulations (CFR 1976), gross alpha measurements were made on quarterly samples from the drinking water systems, namely the potable supply wells.

As shown in Table 5.10, the average gross alpha concentration for all of the supply wells, except Wells 8, J-12, and J-13 was above the median MDC of 1.8 x 10^{-9} µCi/mL. The highest concentration occurred in samples from C-1 in Area 6 and was 10.5 x 10^{-9} µCi/mL (0.39 Bq/L). This is acceptable according to the EPA drinking water standard (CFR 1976) as long as the combined concentration of ^{226}Ra and ^{228}Ra is less than 5 x 10^{-9} µCi/mL (0.19 Bq/L). The combined radium concentration, for these wells, was less than the combined MDC of 4.64 x 10^{-9} µCi/mL (0.17 Bq/L), as shown in Table 5.12.

As added assurance that no radioactivity gets into the systems between the supply wells and end-point users, measurements of gross alpha are also made quarterly on tap water samples. As shown in Table 5.11, the annual concentration averages for gross alpha radioactivity in tap water samples, collected at four locations, exceeded the screening level of 5 pCi/L (0.19 Bq/L), at which ^{226}Ra analysis is required.

RADIUM

Samples from the supply wells were collected and analyzed for both ^{226}Ra and ^{228}Ra. As shown by the radium results in Table 5.12, the sum of the average concentrations for ^{226}Ra and ^{228}Ra were all less than 5 pCi/L, which showed the onsite systems were in compliance with drinking water regulations.

STRONTIUM

Beginning in 1997, ^{90}Sr sampling frequency was reduced from quarterly to annually for supply water samples. Strontium-90 analyses were conducted on an annual bases for the seven selected tap-water endpoints. As indicated by Table 5.11, the ^{90}Sr results for samples collected from all the selected tap water samples had concentrations that were less than the median MDC of the measurements.

MONITORING ON AND AROUND THE NEVADA TEST SITE

NEVADA TEST SITE MONITORING

The present R&IE-LV sampling locations on the NTS, or immediately outside its borders on federally owned land are shown in Figure 5.3. All sampling locations are selected by DOE and many locations are now included in the RREMP. Since 1995, R&IE-LV has sampled only wells without pumps and, for quality assurance purposes, collected samples from some of the potable water supply wells sampled by BN. In 1999, 21 wells were included in the LTHMP and 27 wells were included in the RREMP (exclusive of the water supply wells).

All samples were analyzed by gamma spectrometry and for tritium. No gamma-emitting radionuclides were detected in any of the NTS samples collected in 1999.

Summary results of tritium analyses are given in Tables 5.13 (RREMP) and 5.14 (LTHMP). The highest average tritium activity was 2.12 x 10^5 pCi/L (7.8 kBq/L) at source-term Well RNM #2S (Table 5.13). This activity is above the DCG for tritium as established in DOE Order 5400.5 for comparison with the dose limit (4 mrem) in the National Primary Drinking Water Regulations. Seven of the wells yielded tritium results greater than the MDC. The trend in tritium concentration in samples from Test Well B is shown in Figure 5.7 and is typical of a well with decreasing tritium concentrations. The source of the tritium is unknown.

Well UE-7nS was drilled 137 m from the BOURBON underground nuclear test (U-7n) conducted in 1967. This well was routinely sampled between 1978 and 1987 and again since 1992. In 1999, approximately 241 pCi/L were detected in water samples from Well UE-7nS. This too represents a decreasing trend in recent years in tritium concentrations. However, this monitoring point marks the second known site on the NTS where the regionally important carbonate aquifer has been affected by radionuclides (Smith et al., 1999).

OFFSITE MONITORING IN THE VICINITY OF THE NEVADA TEST SITE

Water sampling around the NTS is conducted by the EPA's R&IE-LV, under an interagency agreement with DOE, to ensure the radiological safety of public drinking water supplies and representative water sources of rural residents and, where suitable, to monitor any migration of radionuclides from the NTS. The LTHMP sampling locations are shown on Figure 5.4 and the analytical results are in Table 5.16. No man-made gamma-emitting radionuclides were detected in any sample.

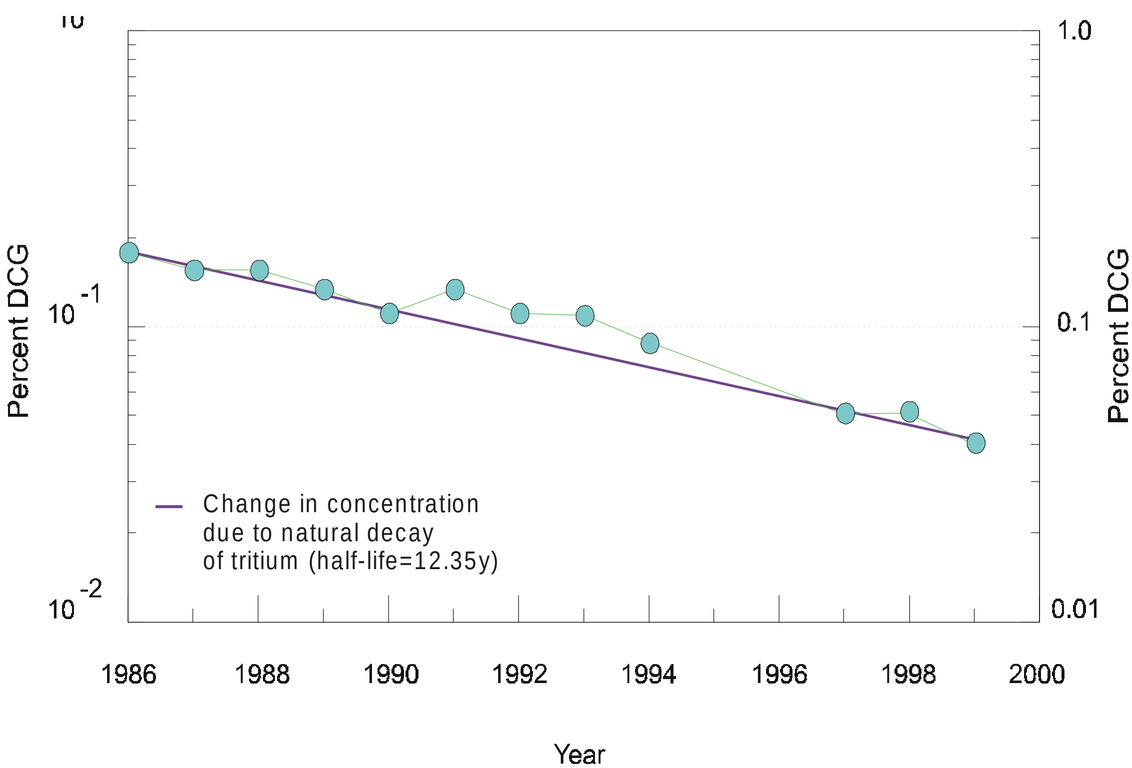

Figure 5.7 Trend in Tritium Concentration, Test Well B on the NTS

In 1999, a suite of offsite wells was also sampled by the RREMP. The RREMP sampling locations are shown on Figure 5.8 and the analytical results are presented in Table 5.15. No man-made gamma-emitting radionuclides were detected in any sample.

GROUNDWATER MONITORING

GROUNDWATER QUANTITY

Water levels are monitored annually by the USGS on and around the NTS at approximately 155 measurement locations, including 63 onsite and 92 offsite locations. Results are used in regional and local groundwater models, but are not routinely analyzed for water level trends. However, no significant water level impacts associated with groundwater usage were detected in 1999.

Water usage on the NTS is monitored by both the USGS and BN. Water use at the NTS continues to decline due to the moratorium on nuclear testing instituted in 1992 and was about 8.32 x 10^5 m^3 (219.8 x 10^6 gal) in 1999. Data for the 1999 water year for water levels and usage will be reported in the USGS "Water Resources Data Report -1999," (Jones, *et al.,* 1999) and is also available on the USGS website: www.nevada.usgs.gov.

GROUNDWATER QUALITY

Regional-scale groundwater investigations concentrated on determining recharge locations and flow paths for the groundwater flow systems in southern Nevada. This included several studies and field sampling activities.

Groundwater quality was determined by monitoring wells and springs, both onsite and offsite, for radioactive constituents as discussed above. The remainder of this chapter summarizes analyses of water for chemical constituents, radioisotopes, and stable isotopes in order to comply with environmental permits, better characterize NTS groundwater quality, and support regional groundwater flow and transport models.

5.6 NONRADIOLOGICAL MONITORING

The 1999 nonradiological monitoring program for the NTS included onsite sampling of various environmental media and substances for compliance with federal and state regulations or permits and for ecological studies.

MONITORING WATER SOURCES

Nonradiological monitoring of non-NTS DOE/NV facilities was conducted at three offsite facilities. This monitoring was limited to wastewater discharges to publicly owned treatment works. Routine nonradiological environmental monitoring on the NTS in 1999 was limited to:

- Sampling of drinking water distribution systems and water haulage trucks for SDWA and state of Nevada compliance.
- Sewage lagoon influent and E Tunnel discharge sampling for compliance with state of Nevada operating permit requirements.

CLEAN WATER ACT RESULTS

NTS OPERATIONS

The NTS General Permit requires quarterly reporting for biochemical oxygen demand (BOD) and specific conductance, organic loading rates, and reporting of second quarter influent toxics sampling. The results of this sampling are shown in Tables 5.17, 5.18, and 5.19, respectively. All values in these tables are in compliance with the permit requirements.

The permit also requires monitoring of the infiltration basins, which attain a depth of 30 cm or more in January and June for parameters listed in Appendix II of the

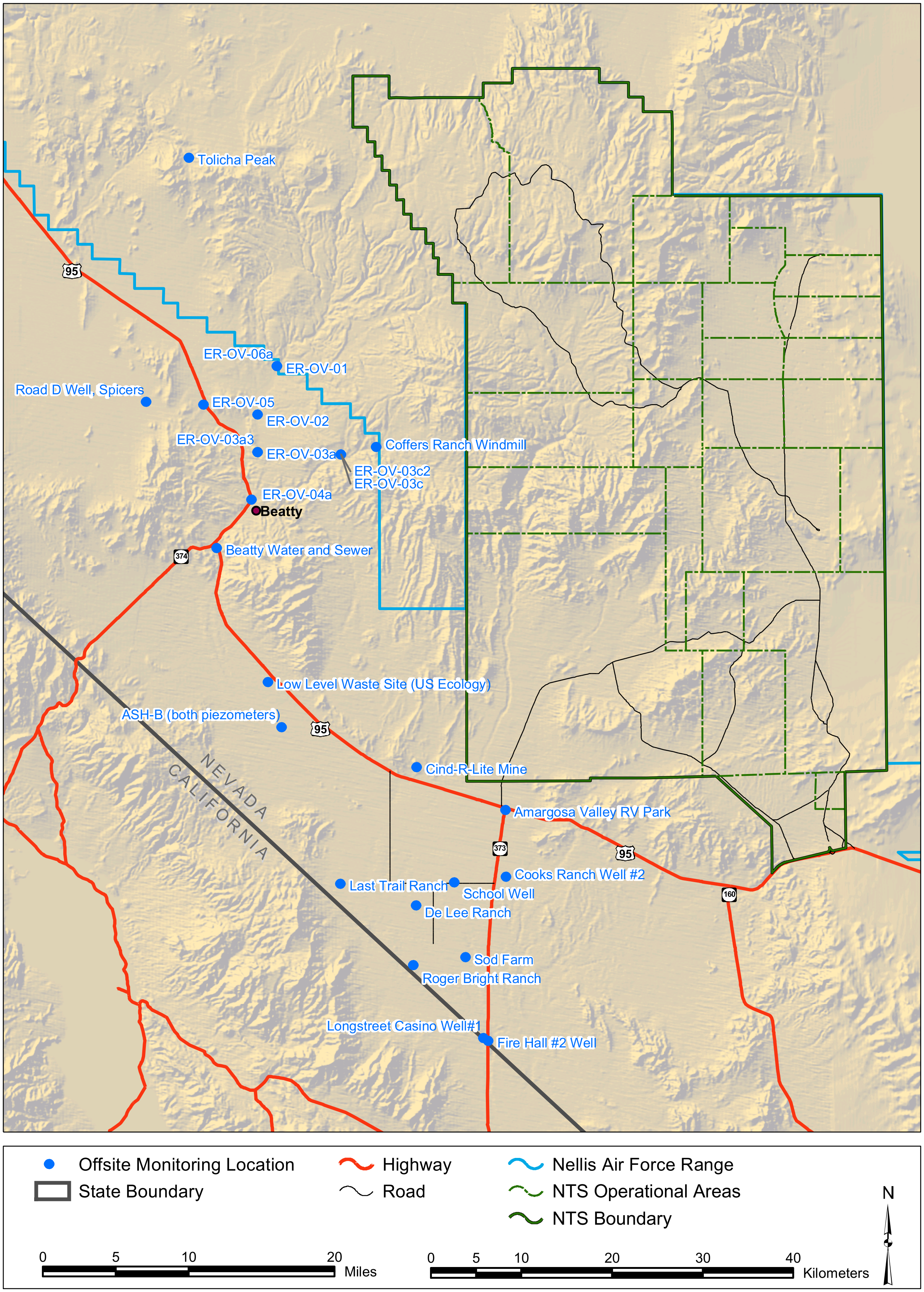

Figure 5.8 NTS Offsite Groundwater Radiological Monitoring Site in the RREMP - 1999

permit. Sampling is required as soon as any other system exceeds the 30 cm. Three secondary ponds at the Area 23 facility usually contain the required depth, but are excluded as needing the sampling in Part III.C.4 of the permit. During 1999, the Area 25 Central Support (Base Camp) was the only system which exceeded the 30 cm limit. Sampling results are given in Table 5.20. All values in this table are in compliance with the permit requirements.

NON-NTS OPERATIONS (NLVF and RSL)

The NLVF is required by permit to sample and analyze wastewater effluent and submit self-monitoring reports. The NLVF self-monitoring report consists of monitoring results for two outfalls and the burn pit batch discharge. All sampling results for 1999 were within permit limits. The RSL facility now discharges into the Nellis Air Force Base system and no longer requires a separate permit. Nellis Air Force Base does, however, require self-monitoring to be conducted in April and November. Reports of analytical results were submitted in 1999.

SAFE DRINKING WATER ACT RESULTS

Water sampling was conducted for analysis of bacteria, volatile organic compounds (VOCs), inorganic constituents, and water quality as required by the SDWA and state of Nevada regulations. Samples were collected from supply wells and from various locations throughout all drinking water distribution systems on the NTS. All samples were collected according to accepted practices, and the analyses were performed by state approved laboratories. Analyses were performed in accordance with Nevada Administrative Code (NAC) 445A (NAC 1996) and Title 40 CFR 141.

BACTERIOLOGICAL SAMPLING

Samples were submitted to the state-approved NEL Laboratories in Las Vegas, Nevada, for coliform analyses. All water distribution systems were tested quarterly at a minimum, with the number of people being served determining the number of samples collected and the frequency. If coliform bacteria are present, confirmation samples are collected, and the source of contamination is determined by the water system operator. Portions of the system may need to be shut down and disinfected. In order to reopen the system, the confirmation samples must meet state requirements. There were no incidents of positive coliform results during 1999.

Residual chlorine levels were determined at the collection point by using colorimetric methods approved by the state.

The results were recorded in BN's drinking water sample logbook, and the chlorine residual level was recorded on an analysis form.

Samples from trucks, which hauled potable water from NTS wells to work areas, were also analyzed for coliform bacteria. There were no positive coliform sample results in 1999.

CHEMICAL ANALYSIS

Chemical analyses in 1999 were performed for metals and inorganics.

ORGANIC COMPOUND ANALYSIS

In accordance with the monitoring waivers issued in 1996, the DOE/NV did not collect VOC samples in 1999. The DOE/NV did request renewals for all current waivers.

METAL ANALYSIS

In compliance with a state agreement, samples were collected in the third quarter and analyzed for lead and copper. These samples were taken from faucets from all four potable water distribution systems. All results were below the method detection limits of 0.5 mg/L for copper. Lead results in Area 1 and Area 2-12 systems exceeded the

0.015 mg/L action level for lead. The source of lead in Area 1 is suspected to be an underground copper pipe. Rather than excavate the line in this sparsely used system, the DOE/NV chose to eliminate potable water taps to prevent potable uses of this water. No further lead sampling will take place unless buildings are reoccupied. Only one building in Area 12, the Miners' Change House (Building 12-43), is used regularly, and all lead and copper samples for this water system were collected in this building. Water in this building exceeded the lead action level. Lead solder is the suspected culprit. DOE/NV is in the process of determining a remedy for this situation, but in the interim, the water is only being used for non-consumption purposes. Water for drinking is supplied from a lead-free source.

INORGANIC COMPOUND ANALYSIS AND WATER QUALITY

To comply with a 1991 variance to the Area 25 water system permit, fluoride samples need to be taken annually before July 31 to confirm that the fluoride concentration is less than four parts per million. Samples taken from Area 25 wells J-12 and J-13 in the second quarter of 1999 confirmed that the fluoride concentration was acceptable.

During the first quarter of 1999, samples were collected and analyzed for nitrates, nitrites, and secondary standards. The results of these analyses are shown in Table 5.21. All results were within acceptable limits.

5.7 WATER QUALITY PERMITS

Water quality permits were required by the state for onsite drinking water systems. Other types of water permits were required for onsite and offsite sewage-related activities.

ONSITE WATER PERMITS

DRINKING WATER SYSTEM PERMITS

Four NTS drinking water system permits issued by the state of Nevada, as shown in Table 5.22 were renewed with new expiration dates. During 1994, the state of Nevada determined that the trucks used for hauling potable water should also have permits, so three additional permits were obtained. These permits were also renewed. No drinking water systems were maintained by non-NTS facilities.

SEWAGE DISCHARGE PERMITS

Sewage discharge permits from the state of Nevada, Division of Environmental Protection are listed in Table 5.23 and require submission of quarterly discharge monitoring reports.

NTS SEWAGE HAULING PERMITS

Permits issued by the state of Nevada, Division of Health for four sewage hauling trucks for the NTS were renewed in November 1999 and are listed in Table 5.24.

NON-NTS SEWAGE PERMITS

One sewage permit was required at the NLVF and two at the Special Technologies Laboratory (STL) as shown in Table 5.23. Each was issued by the county or local municipality in which the facility was located as follows:

- NLVF - The NLVF self-monitoring report was submitted in October 1999. Two outfalls and the burn pit batch discharge are monitored.
- STL - The STL holds wastewater permits for the Botello Road and Ekwill Street locations. There is no required self-monitoring.

Table 5.1 Summary of Analytical Procedures for Water Samples - 1999

Type of Analysis	Analytical Equipment	Count Time-min	Analytical Procedure	Sample Size-mL	Approximate MDC
		RREMP	(BN) Procedures		
Gross α	Gas-flow Proportional Counter	100	Boil down. Place on planchet and heat to dryness	800	2 pCi/L
Gross β	Gas-flow Proportional Counter	100	Boil down. Place on planchet and heat to dryness	800	2 pCi/L
Gamma	HpGe detector calibrated at 1 keV/channel	100	Online computer analysis	500	10 pCi/L for ^{137}Cs
Tritium Convent.	Liquid scintil-lation counter	70	Distillation of 100 mL	2.5	300-700 pCi/L
Tritium Enrichment	Liquid scintil-lation counter	300	Electrolysis of 250 mL basic solution	5	20 pCi/L
Plutonium	Alpha Spectrometer	1000	Tracer, ion exchange, collect precipitate on filter	900	0.02 pCi/L
Radium	Gamma Spectrometer	1000	Tracer, precipitate as sulfate, collect on filter	900	1 pCi/L for ^{228}Ra 3 pCi/L for ^{226}Ra
Strontium	Gas-flow Proportional Counter	100	precipitate as carbonate, count yttrium in-growth	900	0.3 pCi/L
		LTHMP	(R&IE-LV) Procedures		
Gamma	HpGe detector calibrate at 0.5 keV/channel	100	Online computer analysis	3500	Varies with nuclide/detector ^{137}Cs: 7 pCi/L
Tritium Convent.	Liquid scintil-lation counter	300	Distillation of sample	5-10	300-700 pCi/L
Tritium Enrichment	Liquid scintil-lation counter	300	250 mL concentrate by electrolysis, distill	5	5 pCi/L

Table 5.2 Summary of the Onsite Water Surveillance Program - 1999

Sample Type	Description	Collection Frequency	Number of Sampling Locations[a]	Type of Analysis
Tap	Grab sample	Quarterly	7	Gamma spectroscopy, Water gross α & ß, ^{3}H, $^{238,239+240}Pu$, ^{90}Sr annually).
Potable Supply Wells	Grab sample	Quarterly	10	Gamma spectroscopy, gross α & ß, $^{226\ \&\ 228}Ra$, $^{238,239+240}Pu$, ^{3}H enrich, ^{90}Sr.
Nonpotable Supply Wells	Grab sample	Quarterly	2	Gamma spectroscopy, gross α & ß, ^{3}H, (^{90}Sr annually) $^{238,239+240}Pu$.
Containment Ponds	Grab sample	Quarterly	3	Gamma spectroscopy, gross ß, ^{3}H, $^{238,239+240}Pu$ (^{90}Sr annually).
Sewage Lagoons	Grab sample	Quarterly	10	Gamma spectroscopy, gross α, ^{3}H, $^{238,239+240}Pu$ (^{90}Sr annually).
Monitoring Wells	Grab sample	Variable	27	^{3}H[b]

(a) All locations were not sampled for various reasons.
(b) Refer to Table 5.3 for schedules of other analyses.

Table 5.3 Sampling and Analysis Schedule for RREMP Groundwater and Surface Water Monitoring

	Sample Location Type	Analysis	Sample Frequency	Regulatory Driver
Onsite Locations	Potable water supply well within CAU	Ie & II	Quarterly	40 CFR 61 and DOE Order 5400
		III & IV	Annually	“
	Other potable water supply well	I & II	Quarterly	DOE Order 5400 Series
		III & IV	Annually	“
	CAU non-potable water supply well	Ie	Quarterly	DOE Order 5400 Series
		II, III, & IV	Annually	“
	Other non-potable water supply well	I	Semiannually	DOE Order 5400 Series
		II, III, & IV	Biennially	“
	Monitoring Well (Non-water supply)	I	Annually	DOE Order 5400 Series
		II, III, & IV	Biennially	“
	Source Characterization Well[(a)]	I, II, III, & IV	Biennially[(b)]	DOE Order 5400 Series
	New Wells	Ie, II, III, & IV	Quarterly[(c)]	DOE Order 5400 Series
Offsite Locations[(d)]	Group A locations (Oasis Valley and vicinity)	Ie, IIg	Quarterly	40 CFR 61 and DOE Order 5400
		II, III+	Annually	“
	Group B locations (more distant)	I, IIg	Semiannually	DOE Order 5400 Series
	Group C locations (most distant)	I, IIg	Annually	DOE Order 5400 Series
	New locations	Ie, II, III+, IV	First sample	40 CFR 61 and DOE Order 5400

(a) Source Characterization Wells are currently known as the Hot Well Network. Additional sampling parameters may be specified for each hot well.
(b) Biennial frequency can be modified for well-specific sampling program.
(c) After four quarterly samples are acquired, sampling parameters and frequency will be based on the well type.
(d) Offsite locations include both drilled wells and natural springs.

Note: All parameters and frequencies of analysis are subject to revision after data are acquired and reviewed, if justified.
Corrective Action Units (CAUs) are as defined by Underground Testing Area (UGTA) Project (IT, 1996).

Type I Analysis include Standard Tritium; at select wells enriched tritium analysis (Type Ie) will be performed.
Type II Analysis include Gross Alpha and Gross Beta. For drinking water wells, also includes Ra-226 & 228 analyses. Type IIg analysis includes only Gamma emitters.
Type III Analysis include Gamma emitters, Plutonium. Type III+ analysis includes Type III plus Sr-90.
Type IV Analysis include pH, Specific Conductivity, Temperature, Principal Cations/Anions, Total Dissolved Solids, Alkalinity, and Bicarbonate.

Table 5.4 RREMP Sampling and Analysis Schedule for NTS Drinking Water System Consumption Endpoints

Endpoint	System	Supply Wells	Sampling Frequency	Analysis[a]
Area 6, Cafeteria (at CP)	No. 1	Wells C-1, 4, 4A, 5B and Army No. 1	Quarterly	Ie, II, III
Area 6, Building 6-900	"	"	Quarterly	Ie, II, III
Area 2, Restroom[b]	No. 2	Well 8	Quarterly	Ie, II, III
Area 12, Building 12-23[c]	"	"	Annually	Ie, II, III
Area 1, Building 101	No. 3	Well UE-16d	Annually	Ie, II, III
Area 23, Mercury Cafeteria	No. 4	Wells 5b and Army No. 1	Quarterly	Ie, II, III
Area 25, Building 4221	No. 4	Wells J-12 and J-13	Annually	Ie, II, III

(a) Analysis:
Type Ie: Includes tritium (enriched method).
Type II: Includes gross alpha and gross beta.
Type III: Includes gamma spectroscopy, ^{238}Pu, $^{239+240}$Pu, and ^{90}Sr (annually).

(b) Dormant sampling point while building is unused.

(c) Building unused; sampling location changed to Ice House.

Table 5.5 Groundwater Monitoring Parameters at the RWMS-5

Parameters Establishing Water Quality

Ca, Cl, F, Fe, K, SiO_2, Na, Mg, Mn, HCO_3, H_2CO_3, $SO_4^=$, and $CO_3^=$,

Indicators of Contamination

pH
Specfic Conductance
Total Organic Halogen
Total Organic Carbon
Tritium

Additional RREMP Data

Gross Alpha	Gross Beta
Gamma Spectroscopy	Plutonium 238 and 239+240
Strontium 90	Radium 226 and 228

Table 5.6 Groundwater Sampling Locations with Detectable Man-Made Radioactivity - 1999[(a)]

Location	Radionuclide	Concentration x 10^{-9} µCi/mL[(b)]
NTS Onsite Network		
Well A	^3H	668
Well PM-1	^3H	181
Well UE-5n	^3H	120,000
RNM#2S (Source-term well)	^3H	212,000
Well UE-6d	^3H	540
Well UE-7nS	^3H	240
Well ER-12-1	^3H	27.9
Well U-19bh	^3H	62.1
Well USGS HTH#1	$^{239+240}Pu$	0.046

(a) Only ^3H concentrations greater than 0.2 percent of the 4 mrem DCG are shown (i.e., greater than 1.6 x 10^{-7} µCi/mL [160 pCi/L {6 Bq/L}]). Detectable levels of other man-made radioisotopes are also shown.

(b) Underlined results are for enrichment analysis (MDC of 10 x 10^{-9} µCi/mL); otherwise indicates conventional tritium analysis (MDC of 750 x 10^{-9} µCi/mL).

Table 5.7 Radioactivity in NTS Surface Waters - 1999

		Annual Average Concentrations (10^{-9} µCi/mL)					
Source of Non-Potable Water	No. of Sites	Gross Alpha	Gross Beta	Tritium	^{238}Pu	$^{239+240}$Pu	^{90}Sr
Containment Ponds							
E Tunnel[(a)]	2[(b)]	21.7	67.4	9.4×10^{5}	0.33	2.8	1.1
Mean MDC		1.9	1.3	736	0.02	0.02	1.1
U-20n PS#1ddh[(c)]	1	-53	1.47×10^{3}	5.2×10^{7}			
Mean MDC		6.9	7.7	490			
Sewage Lagoons	9	5.9	27.2	-26.2	-0.001	0.0012	0.11
Mean MDC		3.4	1.4	747	0.02	0.023	0.12

(a) ^{137}Cs detected by gamma spectroscopy; annual average concentration was 182 x 10^{-9} µCi/mL.
(b) A pond and an effluent.
(c) Analyses by C&MS Environmental Services, LLNL.

Table 5.8 NTS Well Cross-Check Results - 1999

	Tritium Concentration (10^{-9} µCi/mL)[(a)]	
Location	RREMP (BN)	EPA
Area 4, Test Well D	-2.62	64.6
Area 5, UE-5n	120,000	105,000
Area 5, Well 5C	0.92	-2.9
Area 6, UE-6e	14.40	160
Area 6, Well 4	-.51	1.75
Area 6, Well C-1	4.96	13
Area 17, Well HTH-1	0.66	160
Area 18, Well UE-18r	0.94	-2.05
Area 20, Well PM-1	181	164
Area 25, Well J-13	0.16	1.39

(a) Underlined results are for enrichment analysis (MDC of about 14.7 x 10^{-9} µCi/mL); otherwise indicates conventional tritium analysis (MDC of about 750 x 10^{-9} µCi/mL).

Table 5.9 NTS Drinking Water Sources and Corresponding System End-Points - 1999

System	Supply Wells	End-Point
No. 1	Wells C1, 4, 4A	Area 6, Cafeteria
	Wells 5B, 5C	Area 6, Building 6-900
	Army No. 1	Area 23, Cafeteria
No. 2	Well 8	Area 2, Restroom[(a)]
		Area 12, Building 12-23
No. 3	Well UE-16d	Area 1, Building 101
No. 4	Wells J-12, J-13	Area 25, Building 4221

(a) Dormant sampling point while building is unused.

Table 5.10 NTS Supply Well Radioactivity Averages - 1999

	Annual Average Concentrations - 10^{-9} µCi/mL					
Description	Gross Beta	^{3}H	$^{239+240}Pu$	^{238}Pu	Gross Alpha	^{90}Sr(b)
Potable Water Supply Wells						
Area 5, Well 5C	5.4	0.92	-0.0034	0.0018	7.8	(c)
Area 5, Well 5B	10.7	2.49	-0.0026	-0.0011	5.4	(c)
Area 6, Well 4	5.4	-0.51	-0.0044	-0.0024	7.5	(c)
Area 6, Well 4A	6.1	-0.28	--	--	8.8	(c)
Area 6, Well C1	13.2	4.96	0.0012	-0.0023	10.5	(c)
Area 6, Well C(a)	-	-	-	-	-	-
Area 16, Well UE-16d	6.7	-0.44	-0.0042	-0.0022	7.4	(c)
Area 18, Well 8	2.6	3.02	-0.0039	0.0021	0.7	(c)
Area 22, Army Well No.1	6.5	0.06	-0.0036	-0.0019	6.0	(c)
Area 25, Well J-12	4.0	3.24	0.0012	-0.0023	1.3	(c)
Area 25, Well J-13	3.8	0.16	-0.0011	-0.0021	1.6	(c)
Non-Potable Water Supply Wells						
Area 5, Well UE-5c	7.73	2.2	-0.0009	0.0007	8.13	(c)
Area 20, Well U-20	2.91	0.67	--	--	3.73	(c)
Median MDC	1.24	14.7	-0.0035	0.002	1.8	--

(a) Pump not operable.
(b) Only one sample collected during the year.
(c) No ^{90}Sr analysis in 1999.

Table 5.11 Radioactivity Averages for NTS Tap Water Samples - 1999

	Annual Average Concentrations - 10^{-9} µCi/mL					
Description	Gross Beta	^{3}H(a)	$^{239+240}Pu$	^{238}Pu	Gross Alpha	^{90}Sr(b)
Area 1, Bldg. 101(c)	5.9	-0.6	-0.0014	-0.0028	3.7	-0.02
Area 2, Restroom(d)	-	- (not sampled in 1999)-			-	-
Area 6, Cafeteria	6.5	-1.4	-0.0037	-0.0030	10	-
Area 6, Bldg. 6-900	6.3	-1.4	0.0038	-0.0031	9.4	-0.12
Area 12, Ice House	3.0	-1.6	0.0053	-0.0003	0.30	0.07
Area 23, Cafeteria	10.3	1.4	0.0030	-0.0009	11	-0.76
Area 25, Bldg. 4221	3.8	-3.1	-0.0049	-0.0045	1.3	0.04
Median MDC	1.2	14.7	-0.0035	-0.002	1.8	0.28

(a) Enriched tritium method.
(b) ^{90}Sr values are for one sample.
(c) Water was shut off at all buildings in Area 1 Complex.
(d) Building was not accessible; only one sample collected at outside water tap.

Table 5.12 Radium Analysis Results for NTS Potable Water Supply Wells - 1999

		Concentrations (10^{-9} µCi/mL)			
Location	Number of Samples	^{226}Ra Arithmetic Mean	Standard Deviation	^{228}Ra Arithmetic Mean	Standard Deviation
Area 5, Well 5B	5	0.46	1.77	0.44	0.43
Area 5, Well 5C	4	0.86	0.55	0.21	0.20
Area 6, Well 4	2	0.15	1.72	0.64	0.07
Area 6, Well 4A	4	1.61	1.38	0.41	0.19
Area 6, Well C-1	4	3.22	0.93	0.67	0.28
Area 16, Well UE-16d	4	2.16	1.16	0.46	0.19
Area 18, Well 8	4	0.77	1.18	0.08	0.34
Area 23, Army Well No. 1	5	1.88	1.19	0.56	0.20
Area 25, Well J-12	4	1.17	1.00	0.30	0.19
Area 25, Well J-13	5	-0.29	0.82	0.001	0.32
Median MDC		3.69		0.95	

Table 5.13 Summary of Tritium Results for NTS Wells Sampled by RREMP - 1999, (Enriched Analytical Method, Except UE-5n and RNM #25)

		µCi/mL × 10^{-9}					
Sampling Location	Number of Samples	Mean	Median	Standard Deviation	Minimum	Maximum	Median MDC
Aquifer Monitoring Wells							
Area 1, UE-1q	2	-7.76	-7.76	6.84	-12.60	-2.92	16.15
Area 3, USGS Water Well A	1	668.00					13.70
Area 4, UE-4t #1	1	7.20					20.00
Area 4, UE-4t #2	1	5.09					16.80
Area 4, USGS Test Well D	2	-3.62	-3.62	4.17	-6.57	-0.67	16.80
Area 5, UE-5n	1	120,000					796
Area 6, UE-6e	1	14.40					33.70
Area 17, USGS Well HTH-1	5	0.66	-0.15	1.72	-0.97	3.25	16.00
Area 18, UE-18r	2	0.94	0.94	1.30	0.02	1.86	15.55
Area 19, U-19bh	1	62.10					12.50
Area 20, Well PM-1	1	181.00					13.90
Area 25, UE-25p#1	1	15.9					16.0
Area 25, UE25-WT#6	1	-3.39					17.0
All aquifer monitoring wells combined	17	54.13	1.55	164.61	-12.60	668.00	16.00
UGTA Wells							
Area 2, Water Well 2	1	-4.50					16.50
Area 3, ER-3-2	1	-4.06					16.80
Area 6, ER-6-1	1	2.87					16.40
Area 12, ER-12-1	1	27.90					16.00

Table 5.13 (Summary of Tritium Results for NTS Wells Sampled by RREMP - 1999, [Enriched Analytical Method, except UE-5n and RNM #25], cont.)

Sampling Location	Number of Samples	Mean (μCi/mL × 10^{-9})	Median	Standard Deviation	Minimum	Maximum	Median MDC
UGTA Wells, cont.							
Area 19, UE-19c Water Well	1	3.42					13.20
Area 20, ER-20-1	2	9.38					30.10
Area 20, ER-20-2#1	2	4.12					16.10
Permitted Facility Monitoring Wells							
Area 5, UE5PW-1	2	-1.36					14.15
Area 5, UE5PW-2	2	-3.37					14.35
Area 5, UE5PW-3	2	1.08					12.7
Area 23, SM-23-1	1	8.31					13.5
Source-Term Wells							
RNM #2S	3	212,333					2278

Table 5.14 Summary of Tritium Results for NTS Wells Sampled by R&IE-LV - 1999

Tritium Concentration (μCi/mL × 10^{-9})

Location	Number of Samples	Maximum	Minimum	Arithmetic Mean	1 Sigma	Mean as %DCG[(a)]	Mean MDC
Test Well B	1	---	---	33.1	1.8	0.04	4.9
Test Well D	1	---	---	64.6	64	[(b)]	207
Well HTH-F	1	---	---	-1.49	1.6	[(b)]	5.4
Well C-1	1	12.9	---	12.9	1.76	[(b)]	5.0
Well HTH-1	1	---	---	165	65	0.18	207
Well PM-1	1	---	---	164	5.7	0.18	5.0
Well U-3cn5	(Not Sampled)						
Well UE-1c	2	32	-16.1	7.95	62	[(b)]	204
Well UE-5n	2	124,000	87,600	105,800	382	117	204
Well UE-6d	2	608	470	539	67	0.60	204
Well UE-6e	2	195	124	159	63	[(b)]	204
Well UE-7nS	2	314	169	241	64	0.19	204
Well UE-16f	1	---	---	39.6	63	[(b)]	207
Well UE-18r	2	-1.27	-2.84	-2.05	1.51	[(b)]	5.0
Well UE-18t	1	---	---	144	2.85	0.16	5.6

(a) DCG - Derived Concentration Guide; established by DOE Order as 90,000 pCi/L for water.
(b) Not applicable because the result is less than the MDC or water is known to be nonpotable.
Note: Underline indicates enrichment analysis of ^{3}H, regular font indicates conventional analysis.

Table 5.14 (Summary of Tritium Results for NTS Wells Sampled by R&IE-LV - 1999, cont.)

Tritium Concentration (µCi/mL × 10^{-9})

Location	Number of Samples	Maximum	Minimum	Arithmetic Mean	1 Sigma	Mean as %DCG[(a)]	Mean MDC
Well J-13	1	---	---	1.39	1.5	5	5
Well 2	1	---	---	110	64	(b)	207
Well 4	1	---	---	-1.75	150	(b)	5
Well 5C	1	---	---	-2.9	1.4	(b)	5
Well 6A Army	2	86	-1.33	42	33	(b)	107

(a) DCG - Derived Concentration Guide; established by DOE Order as 90,000 pCi/L for water.
(b) Not applicable because the result is less than the MDC or water is known to be nonpotable.
Note: Underline indicates enrichment analysis of ^{3}H, regular font indicates conventional analysis.

Table 5.15 Summary of Tritium Results for Wells Near the NTS Sampled by BN (RREMP) -1999

Location	Tritium Concentration (10^{-9} µCi/mL)[(a)]	Location	Tritium Concentration (10^{-9} µCi/mL)[(a)]
Amargosa Valley RV Park	3.7	ER-OV-03C2	1.05
Ash-B Piezom #1	8.37	ER-OV-04A	-2.34
Ash-B Piezom #2	-2.97	ER-OV-05	4.89
Beatty Water and Sewer	2.32	ER-OV-06A	-5.12
Cind-R-Lite Mine	1.17	Fire Hall Well #2	1.41
Coffer's Ranch Windmill	4.49	Last Trail Ranch	2.9
Cook's Ranch Well	0.41	Longstreet Casino Well #1	3.76
De Lee Ranch	4.09	Road D Well	-3.95
ER-OV-01	7.64	Roger Bright Ranch	-0.51
ER-OV-02	-5.64	School Well	3.88
ER-OV-03A	-7.65	Sod Farm	4.71
ER-OV-03A3	2.98	Tolicha Peak	14.3
ER-OV-03C	9.26	U.S. Ecology	1.3

(a) Results are for enrichment analysis (MDC of 15.15 x 10^{-9} µCi/mL).
No summary statistics since only one sample was collected at each of these locations.

Table 5.16 LTHMP Summary of Tritium Results for Wells Near the NTS - 1999

Location	Number of Samples	Max	Min	Mean	1 Standard Deviation	% of DCG[(a)]	Mean MDC
		Tritium Concentration (µCi/mL × 10^{-9})					
Adaven							
Adaven Spring	4	-9.2	-2.45	-1.29	65	(b)	220
Alamo							
Well 4 City	2	308	-78	115	65	(b)	207
Amargosa Valley							
Bar-B-Q Ranch	4	-1.1	-6.1	3.75	1.6	(b)	5.3
Ponderosa Dairy Well 2	4	73	-299	-35	66	(b)	220
Ash Meadows							
Big Spring	2	-1.51	-4.87	-3.2	146	(b)	5.0
Crystal Pool	4	-1.43	-7.4	-4.4	1.6	(b)	5.2
Fairbanks Spring	2	0.16	-3.94	-1.90	1.6	(b)	5.4
Longstreet Spring	2	-2.04	-2.81	-2.42	1.6	(b)	5.3
17S-50E-14cac	2	40	-25	7.8	64	(b)	206
Beatty							
Low Level Waste Site	Well Down						
Tolicha Peak	4	132	-305	-122	65	(b)	220
11S-48E-1dd Coffer's	4	83.1	-3.68	23	7.7	(b)	5.2
12S-47E-7dbd City	2	105	0	63	63	(b)	206
Clark Station							
TTR Well 6	2	95	36	65	63	(b)	206
Goldfield							
Klondike #2 Well	2	18	-47	-14	1.3	(b)	208
Hiko							
Crystal Springs	2	140	-25	8	63	(b)	206
Indian Springs							
Sewer Co. Well 1	2	57	-41	27	63	(b)	206
Air Force Well 2	2	27	-41	12	63	(b)	206
Lathrop Wells							
15S-50E-18cdc City	2	88	-1.65	43	63	(b)	206
Nyala							
Sharp's Ranch	2	79	-8	36	63	(b)	206
Rachel							
Penoyer Culinary	4	65	-33	3.6	65	(b)	219
Tonopah							
City Well	2	95	36	65	63	(b)	206
Warm Springs							
Twin Springs Ranch	4	-5.4	-333	-145	65	(b)	220

(a) DCG - Derived Concentration Guide. Established by DOE Order as 90,000 pCi/L.
(b) Not applicable because the result is less than the MDC or water is known to be nonpotable.
Note: Underline indicates enrichment analysis ^3H, regular font indicates conventional analysis.

Table 5.17 NTS Sewage Influent Quality - 1999

	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter	
Facility	S.C.[b] (mS/cm)	BOD5[a] (mg/L)	S.C.[b] (mS/cm)	BOD5[a] (mg/L)	S.C.[b] (mS/cm)	BOD5[a] (mg/L)	S.C.[b] (mS/cm)	BOD5[a] (mg/L)
Gate 100	1.23	266	1.32	1188	2.27	180	1.60	402
Mercury	0.76	184	0.80	339	0.99	150	0.87	585
Yucca Lake	0.85	169	1.05	299	0.63	82	0.88	209
LANL	1.15	162	1.26	159	1.18	150	1.05	174
DAF	1.13	47	1.04	35	1.23	12	1.04	64
Reactor Control	0	0	0	0	0	0	0	180
Test Stand 1[c]	0	0	0	0	0	0	0	0
Area 25 CSF	1.05	142	0.83	89	0.87	61	0.95	331
Area 12 Camp	0.22	<2.0	0.24	2.0	0.24	<5.0	0.25	3.0
Area 5 RWMS	1.09	137	1.31	96	1.41	110	1.11	1071

(a) Biochemical Oxygen Demand - 5-day Incubation.
(b) Specific Conductance.
(c) Standby Status - Portable Toilet Waste Only.

Table 5.18 NTS Sewage Pond Organic Loading Rates - 1999

Facility	Limit (Kg/day)	(Jan-Mar) Mean Daily Load	(Apr-June) Mean Daily Load	(Jul-Sept) Mean Daily Load	(Oct-Dec) Mean Daily Load
Metered Rates					
Mercury	172	31.85	54.78	24.50	86.50
LANL	5.0	0.63	0.64	0.60	0.70
Yucca Lake	8.6	3.20	4.06	2.20	2.90
Area 12 Camp	54	0.01	0.01	0.00	<0.10
Area 5 RWMS	0.995	0.58	0.56	0.60	0.60
Calculated Rates					
DAF	7.6	0.24	0.38	0.60	0.60
Reactor Control	4.2	0	0	0	0
Eng Test Stand	2.3	0	0	0	0
Area 25 CSF	7.4	2.41	1.66	0.70	4.10
Gate 100	2.4	0.23	3.60 [a]	1.40	1.80

(a) Calculated BOD exceeded, no septic conditions noted.

Table 5.19 Influent Toxics for Facilities that Received Industrial Wastewater - 1999

Parameter	Compliance Limit (mg/L)	Mercury Measurement (mg/L)	Area 25 Base Camp Measurement (mg/L)	Area 6 DAF Measurement (mg/L)	Area 5 RWMS Measurement (mg/L)	Area 6 LANL Measurement (mg/L)	Area 6 Yucca Lake Measurement (mg/L)
Arsenic	5.0	(a)	(a)	(a)	(a)	(a)	(a)
Barium	100	(a)	(a)	(a)	(a)	(a)	(a)
Cadmium	1.0	(a)	(a)	(a)	(a)	(a)	(a)
Chromium	5.0	(a)	(a)	(a)	(a)	(a)	(a)
Lead	5.0	(a)	(a)	(a)	(a)	(a)	(a)
Mercury	0.2	(a)	(a)	0.0041	(a)	(a)	(a)
Selenium	1.0	(a)	(a)	(a)	(a)	(a)	(a)
Silver	5.0	(a)	(a)	(a)	(a)	(a)	(a)
Benzene	0.5	(a)	(a)	(a)	(a)	(a)	(a)
Carbon Tetrachloride	0.5	(a)	(a)	(a)	(a)	(a)	(a)
Chlorobenzene	100	(a)	(a)	(a)	(a)	(a)	(a)
Chloroform	6.0	(a)	(a)	(a)	(a)	(a)	(a)
1,4-dichlorobenzene	7.5	(a)	(a)	(a)	(a)	(a)	(a)
1,2-dichloroethane	0.5	(a)	(a)	(a)	(a)	(a)	(a)
1,1-dichloroethylene	0.7	(a)	(a)	(a)	(a)	(a)	(a)
Methylethyl Ketone	200	(a)	(a)	(a)	(a)	(a)	(a)

(a)   Not Detected.

Table 5.19 (Influent Toxics for Facilities that Received Industrial Wastewater - 1999, cont.)

Parameter	Compliance Limit (mg/L)	Mercury Measurement (mg/L)	Area 25 Base Camp Measurement (mg/L)	Area 6 DAF Measurement (mg/L)	Area 5 RWMS Measurement (mg/L)	Area 6 LANL Measurement (mg/L)	Area 6 Yucca Lake Measurement (mg/L)
Pyridine	5.0	(a)	(a)	(a)	(a)	(a)	(a)
Tetrachloroethylene	0.7	(a)	(a)	(a)	(a)	(a)	(a)
Trichloroethylene	0.5	(a)	(a)	(a)	(a)	(a)	(a)
Vinyl Chloride	0.2	(a)	(a)	(a)	(a)	(a)	(a)
Cresol, total	200	(a)	(a)	(a)	(a)	(a)	(a)
2,4-dinitrotoluene	0.13	(a)	(a)	(a)	(a)	(a)	(a)
Hexachlorobenzene	0.13	(a)	(a)	(a)	(a)	(a)	(a)
Hexachlorobutadiene	0.5	(a)	(a)	(a)	(a)	(a)	(a)
Nitrobenzene	2.0	(a)	(a)	(a)	(a)	(a)	(a)
Pentachlorophenol	100	(a)	(a)	(a)	(a)	(a)	(a)
2,4,5-trichlorophenol	400	(a)	(a)	(a)	(a)	(a)	(a)
2,4,6-trichlorophenol	2.0	(a)	(a)	(a)	(a)	(a)	(a)
Chlordane	0.03	<0.03	<0.03	(a)	(a)	<0.03	(a)
Endrin	0.02	<0.02	< 0.02	(a)	(a)	<0.02	(a)
Heptachlor	0.008	<0.008	0.008	0.008	(a)	<0.008	<0.008
Lindane	0.4	<0.40	<0.40	(a)	<0.40	<0.40	(a)
Methoxychlor	10.0	<10.0	<10.0	<10.0	(a)	<10.0	<10.0
Toxaphene	0.5	<0.50	<0.50	(a)	<0.50	<0.50	(a)
2,4-D	10.0	(a)	(a)	(a)	(a)	(a)	(a)
2,4,5-TP (Silvex)	1.0	(a)	(a)	(a)	(a)	(a)	(a)

(a) Not Detected.

Table 5.20 Sampling Data for Infiltration Ponds Containing 30 cm or More - 1999

Parameter	Action Level (mg/L)	A-25 CSF January (mg/L)	A-25 CSF June (mg/L)
Arsenic	0.5	0.03	(a)
Cadmium	0.1	(a)	(a)
Chromium	0.5	(a)	0.01
Lead	0.5	0.002	0.06
Selenium	0.1	0.012	(a)
Silver	0.5	(a)	(a)
Nitrate Nitrogen	100	(a)	(a)
Sulfate	5000	66	170
Chloride	1000	53	150
Fluoride	40	6.6	15
Tritium	Monitor Only	--------	72 (pCi/L)

(a) Not Detected.
Note: Most sewage ponds on the NTS are exempt from this requirement.

Table 5.21 Nitrate Analyses of Well Water Samples, First Quarter - 1999

Water System/Well	Nitrates (MCL[c] 10 ppm[a])	Nitrates + Nitrites (MCL10 ppm)	Fluoride (MCL 4 ppm)	Arsenic (MCL .05 ppm)	Lead (action level .015 ppm)
NY-0360-12C					0.0073
Army Well	0.3	(b)		(b)	
Well 5B	3.3	(b)		(b)	
Well 5C	1.7	(b) 4.3		0.035	
Well 4	4.2	4.2		(b)	
Well 4A	4.1	(b)		(b)	
Well C-1	ND			(b)	
NY-4098-12NCN					0.0076
Well J-12	2.0	(b)	2.1	(b)	
Well J-13	2.1	(b)	2.3	(b)	
NY-4099-12C					0.0275
Well 8	1.2	1.2		(b)	
NY-5024-12NCN					0.03
Well UE16d	(b)	(b)		(b)	

(a) Parts per Million.
(b) Not Detected.
(c) Maximum Contaminant Level.

Table 5.22 NTS Drinking Water System Permits - 1999

Permit No.	Area(s)	Expiration Date	Reporting Required
NY-5024-12CNT	Area 1	09/30/2000	None
NY-4099-12C	Area 2 & 12	09/30/2000	None
NY-360-12C	Area 5,6,22, 23	09/30/2000	None
NY-4098-12CNT	Area 25	09/30/2000	None
NY-835-12H	Sitewide Truck	09/30/2000	None
NY-836-12H	Sitewide Truck	09/30/2000	None
NY-841-12H	Sitewide Truck	09/30/2000	None

Table 5.23 Sewage Discharge Permits - 1999

Permit No./Location	Areas	Expiration Date	Reporting Required
	NTS Permits		
GNEV93001[(a)]	NTS General Permit	12/07/2004	Quarterly
NY-17-05704	X Tunnel Collection System	09/30/00	Quarterly
	Off-NTS Permits		
North Las Vegas Facility			
VEH-112	Class II Wastewater Contribution Permit[(a)]	12/31/2001	Annually
Special Technologies Laboratory			
AII-204/Santa Barbara, California		12/31/2001	
III-331/Santa Barbara, California		12/31/2001	

(a) Owner/Operator effluent monitoring required by permit.

Table 5.24 Permits for NTS Septic Waste Hauling Trucks - 1999

Permit Number	Vehicle Identification Number	Expiration Date
NY-17-03313	Septic Tank Pumper E-105293	11/30/2000
NY-17-03315	Septic Tank Pumper E-105919	11/30/2000
NY-17-03317	Septic Tank Pumper E-105918	11/30/2000
NY-17-03318	Septic Tank Pumping Subcontractor	11/30/2000

U12N Overview of All Ponds from the Top of Muck Pile (March 13, 1989)