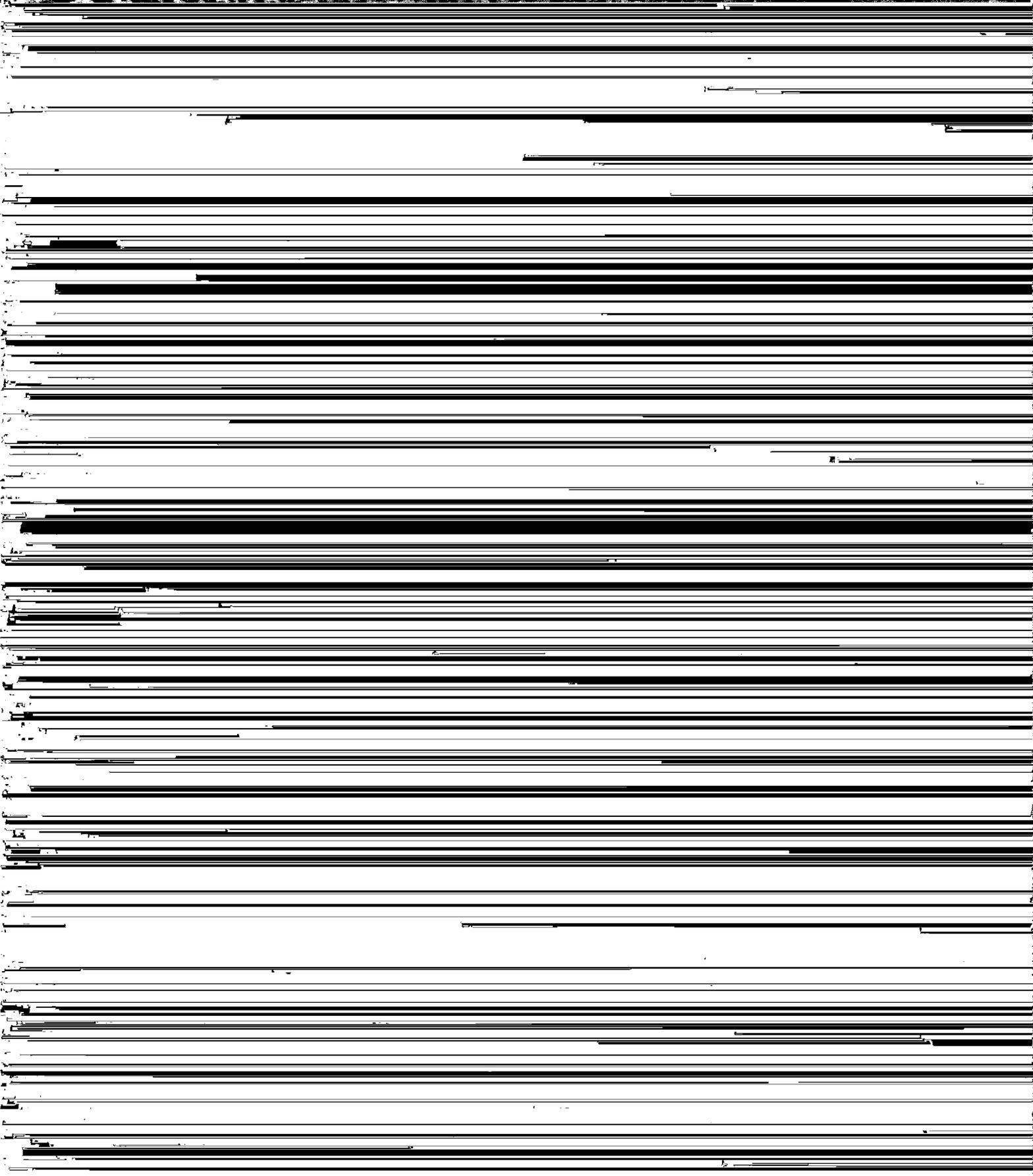


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Nevada Test Site Annual Site Environmental Report for Calendar Year - 1996

Editors:

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October 1997

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FOREWORD

Prior to 1989, annual reports of environmental monitoring and assessment results for the Nevada Test Site (NTS) were prepared in two separate parts. Onsite effluent monitoring and environmental monitoring results were reported in an onsite report prepared by the U.S. Department of Energy, Nevada Operations Office (DOE/NV). Results of the Offsite Radiological Surveillance and Long-Term Hydrological Monitoring programs conducted by the U.S. Environmental Protection Agency's (EPA's) Laboratory (various names) in Las Vegas, Nevada, were reported separately by that Agency.

Beginning with the 1989 Annual Site Environmental Report for the NTS, these two documents were combined into a single report to provide a more comprehensive annual documentation of the environmental protection activities conducted for the nuclear testing program and other nuclear and non-nuclear operations at the NTS. The two agencies have coordinated preparation of this eighth combined onsite and offsite report through sharing of information on environmental surveillance and releases as well as meteorological, hydrological, and other supporting data used in dose-estimation calculations.

ACKNOWLEDGEMENTS

The skill, dedication, and perseverance of Angela L. McCurdy in text processing and graphics support were crucial to the production of this report. The review and advice offered by the DOE/NV's Environmental Protection Division (EPD) and the EPA's Radiation & Indoor Environments National Laboratory, Las Vegas (R&IE-LV) reviewers were invaluable. The efforts of N. George McNeill in coordinating the review of the 1996 ASER by the EPD was greatly appreciated. Compilation and verification of onsite data were provided by Robert F. Grossman, Balwan S. Hooda, and Orin L. Haworth. Compilation and verification of Bechtel Nevada's offsite data were provided by James W. Kesler. Statistical analyses of data were provided by Robert R. Kinnison. The cooperative support of Anita A. Mullen of the R&IE-LV in production of this combined onsite and offsite environmental report is greatly appreciated.

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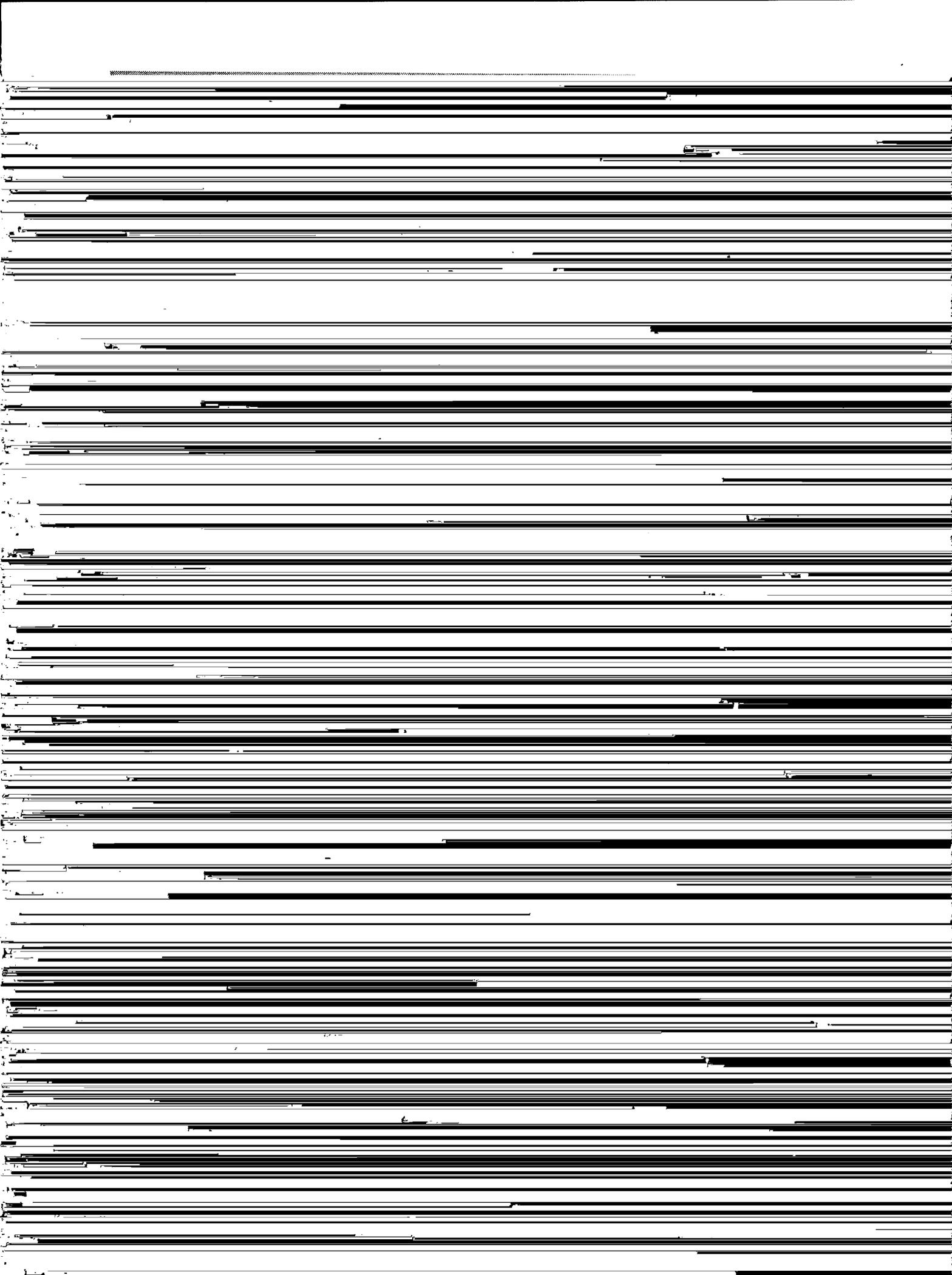
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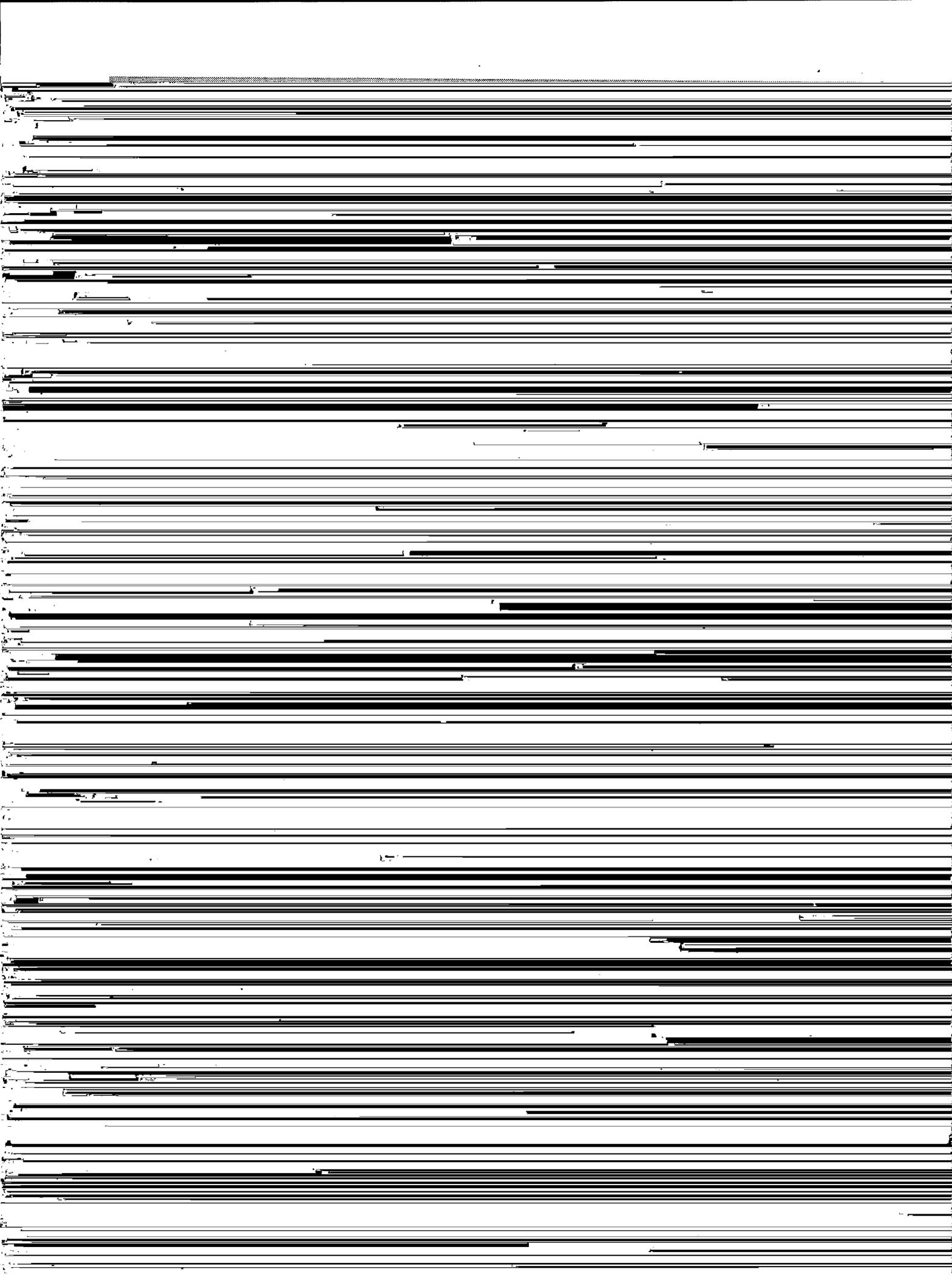
MEASUREMENT UNITS AND NOMENCLATURE

Radioactivity data in this report are expressed in both traditional units (e.g., pCi/L) and International System (abbreviated SI) units. These units are explained below.

- background** Ambient background radiation to which people are exposed. Naturally occurring radioactive elements contained in the body, in the ground, and in construction materials, cosmic radiation, and radioactivity in the air all contribute to an average radiation dose equivalent to humans of about 350 mrem per year. In laboratory measurements of radioactivity in samples, background is the activity determined when a sample of distilled water is processed through the system (also called a blank).
- becquerel** Abbreviation Bq. The Bq is the SI unit for disintegration rate. 1 Bq = 1 disintegration per second.
- concentration** Usually expressed as $\mu\text{Ci/mL}$, or pCi/m^3 .
- curie** Abbreviation Ci. The historic unit for disintegration rate. $1 \text{ Ci} = 3.7 \times 10^{10}$ disintegrations per second = $3.7 \times 10^{10} \text{ Bq}$. The usual submultiples of Ci are mCi (10^{-3} Ci or one thousandth Ci), μCi (10^{-6} Ci or one millionth Ci), and pCi (10^{-12} or one trillionth Ci).
- EDE** Effective dose equivalent - radiation dose corrected by various weighting factors that relate dose to the risk of serious effects.
- rem** Rem (for roentgen equivalent man) is the unit for expressing dose equivalent, or the energy imparted to a person when exposed to radiation. The commonly used subunit is the millirem (10^{-3} rem or one thousandth rem), abbreviated mrem.
- roentgen** Abbreviation R. A unit expressing the intensity of X or γ radiation at a point in air. The usual units are mR for 10^{-3} R (one thousandth R).
- volume** The SI unit for volume is m^3 (cubic meter). Other units used are liter (L) and mL (10^{-3} L or one thousandth liter). One cubic meter = 1,000 L.

The elements and corresponding symbols used in this report are:

<u>Element</u>	<u>Symbol</u>	<u>Element</u>	<u>Symbol</u>
Aluminum	Al	Iron	Fe
Americium	Am	Krypton	Kr
Argon	Ar	Lithium	Li
Arsenic	As	Mercury	Hg
Barium	Ba	Nitrogen	N
Beryllium	Be	Oxygen	O
Boron	B	Plutonium	Pu
Cadmium	Cd	Radium	Ra
Calcium	Ca	Radon	Rn
Carbon	C	Selenium	Se
Cesium	Cs	Sulfur	S
Chlorine	Cl	Strontium	Sr
Chromium	Cr	Technetium	Tc
Copper	C	Thorium	Th
Fluorine	F	Thulium	Tm
Germanium	Ge	Tritium	^3H
Hydrogen	H	Uranium	U
Iodine	I	Xenon	Xe



List of Acronyms and Expressions, cont.

EOD	Explosive Ordnance Disposal (NTS)
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Reporting and Community Right-to-Know Act
EPD	DOE Environmental Protection Division
ERP	Environmental Restoration Project
ESA	Endangered Species Act
ESS&H	Environment, Safety, Security, and Health
FFACO	Federal Facilities Agreement and Consent Order
FFCA	Federal Facilities Compliance Act
FONSI	Finding of No Significant Impact
FY	Fiscal Year
gal	Gallon
GBq	Gigabequerel (10^9 bequerels)
GCD	Greater Confinement Disposal
GIS	Geographical Information System
gpm	Gallons Per Minute
GZ	Ground Zero
HSC	Hazardous Material Spill Center
HTO	Tritiated Water
HWAS	Hazardous Waste Accumulation Storage
HWSU	Hazardous Waste Storage Unit
ICRP	International Commission on Radiological Protection
ID	Identification

List of Acronyms and Expressions, cont.

NHPA
NIST

National Historic Preservation Act
National Institute of Standards and Technology

List of Acronyms and Expressions, cont.

TSD	Treatment, Storage and Disposal
TTR	Tonopah Test Range
UGTA	Underground Test Area
U.S.	United States of America
USAF	United States Air Force
USFWS	United States Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	Underground Storage Tank
UTM	Universal Transverse Mercator
VOC	Volatile Organic Compound
WAC	Waste Acceptance Criteria
WAMO	Washington Aerial Measurements Operations (BN)
WIPP	Waste Isolation Pilot Plant
WMP	Waste Management Program
WMP/TS	Waste Management Project Technical Support (BN)
YMSCO	Yucca Mountain Site Characterization Office

1.0 SUMMARY

Monitoring and surveillance on and around the Nevada Test Site (NTS) by U.S. Department of Energy (DOE) contractors and NTS user organizations during 1996 indicated that operations on the NTS were conducted in compliance with applicable DOE, state, and federal regulations and guidelines. All discharges of radioactive liquids remained onsite in containment ponds, and there was no indication of potential migration of radioactivity to the offsite area through groundwater. Surveillance around the NTS indicated that airborne radioactivity from diffusion, evaporation of liquid effluents, or resuspension of soil was not detectable offsite, and exposure above background to members of the offsite population was not measured by the offsite monitoring program. Using the U.S. Environmental Protection Agency's (EPA) Clean Air Package 1988 (CAP88)-PC model and NTS radionuclide emissions and environmental monitoring data, the calculated effective dose equivalent (EDE) to the maximally exposed individual offsite would have been 0.11 mrem. This value is less than 2 percent of the federal dose limit prescribed for radionuclide air emissions. Any person receiving this dose would also have received 144 mrem from natural background radiation. There were no nonradiological releases to the offsite area. Hazardous wastes were shipped offsite to approved disposal facilities. Compliance with the various regulations stemming from the National Environmental Policy Act (NEPA) is being achieved and, where mandated, permits for air and water effluents and waste management have been obtained from the appropriate agencies. Cooperation with other agencies has resulted in seven different consent orders and agreements.

Support facilities at off-NTS locations have complied with the requirements of air quality permits and state or local wastewater discharge and hazardous waste permits as mandated for each location.

1.1 ENVIRONMENTAL MANAGEMENT

The DOE Nevada Operations Office (DOE/NV) is committed to increasing the quality of its management of NTS environmental resources. This has been promoted by the establishment of an Environmental Protection Division within the Office of Technical Services and upgrading the Environmental Management activities to the Assistant Manager level to address those environmental issues that have arisen in the course of performing the original primary mission of the DOE/NV, underground testing of nuclear explosive devices. An environmental survey in 1987

and a Tiger Team assessment in 1989 identified numerous issues that had to be resolved before DOE/NV could be considered to be in full compliance with environmental laws and regulations. At the end of 1996, all of the 149 Tiger Team findings had been satisfied.

Operational releases of radioactivity are reported soon after their occurrence. This year, only liquid effluents have been reported for the NTS. In compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAP), as set forth in Title 40 Code of Federal Regulations (C.F.R.) 61, the accumulated annual data from these reports are used each year as part of the input to the EPA's CAP88-PC software program to calculate potential EDEs to

people living beyond the boundaries of the NTS and the surrounding exclusion areas.

1.2 RADIOLOGICAL ENVIRONMENT

Radiological effluents in the form of air emissions and liquid discharges are normally released into the environment as a routine part of operations on the NTS. Radioactivity in liquid discharges released to onsite waste treatment or disposal systems (containment ponds) is monitored to assess the efficacy of treatment and control and to provide a quantitative and qualitative annual summary of released radioactivity. Air emissions are monitored for source characterization and operational safety as well as for environmental surveillance purposes.

Air emissions in 1996 consisted primarily of

traces of tritium, radioactive noble

gases, and other radionuclides. Table 1.1 shows the quantities of radionuclides released from all sources, including postulated loss of laboratory standards. None of the radioactive materials listed in this table were detected in the offsite area above ambient levels.

Onsite liquid discharges to containment ponds included approximately 271 Ci (10 TBq) of tritium. This was about the same as last year's tritium releases, because effluent from characterization wells drilled in Area 20 continued during most of the year. Evaporation of this material could have contributed HTO to the atmosphere, but the amounts were too small to be detected by the tritium monitors onsite. No liquid effluents were discharged to offsite areas.

ONSITE ENVIRONMENTAL SURVEILLANCE

Approximately 2,500 air samples were analyzed by gamma spectroscopy. All isotopes detected by gamma spectroscopy were naturally occurring in the environment (^{40}K , ^7Be , and members of the uranium and thorium series), except for a few instances where very low levels of ^{137}Cs were detected. Gross beta analysis of the air samples yielded an annual average for the network of $1.8 \times 10^{-14} \mu\text{Ci/mL}$ (0.74 mBq/m^3). Plutonium analyses of monthly or quarterly composited air filters indicated an annual arithmetic average below $10^{-16} \mu\text{Ci/mL}$ ($4 \mu\text{Bq/m}^3$) of $^{239+240}\text{Pu}$ and below $10^{-17} \mu\text{Ci/mL}$ ($0.4 \mu\text{Bq/m}^3$) of ^{238}Pu for all locations during 1996, with the majority of results for both isotopes being on the order of $10^{-18} \mu\text{Ci/mL}$ ($0.04 \mu\text{Bq/m}^3$). A slightly higher average was found in samples in certain areas, but that level was calculated to be only 0.01 percent of the Derived Concentration Guide (DCG) for exposure to the public. Higher than background levels of plutonium are to be expected in some air samples because atmospheric testing in the 1950s, and nuclear safety tests dispersed plutonium over a small portion of the surface of the NTS.

The annual average concentration of ^{85}Kr from the three noble gas monitoring stations was $25 \times 10^{-12} \mu\text{Ci/mL}$ (1 Bq/m^3). This concentration is similar to that reported in previous years and is attributed to worldwide distribution of ^{85}Kr from the use of nuclear technology.

Throughout the year atmospheric moisture was collected for two-week periods at 15 locations on the NTS and analyzed for HTO content. The annual arithmetic average of $(3.5 \pm 5.0) \times 10^{-6} \text{ pCi/mL}$ ($0.13 \pm 0.18 \text{ Bq/m}^3$) was similar to last year's average. The highest annual average concentrations were at the E Tunnel pond, the SEDAN crater, and RWMS-5 locations, in that order. The primary radioactive liquid discharge to the onsite environment in 1996 was 120 Ci (4.4 Tbq) of tritium (as HTO) in effluent produced during drilling of characterization wells in

Area 20. Seepage from E Tunnel in Rainier Mesa (Area 12) contributed 20 million liters of water containing about 11 Ci (0.41 Tbq) of tritium to containment ponds near the tunnels. For dose calculations, all of the HTO was assumed to have evaporated.

Surface water sampling was conducted quarterly at eight open reservoirs, seven springs, eight containment ponds, and an effluent and eight sewage lagoons. A grab sample was taken from each of these surface water sites for analysis of gross beta, tritium, gamma-emitters, and plutonium isotopes. Strontium-90 was analyzed once per year for each location. Water samples from the springs, reservoirs, and lagoons contained background levels of gross beta, tritium, plutonium, and strontium. Samples collected from the tunnel containment pond and characterization well effluent ponds contained detectable levels of radioactivity as would be expected.

Water from onsite supply wells and drinking water distribution systems was sampled and analyzed for radionuclides. The supply well average gross beta activity of $7.2 \times 10^{-9} \mu\text{Ci/mL}$ (0.27 Bq/L) was 3 percent of the DCG for ^{40}K (used for comparison purposes); gross alpha was $6.2 \times 10^{-9} \mu\text{Ci/mL}$ (0.23 Bq/L), which was about 40 percent of the drinking water standard; the maximum ^{90}Sr measured was $0.26 \times 10^{-10} \mu\text{Ci/mL}$ (0.9 Bq/L), about 1 percent of the DCG; ^3H concentrations averaged about $1.9 \times 10^{-9} \mu\text{Ci/mL}$ (70 mBq/L), less than 0.002 percent of the DCG; $^{239+240}\text{Pu}$ and ^{238}Pu were both below their minimum detectable levels of about $2 \times 10^{-11} \mu\text{Ci/mL}$ (0.074 mBq/L).

Analysis of the TLD network showed that the 16 boundary station locations had an annual average exposure of 120 mR, and the 9 control stations annual average was 91 mR, both within the range of values previously reported.

OFFSITE ENVIRONMENTAL SURVEILLANCE

The offsite radiological monitoring program is conducted around the NTS by the EPA's

Radiation & Indoor Environments National Laboratory-Las Vegas (R&IE-LV), under an Interagency Agreement with DOE. This program consists of several environmental sampling, radiation detection, and dosimetry networks that are described below. These networks operated continuously during 1996.

The Air Surveillance Network (ASN) was made up of 20 continuously operating sampling locations surrounding the NTS. The ASN stations included 15 located at Community Technical Liaison Program (CTLP) stations, described below. During 1996, no airborne radioactivity related to current activities at the NTS was detected on any sample from the ASN. Other than naturally occurring ^7Be , the only specific radionuclide possibly detected by this network was ^{238}Pu or $^{239+240}\text{Pu}$ on a few high-volume air-filter samples.

The Milk Surveillance Network consisted of 11 sampling locations within 300 km (186 mi) of the NTS, but samples were collected only from 10. Tritium, ^{89}Sr , and ^{90}Sr are rarely detected in milk samples at present. The levels in the milk network have decreased over time since reaching a maximum in 1964. The results from this network are consistent with previous data and indicate little or no change.

Other foods that have been analyzed regularly included meat from domestic or game animals collected on and around the NTS and fruit and vegetables from local gardens. None of these samples were collected this year.

In 1996, external exposure was monitored by a network of 51 TLDs and 27 pressurized ion chambers (PICs) located in towns and communities around the NTS. Also, there was a PIC located at the SALMON site near Baxterville, Mississippi. The PIC network in the communities surrounding the NTS indicated background exposures, ranging from 71 to 156 mR/yr, that were consistent with previous data and well within the range

of background data in other areas of the United States. The exposures measured by the TLDs were slightly less as has been true in the past.

Sampling of Long-Term Hydrological Monitoring Program (LTHMP) wells and surface waters around the NTS showed only background radionuclide concentrations. The LTHMP also included groundwater and surface water monitoring at locations in Colorado, Mississippi, New Mexico, and Nevada where underground tests were conducted. The results obtained from analysis of samples collected at those locations were consistent with previous data except for a sample from a deep well at Project GASBUGGY where the ^3H and ^{137}Cs has been detected the last few years. No concentrations of radioactivity that were detected in air, water, milk, or animal samples posed any significant health risk to nearby residents.

A network of 15 CTLP stations was operated by local residents. Each station was an integral part of the ASN and TLD networks. In addition, they were equipped with a PIC connected to a gamma-rate recorder. Each station also had satellite telemetry transmitting equipment so that gamma exposure measurements acquired by the PICs are transmitted via the Geostationary Operational Environmental Satellite to the NTS and from there to the R&IE-LV by dedicated telephone line. Samples and data from these CTLP stations were analyzed and reported by R&IE-LV and interpreted and reported by the Desert Research Institute, University of Nevada System. All measurements for 1996 were consistent with previous years and were within the normal background range for the United States.

Although no radioactivity attributable to current NTS operations was detected by any of the offsite monitoring networks, based on the NTS releases reported in Table 1.1, an atmospheric dispersion model calculation (CAP88-PC) indicated that the maximum potential EDE to any offsite individual would

have been 0.11 mrem (1.1×10^{-3} mSv), and the dose to the population within 80 km of the several emission sites on the NTS would have been 0.34 person-rem (3.4×10^{-3} person-Sv), both of which were less than last year. The hypothetical person receiving this dose would also have been exposed to 144 mrem from natural background radiation. A summary of the potential EDEs due to operations at the NTS is presented in Table 1.2.

ECOLOGICAL STUDIES

The Basic Environmental Compliance and Monitoring Program was redesigned to address changes in DOE/NV missions and

the culmination of several years of intensive field surveys and literature reviews on 11 Category 2 candidate plant species. The results of these surveys and a previous report on the Category 1 species, Beatley's milkvetch (*Astragalus beatleyae*), contributed to the removal of these species from the U.S. Fish and Wildlife Service (USFWS) candidate list.

LOW-LEVEL WASTE DISPOSAL

Environmental monitoring at the Radioactive Waste Management Site, Area 3 (RWMS-3) has detected plutonium in air samples. However, plutonium was detected in other air samples from Area 3 indicating that the source is resuspended plutonium. Elevated

support facilities in North Las Vegas, at Nellis Air Force Range Complex, and in Santa Barbara, California. The 1996 results indicated that only background radiation was detected at the fence line. In 1995, a small amount of tritium was accidentally released from a calibration range building in North Las Vegas that was still detectable this year in the room where the release occurred. Monitoring of the release provided data for input into the CAP88-PC program for calculating offsite exposures. The maximum offsite exposure was calculated to be only 0.00025 mrem, which is less than last year and far below the EPA permissible limit of 10 mrem.

1.3 NONRADIOLOGICAL MONITORING

Nonradiological environmental monitoring of NTS operations involved only onsite monitoring because there were no discharges offsite that involved nonradiological hazardous materials. The primary environmental permit areas for the NTS were monitored to verify compliance with ambient air quality and the RCRA requirements. Air emissions sources common to the NTS included particulates from construction, aggregate production, and surface disturbances, fugitive dust from unpaved roads, fuel burning equipment, open burning, and fuel storage facilities. NTS environmental permits active during 1996, which were issued by the state of Nevada or by federal agencies, included 17 air quality permits involving emissions from construction of facilities, boilers, storage tanks, and open burning; 8 permits for onsite drinking water distribution systems; 1 permit for sewage discharges to lagoon collection systems; 7 permits for septage hauling; 1 incidental take permit for the threatened desert tortoise; and 1 permit for the collection and study of various species on the NTS. A RCRA permit has been obtained for general NTS operations and for two specific facilities on the NTS.

Permits at non-NTS operations included 16 air pollution control permits, 4 sewage

discharge permits, and 4 hazardous material storage permits. Five EPA Generator Identification numbers were issued to the seven off-NTS operations, and three local RCRA-related permits were required at two of those operations.

The only nonradiological air emission of regulatory concern under the Clean Air Act (CAA) has been due to asbestos removal during building renovation projects and from insulated piping at various locations on the NTS. During 1996, there were no projects that required state of Nevada notifications. The annual estimate for non-scheduled asbestos demolition/renovation for fiscal year 1997 was sent to EPA Region 9 in December 1996.

RCRA requirements were met through an operating permit for hazardous waste storage, mixed waste storage, and explosive ordnance disposal operations. A Federal Facilities Agreement and Consent Order (FFACO) has been signed with the state that exempts the NTS from potential enforcement action related to mixed waste storage prohibition under RCRA.

The state conducted an annual Compliance Evaluation Inspection during 1996 and found only minor potential violations but will take no action on them.

As there are no liquid discharges to navigable waters, offsite surface water drainage systems, or publicly owned treatment works, no Clean Water Act (CWA), National Pollution Discharge Elimination System (NPDES) permits were required for NTS operations. Under the conditions of the state of Nevada operating permits, liquid discharges to onsite sewage lagoons are regularly tested for biochemical oxygen demand, pH, and total suspended solids. In addition to the state-required monitoring, these influents were also tested for RCRA-related constituents as an internal initiative to further protect the NTS environment.

In compliance with the Safe Drinking Water Act (SDWA) and eight state of Nevada drinking water supply system permits for

onsite distribution systems supplied by onsite wells, drinking water systems are sampled monthly for residual chlorine, pH, bacteria, and, less frequently, for other water quality parameters. No exceedances have been found.

Monitoring for polychlorinated biphenyls as required by the Toxic Substances Control Act (TSCA) involved analysis of 43 various samples. None of the samples had results exceeding five parts per million.

At the HSC, a series of snill tests using 28

During 1996, nine underground storage tanks were removed in accordance with state and federal regulations (see Chapter 3, Table 3.1). Reportable releases were discovered with the removal of tanks at three locations on the NTS.

In 1996, a cultural resource survey was conducted for historical and archaeological sites in Area 29. A data-recovery report for archeological data at a site in that area was prepared.

The American Indian Religious Freedom Act

consistent with previous experience. The ^3H and ^{137}Cs in water from Well EPNG 10-36 at GASBUGGY that began to be detected about 1984, was detected for the fifth year in a row.

Because wells that were drilled for water supply or exploratory purposes are used in the NTS monitoring program rather than wells drilled specifically for groundwater monitoring, a program of well drilling for groundwater characterization has been started. The design of the program is for installation or recompletion of groundwater characterization wells at strategic locations on and near the NTS. Through 1996, 13 of these wells have been drilled and 11 existing wells recompleted for a total of 24. Of these, five wells were completed and sampled on Pahute Mesa and three zones were developed and sampled in wells on Buckboard Mesa and Yucca Flat.

Other activities in this program included studies of groundwater transport of contaminants (radionuclide migration studies) and nonradiological monitoring for water quality assessment and RCRA requirements.

1.6 RADIOACTIVE AND MIXED WASTE STORAGE AND DISPOSAL

Two RWMSs are operated on the NTS, one each in Areas 3 and 5. During 1996, the RWMSs received LLW generated at the NTS and other DOE facilities. Waste is disposed of in shallow pits, trenches in the RWMS-5, and in selected craters in the RWMS-3. Transuranic (TRU) and TRU mixed wastes are stored on a curbed asphalt pad on pallets in overpacked 55-gal drums and assorted steel boxes pending shipment to the Waste Isolation Pilot Plant in New Mexico. The RWMS-3 is used for disposal of bulk LLW waste and LLW that is contained in packages that are larger than the specified standard size used at the RWMS-5.

Environmental monitoring at both sites included air sampling for radioactive particulates and HTO in air and external exposure measurements using TLDs. Water sampling and vadose zone monitoring for moisture and hazardous constituents are conducted at the RWMS-5. Environmental monitoring results for 1996 indicated that measurable radioactivity from waste disposal operations was detectable only in the immediate vicinity of the facilities.

Because the NTS is not a RCRA-permitted disposal facility, RCRA regulations require the shipment of nonradioactive hazardous waste to licensed disposal facilities offsite. No disposal of hazardous waste was performed at the NTS in 1996.

A Mixed Waste Management Unit (MWMU) is planned to be located immediately north of the existing pits within RWMS-5 and will be part of routine disposal operations. This area, designed to encompass 10 ha (25 acres), will contain eight landfill cells to be used for mixed waste disposal. Construction of the MWMU will commence upon completion of necessary NEPA documentation and issuance of a state of Nevada Part B Hazardous Waste Permit.

Mixed waste and LLW will only be accepted for disposal from generators (onsite and offsite) that have submitted a waste application that meets the requirements of the Waste Acceptance Criteria document (NTS 1996) and that have received DOE/NV approval of the waste stream(s) for disposal at NTS.

1.7 QUALITY ASSURANCE

The quality assurance (QA) program covering NTS activities has three components. There are QA programs for nonradiological analyses, for onsite radiological analyses, and for offsite radiological analyses conducted by EPA's R&IE-LV.

ONSITE NONRADIOLOGICAL QUALITY ASSURANCE

The onsite nonradiological QA was not operative during 1996 because budgetary restrictions caused deactivation of the laboratory. The offsite subcontract laboratories are monitored for their participation and performance in various performance evaluation programs.

ONSITE RADIOLOGICAL QUALITY ASSURANCE

The onsite radiological QA program includes conformance to best laboratory practice and implementation of the provisions of DOE Order 5700.6C. The external QA intercomparison program for radiological data QA consists of participation in the DOE Quality Assessment Program administered by the DOE Environmental Measurements Laboratory and the Performance Evaluation Studies Program conducted by the EPA's National Exposure Research Laboratory.

OFFSITE RADIOLOGICAL QUALITY ASSURANCE

The policy of the EPA requires participation in a centrally managed QA program by all EPA organizational units involved in environmental data collection. The QA program developed by the R&IE-LV for the Offsite Radiological Safety Program meets all requirements of EPA policy and also includes applicable elements of the DOE QA requirements and regulations. The program defines data quality objectives (DQOs), which are statements of the quality of data a decision maker needs to ensure that a decision based on those data is defensible. Achieved data quality may then be evaluated against these DQOs.

1.8 ISSUES AND ACCOMPLISHMENTS

PRINCIPAL COMPLIANCE PROBLEMS FOR 1996

- On June 28, 1994, the state of Nevada filed a Complaint for Declaratory

Judgement and Injunction in the U.S. District Court against DOE. Nevada claims that DOE has failed to comply with NEPA requirements at the NTS and must initiate a single, sitewide EIS for all major federal actions at the NTS. The state was seeking to halt shipments of LLW from Fernald and all other transportation, receipt, storage, and disposal of mixed waste, hazardous waste, and defense waste and was also seeking to enjoin DOE from pursuing any "Weapons Complex" activities until publication of the EIS. In January 1995, the U.S. District Court dismissed the claims regarding Fernald waste and the sitewide EIS. The remaining claim, regarding disposal of LLW from offsite facilities is still unsettled.

- A notification letter was received regarding alleged potentially responsible party status connected with a commercial disposal site in California. The state notified DOE/NV that Omega Chemical Co., a hazardous waste treatment and storage facility, possessed documents indicating that DOE/NV had shipped hazardous waste to the site between 1988 and 1992. The company has declared bankruptcy and is unable to clean up the site. Jurisdiction of this site has been transferred to the EPA which, so far, has made no contact.

ACCOMPLISHMENTS FOR 1996

- The draft sitewide EIS for the NTS and offsite locations in the state of Nevada was released for public comment in February 1996. The EIS was approved for publication in August and the Record of Decision was published in December 1996.
- Work was performed on seven EAs during 1996, of which two were assessed in the EIS.
- Throughout 1996, DOE/NV continued to maintain and update the "DOE/NV Compliance Guide" (Volume III), a handbook containing procedures,

formats, and guidelines for personnel responsible for NEPA compliance activities.

- Continued use of a Just-in-Time supply system allowed NTS contractors to reduce product stock and control potentially hazardous products.
- Progress continued on the NTS groundwater characterization program. Thirteen special wells have been completed and eleven existing wells have been recompleted to meet program requirements.
- The Waste Management Projects installed three pilot wells at RWMS-5 to monitor underground conditions. The data have also been used for site characterization. The uppermost groundwater table was found at approximately 244 m (800 ft). Only naturally occurring radioactivity was detected in the groundwater.
- DOE/NV has entered into several consent orders and agreements. These are: (1) a Memorandum of Understanding with the state covering radiological releases, (2) an Agreement in Principle with Nevada and Mississippi covering oversight of environmental safety and health activities, (3) a Cooperative Agreement with Alaska's Fish and Wildlife Service, (4) a Settlement Agreement with the state to manage mixed TRU waste, (5) a FFACO for providing storage of low-level mixed waste generated at the NTS, and (6) a Programmatic Agreement with the state covering archaeological and historic preservation activities.
- The following remedial actions were completed in 1996:
 - 1) Plutonium-contaminated soil was removed from the site of the 1963

DOUBLE TRACKS nuclear device safety test on the Nellis Air Force Range Complex and the site was revegetated. The soil was disposed of in the LLW site in Area 3, NTS.

- 2) The access shaft for the 1963 Project SHOAL underground test near Fallon, Nevada, was closed. The approximately 1,100-ft (433-m) deep shaft was filled with screened granite.
- 3) The injection well at the Area 2 Bitcutter Shop was closed in place and the well at the Lawrence Livermore National Laboratory Postshot Containment Building was clean closed.
- 4) One Corrective Action Unit under the FFACO, which described 23 abandoned lead sites on the NTS, was closed as all the sites have been remediated.

The environmental monitoring results presented in this report document that operational activities on the NTS in 1996 were conducted so that no measurable radiological exposure occurred to the offsite public. Calculation of the highest individual dose that could have been received by an offsite resident (based on estimation of onsite worst-case radioactive releases obtained by measurement or engineering calculation and assuming the person remained outside all year) equated to 0.11 mrem to a person living in Springdale, Nevada. This may be compared to that individual's exposure to 144 mrem from natural background radiation as measured by the PIC instrument at Beatty, Nevada.

There were no major incidents of nonradiological contaminant releases to the environment, and intensive efforts to characterize and protect the NTS environment, implemented in 1990, were continued in 1996.

Table 1.1 Radionuclide Emissions on the NTS - 1996^(a)

<u>Radionuclide</u>	<u>Half-life (years)</u>	<u>Quantity Released (Ci)</u> ^(b)
Airborne Releases:		
³ H	12.35	^(c) 0.35
⁸⁵ Kr	10.72	0.019
²³⁹⁺²⁴⁰ Pu	24065.	^(c) 0.28
Containment Ponds:		
³ H	12.35	^(d) 130
²³⁸ Pu	87.743	3.4×10^{-6}
²³⁹⁺²⁴⁰ Pu	24065.	2.7×10^{-5}
⁹⁰ Sr	29.	4.4×10^{-6}
¹³⁷ Cs	30.17	1.5×10^{-3}
Gross Beta	---	1.2×10^{-3}

(a) Assumes worst-case point and diffuse source releases.

(b) Multiply by 37 to obtain GBq.

(c) Includes calculated data from air sampling results, postulated loss of laboratory standards, and calculated resuspension of surface deposits.

(d) This amount is assumed to evaporate to become an airborne release.

Table 1.2 Summary of Effective Dose Equivalents from NTS Operations During 1996

	<u>Maximum EDE at NTS Boundary</u> ^(a)	<u>Maximum EDE to an Individual</u> ^(b)	<u>Collective EDE to Population within 80 km of the NTS Sources</u>
Dose	0.12 mrem (1.2×10^{-3} mSv)	0.11 mrem (1.1×10^{-3} mSv)	0.34 person-rem (0.34×10^{-2} person Sv)
Location	Site boundary 40 km WNW of NTS CP-1	Springdale, NV 58 km WNW of NTS CP-1	32,210 people within 80 km of NTS Sources
NESHAP Standard	10 mrem per yr (0.1 mSv per yr)	10 mrem per yr (0.1 mSv per yr)	-----
Percentage of NESHAP	1.2	1.1	-----
Background	144 mrem (1.44 mSv)	144 mrem (1.44 mSv)	3064 person-rem (30.6 person Sv)
Percentage of Background	8.0×10^{-2}	8.0×10^{-2}	1.1×10^{-2}

(a) The maximum boundary dose is to a hypothetical individual who remains in the open continuously during the year at the NTS boundary located 40 km (25 mi) WNW from the NTS Control Point 1.

(b) The maximum individual dose is to an individual outside the NTS boundary at a residence where the



2.0 INTRODUCTION

The Nevada Test Site (NTS), located in southern Nevada, was the primary location for testing of nuclear explosives in the continental U.S. from 1951 to 1992. Historically, nuclear testing has included the following: (1) atmospheric testing in the 1950s and early 1960s; (2) underground testing in drilled, vertical holes and horizontal tunnels; (3) earth-cratering experiments; and (4) open-air nuclear reactor and engine testing. No nuclear

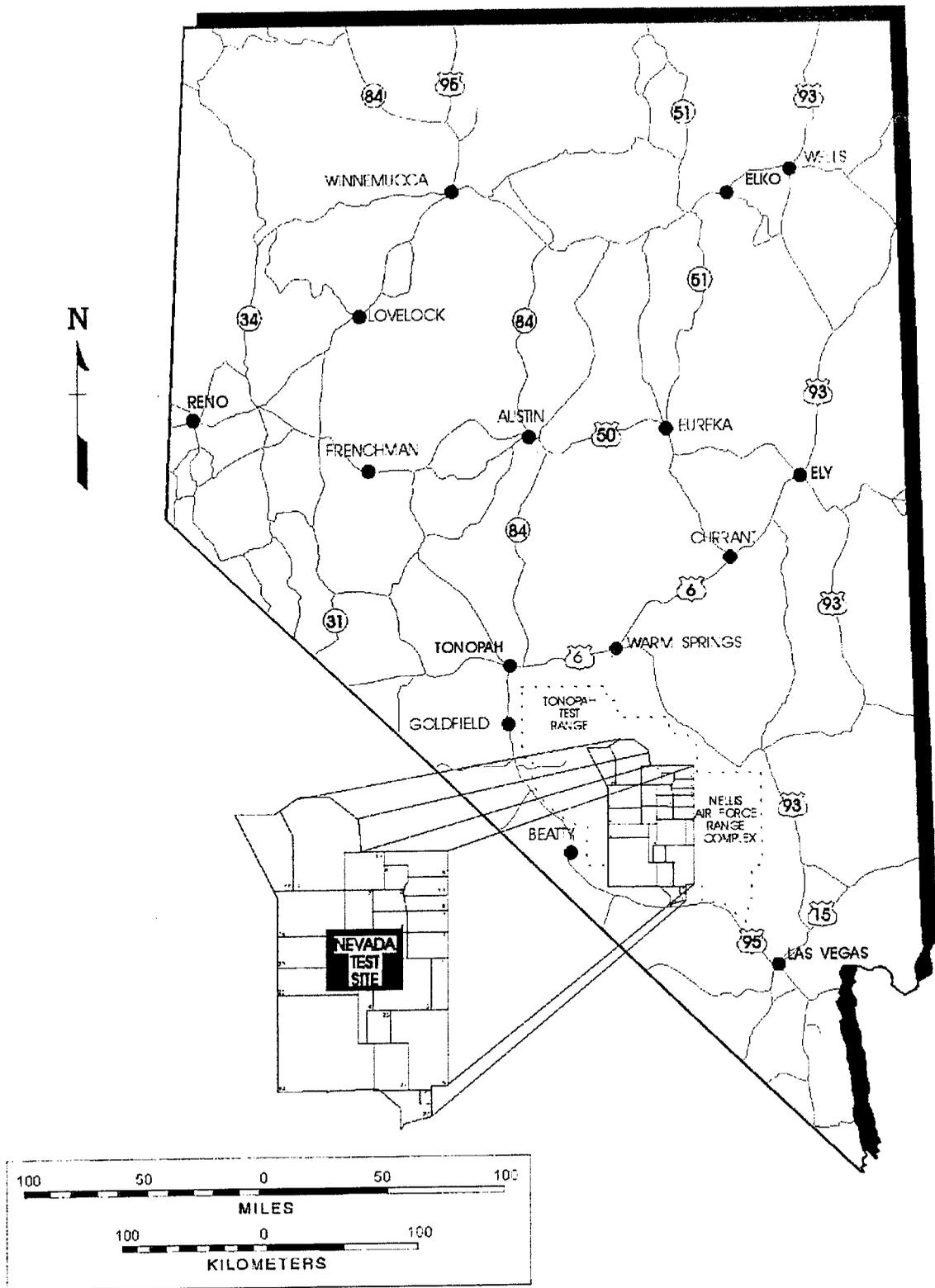


Figure 2.1 NTS Location in Nevada

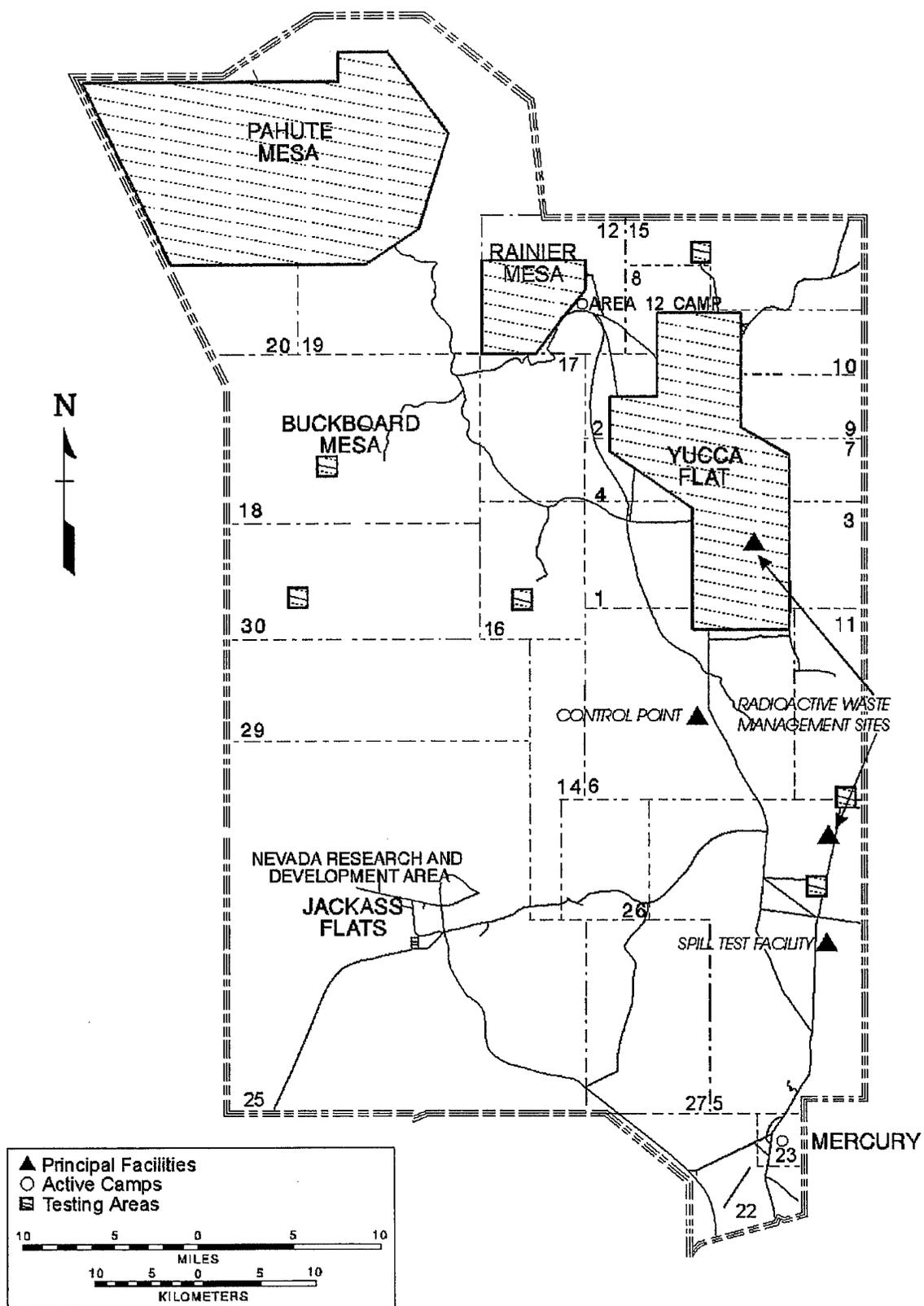


Figure 2.2 NTS Area Numbers, Principal Facilities, and Testing Areas

facilities and area numbers referred to in this report. The areas outlined in green in Figure 2.2 indicate the principal geographical areas used recently for underground nuclear testing. Mercury, Nevada, at the southern end of the NTS, is the main base camp for worker housing and administrative operations for the NTS. Area 12 Base Camp at the northern end of the NTS was

1968 as part of the Plowshare Program, which explored peaceful uses of nuclear explosives. The first and largest test (SEDAN) was detonated at the northern end of Yucca Flat. There have been no U.S. nuclear explosive tests since September 1992.

Other nuclear testing over the history of the

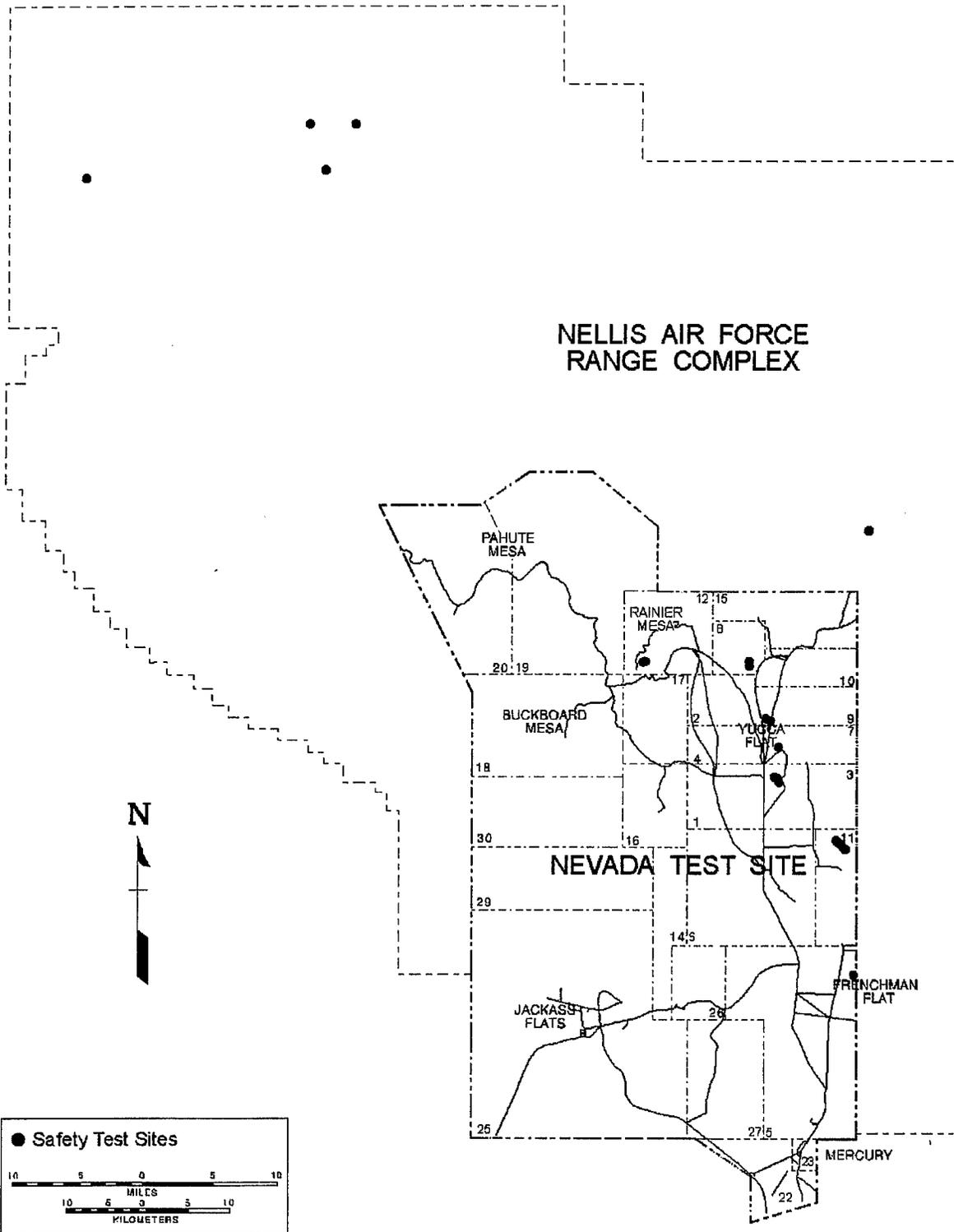


Figure 2.3 Location of Safety Tests on the NTS and the Nellis Air Force Range Complex

Transuranic (TRU) wastes are retrievably stored in surface containers at the RWMS-5 pending shipment to the Waste Isolation Pilot Plant (WIPP) facility in New Mexico. Nonradioactive hazardous wastes are accumulated at a special accumulation site before shipment to a licensed offsite disposal facility. At the Area 3 RWMS, bulk LLW (such as debris from atmospheric nuclear test locations) and LLW in large non-standard packages are emplaced and buried in selected surface subsidence craters (formed as a result of prior underground nuclear tests).

1996 ACTIVITIES

NUCLEAR TESTS

No nuclear explosives tests were conducted during 1996 due to the moratorium announced in late 1992. However, continuous environmental surveillance for radioactivity and radiation was conducted both onsite and offsite because of the large number of potential effluent sources that exist on the NTS as a result of the prior nuclear tests. The surveillance program and results are described in Chapters 4 and 5.

NTS-RELATED ACTIVITIES

LLW and mixed waste handling and disposal, TRU waste storage and monitoring prior to shipment to the WIPP in New Mexico, and remedial actions related to sites contaminated by tests of nuclear devices are some of the activities that occurred in 1996.

Compliance with state and federal environmental laws and regulations was another principal activity during 1996. Specifically included were actions related to: (1) National Environmental Policy Act documentation preparation, such as the Sitewide Environmental Impact Statement;

compliance involving monitoring of drinking water distribution systems; (5) Resource Conservation and Recovery Act management of hazardous wastes; (6) Comprehensive Environmental Response, Compensation, and Liability Act reporting; and (7) Toxic Substances Control Act management of polychlorinated biphenyls. Also included were preactivity surveys to detect and document archaeological and historic sites on the NTS. Compliance with the Endangered Species Act involved conducting pre-operation surveys to document the status of state of Nevada and federally listed endangered or threatened plant and animal species.

HAZARDOUS MATERIALS SPILL CENTER

DOE/NV's HSC is a research and demonstration facility available on a user-fee basis to private and public sector test and training sponsors concerned with the safety aspects of hazardous chemicals. The site is located in Area 5 of the NTS and is maintained by BN. The HSC is the basic research tool for studying the dynamics of accidental releases of various hazardous materials. Discharges from the HSC tanks occur at a controlled rate and consist of a measured volume of hazardous test fluid released on a surface especially prepared to meet the test requirements. The facility has the capability for releasing large volumes of cryogenic and non-cryogenic liquids. Spill rates for the cryogenic system range up to 98-m³/min (26,000-gpm) capability to release the entire contents of two tanks in two minutes. The non-cryogenic system can release materials at rates up to 19 m³/min (5,000 gpm). Test sponsors can vary intake air humidity, temperature, release rate, and release volume in an 8-ft x 16-ft x 96-ft wind tunnel. There are two spill pads available for use in contained open air releases of volumes up to 3.8 m³ (1,000 gal). An area has been added to provide the capability for

An array of diagnostic sensors may be placed up to 16 km downwind of the spill point to obtain cloud-dispersion data.

are onto the dry lake beds (playas) in each valley. The remaining areas of the NTS drain via arroyos and dry stream beds that

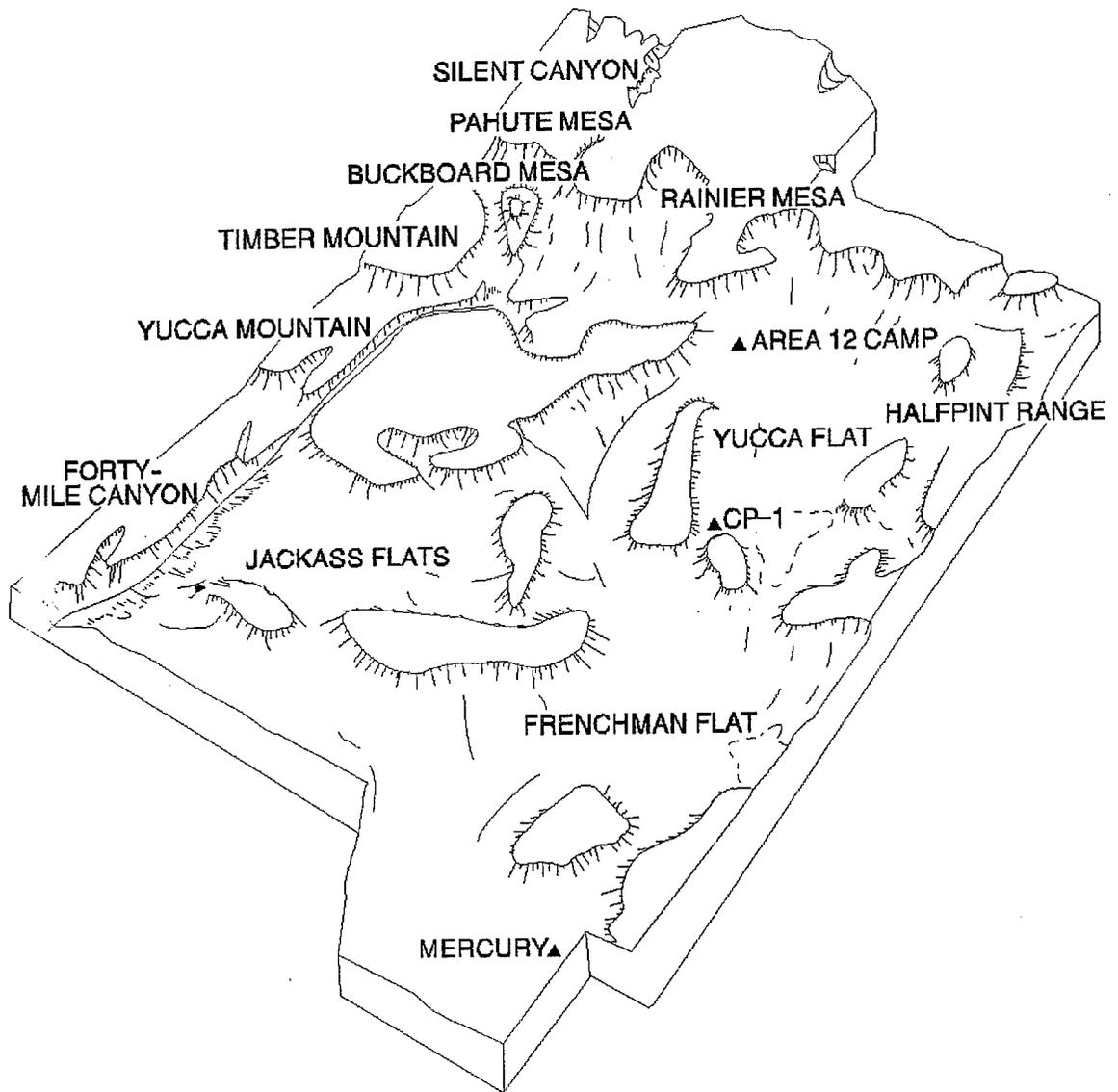
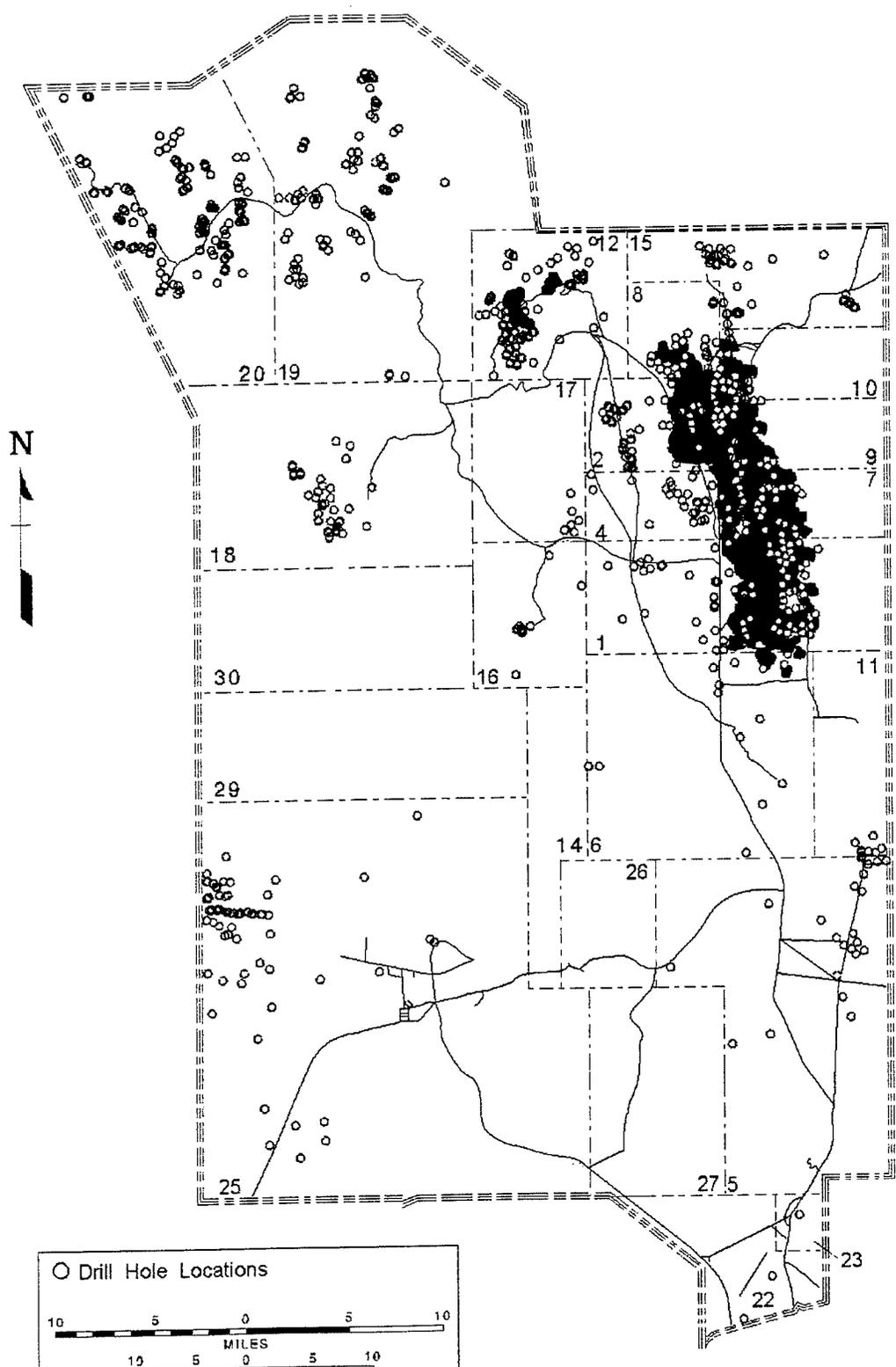


Figure 2.4 Topography of the NTS



nondeposition. These materials erupted before the collapse of large volcanic centers known as *calderas*. Alluvial materials fill the intermountain valleys and cover the adjacent slopes. These sediments attain thicknesses of 600 to 900 m (2000 to 3000 ft) in the central portions of the valleys. The alluvium in Yucca Flat is vertically offset along the prominent north-south-trending Yucca fault.

HYDROGEOLOGY

The deep aquifers, slow groundwater movement, and exceedingly slow downward movement of water in the overlying unsaturated zone serve as significant barriers to transport of radioactivity from unsaturated zone sources via groundwater, greatly limiting the potential for transport of

groundwater subbasin. Groundwater occurs within the valley-fill, volcanic, and carbonate aquifers and in the volcanic and clastic aquitards. The depth to water generally ranges from 160 m (525 ft) to about 580 m (1,900 ft) below the ground surface. The tuff aquitard forms the principal Cenozoic hydrostratigraphic unit beneath the water table in the eastern two-thirds of the valley and is unconfined over most of its extent. The valley-fill aquifer is saturated in the central part of the valley and is unconfined (Winograd and Thordarson 1975).

Some underflow, past all of the subbasin discharge areas, probably reaches springs in Death Valley. Recharge for all of the subbasins most likely occurs by precipitation at higher elevations and infiltration along

The water table beneath Frenchman Flat is considerably shallower (and stratigraphically higher) than beneath Yucca Flat. Consequently, the areal extent of saturation in the valley-fill and volcanic aquifers is

Meadows or the Alkali Flat/Furnace Creek Ranch subbasin. The regional flow from the mesa may be directed either towards Yucca Flat or, because of the intervening upper clastic aquitard, towards the Alkali Flat

associated with large-scale pressure systems. This scenario is very sensitive to the orientation of the mountain slopes and valleys. At higher elevations such as Area 20, the average annual wind speed is 17 km/h (10 mi/h) but is only 11 km/h (7 mi/h) in the valleys, such as Yucca Flat. The prevailing wind direction during winter months is from the north-northeast and north-northwest, but it reverses in the summer months. The 1992 10-m wind roses for the NTS are shown in Figure 2.8.

FLORA AND FAUNA

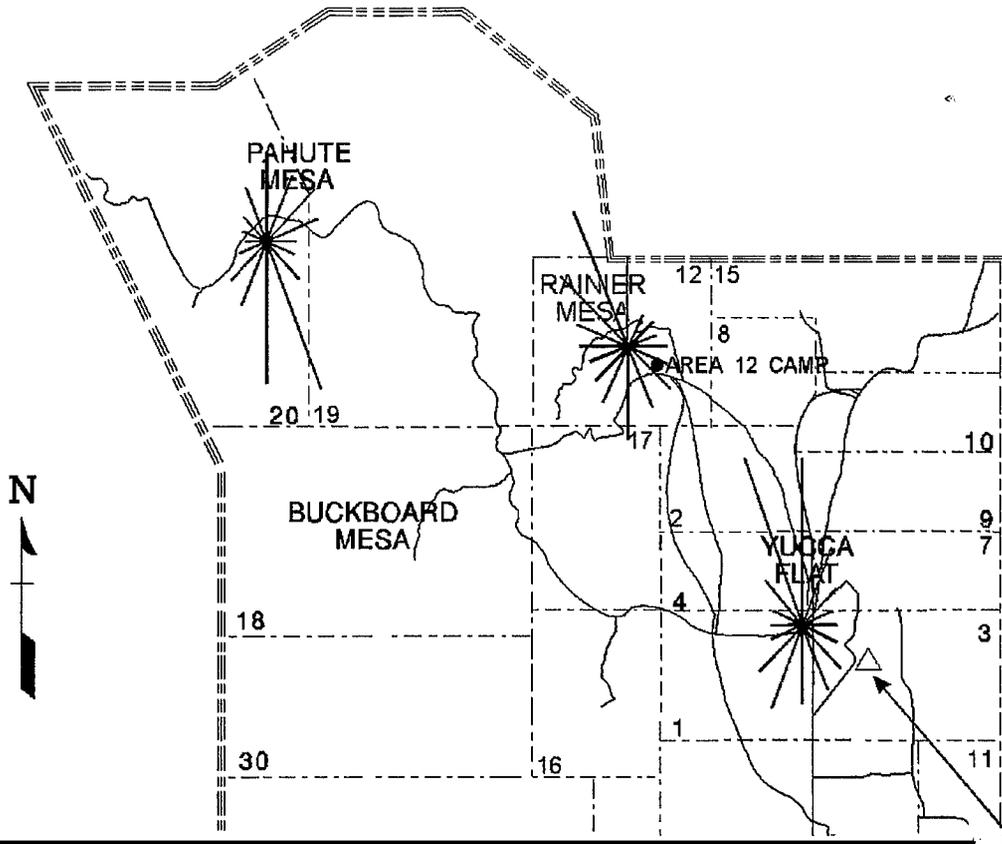
The vegetation on most of the NTS includes various associations of desert shrubs typical of the Mojave or Great Basin Deserts or the zone of transition between these two. Extensive floral collection has yielded 711 taxa of vascular plants within or near the boundaries of the NTS (O'Farrell and Emery 1976). Associations of creosote bush, *Larrea tridentata*, which are characteristic of the Mojave Desert, dominate the vegetation mosaic on the bajadas of the southern NTS. Between 1,220 and 1,520 m (4,000 and 5,000 ft) in elevation in Yucca Flat, transitional associations are dominated by *Grayia spinosa*-*Lycium andersonii* (hopsage/desert thorn) associations, while the upper alluvial fans support *Coleogyne* types. Above 1,520 m (5,000 ft), the vegetation mosaic is dominated by sagebrush associations of *Artemisia tridentata* and *Artemisia arbuscula* subspecies *nova*. Above 1,830 m (6,000 ft), piñon pine and juniper mix with the sagebrush associations where there is suitable moisture for these trees. No plant species located on the NTS is currently on the federal endangered species list; however, the state of Nevada has placed *Astragalus beatleyae* on its critically endangered species list.

Most mammals on the NTS are small and secretive (often nocturnal in habitat), hence not often seen by casual observers. Rodents are the most important group of mammals on the NTS, based on distribution and relative abundance. Larger mammals

include feral horses, mule deer, mountain lions, bobcats, coyote, kit foxes, and rabbits, among others. Among others Reptiles include: the desert tortoise, over 12 lizards, and 17 snakes; 4 of which are venomous. Bird species are mostly migrants or seasonal residents. Most nonrodent mammals have been placed in the "protected" classification by the state of Nevada. On August 4, 1989, the Mojave population of the desert tortoise, *Gopherus agassizii*, was placed on the endangered species list by the U.S. Fish and Wildlife Service. This population was relisted as threatened on April 2, 1990. The reasons for listing this population included deterioration, loss of habitat, and collection for pets. Other purposes included elevated levels of predation, loss from disease, and the inadequacy of existing regulatory mechanisms to protect tortoises and their habitat. The habitat of the desert tortoises on the NTS is found in the southern third of the NTS outside the recent areas of nuclear explosive test activities.

CULTURAL RESOURCES

Human habitation of the NTS area began at least as early as 10,000 years ago. Various indigenous cultures occupied the region in prehistoric times. The survey of less than 5 percent of the NTS area has located more than 2,000 archaeological sites which contain the only information available concerning the prehistoric inhabitants. The site types identified include rock quarries, tool-manufacturing areas, plant-processing locations, hunting locales, rock art, temporary camps, and permanent villages. The prehistoric people's lifestyle was sustained by a hunting and gathering economy which utilized all parts of the NTS. While major springs provided perennial water, the prehistoric people developed strategies to take advantage of intermittent fresh water sources in the arid region. In the nineteenth century, at the time of initial contact, the area was occupied by Paiute and Shoshone Indians.



Prior to 1940, the historic occupation consisted of ranchers, miners, and Native Americans. Several natural springs were able to sustain livestock, ranchers, and miners. Stone cabins, corrals, and fencing stand today as testaments to these early settlers. The mining activities included two large mines: one at Wahmonie, the other at Climax Mine. Prospector claim markers are found in these and other parts of the NTS. Native Americans coexisted with the settlers and miners, utilizing the natural resources of the region and, in some cases, working for the new arrivals. They also maintained a connection with the land, especially areas important to them for religious and historical reasons. These locations, referred to as traditional cultural properties, continue to be significant to the Paiute and Shoshone Indians.

Between 1940 and 1950, the area now known as the NTS was under the jurisdiction

distances from the NTS were determined. Several small communities are located in the area, the largest being in the Pahrump Valley. This growing rural community, with an estimated population of 20,000, is about 50 mi (80 km) south of CP-1. The Amargosa Farm area, which has a population of about 1,200, is approximately 50 km (30 mi) southwest of CP-1. The largest town in the near offsite area is Beatty, which has a population of about 1,500 and is approximately 65 km (40 mi) to the west of CP-1.

The Mojave Desert of California, which includes Death Valley National Monument, lies along the southwestern border of Nevada. The National Park Service estimated that the population within the boundaries ranges from 200 permanent residents during the summer months to as many as 5,000 tourists and campers on any particular day during holiday periods in the

several small communities lie along the Colorado River. The largest towns in the area are Bullhead City, 165 km (103 mi) south-southeast of the NTS, with a population estimate of 22,000, and Kingman, located 280 km (174 mi) southeast of the NTS, with a population of about 13,000.

SURROUNDING LAND USE

Figure 2.9 is a map of the offsite area showing a wide variety of land uses such as farming, mining, grazing, camping, fishing, and hunting within a 300-km (180-mi) radius of the CP-1. West of the NTS, elevations range from 85 m (280 ft) below MSL in Death Valley to 4,400 m (14,500 ft) above MSL in the Sierras, including parts of the Owens and San Joaquin agricultural valleys. The areas south of the NTS are more uniform, since the Mojave Desert ecosystem (mid-latitude desert) comprises most of this portion of Nevada, California, and Arizona. The areas east of the NTS are primarily mid-latitude steppe with some of the older river valleys, such as the Virgin River and Moapa Valleys, supporting irrigation for small-scale but intensive farming of a variety of crops. Grazing is also common in this area, particularly towards the northeast. The area north of the NTS is also mid-latitude steppe where the major agricultural activity is grazing of cattle and sheep, and a minor agricultural activity is growing of alfalfa hay. Many of the residents cultivate home gardens.

Recreational areas lie in all directions around the NTS and are used for such activities as hunting, fishing, and camping. In general the camping and fishing sites to the north of the NTS are not utilized in the winter months. Camping and fishing locations to the south are utilized throughout the year. The peak hunting season is from

the DOE/NV. Those that were operational in support of NTS activities are described in the following sections. Each of these facilities is located in a metropolitan area.

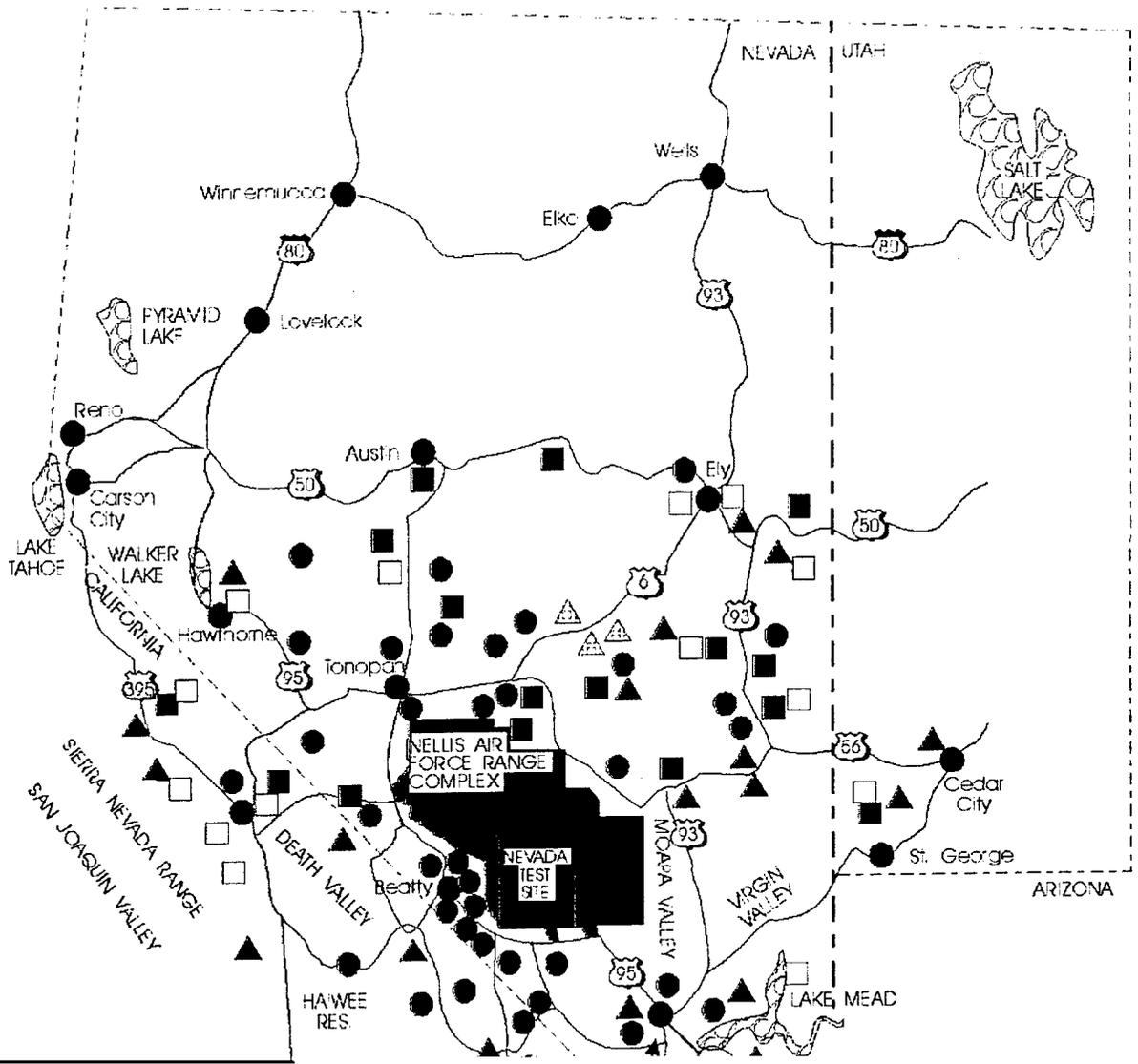
City, county, and state regulations govern emissions, waste disposal, and sewage. No independent BN systems exist for sewage disposal or for supplying drinking water, and hazardous waste is moved off the facility sites for disposal. Radiation sources are sealed, and no radiological emissions are expected during normal facility operations.

AMADOR VALLEY OPERATIONS (AVO)

The AVO facility in Pleasanton, California, occupies a 5,520-m² (59,445-ft²) two-story combination office/laboratory building. AVO is located near the Lawrence Livermore National Laboratory (LLNL) in Livermore, California, to simplify logistics and communications associated with BN support of LLNL programs. Although most of the work has been in support of NTS underground weapons testing, AVO also supports LLNL with optical alignment systems and a variety of mechanical and electrical engineering activities associated with energy research and development programs. Areas of environmental interest include two small chemical cleaning operations.

SPECIAL TECHNOLOGIES LABORATORY (STL)

STL is located in Santa Barbara, California. The current facilities occupy approximately 4,608 m² (49,600 ft²) and consist of combination office/lab areas used primarily for engineering and electronic research. The research is conducted to develop a



LAS VEGAS AREA OPERATIONS (LVAO)

The LVAO includes the North Las Vegas Facility (NLVF) and the Remote Sensing Laboratory (RSL) on the NAFB in North Las Vegas, Nevada. These facilities provide technical support for the DOE/NV activities.

The NLVF includes multiple structures totaling about 53,820 m² (585,000 ft²). At the facility there are numerous areas of environmental interest, including metal finishing operations, a radiation source range, an X-ray laboratory, solvent and chemical cleaning operations, small amounts of pesticide and herbicide application, photo laboratories, and hazardous waste generation and accumulation.

The RSL is an 11,000-m² (118,000-ft²) facility located on a 14-ha (35-acre) site within the confines of the NAFB. The facility includes space for aircraft maintenance and operations, mechanical and electronics assembly, computer operations, photo processing, a light laboratory, warehousing, and emergency operations. Areas of environmental interest are photo processing, aircraft maintenance, and operations.

LOS ALAMOS OPERATIONS (LAO)

The LAO resides in a facility of approximately 4,645 m² (50,000 ft²). It is a two-story combination engineering laboratory office complex located near the Los Alamos National Laboratory (LANL) facility to provide local support for LANL's programs. The work performed includes direct support to the LANL Science-Based Stockpile Stewardship program, the DOE Research and Development Program, and miscellaneous DOE cash-order work. LAO's primary activities are twofold: the design, fabrication, and fielding of data acquisition systems used in underground and above ground testing diagnostics; and the analysis

of data from prior experiments. Areas of environmental interest include small solvent cleaning, metal machining operations, and a small photo laboratory.

WASHINGTON AERIAL MEASUREMENTS OPERATIONS (WAMO)

The WAMO, located at Andrews Air Force Base, consists of five buildings: a 186-m² (2,000-ft²) Butler building used as office space; a 1,110-m² (12,000-ft²) hangar, combination electronics laboratory, aircraft maintenance, and office complex; a 37-m² (400-ft²) equipment service and storage building; and 186 m² (2,000 ft²) in each of two other joint tenant buildings. WAMO operations provide an effective east coast emergency response capability and an eastern aerial survey capacity to the DOE/NV. Areas of environmental interest include minor solvent cleaning operations, used fuels, and oils.

2.3 NON-NTS UNDERGROUND TEST SITES

In past years, nuclear explosive tests were conducted for a variety of purposes at eight different non-NTS sites in the U.S. The events and their locations appear in Table 2.1 (AEC 1964, 1965, 1966, 1970, 1972, 1973a, 1973b)(DOE 1978, 1984, 1986)(PHS 1966). Those that were not sampled in 1996 are indicated. Activities at these locations generally are limited to annual sampling of surface and groundwater at over 200 wells, springs, etc., at locations near the sites where tests were conducted. However, a Remedial Investigation/Feasibility Study has begun at the Mississippi test location which will include significant new characterization activities. Sampling near three test sites on Amchitka Island, Alaska, occurs only periodically. Sampling results for these sites appear in Chapter 9 of this report.

Table 2.1 Non-NTS Nuclear Underground Test Sites

<u>Event Name</u>	<u>Location</u>	<u>Purpose</u>	<u>Date of Test</u>
GNOME	Carlsbad, New Mexico	Multi-purpose in salt	12/10/61
SHOAL	Fallon, Nevada	Test detection research	10/26/63
SALMON (Dribble)	Hattiesburg, Mississippi	Test detection research	10/22/64
LONG SHOT ^(a)	Amchitka Island, Alaska	Test detection research	10/29/65
STERLING (Dribble)	Hattiesburg, Mississippi	Test detection research	12/03/66
GASBUGGY	Farmington, New Mexico	Gas stimulation experiment	12/10/67
FAULTLESS	Central Nevada, Nevada	Seismic calibration	01/19/68
RULISON	Grand Valley, Colorado	Gas stimulation experiment	09/10/69
MILROW ^(a)	Amchitka Island, Alaska	Seismic calibration	10/02/69
CANNIKIN ^(a)	Amchitka Island, Alaska	Spartan missile warhead test	11/06/71
RIO BLANCO	Rifle, Colorado	Gas stimulation experiment	05/17/73

(a) Not sampled in 1996.

3.0 COMPLIANCE SUMMARY

Environmental compliance activities at the Nevada Test Site (NTS) during calendar year 1996 (CY96) involved the permitting and monitoring requirements of numerous state of Nevada and federal regulations. Primary activities included the following: (1) National Environmental Policy Act (NEPA) documentation preparation; (2) Clean Air Act (CAA) compliance for asbestos renovation projects, radionuclide emissions, and state air quality permits; (3) Clean Water Act (CWA) compliance involving state wastewater permits; (4) Safe Drinking Water Act (SDWA) compliance involving monitoring of drinking water distribution systems; (5) Resource Conservation and Recovery Act (RCRA) management of hazardous wastes; (6) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) reporting; and (7) TSCA management of polychlorinated biphenyls. Also included were pre-activity surveys to detect and document archaeological and historic sites on the NTS. Compliance with the Endangered Species Act (ESA) involved conducting pre-operation surveys to document the status of state of Nevada and federally listed endangered or threatened plant and animal species. There were no activities requiring compliance with Executive Orders on Flood Plain Management or Protection of Wetlands.

Throughout 1996, the NTS was subject to several formal compliance agreements with regulatory agencies, including: a Programmatic Agreement with the Nevada Division of Historic Preservation and Archaeology and the Advisory Council on Historic Preservation; the U. S. Fish and Wildlife Service (USFWS) for protection of the desert tortoise; a Memorandum of Understanding with Nevada covering releases of radioactivity; a Federal Facilities Agreement and Consent Order (FFACO) with Nevada; Agreements in Principle with Nevada and Mississippi covering environment, safety, and health activities; and a Settlement Agreement to manage mixed transuranic (TRU) waste. Emphasis on waste control and minimization at the NTS continued in 1996.

In June 1994, the state of Nevada filed a Complaint for Declaratory Judgement and Injunction against the U.S. Department of Energy (DOE). This action seeks a judgement that DOE has failed to comply with NEPA requirements at the NTS. In January 1995, three of the claims in this case were dismissed by the U.S. District Court, the remainder are yet unresolved.

Compliance activities at the DOE Nevada Operations Office (DOE/NV) non-NTS facilities involved the permitting and monitoring requirements of (1) the CAA for airborne emissions, (2) the CWA for wastewater discharges, (3) SDWA regulations, (4) RCRA disposal of hazardous wastes, and (5) hazardous substance reporting. Waste minimization efforts continued at all locations.

3.1 COMPLIANCE STATUS

NATIONAL ENVIRONMENTAL POLICY ACT

Section 102 of the NEPA of 1969 requires all federal agencies to consider environmental effects and values and reasonable alternatives before making a decision to implement any major federal action which may have a significant impact on the human environment.

Since November 1994, DOE/NV has had full delegation of authority from DOE

a toll free number and post office box were established to receive comments. The public comment period closed on May 3, 1996. Public comments were addressed, and the draft EIS revised and approval to publish the final EIS was granted in August 1996. The final EIS distribution occurred in October 1996. The Record of Decision was published in December 1996.

Some effort was also expended on the following EISs or Programmatic EISs (PEIS) during 1996:

- (1) Waste Management PEIS.
- (2) Stockpile Stewardship and Management PEIS.
- (3) Storage and Disposition of Weapons-

Item	Compliance Status	Notes
1	Compliant	
2	Compliant	
3	Compliant	
4	Compliant	
5	Compliant	
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100	Compliant	

airborne. For HTO vapor diffusing from the RWMS-5, plutonium particulate resuspension from Areas 3 and 9, and various other areas on and near the NTS, the airborne effluents were conservatively estimated as follows. The monitoring station with the maximum annual average concentration for the radionuclide in question was selected from among the surrounding sampling stations. An effective

NTS air quality permits limit particulate emissions to 20 percent opacity, with the exception of one permit which limits opacity to 10 percent. Certification of personnel to perform visible emission opacity evaluations is required by the state, with recertification required every six months. During 1996, two Bechtel Nevada (BN) Environmental Compliance Department personnel and operational personnel were certified and/or

Alamos Operation (LAO), and (6) the Washington Aerial Measurements Operation (WAMO).

Air quality operating permits were required for three of the six non-NTS operations. There were no effluent monitoring requirements associated with these permits. Compliance for each of these specific permits is discussed below. Nineteen emission units at the Las Vegas Area Operation (LVAO), which includes the NLVF and the RSL, were regulated during 1996

Pollution Control Act (NRS 445.131 - 354). The state of Nevada also regulates the design, construction, and operation of wastewater collection systems and treatment works. Wastewater monitoring at the NTS was limited to sampling wastewater influents to sewage lagoons and containment ponds.

State general permit GNEV93001, which regulates the ten usable sewage treatment facilities on the NTS, was issued by the Nevada Division of Environmental Protection

September 3, 1996, by BN Nonradioactive Waste Section staff. Sewage was found flowing from a manhole located downgradient and northeast of Building 12-5 at an approximate rate of one gallon per minute. The discharge extended around 1,500 ft (457 m) from the manhole, crossing an unpaved road twice before dissipating on its north side. The partial blockage was probably caused when recent flows, containing excessive solids and previously deposited solids within the system were transported to an area in the collection system which was constructed with turns greater than 45 degrees within 100 ft (30 m). This collection system, which is intermittently used, will be flushed before future sewage flows are initiated in an attempt to prevent blockages and discharges.

Two of six primary aerated sewage lagoons at the Area 23 facility were taken out of service on February 21, 1996, to reduce operation and maintenance costs. A review of the influent flow rates for the previous CY revealed that less than 100,000 gal (379 m³) per day as 30-day averages were being received. This facility still has supplemental capacity for existing flows, since it has a design flow of 227,000 gal. (860 m³) per day with all six aerated ponds in service. A third aerated pond was taken out of service in July 1996, as average flow rates less than 90,000 gal (341 m³) per day were recorded for the first and second calendar quarters of 1996.

Permanent closure of the Area 2 Camp sewage lagoons was completed on May 8, 1996. This activity was performed in accordance with directions contained in a June 9, 1995, letter from the NDEP and an outline submitted to the NDEP on May 31, 1995. A request to remove the facility from the existing state general water pollution control permit was made in a June 6, 1996, letter to the NDEP.

An insert was installed within the three-inch parshall flume at the Area 6 Yucca Lake

facility on April 11, 1996. This installation eliminated inaccurate influent flow measurements and BOD sampling. An elevation drop was furnished at the downgradient edge of the flume to prevent submerged conditions. Depressed areas immediately upgradient and downgradient of the flume were filled to prevent accumulation of solids.

An evaluation to determine the best method of influent flow measuring and sampling at the Area 6 Los Alamos National Laboratory (LANL) Camp raw sewage lift station was initiated on June 10, 1996, and completed on September 11, 1996. Flow measuring with pump timers and constant volume sampling every two hours during a ten-hour work day was recommended to obtain accurate data at this site. Five samples will be taken beginning at 7:30 a.m. and ending at 3:30 p.m. to satisfy permit requirements. The NDEP approval for these methods was received on November 8, 1996.

State NDEP certification of as-built engineering drawings for the RWMS-5 sewage lagoons was received on August 27, 1996. This facility was incorporated into the state general water pollution control permit on that date and is now subject to all permit requirements and conditions.

Attempts to terminate the surface discharge from the U-12e Tunnel portal by the Defense Special Weapons Agency were unsuccessful. The flow rate is still averaging approximately seven gallons per minute and is directed to infiltration ponds via an above ground pipeline for disposal.

The NDEP issued an initial draft permit in July 1996, which was sent to permittees for a preliminary review.

The state of Nevada compliance personnel inspected the NTS sewage lagoons on February 12, 1996. No alleged notices of violation or administrative orders were issued for noncompliance at these facilities.

Arsenic at a concentration of 0.91 mg/L was found within the Area 6 Yucca Lake

infiltration basins in June of 1995. The general permit requires that an investigation be performed to determine the cause of any exceedance which is ten times the Nevada drinking water standard for specific inorganic constituents of infiltration basin liquids. In January 1996, a composite sample was taken and the result suggested that the 1995 sample be classified a false positive.

NON-NTS OPERATIONS

Four permits for wastewater discharges were held by non-NTS facilities. Monitoring and reporting were performed according to

residual chlorine content and coliform bacteria. Monitoring results for 1996 are discussed in Section 7.1; there were no incidents of positive coliform.

NTS potable water distribution systems are also monitored for volatile organic compounds, inorganic compounds, synthetic organic compounds, and other water quality parameters. These monitoring results are discussed in Section 7.1. Organic compounds were not detected in any NTS potable water distribution system. Nitrate, nitrite, and fluoride samples were also collected during 1996 with all of the results

Under Section 3006 of RCRA, the EPA may authorize states to administer and enforce hazardous waste regulations. Nevada has received such authorization and acts as the primary regulator for many DOE/NV facilities. The Federal Facilities Compliance Act (FFCA) of 1992 extends the full range of enforcement authorities in federal, state, and local laws for management of hazardous wastes to federal facilities, including the NTS. A discussion of actions regarding the FFCA at the NTS is given in Section 3.1.

NTS RCRA COMPLIANCE

In 1995, DOE/NV received a RCRA Hazardous Waste Operating Permit for operating the Area 5 Hazardous Waste Storage Unit (HWSU) and the Area 11 Explosive Ordnance Disposal (EOD) Unit. In addition, the Part B Permit application

also finalized in March 1996. Compliance with the Consent Order exempts the NTS from potential enforcement action resulting from the mixed waste storage prohibition under RCRA.

The NDEP conducted its annual Compliance Evaluation Inspection (CEI) from May-June 1996. Several minor potential violations were identified. In its cover letter transmitting the 1996 CEI report dated September 27, 1996, the NDEP stated that it would not pursue formal enforcement proceedings against DOE or BN with respect to these potential violations.

HAZARDOUS WASTE REPORTING FOR NON-NTS OPERATIONS

LVAO submitted to DOE/NV, in February 1996 for submission to the state of Nevada,

Remedial activities are planned at each site during 1997 if funding is available.

During segmentation activities of the tank removed from the Area 26 Disassembly Building (Tank 26-2201-2), a small quantity of sludge containing radionuclides was released to the concrete pad and a small area of the adjacent soil. A minor cleanup was initiated and completed. The waste is pending disposal at the Area 6 Decontamination Facility and the Area 5 TRU Pad.

NON-NTS OPERATIONS

There were no issues involving USTs at non-NTS locations during 1996.

COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT/SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA)

In April 1996, the DOE/NV Department of

SARA Title III Reports NTS Compliance

<u>EPCRA</u>	Not		
	<u>Yes</u>	<u>No</u>	<u>Required</u>
302-302: Planning Notification	x		
304: EHS Release Notification			x
311-312: MSDS/Chemical Inventory	x		
313: TRI Reporting		x	

Additional compliance activities under CERCLA/SARA for 1996 included SARA Section 312, Tier II reporting, and SARA Section 313 reporting to the state of Nevada.

In 1992, the state of Nevada combined reporting requirements for the SARA Title III, Sections 301-312 Tier II report to include information for the "Nevada Fire Marshall Division, Uniform Fire Code Materials Report." The state renamed the document the "Nevada Combined Agency Hazardous Substances Report." The 1995 Nevada Combined Agency Hazardous Substances Report for the NTS was submitted to the

DOE/NV in April 1996. There were no reportable EHS at either facility.

STATE OF NEVADA CHEMICAL CATASTROPHE PREVENTION ACT

The state of Nevada Chemical Catastrophe Prevention Act of 1992 contains regulations for facilities defined as Highly Hazardous Substance Regulated Facilities. This law requires the registration of highly hazardous substances above predetermined thresholds. There were no reportable chemicals for 1995, and therefore no reports were submitted to the state in 1996.

TOXIC SUBSTANCES CONTROL ACT

State of Nevada regulations implementing the TSCA require submittal of an annual report describing polychlorinated biphenyl (PCB) control activities. The 1995 NTS PCB annual report was transmitted to EPA and the state of Nevada on May 15, 1996. The report included the quantity and status of PCB and PCB-contaminated transformers and electrical equipment at the NTS. Also reported were the number of shipments of PCBs and PCB-contaminated items from the NTS to an EPA-approved disposal facility. Fifty-two large and five small low volume PCB capacitors remain under the management of the LANL in Area 27 of the NTS. One PCB-containing transformer was repaired and put in service at the NTS in 1996, but was later found to still contain PCBs so it was removed from service again.

FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT

Pesticide usage included insecticides, herbicides, and rodenticides. Insecticides were applied twice a month at the food service and storage areas. Herbicides were applied once or twice a year at NTS sewage lagoons berms. All other pesticide applications were on an as-requested basis.

General-use pesticides were preferred, although restricted-use herbicides and rodenticides were used. Contract companies applied pesticides at all non-NTS facilities in 1996.

Records were maintained on all pesticides used, both general and restricted. These records will be held for at least three years. State-sponsored training materials are available for all applicators. No unusual environmental activities occurred in 1996 at the NTS relating to the Federal Insecticide, Fungicide, and Rodenticide Act.

HISTORIC PRESERVATION

The National Historic Preservation Act (NHPA) requires federal agencies to consider any impact of their actions on cultural resources (archaeological sites, historic sites, historic structures, and traditional cultural properties) eligible for listing in the National Register (NR) of Historic Places. Accordingly, cultural resource surveys and other studies are conducted to assess any impacts NTS operations may have on such resources. When cultural resources eligible for the NR are found in a project area, and they cannot be avoided, plans are written for programs to recover data to mitigate the effects of the projects on these sites. Technical reports contain the results of these data recovery programs. One such report for archaeological data recovery at a site in Area 29 was completed and distributed in 1996.

The NHPA also requires that federal agencies inventory the cultural resources under their jurisdiction. In 1994, a survey of archaeological sites near four springs on the NTS was conducted. The results of this inventory were presented in a 1996 draft technical report that is in review. Additional inventory activities were conducted at rock art locations in Fortymile Canyon during May and December of 1996.

The American Indian Religious Freedom Act (AIRFA) directs federal agencies to consult

with Native Americans to protect their right to exercise their traditional religions. In 1989, the NTS AIRFA Compliance Program was established as an aid in the development and implementation of a consultation plan, designed to solicit Native

THREATENED AND ENDANGERED SPECIES PROTECTION

The ESA (Title 50 C.F.R. 17.11) requires federal agencies to insure that their actions do not jeopardize the continued existence of

transect data. These areas will not need to be surveyed prior to land-disturbing activities according to the new 1996 USFWS Biological Opinion. Results of these surveys will be analyzed and presented to the USFWS for their concurrence in 1997.

There is one bird (mountain plover [*Charadrius montanus*]) and two plant species (Clokey's eggvetch [*Astragalus oophorus* var. *clokeyanus*]), and Blue Diamond cholla [*Opuntia whipplei* var. *multigeniculata*]) which are known or expected to exist on the NTS that are candidates for listing by the USFWS under the ESA. In 1996, ten preconstruction biological surveys were conducted at proposed construction sites to determine the presence of these species. Survey results and mitigation recommendations were documented in survey reports. Field surveys to determine the presence and distribution of the two plant species on the

wetlands. NTS design criteria do not specifically address protection of wetlands; however, all projects are reviewed pursuant to the requirements of DOE Order 5400.1.

Field surveys were conducted from June through December to identify those natural NTS springs, seeps, tanks, and playas which could be designated by the U.S. Army Corps of Engineers as jurisdictional wetlands. A summary report of the survey findings will be completed in 1997.

EXECUTIVE ORDER 12856, FEDERAL COMPLIANCE WITH RIGHT-TO-KNOW LAWS AND POLLUTION PREVENTION REQUIREMENTS

Actions taken to comply with the requirements of this Order are discussed in

Under Title V, Part 70 of the CAA Amendments, all owners or operators of Part 70 sources must pay annual fees that are sufficient to cover costs of state operating permit programs. Annual maintenance and emissions fees for the NTS in 1995 were \$17,500. In 1996, the fee schedule was revised to more fairly distribute the fees to those facilities contributing the greatest amount of emissions. Annual fees for facilities generating less than 25 tons of emissions were reduced from \$3.36/ton to \$0. Annual maintenance fees for construction-related activities were reduced from \$75 per source to \$0. The total actual emissions for the NTS for 1996 were only 6.5 tons, resulting in no maintenance and emissions fees.

To offset reductions in maintenance and emissions fees, permit fees were increased. The fees for a new Class II permit, renewal, or modification were increased from \$250 to \$1,800, \$700, and \$900, respectively. A Class I permit will cost \$14,500, with fees of \$7,500 and \$1,500 for significant and minor modifications to the permit, respectively.

During a state inspection in June 1996, a Notice of Alleged Violation was issued for construction of a cement blending/holding tank at the Area 6 Cementing Services.

and the Office of Management and Budget revealed that the primary SIC code for the NLVF suggested that it was not an activity subject to those regulations. A survey report was prepared and submitted to the state of Nevada requesting a formal determination on the regulatory status of the NLVF. This is still pending.

Dewatering of septage and wintertime portable toilet waste was conducted in the Area 25 Engine Test Stand Number one sewage lagoon and two Area 12 sewage lagoon secondary infiltration basins during 1996, and will be used again in 1997 for this application.

A total of 12 active septic tank systems are in service on the NTS. Two active holding tanks which require replacement with an approved system are still in service on the NTS. Nine additional septic tank systems serve unoccupied buildings but will remain on active status unless permanently closed. Facility Managers have been informed of deficiencies noted during inspections.

Construction of the Area 23 Infiltration Basin Groundwater Monitoring Well was completed on February 27, 1996. Installation of a pump with cable and discharge piping and development of a completion report are still

A report verifying the existence of an engineered liner in the Area 12 primary sewage lagoons was submitted to the NDEP on September 6, 1996. Inspections and soil sampling activities within the lagoons revealed that a minimum six inch thick engineered liner was installed in all the primary lagoons to a vertical depth of three

secured by the lessee of the site after approval of the drawings.

The Area 25 Test Cell C will be taken out of service during the first quarter of 1997 to comply with SDWA regulations. No action will be required at the sewage lagoons to comply with the permit requirements at this

Samples from the secondary lagoon bottom could not be obtained to perform preliminary soils investigations due to the preponderance of rocks and cobbles. Experience in performing in-situ infiltration rate testing of primary lagoons at the NTS indicates that existing soils would not attain acceptable infiltration rates to represent a natural barrier caused by biological plugging. The costs of hydrogeological modeling with site-specific soil characterization and installation of a groundwater monitoring well is currently more than the costs that would be incurred by lining the primary lagoon. The wetting front may have extended beyond the realistic depths of soil sampling or vadose zone moisture monitoring. Drilling activities would be more difficult in the local rocky soils.

Construction of the RWMS-5 sewage collection system and lagoons was completed in September 1995. Engineered liners have been installed within both primary lagoons and both secondary basins to comply with the groundwater protection requirements in the state general permit. As-built certification and sewage lagoon specifications were forwarded to the NDEP for approval and addendum to the general permit. The NDEP approved these on August 27, 1996.

SAFE DRINKING WATER ACT

Engineering design has been completed on approximately 50 buildings or facilities at the NTS requiring retrofit through installation of backflow prevention devices on water service lines. These facilities require over 110 separate installations. As of the end of 1996, work has been completed on all but one of the facilities.

The state conducted a vulnerability assessment early in 1996. Because of good operation of the system, the findings of that survey resulted in specific waivers of sampling and sampling frequencies that will reduce the operating costs of the water system.

In 1995, the state implemented a requirement to sample for synthetic organic compounds (SOCs). About 98 percent of the new requirements were met and the remainder were addressed in 1996. Since all results were below the reportable concentrations, in the vulnerability assessment report, the state agreed that SOC sampling could be waived in the third and fourth quarters of 1996 and revert to a ten-year cycle.

During 1996, several system improvements were made. A booster pump and two storage tanks were installed at Well 4A in Area 6. One new storage tank was brought online at Well UE-16d and in Mercury. The overflow/drain lines for storage tanks at Wells J-11 and J-13 were rerouted to correct a previous inspection deficiency. Lastly, approximately ten miles of water line was installed between the Well 5A booster pump and the Well 4A booster pump, which thus connected the water distribution systems servicing Areas 6 and 23.

There was a sanitary survey of the water distribution systems by the Nevada Bureau of Health Service during 1996 that resulted in several recommendations and four requirements. The four identified requirements were met by the end of 1996.

COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT

Other than the reporting covered in Section 3.1, there is no formal CERCLA program at the NTS. The FFAO with the state may preclude the NTS from being placed on the National Priority List. The FFAO will take more of a RCRA approach in remediating environmental problems.

HISTORIC PRESERVATION

Historic preservation studies and surveys are conducted by the Desert Research Institute (DRI), University and Community

College System of Nevada. In 1996, 23 surveys were conducted for historic properties on the NTS, and reports on the findings were prepared. These surveys identified 24 prehistoric and historic

the NTS and NLVFs in accordance with DOE/NV and DOE/HQ requirements. This plan is a guidance document utilized to reduce waste generation and any potential pollutant releases to the environment. RN

PROCUREMENT CONTROLS

The purchase of any item that requires a Material Safety Data Sheet (MSDS), including JIT purchase requisitions, is screened by the Industrial Hygiene Section and Waste Management Project (WMP) personnel. This determines the need for the hazardous material request and the review of MSDSs for products not being purchased within the BN JIT system. These products may be approved or disapproved. The approval process relies on the health, safety, and environmental issues related to the product.

Purchase requisitions for the procurement of materials outside the JIT are reviewed by the WMP and the Industrial Hygiene Section

Freon is reclaimed, recycled, and reused, therefore eliminating ozone depleting substance emissions into the atmosphere. Service personnel are trained and certified according to Section 608 of the 1990 CAA. Approximately 35 service personnel are currently certified to operate Freon recycling equipment. Additional EPA-certified equipment has been procured to assist in the systematic changeover of DOE motor vehicles from the use of R12 to R134a. The equipment reduces the use of ozone depleting chemicals and complies with EPA requirements. Approximately 25 percent of the DOE/NV fleet has been converted from R12 to R134a.

TRAINING

with 1,1,1-trichloroethane (TCE) to clean electronic circuit boards. The TCE is an ozone-depleting chemical and known carcinogen. A state-of-the art aqueous cleaning system was purchased, which allows the introduction of an environmentally-friendlier product. This eliminated the use of 90 gal of TCE annually.

- The Aircraft Maintenance Section at the RSL has replaced Safety Kleen solvent with Voltz II. The synthetic solvent is environmentally safe and is managed as non-hazardous waste.

POLLUTION PREVENTION OPPORTUNITY ASSESSMENTS (PPOAs)

BN implements waste minimization options involving source reduction and elimination via product substitution, reuse, and recycle. These efforts reduce the total volume of hazardous, radioactive, mixed, and nonhazardous solid waste streams generated and disposed of. Waste streams are carefully reviewed to identify opportunities for reducing or eliminating the volume and toxicity of wastes generated through PPOAs.

BN implements pollution prevention options in accordance with the Pollution Prevention Act hierarchy that states the following criteria should be implemented to prevent or

meeting mission objectives poses continuing challenges and opportunities for pollution prevention to reduce future risks and costs associated with managing wastes and pollutants.

The sitewide (NTS and NLVFs) waste reduction results have come from formal processes such as PPOAs, a Return on Investment (ROI) Project, solid and liquid waste recycling, affirmative procurement, and from employees knowledgeable with processes which generate waste or use hazardous chemicals.

PPOA is a systematic, planned, and documented procedure with the objective of identifying methods that reduce energy consumption or eliminate waste streams. The technical and economical feasibility of options are evaluated, and the most promising options are selected for implementation. Options include product substitution, cross contamination control, process change (i.e., use of different equipment or procedure), and onsite recycling. PPOAs have been conducted and implemented on items listed below.

To improve the recovery and reuse of antifreeze at the NTS Fleet Operations, a recycling machine was purchased, and a closed-loop, bulk-recycling system was manufactured onsite. The recycling unit makes the process efficient. reduces

to expose and develop the associated color prints. The CVIS and the print processors and their associated waste streams were the focal point of one PPOA. The RSL's Photo/Video Section also processes

RETURN ON INVESTMENT (ROI)

The ROI program was initiated to demonstrate the economic benefit of implementing pollution prevention projects

REPORTS

The Health Hazard Inventory database

was closed on October 5, 1995, for retrofit as a Class III Site. The retrofit consisted of the installment of a barrier layer of at least four feet of native soil to aggregate the

closure report for each of these ten sites includes identification of any post-closure monitoring requirements (including future reporting of such activities) and certification that each has been closed in accordance with the approved closure plan or corrective action plan. The closure report also includes certification that the metes and bounds of the Corrective Action Sites have been appropriately noted in the land withdrawal records as "land use restricted." These ten sites are subject to post-closure monitoring (inspections) and reporting for a minimum of five years.

The eleventh Corrective Action Site, U-3aus Crater, was removed from permanent closure consideration because of its remaining unused capacity and potential for future use as a solid waste disposal site. This site has been placed in Appendix II of the FFACO.

The NTS Cleanup Project, initiated in 1994, is an activity devised to remove and dispose or recycle, where applicable, nonhazardous debris and material and readily identify hazardous debris and material. Approximately 128,700 lb of solid waste was removed from Area 2 and properly disposed of in 1996. Also, 8,988 lb of lead materials and 16,720 lb of electrical cable were delivered to the NTS Salvage Yard for recycling and reclamation. NTS cleanup activity in Area 2 will continue in 1997 as funding and manpower become available.

ENVIRONMENTAL RESTORATION/REMEDIATION ACTIVITIES

The NTS has an ongoing Environmental Restoration Program (ERP) for the characterization and restoration of contaminated facilities or areas. In 1996, characterization and restoration activities associated with the ERP included:

- Post-closure monitoring, of the Mercury Landfill Hazardous Waste Trenches RCRA Closure Unit, was conducted on a

quarterly basis for soil moisture. The covers are performing as designed with no releases occurring. Maintenance is anticipated in 1997 to seal the neutron tubes outside of the covers to prevent infiltration of water.

- Post-closure monitoring of the U-3fi Injection Well RCRA Closure Unit was conducted, on a monthly basis, for soil moisture from January to July, and quarterly thereafter, to establish a baseline. A change in the monitoring from volumetric moisture content to neutron counts was approved by the NDEP.
- Nine underground storage tanks were removed under the Environmental Restoration Program. All tank contents were removed and properly disposed, and the soil around the tanks was sampled for proper site closure.
- Closure of the Project SHOAL access shaft was completed to meet a DOE/NV milestone. The approximately 1,100-ft deep shaft was backfilled with screened granite from the existing muckpile with the concurrence of two state of Nevada regulatory divisions. The Project SHOAL area is located approximately 170 mi (274 km) northwest of the NTS.
- The Area 6 Decontamination Pond RCRA Closure Unit characterization was initiated. A ramp was constructed for drill rig access into the pond area. The characterization report, closure plan, and closure activities are planned for 1997.
- The Area 2 Bitcutter Shop and Lawrence Livermore National Laboratory (LLNL) Post Shot Containment Building Injection Wells RCRA Closure Unit were closed on September 27, 1996, to meet a DOE/NV milestone. The Bitcutter Shop injection well was closed in place without monitoring requirements. The LLNL Post Shot Containment Building Injection Well was cleaned and closed.

- The Area 25 Jr. Hot Cell disassembled materials were stored in a Radiological Management Area and monitored on a weekly basis. Attempts to locate a "party" interested in the hot cell were not successful. A sampling and analysis plan will be prepared and implemented in 1997 to evaluate potential disposal options.
- A characterization report was prepared for the Area 15 EPA Farm. Preparation of the Corrective Action Plan was temporarily halted because funding was reallocated to the Decommissioning and Decontamination activities listed next.
- Characterization of the Area 25 E-MAD Building was initiated as part of the NTS Decommissioning and Decontamination activities. Characterization and decontamination activities are anticipated to continue in 1997 for potential utilization of the facility by Kistler Aerospace.
- The Area 12 Fleet Operations Steam Cleaning Discharge Area characterization was completed. The Corrective Action Decision Document and Corrective Action Plan will be prepared and transmitted to the NDEP for concurrence during 1997. Remedial activities are planned for 1997.
- Characterization of the Area 6 Steam Cleaning Effluent Ponds RCRA Closure Unit was completed. Approximately 50 yd³ of non-hazardous hydrocarbon and 70 yd³ of hazardous soil were disposed of from the characterization activities. The Corrective Action Decision Document, Corrective Action Plan, and implementation of closure activities are planned for 1997.
- Work began in June 1996, on a process for removing plutonium contamination from the soil, at the DOUBLE TRACKS site, on the Nellis Air Force Range Complex. This activity was described in Environmental Assessment DOE/EA-1136, which had a Finding of No Significant Impact determination in March

1996. The contaminated surface soil was removed and stockpiled. The stockpiled soil was bagged and then trucked to Area 3 low-level waste site for disposal. The DOUBLE TRACKS site that was disturbed was stabilized with a short-term chemical stabilizer and reseeded in the fall as specified in the reclamation plan for the site. An irrigation study was completed at field trial plots located adjacent to the DOUBLE TRACKS site to evaluate the effectiveness of different irrigation strategies in reestablishing native plants. Information from these plots was used in designing the irrigation system and irrigation levels for the final revegetation efforts, at DOUBLE TRACKS, scheduled for winter and spring of 1997.

Also during 1996, one Corrective Action Unit under the FFACO, which described 23 abandoned lead sites at the NTS, was closed because all the lead sites were remediated; most of the material was recycled.

RADIATION PROTECTION

NTS OPERATIONS

Redesign of the environmental surveillance networks on the NTS during 1995 resulted in a reduction of monitoring costs while maintaining necessary and sufficient coverage. Results of this monitoring, during 1996, indicated full compliance with the radiation exposure guidelines of DOE Order 5400.5, "Radiation Protection of the Public and the Environment", and the Title 40 C.F.R. 141 National Primary Drinking Water Regulations. Onsite air monitoring results showed average annual concentrations ranging from 0.008 percent of the DOE Order 5400.5 guidelines for ⁸⁵Kr in air to 2.6 percent of the guidelines for ²³⁹⁺²⁴⁰Pu in air. Drinking water supplies on the NTS contained less than 0.001 percent of the DOE Order 5400.5 guideline and less than 0.004 percent of the National Primary Drinking Water Regulation for tritium. Supply wells contained 0.0 percent of the DOE Order 5400.5 guideline for ²³⁹⁺²⁴⁰Pu.

NON-NTS BN OPERATIONS

Results of environmental monitoring at the off-NTS operations performing radiological work during 1996 indicate full compliance with the radiation exposure guidelines of DOE Order 5400.5 and Title 10 C.F.R. 835. No radioactive or nonradioactive surface water/liquid discharges, subsurface discharges through leaching, leaking, seepage into the soil column, well disposal, or burial occurred at any of the BN operations. Use of radioactive materials is primarily limited to sealed sources; however,

formally tracked by BN, the successor to REECo. The assessment identified approximately 55 of these system deficiencies. As of the end of 1996, only one of the identified deficiencies remains open.

OCCURRENCE REPORTING

Occurrences are environmental, health, and/or safety-related events which are reported in several categories in accordance with the requirements of DOE Order 5000.2B, "Occurrence Reporting and

process for a sitewide EIS, dismissed Nevada's claims regarding shipment of Fernald low-level waste, and dismissed claims regarding contents of the EIS as not yet ripe for adjudication. The remaining claim is regarding disposal of low-level radioactive waste from offsite facilities, and the issue was still unsettled at the close of 1996.

DOE/NV and REECo received a notification letter regarding alleged potentially responsible party status connected with a commercial disposal site in California. The California Department of Toxic Substances Control notified DOE/NV that Omega Chemical Co., a hazardous waste treatment and storage facility which recently declared bankruptcy and is unable to clean up the site, possessed records indicating that DOE/NV had shipped hazardous waste to

the site between January 1988 and January 1992. Jurisdiction of this site has been transferred to the EPA, which has made no contact as of the close of 1996.

3.3 PERMIT SUMMARY

For facilities used in the operation and maintenance of the NTS and non-NTS facilities, the contractors providing such operation and support activities for the DOE/NV have been granted numerous permits by the appropriate regulatory authorities. In addition to the existing number of permits in 1996 (Table 3.4), the EOD Facility and the Area 5 Storage Facility of the RCRA Part B permit application were permitted, while the other units in the application are in various stages of the NDEP review for permission to construct or operate.

Table 3.1 Underground Storage Tank Activities - 1996

<u>Location</u>	<u>Tank Number</u>	<u>Action Taken</u>
Area 2, Vert. Pull Test	02-VPTF-1	Removal
Area 12, B-Tunnel	12-B-1	Removal
Area 12, Comm. Building	12-COMM-1	Removal
Area 23, Warehouse 7	23-W7-1	Removal
Area 23, Fire Station	23-425-1	Removal
Area 23, JTO Building	23-600-1	Removal
Area 25, R-MAD	25-3110-2	Removal
Area 25, E-MAD	25-3900-1	Removal
Area 26, Disassembly Building	26-2201-1	Removal

Table 3.2 NTS Recycling Activities - 1996

<u>Material</u>	<u>Quantity</u>
Office Paper	149.70 mt ^(a)
Aluminum (bulk)	314.80 mt
Aluminum cans	.90 mt
Used Motor Oil	74.40 mt
Cable	485.00 mt
Iron	3576.70 mt
Copper	201.30 mt
Batteries	326.00 mt
Tires	173.40 mt
Cardboard	.90 mt
Lead	129.00 mt

(a) metric ton (1,000 kg)

Off-NTS Recycling Activities, NLVF

Automotive Batteries	.90 mt ^(a)
Toner Cartridges	1.20 mt
SEC/High-Grade Paper	121.30 mt
Silver Recovery	.02 mt
Mixed Paper	34.60 mt
Cardboard	12.00 mt
Aluminum Cans	2.60 mt
Used Oil	1.00 mt

(a) metric ton (1,000 kg)

Table 3.3 Off-Normal Occurrences at NTS Facilities

<u>Date</u>	<u>Report Number</u>	<u>Description</u>	<u>Status</u>
03/25/96	NVOO-BNOO-NTS-1996-0004	Used oil spill (100 gal), pumper truck hose came loose	Complete
06/04/96	NVOO-BNOO-NTS-1996-0007	Petroleum Leakage from Abandoned Underground Storage Tank, Area 2	Complete
06/12/96	NVOO-BNOO-NTS-1996-0009	Radioactive Sludge released when Underground Storage Tank cut open, Area 6	Complete
09/06/96	NVOO-BNOO-NTS-1996-0014	Sewage release to ground due to clogged line, Area 12	Pending

Note: There were two historic petroleum leaks discovered on July 2, 1996, and July 23, 1996, when underground storage tanks were removed. According to new reporting guidelines, these were combined into the June 4, 1996, Occurrence Report.

Table 3.4 Environmental Permit Summary - 1996

	Air Pollution	Wastewater	Drinking Water	Number of EPA Generator User IDs	Hazardous Materials Storage Permit	Endangered Species Act
NTS	17	9	8	1 ^(a)	3	2
Las Vegas Area Operations Office	15 ^(b)	2		1 ^(a)	2	
Amador Valley Operations				1	1	
Los Alamos Operations						
Special Technologies Laboratory (Santa Barbara)	1	2		2	1	
TOTAL	33	13	8	5	7	2

(a) Biennial Report Required.

(b) Routine Monitoring of Emissions is Not Required.



4.0 ENVIRONMENTAL PROGRAM INFORMATION

The environmental monitoring and compliance programs for the Nevada Test Site (NTS) and several offsite facilities consist of radiological and nonradiological monitoring and environmental permit and operations compliance.

4.1 RADIOLOGICAL MONITORING

There are two radiological monitoring programs associated with the NTS, one onsite and the other offsite. The onsite program is conducted by Bechtel Nevada (BN), the operations & maintenance contractor for the NTS. BN is responsible for NTS environmental surveillance and effluent

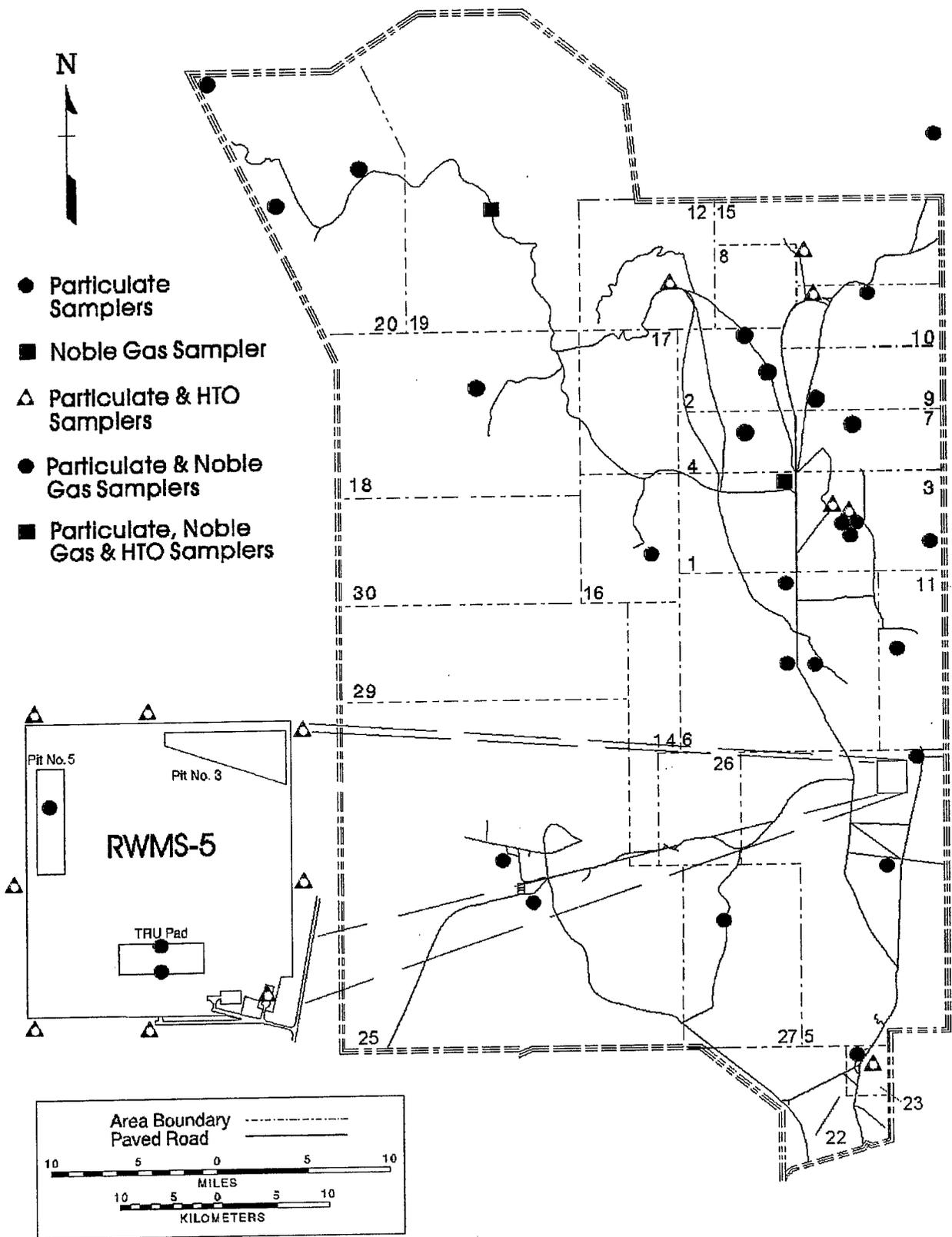


Figure 4.1 Air Sampling Stations on the NTS - 1996

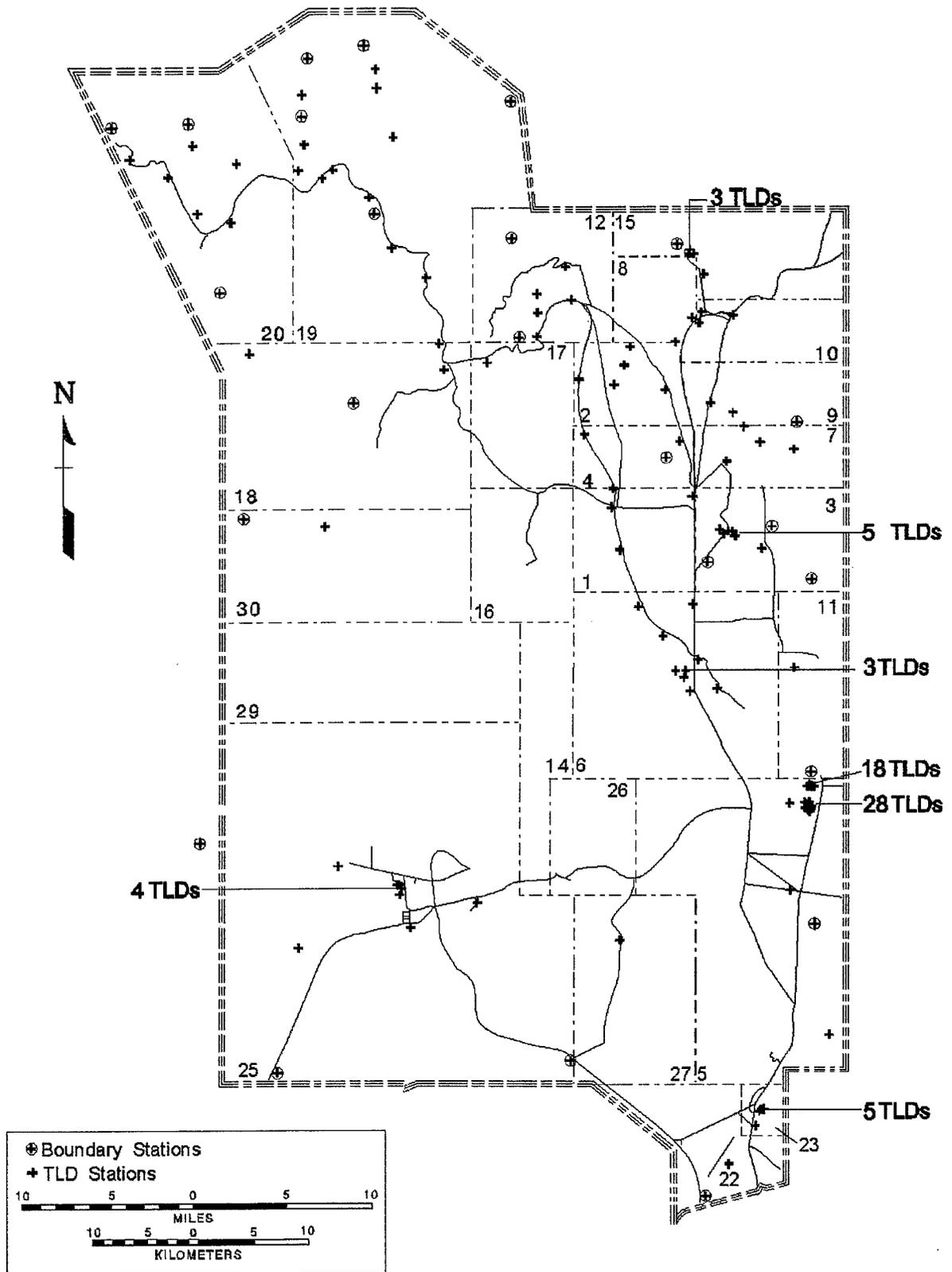
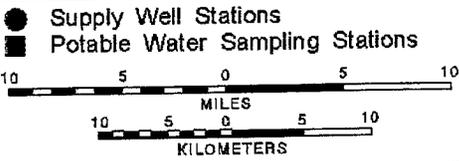
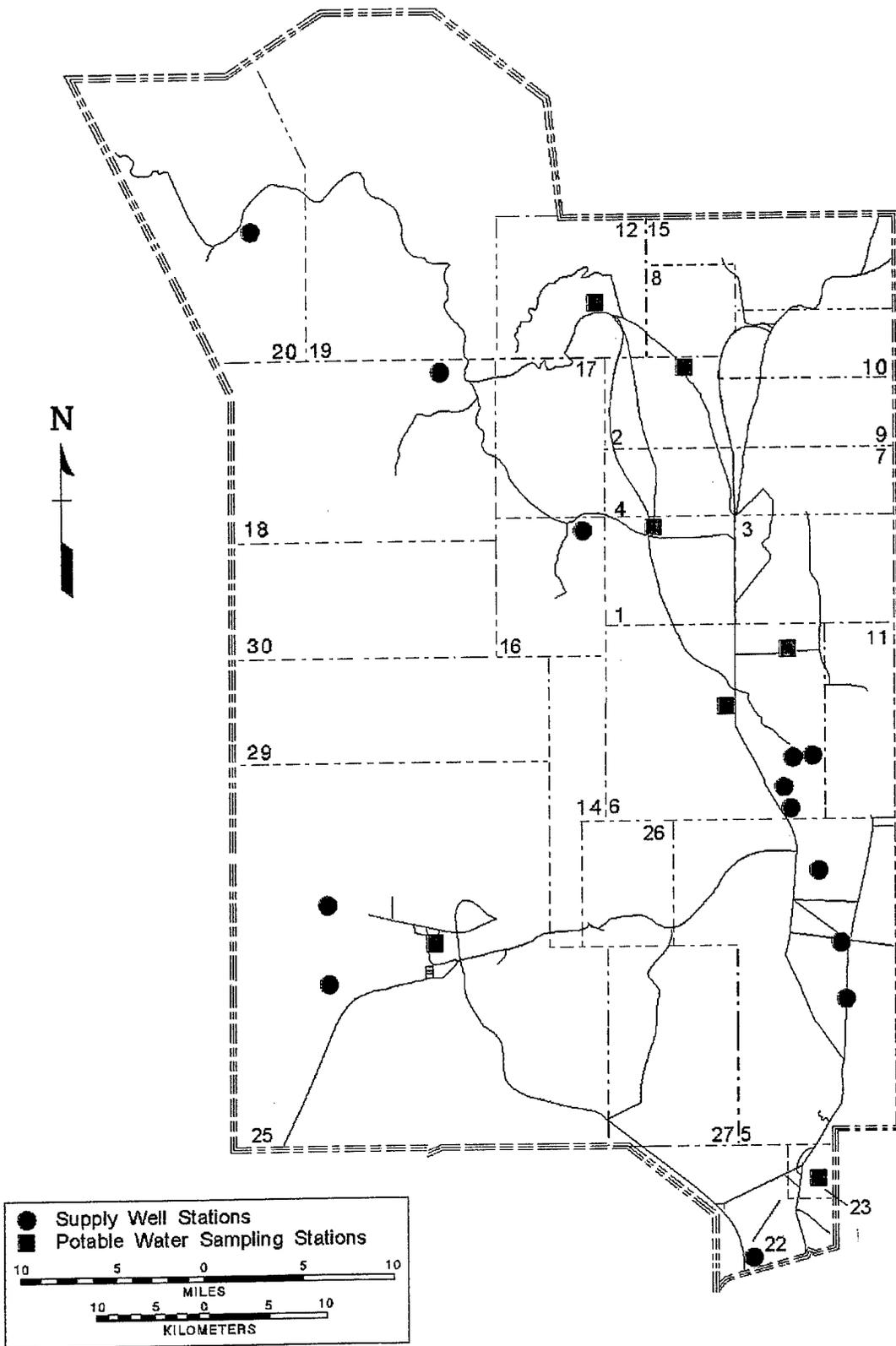


Figure 4.2 TLD Stations on the NTS (+) - 1996



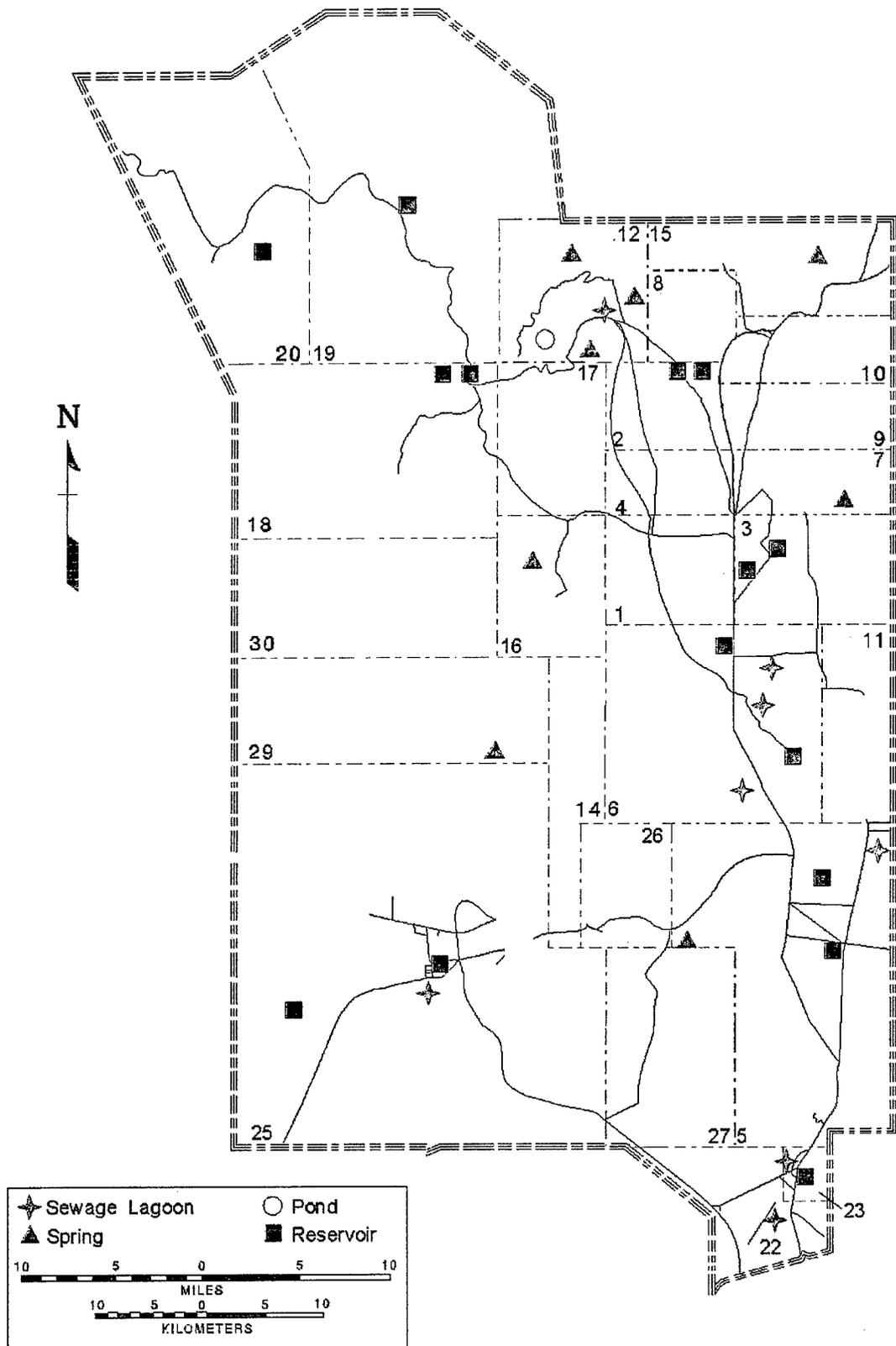


Figure 4.4 Surface Water Sampling Locations on the NTS - 1996

Order 5480.1B, "Environment, Safety, and Health Program for DOE Operations"; DOE Order 5484.1, "Environmental Protection, Safety, and Health Protection Information Reporting Requirements"; 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."

EFFLUENT MONITORING

During 1996, effluent monitoring at the NTS involved several operational facilities and some inactive locations. Due to the continuation of the moratorium on nuclear

the water depth. An average concentration of tritium in water (HTO) was used to obtain the total volume of water discharged from the characterization wells. Tritium was the only radionuclide detected in these water samples.

Typical minimum detectable concentrations for water analyses were:

- Gross α : 1.4×10^{-9} $\mu\text{Ci/mL}$ (5.2×10^{-2} Bq/L)
- Gross β : 1.2×10^{-9} $\mu\text{Ci/mL}$ (4.4×10^{-2} Bq/L)
- Gamma Spectroscopy: 0.1 to 20×10^{-7}

ENVIRONMENTAL PROGRAM INFORMATION

The noble gases were separated from the atmospheric sample by cryogenic gas fractionation. Water and carbon dioxide were removed at room temperature, and the krypton and xenon were collected on charcoal at liquid nitrogen temperatures. These gases were transferred to a molecular sieve where they were separated from any remaining gases and from each other. The krypton was transferred to a scintillation vial and counted on a liquid scintillation counter. The MDC for ^{85}Kr was $9.6 \times 10^{-12} \mu\text{Ci/mL}$ (0.33 Bq/m^3).

Airborne HTO vapor was initially monitored at 16 locations throughout the NTS, but this was reduced to 12 locations during the year. For this monitoring, a small pump continuously drew air into the sampler at approximately 0.4 L/min, the total volume being measured with a dry gas meter. The HTO vapor was removed from the air stream by a silica-gel drying column followed by a drierite column. These columns were exchanged every two weeks. Appropriate aliquots of condensed moisture were obtained by heating the silica gel. The tritium activity was then obtained by liquid scintillation counting. The MDC for HTO vapor analysis was $3.2 \times 10^{-12} \mu\text{Ci/mL}$ (0.12 Bq/m^3) of air at standard conditions.

AMBIENT GAMMA MONITORING

Ambient gamma monitoring was conducted at 169 stations within the NTS (Figure 4.2), reduced to 160 by the end of the year through use of TLDs. The dosimeter used was the Panasonic UD-814AS environmental dosimeter, consisting of four elements housed in an air-tight, water-tight, ultraviolet-light-protected case. One element, made of lithium borate, was only slightly shielded in order to measure low-energy radiation. The other three elements, made of calcium sulfate, were shielded by $1,000 \text{ mg/cm}^2$ of plastic and lead to monitor penetrating gamma radiation only. TLDs were deployed in a holder placed about one meter above the ground and exchanged quarterly. Locations were chosen at the site

boundary, where historical monitoring has occurred, or where operations or ground contamination occurred.

WATER MONITORING

Water samples were collected from selected potable tap-water points, water supply wells, natural springs, open reservoirs, sewage lagoons, and containment ponds. The frequency of collection and types of analyses performed for these types of samples are shown in Table 4.1. Sampling locations are shown on Figures 4.3 and 4.4, above.

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 ^3H analysis by liquid scintillation counting. The remainder of the original sample 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 performed by concentrating the volume and tritium content of a 250-mL sample aliquot to 10 mL by electrolysis of the basic solution and analyzing a 5-mL portion of the concentrate by liquid scintillation counting.

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

The radiochemical procedure for plutonium was similar to that described in Section 4.1. Alpha spectroscopy was used to measure any ^{238}Pu , $^{239+240}\text{Pu}$, and the ^{242}Pu tracer present in the samples.

**WASTE MANAGEMENT SITE
MONITORING**

Environmental surveillance on the NTS included Radioactive Waste Management Sites (RWMS). These sites are used for the disposal of low-level radioactive waste from the NTS and other DOE facilities. Shallow-

OFFSITE MONITORING

Under the terms of an Interagency Agreement between DOE and EPA, EPA's Office of Radiation and Indoor Air assumed responsibility for the Offsite Radiation Safety Program in areas surrounding the NTS. In

communities continued to operate. The CTLP stations contain samplers for several of the monitoring networks and are managed by local residents. The DRI is a cooperater with R&IE-LV in the CTLP.

AIR MONITORING

The inhalation of radioactive airborne particles can be a major pathway for human exposure to radiation. The atmospheric monitoring networks are designed to detect environmental radioactivity from both NTS and non-NTS activities. Data from atmospheric monitoring can be used to determine the concentration and source of airborne radioactivity and to project the fallout patterns and durations of exposure to man.

The Air Surveillance Network (ASN) was originally designed to monitor the areas within 350 km (220 mi) of the NTS. Due to the current moratorium on nuclear weapons testing, DOE began reducing the area of the offsite monitoring networks to within approximately 130 km (80 mi) of the NTS. Station location depends in part on the availability of electrical power and a resident willing to operate the equipment.

At the beginning of 1996, the ASN consisted

collect gaseous radioiodine are changed at the same time as the fiber filters. High-volume air samplers at selected stations collect particulate on 20-x 25-cm (8-x 10-in) glass-fiber filters at a flow rate of approximately 1,600 m³ (58,000 ft³) per day. Duplicate air samples are collected from two routine ASN stations each week. The duplicate samplers operate at randomly selected stations for three months and are then moved to new locations. One duplicate high-volume sampler is operated in the same manner as the duplicate low-volume sampler. High-volume samples are collected every two weeks (approximately 22,000 m³ or 800,000 ft³ of air is sampled).

At the R&IE-LV laboratory, both the glass-fiber filters and the charcoal cartridges were promptly analyzed by high-resolution gamma spectrometry. Each of the glass-fiber filters was then analyzed for gross alpha and gross beta activity 7 to 14 days after sample collection to allow time for the decay of naturally occurring radon/thoron progeny. Filters from high-volume air samplers were analyzed using high-resolution gamma spectrometry and then were composited by month for each station and analyzed for plutonium isotopes.

WATER MONITORING

As part of the I THMP R&IE-LV personnel

material. It is one of the most universally consumed foodstuff and certain radionuclides are readily traceable through the chain from feed or forage to the consumer. This is particularly true of radioiodine isotopes which, when consumed in sufficient quantities, can cause impairment of thyroid function. Because dairy animals consume vegetation representing a large area and because many radionuclides are transferred to milk, analysis of milk samples yields information on the deposition of small amounts of radionuclides over a relatively large area.

The MSN includes commercial dairies and family-owned milk cows and goats representing the major milksheds within 300 km (186 mi) of the NTS. The 11 locations comprising the MSN at the beginning of 1996 and any changes are shown in Figure 4.6. Samples were collected from only ten of these locations because the Hafen Ranch in Ivins, Utah, was not milking during the collection period.

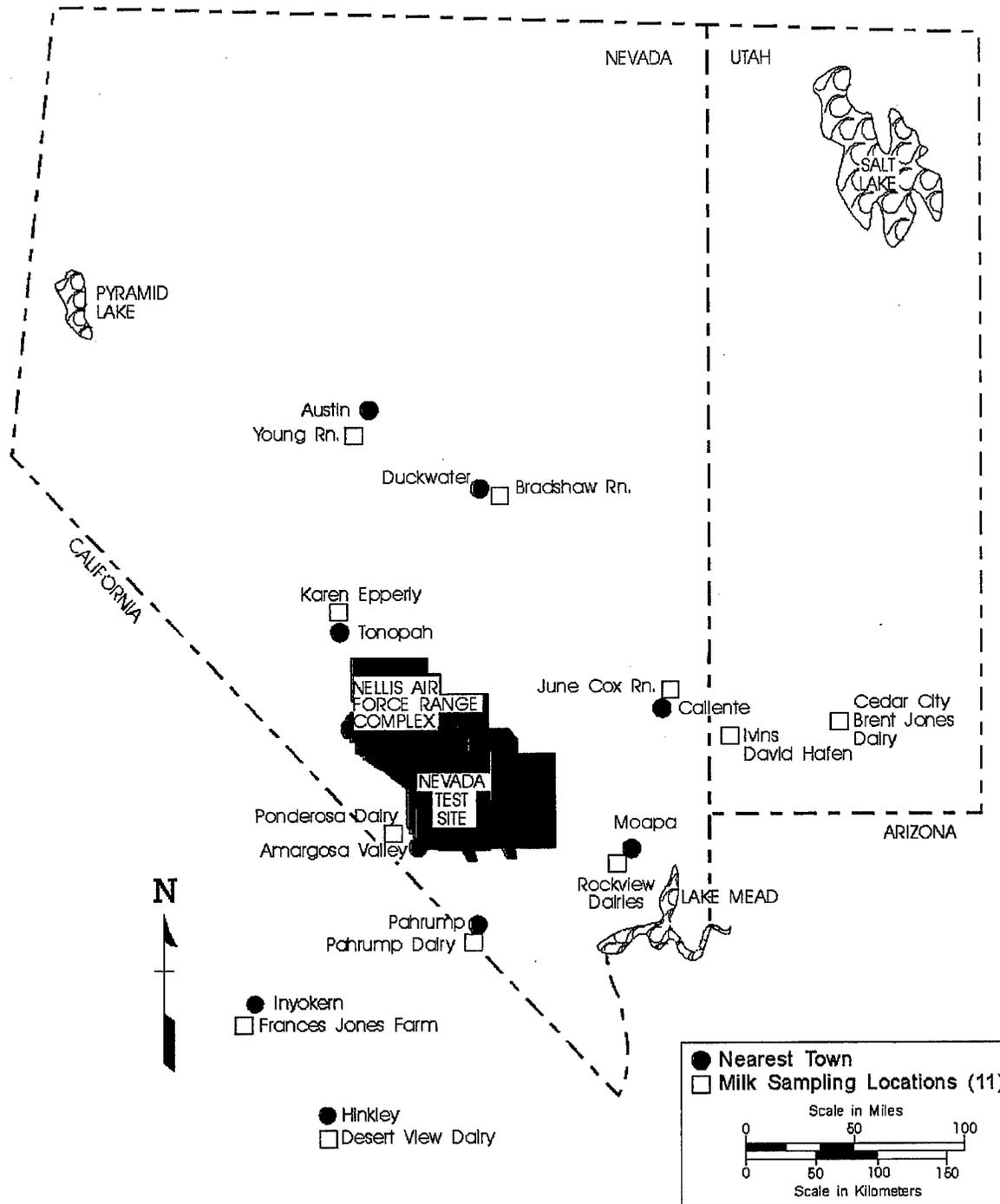
Raw milk was collected in 3.8-L (1-gal) cubitainers from each MSN location in July

exposure to ambient radiation, natural or otherwise.

The primary purpose of EPA's offsite environmental dosimetry program is to establish dose estimates to populations living in the areas surrounding the NTS. Panasonic Model UD-814 TLDs are used for environmental monitoring. The UD-814 consists of one element of $\text{Li}_2\text{B}_4\text{O}_7:\text{Cu}$ and three elements of $\text{CaSO}_4:\text{Tm}$ phosphors. The $\text{CaSO}_4:\text{Tm}$ elements are behind a filter of approximately $1,000 \text{ mg/cm}^2$. An average of the corrected values for the latter three elements gives the total exposure for each TLD. For quality assurance purposes, two UD-814 TLDs are deployed at each fixed environmental station location. The TLDs are exchanged quarterly.

In addition to a fixed environmental TLD, EPA deploys personnel TLDs to individual volunteers, predominantly CTLP station managers and their alternates, living in areas surrounding the NTS.

Panasonic Model UD-802 TLDs are used for personnel monitoring. The UD-802 consists of two elements each of $\text{Li}_2\text{B}_4\text{O}_7:\text{Cu}$ and



NOTE: When Sampling location occurred in city or town, the sampling location symbol was used for showing both town and sampling location.

Figure 4.6 MSN Stations - 1996

In 1996, the TLD program consisted of 51 fixed environmental monitoring stations and 26 offsite personnel. Henderson and Boulder City, Nevada, and Furnace Creek, California, were added to the network in the fourth quarter. Figure 4.7 shows the fixed environmental TLD monitoring stations and the location of personnel monitoring participants.

PRESSURIZED ION CHAMBER (PIC) NETWORK

The PIC network uses Reuter-Stokes models 1011, 1012, and 1013 PICs. The PIC is a spherical shell filled with argon gas at 25 times atmospheric pressure. In the center of the chamber is a spherical electrode with an electrical charge opposite to the outer shell. When gamma radiation penetrates the sphere, ionization of the gas occurs and the negative ions are collected

There are 27 PICs located in communities around the NTS and one in Mississippi, which provide near real-time estimates of gamma exposure rates. Stations at Henderson and Boulder City, Nevada, were added to the network in the fourth quarter of 1996. The PIC at Boulder City was vandalized after only five days of data collection. Another site in Boulder City is being proposed to prevent future incidents. The locations of the PICs are shown in Figure 4.5, for stations around the NTS.

INTERNAL DOSIMETRY NETWORK

This network has been discontinued, and a summary report of the program is in preparation.

COMMUNITY TECHNICAL LIAISON PROGRAM (CTLTP)

Because of the successful experience with

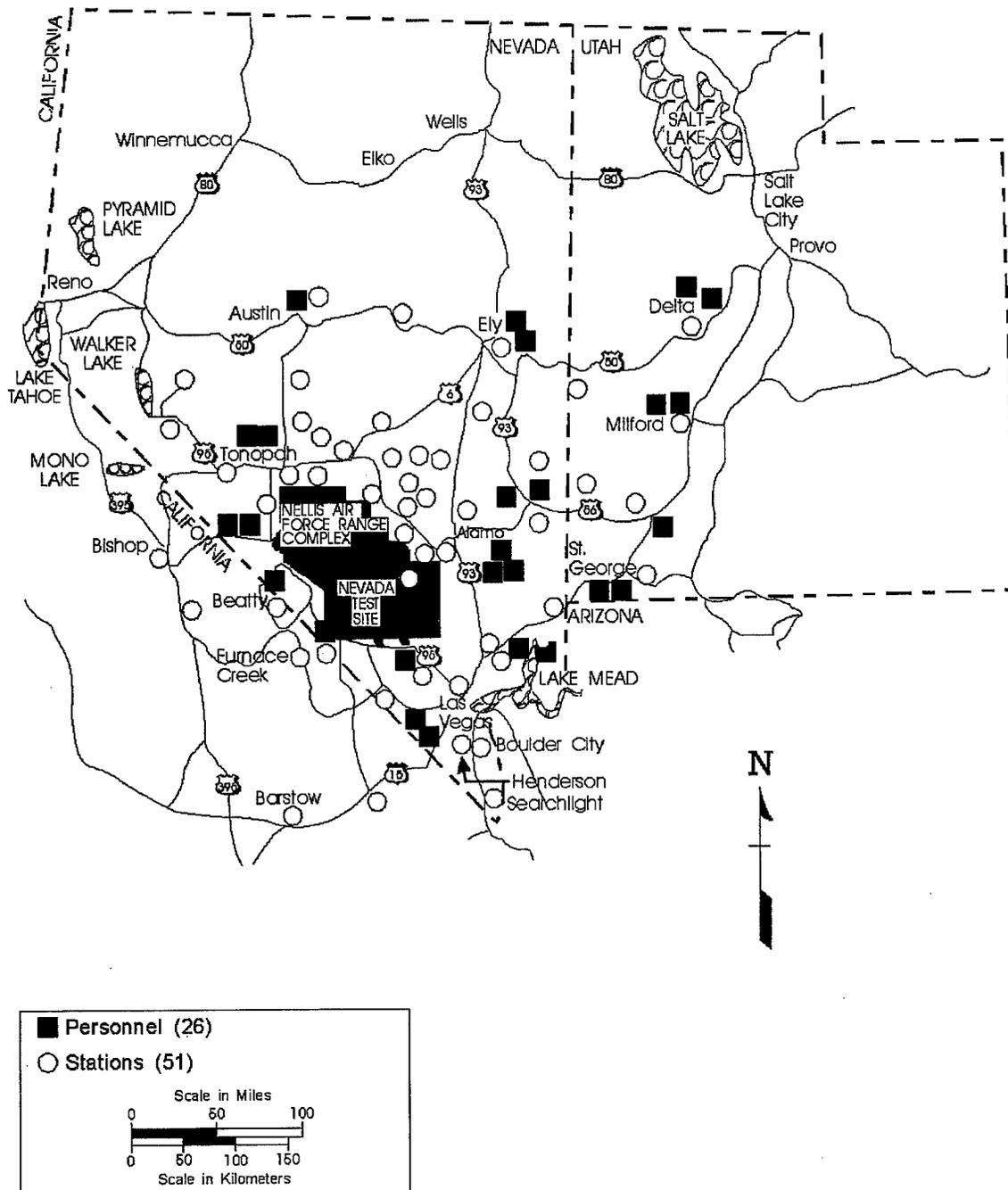


Figure 4.7 Location of TLD Fixed Stations and Personnel Monitoring Participants - 1996

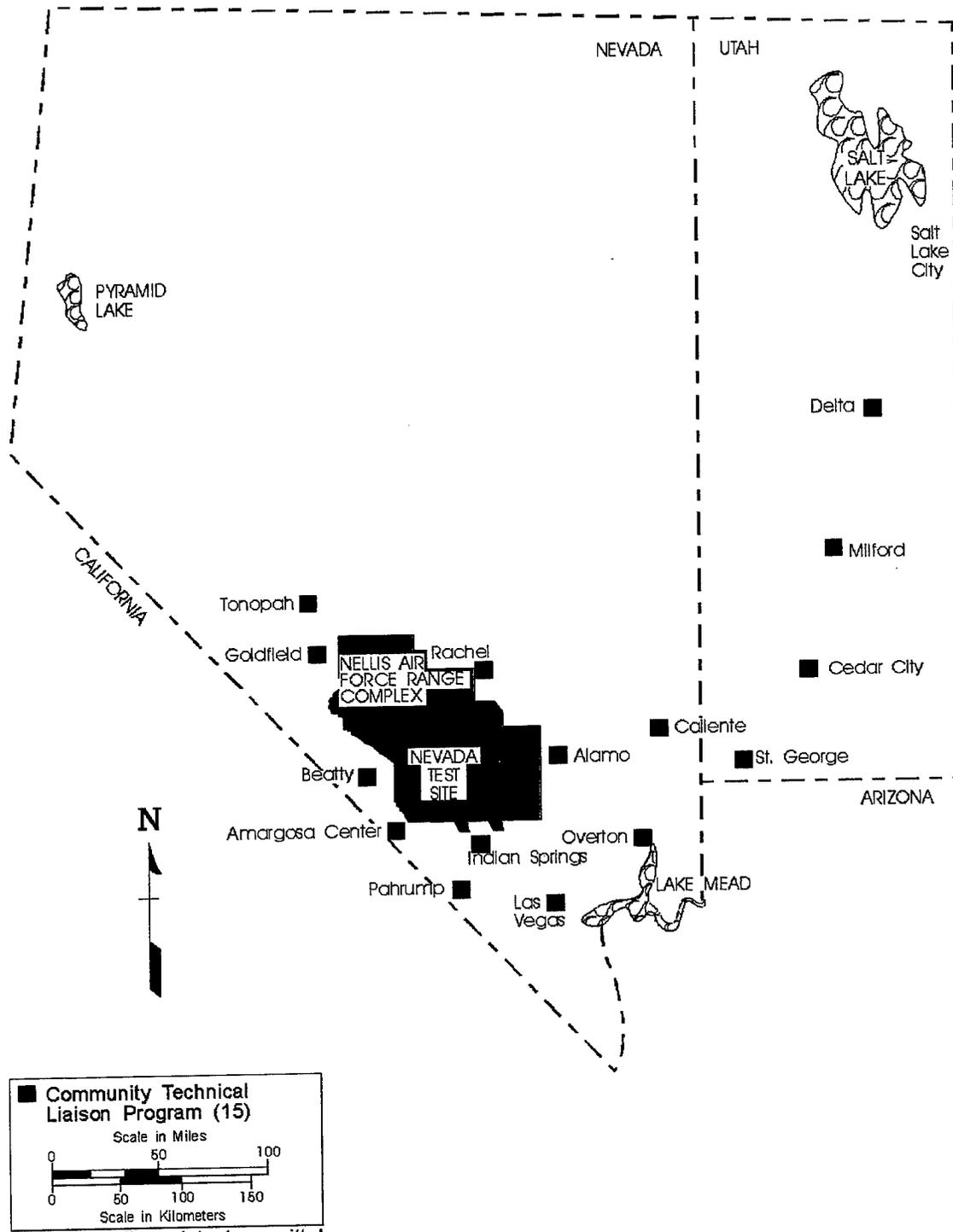
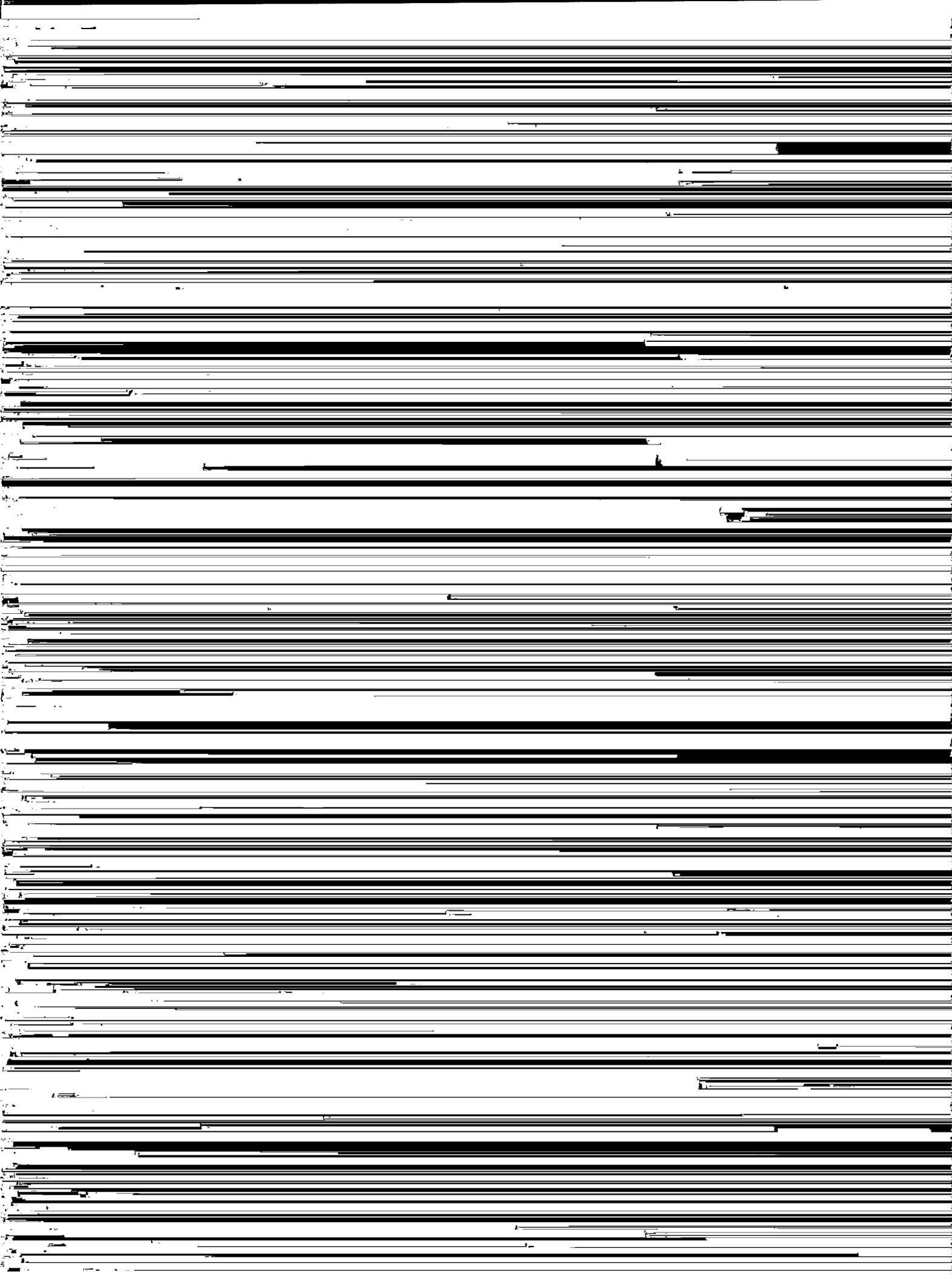


Figure 4.8 CTLP Station Locations - 1996

by DRI to the communities involved. All of the 15 CTLP stations had one of the samplers for the ASN and Noble Gas and Tritium Surveillance Network, on either routine or standby status, and a TLD. In addition, a PIC and recorder for immediate readout of external gamma exposure and a

recording barograph are located at the station. All of the equipment is mounted on a stand at a prominent location in each community so the residents can become aware of the surveillance and, if interested, can check the data. Also, computer-generated reports of the PIC data are issued monthly for each station.



monitoring was completed in May. The new program is designated as EMAC. The ecological monitoring tasks which were selected for 1996 included vegetation mapping within the range of the desert tortoise, characterizing the natural springs on the NTS, conducting a census of horse and chukar populations, and periodically monitoring man-made water sources to assess their effects on wildlife. The Environmental Assessment for the HSC (formerly the Liquefied Gaseous Fuels Spill Test Facility) calls for ecological monitoring of certain spill tests, and a monitoring plan was developed and implemented in 1996.

CHARACTERIZATION OF NTS SPRINGS

From June through December, biologists visited 25 natural water sources at the NTS to determine if these mesic habitats qualify for jurisdictional wetlands protection. These included all known springs, seeps, tanks (natural rock basins), and ephemeral ponds. The presence of wetland plants, wetland hydrology, and hydric soils (all indicators for jurisdictional wetlands) was recorded at each site. A summary report of all findings will be completed in 1997. Permits would be required under section 404 of the Clean Water Act before any alterations of the aquatic habitat could be made at any of the NTS sites which qualify as jurisdictional wetlands.

MONITORING OF MAN-MADE WATER SOURCES

Quarterly monitoring of man-made water sources began in April to identify any possible impacts of these open water sources on wildlife. These water sources include plastic-lined, cement-lined, and/or earthen sumps, containment ponds, and sewage ponds located throughout the NTS.

HSC MONITORING

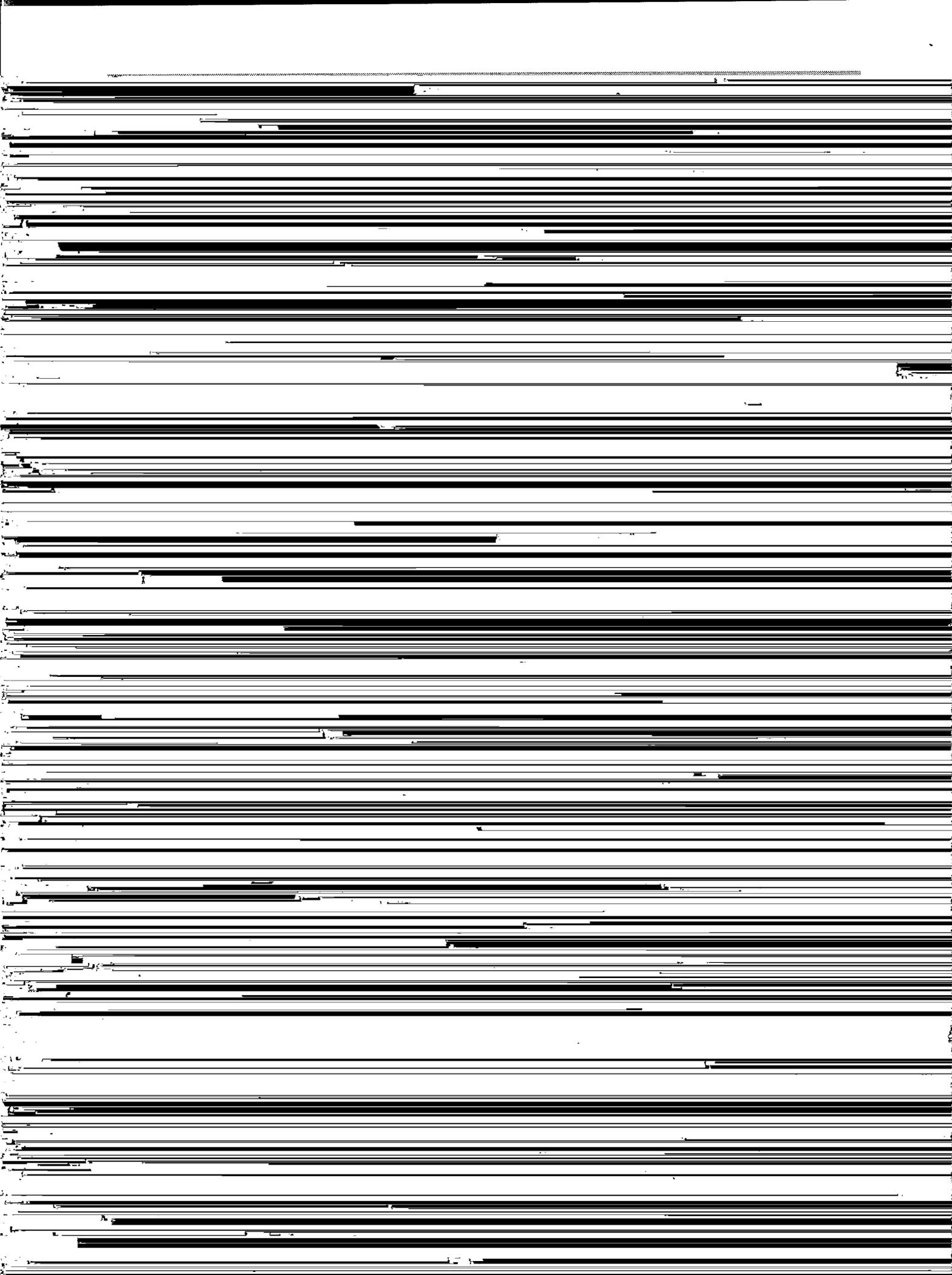
A document titled "Biological Monitoring Plan for Hazardous Materials Testing at the Liquefied Gaseous Fuels Spill Test Facility on the Nevada Test Site" was prepared in

January. Biological monitoring is prescribed in the facility's programmatic Environmental Assessment for those chemicals that have either not been tested before, not been tested in large quantities, or for which there are uncertain modeling predictions of downwind air concentrations. The monitoring plan addresses how vegetation and animals will be sampled to determine test impacts under these circumstances and to verify that the spill program complies with pertinent state or federal environmental protection legislation. The plan calls for the establishment of three spatial control transects at three distances from the chemical release point, which have similar environmental and vegetational characteristics as their treatment transect counterparts. The establishment and first sampling of these control transects are currently scheduled for the first quarter of FY97, provided funding is approved.

After approval of the monitoring plan, chemical spill test plans for three experiments were reviewed: (1) Dual Source Experiments using propane and ammonia; (2) KITFOX Add-on Experiments using dibutyl phosphate, kerosene, nitric acid, nitrobenzene, tributyl phosphate, and triethyl phosphate; and (3) KITFOX Add-on Experiment MOROC using hydrochloric acid and nitrogen dioxide. The test plans were reviewed, and it was determined that all experiments would represent minimal risk and no field biological monitoring would be required. Letters documenting these reviews were submitted to the DOE Environmental Protection Division in June and July of 1996.

OFFSITE MONITORING

The HSC was established in the Frenchman Basin in Area 5 as a basic research tool for studying the dynamics of accidental releases of various hazardous materials and the effectiveness of mitigation procedures. The HSC was designed and equipped to (1) discharge a measured volume of a hazardous fluid at a controlled rate on a



4.3 ENVIRONMENTAL PERMITS

NTS environmental permits active during 1996, which were issued by the state of Nevada or federal agencies, included 18 air quality permits involving emissions from construction operation facilities, boilers, storage tanks, and open burning; 8 permits for onsite drinking water distribution systems; 1 permit for sewage discharges to lagoon collection systems; 7 permits for septage hauling; 1 incidental take permit for the threatened desert tortoise; and 1 permit for wildlife handling and collection. RCRA Part A and Part B permit applications, based on comments made by the state of Nevada, continued during 1996.

Non-NTS permits included 16 air pollution control permits and 4 sewage discharge permits. Four EPA Generator Identification (ID) numbers were issued to three offsite operations, and four local RCRA-related permits were required at the same three operations.

AIR QUALITY PERMITS

(2) 10 tons per year or more of any one

communication. During 1996, two open burns of explosives-contaminated debris were conducted in Area 27. As the Part A and B RCRA permit applications did not include burning of explosives in Area 27, these burn activities were transferred to the Area 11 Explosive Ordnance Disposal (EOD) site that received RCRA permit approval by the state during 1995.

The open burn permit for fire and radiological emergency response training exercises was renewed in October 1996 and issued as Permit Number 97-20. Many of the restrictions in the previous permit, 96-20, were not included in the new permit. Conditions no longer shown on the new permit include the requirement to submit an annual report of training exercises, hours in which exercises must be conducted, the number of training fires to be conducted, and

Area Operations (LVAO). These permits were issued through the Clark County Health District. Annual renewal is contingent upon payment of permit fees. Permits are amended and revised only if the situation under which the permit has been issued changes. STL has one air pollution control permit. For the other non-NTS operations, no permits have been required or the facilities have been exempted. Table 4.3 lists each of the required permits.

DRINKING WATER SYSTEM PERMITS

Five NTS drinking water system permits issued by the state of Nevada, as shown in Table 4.4, 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

(ID) Number NV3890090001. The NTS continues to be regulated by the 1995 NTS RCRA Hazardous Waste Operating Permit (No. NEV HW009) for the general operation of the facility and the specific operation of the Hazardous Waste Storage Unit and the EOD Unit. Three permit modifications have occurred since October 1, 1996. These modifications include changes in the NTS Training Program and personnel changes in the Area 5 and Area 11 Emergency Management Plans. The Pit 3 Mixed Waste Disposal Unit located in the Area 5 RWMS continues to operate under RCRA Interim Status (see Table 4.7).

NON-NTS OPERATIONS

Four EPA Generator ID numbers have been issued to five non-NTS operations. In addition, three local ID numbers were required at one operation. Hazardous waste is managed at all locations using satellite accumulation areas. Three operations have centralized accumulation areas. All hazardous and industrial wastes are transported offsite to RCRA-permitted facilities for approved treatment and/or disposal.

ENDANGERED SPECIES ACT/WILDLIFE PERMITS

Federal and state permits have been issued to DOE/NV and to BN (Table 4.7). These permits are required for the conduct of DOE/NV activities in habitat of the threatened desert tortoise and for the study and collection of this threatened species and other wildlife. (All BN non-NTS facilities are located in existing metropolitan areas and are not subject to the Endangered Species Act.) Annual reports associated with these permits are filed as stipulated in each permit.

DOE/NV activities on the NTS comply with all terms and conditions of a desert tortoise incidental take authorization issued in a Biological Opinion (File Number 1-5-96-F-33) from the U.S. Fish and Wildlife Service (USFWS).

The Nevada Division of Wildlife issued a scientific collection permit to BN (Number S-12888) on January 5, 1996, for the collection and study of various species at the NTS. This permit expired on December 31, 1996.

Table 4.1 Summary of the Onsite Environmental Surveillance Program - 1996

<u>Sample Type</u>	<u>Description</u>	<u>Collection Frequency</u>	<u>Number of Sampling Locations^(a)</u>	<u>Type of Analysis</u>
Air	Sampling through	Weekly	44	Gamma spectroscopy

Table 4.2 NTS Active Air Quality Permits - 1996

<u>Permit No.</u>	<u>Facility or Operation</u>	<u>Expiration Date</u>
AP9711-0549	Area 1 Facilities: Shaker Plant Rotary Dryer Aggregate Plant Concrete Batch Plant Sandbag Facility	03/21/00
AP9711-0554	Area 6 Facilities: Cementing Equip. (silos) Decontamination Facility Boiler Diesel Fuel Tank Gasoline Fuel Tank Slant Screen	11/21/99
AP9711-0555	Area 23 Facilities: Building 753 Boiler Cafeteria Boilers (2) Diesel Fuel Tank Gasoline Fuel Tank Slant Screen NTS Surfaces Disturbances WSI Incinerator	04/14/96
AP9711-0578	Area 5 Facilities: Slant Screen	05/05/00
AP9711-0664	Navy Thermal Treatment Unit	02/23/01
AP9611-0683	DOUBLE TRACKS Surface Disturbance (TTR)	06/12/01
OP 1975 ^(a)	Area 2 Portable Stemming System	12/04/94
OP 1976 ^(a)	Area 2 Portable Stemming System	12/04/94
OP 2625	Area 5 Spill Test Facility	11/02/97
OP 2744	Area 12 Cafeteria Boiler	03/23/98
OP 2849	Area 12 Concrete Batch Plant	12/02/98
OP 2850	Area 6 Portable Field Bins	12/02/98
PC 2988	Area 3 Two-Part Epoxy Batch Plant	Varies
PC 3246	Area 3 Mud Plant	Varies
PC 3774	Area 6 Portable Stemming System	Varies
OP 96-20	NTS Open Burn - Training	10/24/96
OP 95-24	Area 4 BEEF Facility	02/29/96

(a) Permits renewal submitted.

Table 4.3 Active Air Quality Permits, Non-NTS Facilities - 1996

<u>Permit No.</u>	<u>Facility or Operation</u>	
Las Vegas Area Operation ^(a)		
A38702	Hamada Offset Press, NLVF	02/28/98
A06501	Spray Paint Booth, NLVF	02/28/98
A06505	Time Saver Aluminum Sander, NLVF	02/28/98
A06506	Abrasive Blasting, NLVF	02/28/98
A06507	Trinco Dry Blast with Dry Bag Dust Filters, NLVF	02/28/98
A38701	Spray Paint Booth, NLVF	02/28/98
A06502	Vapor Degreasers #1	02/28/98
A06503	Three Emergency Generators, and Emergency Fire Control Equipment, NLVF	02/28/98
A38703	Emergency Generator, NLVF	02/28/98
A34801	Columbia Boiler Model WL-180, Penthouse #1, RSL	02/28/98
A34802	Columbia Boiler Model WL-90, Penthouse #1, RSL	02/28/98
A34803	4.0 MM BTU Water Heater #2, RSL	02/28/98
A34804	Cummins Emergency Generator and Emergency Fire Control Pump, RSL	02/28/98
A34805	Spray Paint Booth, RSL	02/28/98
A34811	Excimer Laser, RSL	Indef.

Special Technologies Laboratory^(a)

8477	Permit to Operate a 12 Gallon Capacity Vapor Degreaser	Indef.
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(a) An annual fee is paid on these permits.

Table 4.4 NTS Drinking Water Supply System Permits - 1996

<u>Permit No.</u>	<u>Area(s)</u>	<u>Expiration Date</u>
NY-5024-12NC	Area 1	09/30/97
NY-4099-12C	Area 2 & 12	09/30/97
NY-360-12C	Area 23	09/30/97
NY-4098-12NCNT	Area 25	09/30/97
NY-5000-12NCNT	Area 6	09/30/97
NY-835-12NCNT	Sitewide Truck	09/30/97
NY-836-12NCNT	Sitewide Truck	09/30/97
NY-841-12NCNT	Sitewide Truck	09/30/97

Table 4.5 Sewage Discharge Permits - 1996

<u>NTS Permits</u>		
<u>Permit No./Location</u>	<u>Areas</u>	<u>Expiration Date</u>
GNEV93001 ^(a)	NTS General Permit	01/31/99
<u>Off-NTS Permits</u>		
Las Vegas Area Operations		
CCSD-032/Remote Sensing Laboratory ^(a)		06/30/97
VEH-112/North Las Vegas Facility ^(a)		12/31/97
Special Technologies Laboratory		
All-204/ Santa Barbara, California		12/31/98
III-331/ Santa Barbara, California		12/31/98

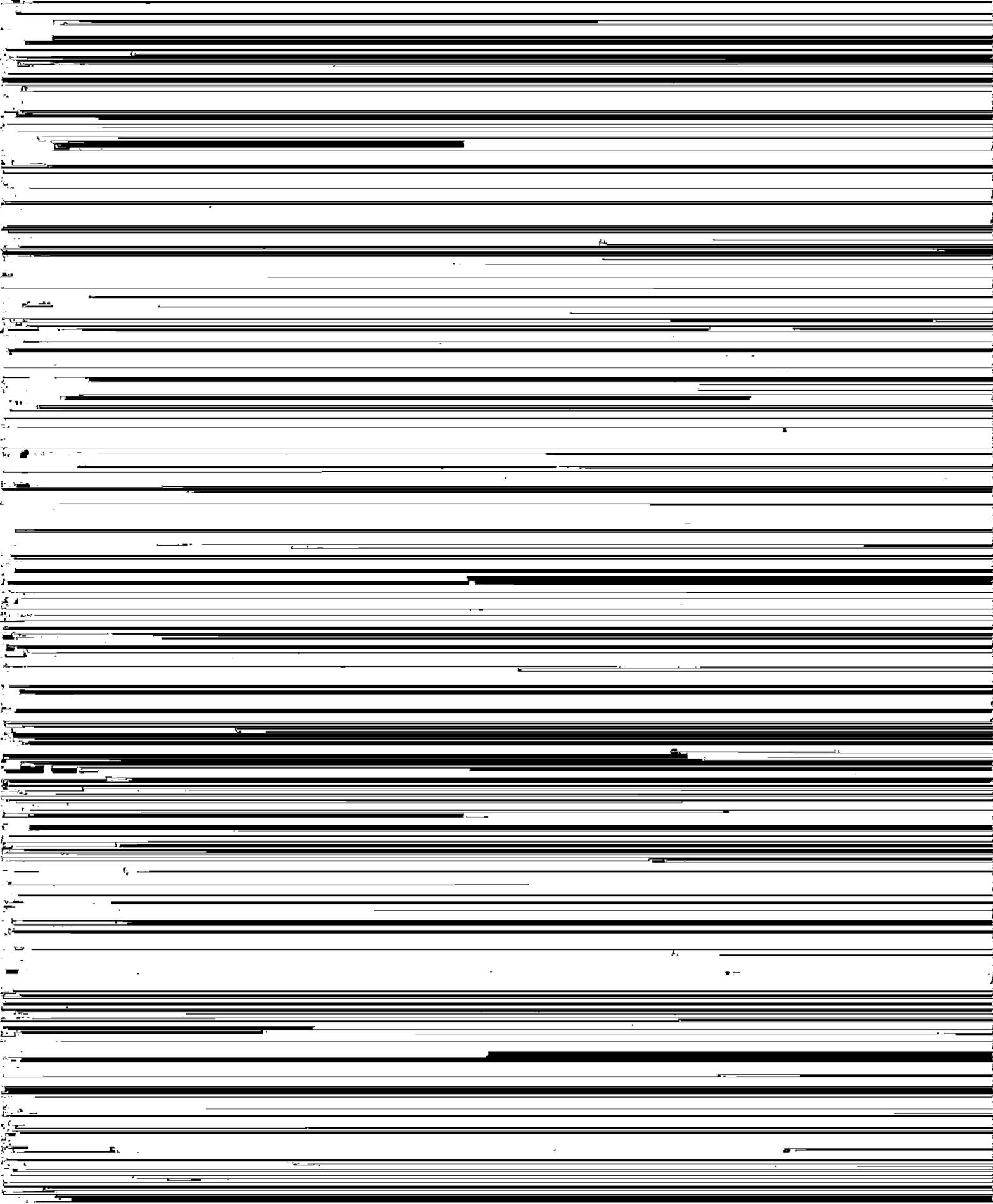
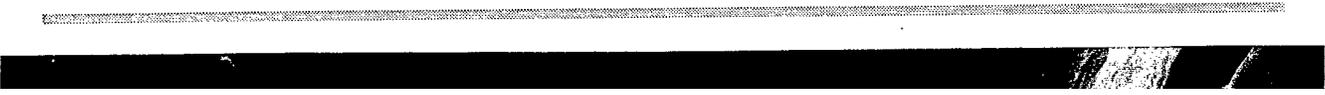
(a) Owner/Operator effluent monitoring required by permit.

Table 4.6 Permits for NTS Septic Waste Hauling Trucks - 1996

<u>Permit Number</u>	<u>Vehicle Identification Number</u>	<u>Expiration Date</u>
NY-17-03311	Septic Tank Pumper E-104573	11/30/97
NY-17-03312	Septic Tank Pumper E-104296	11/30/97
NY-17-03313	Septic Tank Pumper E-105293	11/30/97
NY-17-03314	Septic Tank Pumper E-105299	11/30/97
NY-17-03315	Septic Tank Pumper E-105919	11/30/97
NY-17-03317	Septic Tank Pumper E-105918	11/30/97
NY-17-03318	Septic Tank Pumping Subcontractor Vehicle	11/30/97

Table 4.7 Miscellaneous Permits

<u>Permit</u>	<u>Type and Purpose</u>	<u>Expiration</u>
NEV HW009	RCRA -- General NTS operation: Operation of Two Facilities	05/05/00
File 1-5-96-F-33	USFWS -- Desert Tortoise Incidental Take Authorization	08/00/06
NEV S-12888	Wildlife -- Collection and Study of Species on the NTS	12/31/96
Interim Status	RCRA Part B -- Pit 3 Mixed Waste Disposal Operation	On Permit Approval
13-94-0034-X	State Chemical Catastrophe Prevention Act Compliance	Renewal on



5.0 RADIOLOGICAL MONITORING RESULTS

Radiological monitoring results from onsite environmental programs included effluent sampling results for airborne emissions and liquid

Airborne radioactive effluents are the emissions on the NTS with the greatest potential for reaching members of the public. All radioactive liquid effluents from activities on the NTS are contained within its boundaries. For all activities on the NTS, the estimated effective dose equivalent to any member of the public from all airborne radionuclide emissions is much less than one mrem/yr. Requirements of the "National Emission Standards for Hazardous Air

Support Facilities," DOE/NV/10630-28, published in November 1991. This plan was updated in 1992 and 1993.

CHARACTERIZATION WELL EFFLUENT

As part of environmental restoration activities, the groundwater under the NTS is being characterized by drilling special wells for measuring the characteristics of NTS aquifers. In 1996, such wells were drilled

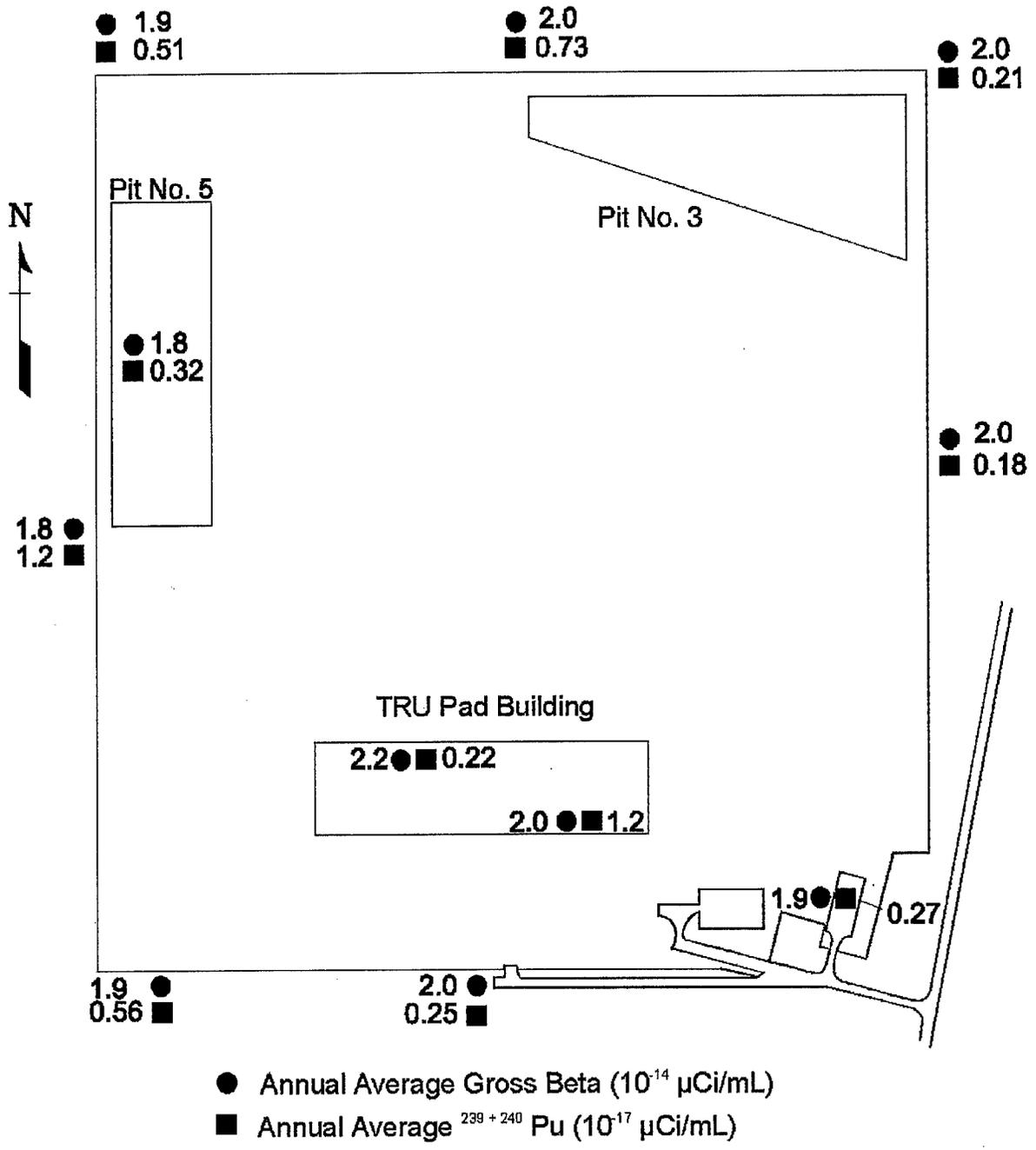


Figure 5.1 RWMS-5 Air Sampling Annual Average Results - 1996

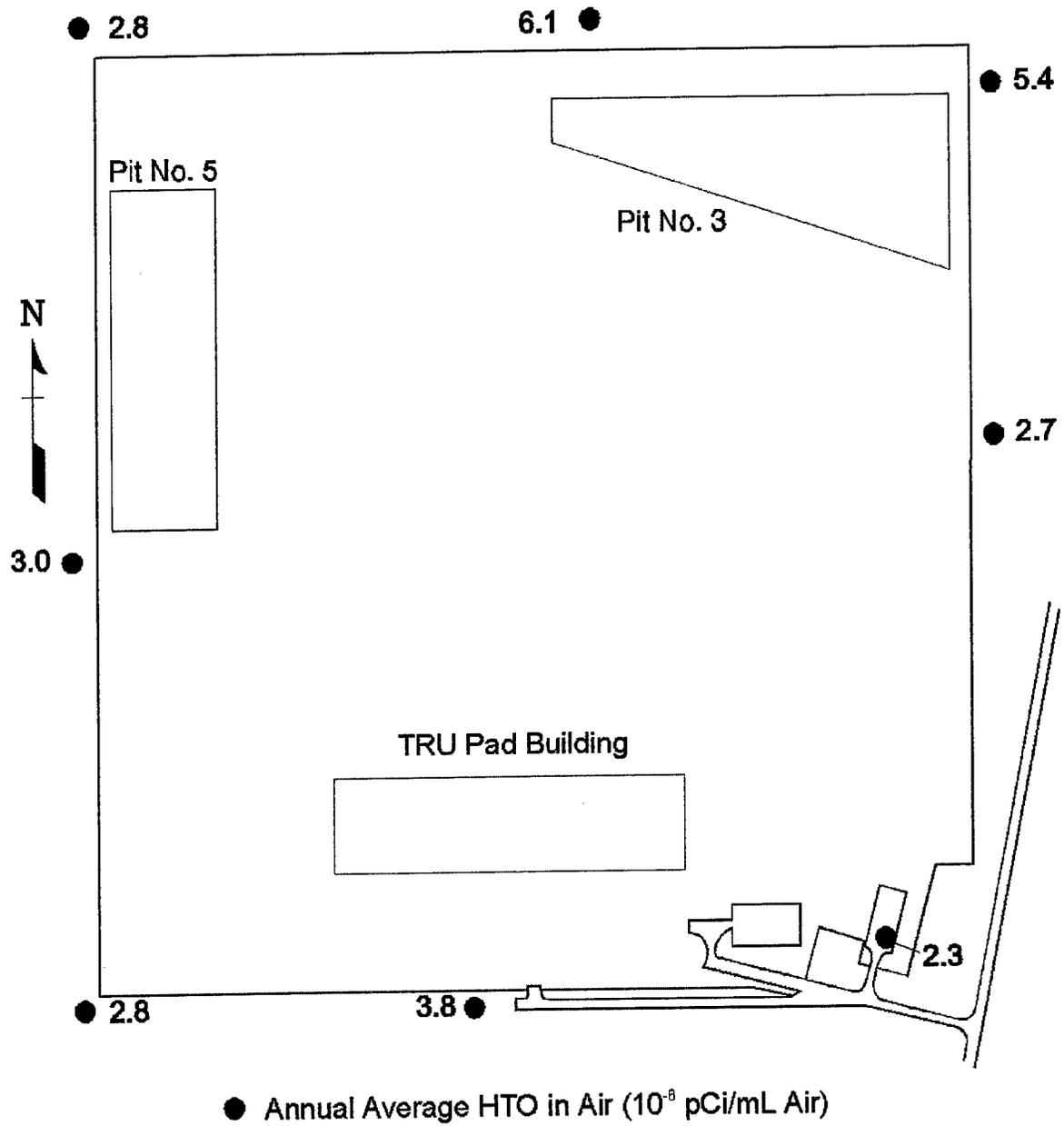


Figure 5.2 RWMS-5 HTO Annual Average Results - 1996

values are displayed in Figure 5.2. This value is less than 0.06 percent of the derived concentration guide (DCG) for HTO vapor in air.

The Area 3 RWMS (RWMS-3) is used for disposal of radiologically contaminated waste in packages that are unsuitable for disposal in the Area 5 facility. This waste is buried in subsidence craters much like waste is buried at the RWMS-5. The RWMS-3 is surrounded by four permanent particulate samplers located approximately

from water pumped from characterization wells in Area 20. Typically, all liquid discharges within the NTS have been held in containment ponds. Monthly grab samples were taken from each pond and, where possible, from the influent.

Radioactivity in liquid discharges released to the containment ponds was monitored to assess the efficacy of tunnel sealing and provide a quantitative and qualitative annual summary of the radioactivity released onsite

DECONTAMINATION FACILITY

Since no nuclear tests were conducted in 1996, only insignificant amounts of materials were treated at the Decontamination Facility

in Area 6. Until a new lined containment pond is constructed, any effluent from that facility will be captured in holding tanks and held for disposal.

5.2 RADIOLOGICAL ENVIRONMENTAL SURVEILLANCE

Onsite surveillance of airborne particulates, noble gases, and HTO vapor indicated concentrations that, with a few exceptions, were generally not statistically different from background concentrations. Tritium effluent was detectable from the low-level radioactive waste (LLW) site in Area 5 and plutonium was detectable on air samples at several locations on and off the NTS. Surface water samples collected from open reservoirs or natural springs and industrial-purpose water, exclusive of tunnel ponds, gave no indication of statistically significant contamination levels. External gamma exposure monitoring results indicated little change from 1995. A special environmental study measured tritium in water of plants collected NTS-wide. Results of offsite environmental surveillance by the EPA R&IE-LV showed that no NTS-related radioactivity was detected by the offsite monitoring networks and that there were no apparent net exposures detectable by the offsite dosimetry network.

ONSITE ENVIRONMENTAL SURVEILLANCE

At the end of 1996, the onsite radiological surveillance networks consisted of 45 air sampling stations; 3 radioactive noble gas sampling stations; 12 HTO vapor sampling stations; surface water samples from 8 open water supply reservoirs, 7 springs, 8 containment ponds plus an effluent, and 8 sewage lagoons; groundwater samples from 10 potable and 2 non-potable supply wells and 7 tap water locations; and 160 locations where TLDs measure gamma exposures. Summary tables for each of the analytes for this program are placed at the end of this chapter. Individual results for each collected sample are published separately and may be found in the "Environmental Data Report for the Nevada Test Site - 1996" (DOE/NV/11718-138, in prep.).

RADIOACTIVITY IN AIR

A total of 49 air sampling stations were operated at various times during the year.

Four stations were deleted and four new ones added, so the network ended the year with 45 stations. Solar-photovoltaic, battery-powered samplers were placed at ten locations in or near contaminated areas where commercial power was unavailable. At each of the stations, particulate samples were collected weekly on glass-fiber filters. The filters were counted for gamma and gross alpha/beta activity, composited monthly for RWMS samplers, or quarterly for the remainder of the sampling locations, and then analyzed for ^{238}Pu and $^{239+240}\text{Pu}$. Due to the lack of any sources for airborne halogens, charcoal filters were not used in the air samplers this year.

In an effort to reduce analytical costs, gross alpha analyses of collected particulate filters was begun about midyear and compared to the later plutonium analyses. In general, there was no relation between gross alpha analyses (units of 10^{-15} $\mu\text{Ci/mL}$) and $^{239+240}\text{Pu}$ analyses (units of 10^{-18} $\mu\text{Ci/mL}$). However, all gross alpha analyses were above the mean minimum detectable concentration (MDC), so this monitoring will continue until the source of the alpha activity is identified. Air monitoring for the noble gases began at

six fixed locations that were reduced to three by year's end. These air samples were collected weekly. A distillation process separated the radioactive noble gases from the sample for measurement.

HTO vapor was monitored at 16 locations on the NTS, but for only a portion of the year at five locations which were either terminated or added during the year. There were 12 sampling locations by the end of the year. Samples were collected every two weeks and analyzed for ^3H . Liquid scintillation counting was used for these measurements.

For the purpose of comparing measured quantities of airborne radioactivity to the Derived Air Concentrations (DAC), the guides for occupational exposures found in DOE Order 5480.11, and to the DCG, the guides for exposures to members of the general public found in DOE Order 5400.5, the following assumptions were made:

- The chemical species of the radionuclides detected was unknown so the most restrictive DAC or DCG was used (almost always Class Y compounds which take on the order of years to clear from the respiratory system). The DCG and DAC values used are listed in Table 5.6.
- For air sampling results, all of the gross beta activity detected was assumed to be ^{90}Sr , and the gross alpha activity was assumed to be naturally occurring uranium, thorium, and progeny.

AIR SAMPLING RESULTS

GROSS ALPHA

Figure 5.3 displays the average NTS gross alpha results for 1996. Air particulate samples were held for five to seven days prior to gross alpha/beta counting and gamma spectrum analysis, to allow for the decay of radon and radon progeny. Table 5.2 presents the network arithmetic averages, minimums, and maximums for

gross alpha in air during 1996. All results exceeded the MDC. The network 1996 annual average gross alpha concentration was $2.1 \times 10^{-15} \mu\text{Ci/mL}$ (0.08 mBq/m^3). This concentration is about 0.03 percent of the $^{239+240}\text{Pu}$ DAC listed in DOE Order 5480.11 and about 100 percent of the 10 mrem DCG in DOE Order 5400.5. A statistical evaluation of the gross alpha concentrations indicated that a lognormal distribution provides an adequate approximation to the true distribution.

GROSS BETA

Figure 5.4 displays the average NTS gross beta results for 1996, and Table 5.3 presents the network arithmetic averages, minimums, and maximums for gross beta in air. All results exceeded the MDC, except for instances where the sample volume was unusually low. The network 1996 annual average gross beta concentration was $1.8 \times 10^{-14} \mu\text{Ci/mL}$ (0.67 mBq/m^3), slightly less than in 1995. This concentration is about 0.001 percent of the ^{90}Sr DAC listed in DOE Order 5480.11 and less than 3 percent of the 10 mrem DCG in DOE Order 5400.5. A statistical evaluation of the gross beta concentrations indicated that a lognormal distribution provides an adequate approximation to the true distribution. Although the average gross beta concentration for all stations was similar to last year's, the trend of weekly averages was different, being almost sinusoidal rather than increasing gradually throughout the year.

PLUTONIUM

The composite filter samples from each particulate sampling location were analyzed for ^{238}Pu and $^{239+240}\text{Pu}$. Figure 5.5 shows the airborne $^{239+240}\text{Pu}$ annual average results for each of the sampling locations. Tables 5.4 and 5.5 list the maximum, minimum, annual arithmetic mean, standard deviation, and the mean expressed as a percentage of the DCG for each sampling location, for $^{239+240}\text{Pu}$ and ^{238}Pu , respectively. The ranges in the annual mean concentrations for ^{238}Pu and

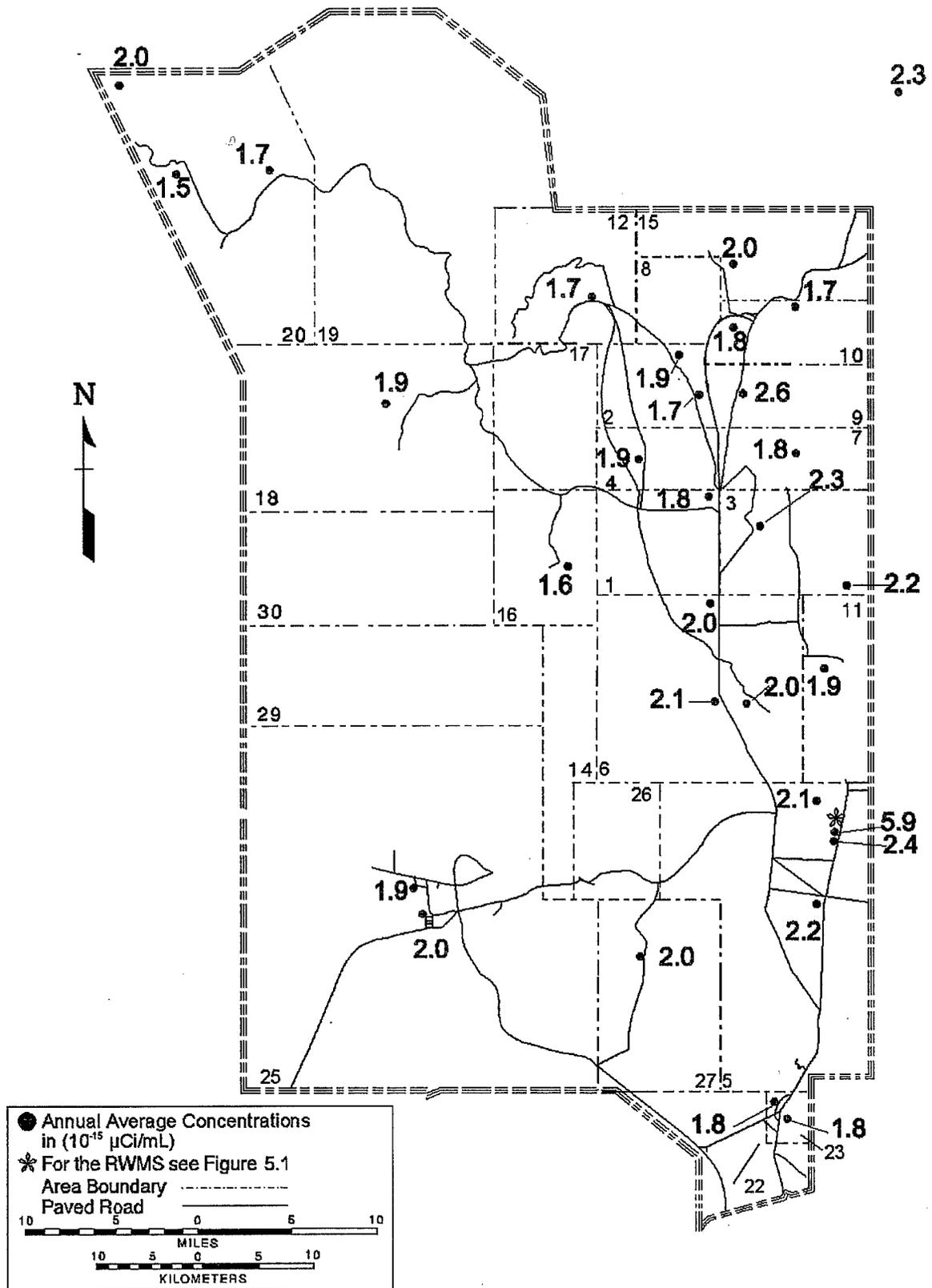
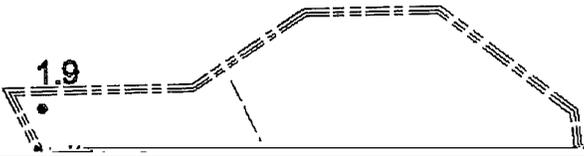


Figure 5.3 NTS Airborne Gross Alpha Annual Average Concentrations - 1996



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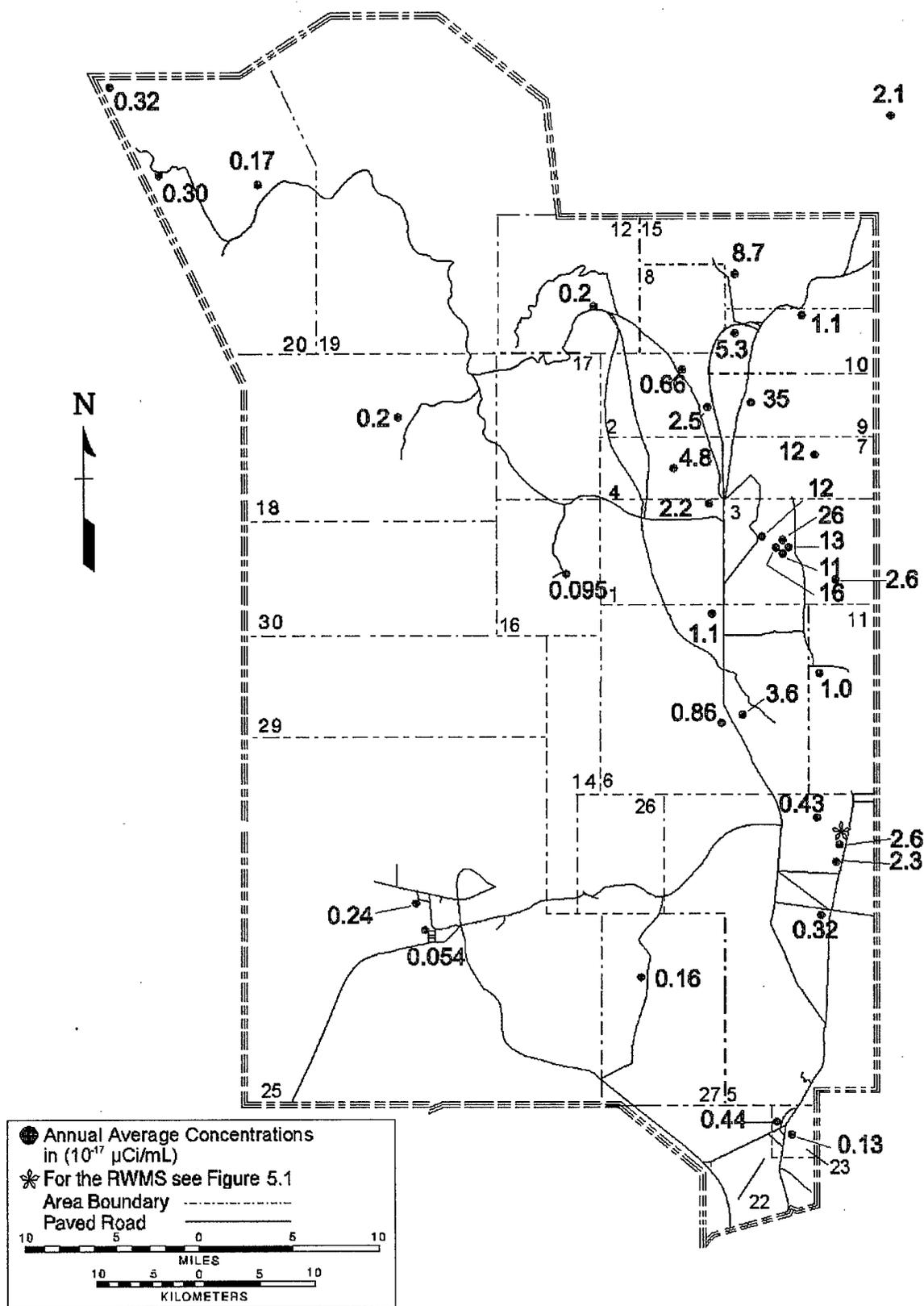


Figure 5.5 NTS Airborne $^{239+240}\text{Pu}$ Annual Average Results - 1996

$^{239+240}\text{Pu}$ for all stations were -0.018 to 1.1×10^{-17} $\mu\text{Ci/mL}$ and 0.054 to 45×10^{-17} $\mu\text{Ci/mL}$ (-0.007 to 0.41 and 0.02 to 17 $\mu\text{Bq/m}^3$), respectively. The arithmetic mean and standard deviation of ^{238}Pu in air for all stations were $(1.0 \pm 2.5) \times 10^{-18}$ $\mu\text{Ci/mL}$ (0.037 ± 0.093 $\mu\text{Bq/m}^3$). Most observed values of ^{238}Pu were well below the limit of detection. The arithmetic mean and standard deviation of $^{239+240}\text{Pu}$ in air for all stations were $(5.2 \pm 14) \times 10^{-17}$ $\mu\text{Ci/mL}$ (1.9 ± 5.2 $\mu\text{Bq/m}^3$). The network arithmetic mean for $^{239+240}\text{Pu}$ was 62 percent higher than the 1995 mean concentration, an increase that is within the statistical variation of all results.

During 1996, the maximum annual average $^{239+240}\text{Pu}$ concentration was found at the Area 52 DOUBLE TRACKS (probably due to cleanup activities) and the next highest at the Area 9 9-300 Bunker sampling locations. Results from samples taken at the DOUBLE TRACKS site averaged 45×10^{-17} $\mu\text{Ci/mL}$ (17 $\mu\text{Bq/m}^3$) during 1996. This quantity was less than 1 percent of the DAC and 23 percent of the 10 mrem DCG. Historically, the highest concentrations of $^{239+240}\text{Pu}$ have occurred in Areas 3 and 9. A statistical analysis of the $^{239+240}\text{Pu}$ results suggests that, due to the heterogeneity of the variances, the differences among the areas are not statistically significant.

The presence of plutonium on the NTS is

spectroscopy. The only radionuclides detected by gamma spectroscopy were naturally occurring in the environment (^{40}K , ^7Be , and members of the uranium and thorium series), except for traces of an event-related radionuclide, ^{137}Cs , which was detected in nine samples. The concentration of ^{137}Cs in these samples was <0.1 percent of the 10 mrem DCG.

NOBLE GAS SAMPLING RESULTS

The three locations at which compressed air samples were routinely collected throughout the year are shown in Figure 5.6 with the annual averages of the ^{85}Kr analyses. All average concentrations were well below the DCG values of 3×10^{-7} $\mu\text{Ci/mL}$ (1.1×10^4 Bq/m^3) for ^{85}Kr . Summaries of the results are listed in Table 5.7. Individual results for each collected sample are published separately and may be found in the "Environmental Data Report for the Nevada Test Site - 1996" (DOE/NV/11717-138, in prep.).

As in the past, the levels of ^{85}Kr (half-life of 10.76 years) observed in the samples were from worldwide nuclear power and fuel processing operations, with possibly a small contribution of ^{85}Kr from underground nuclear tests conducted at the NTS. Xenon-133 analyses were not done this year, because its short half-life of 5.27 days and

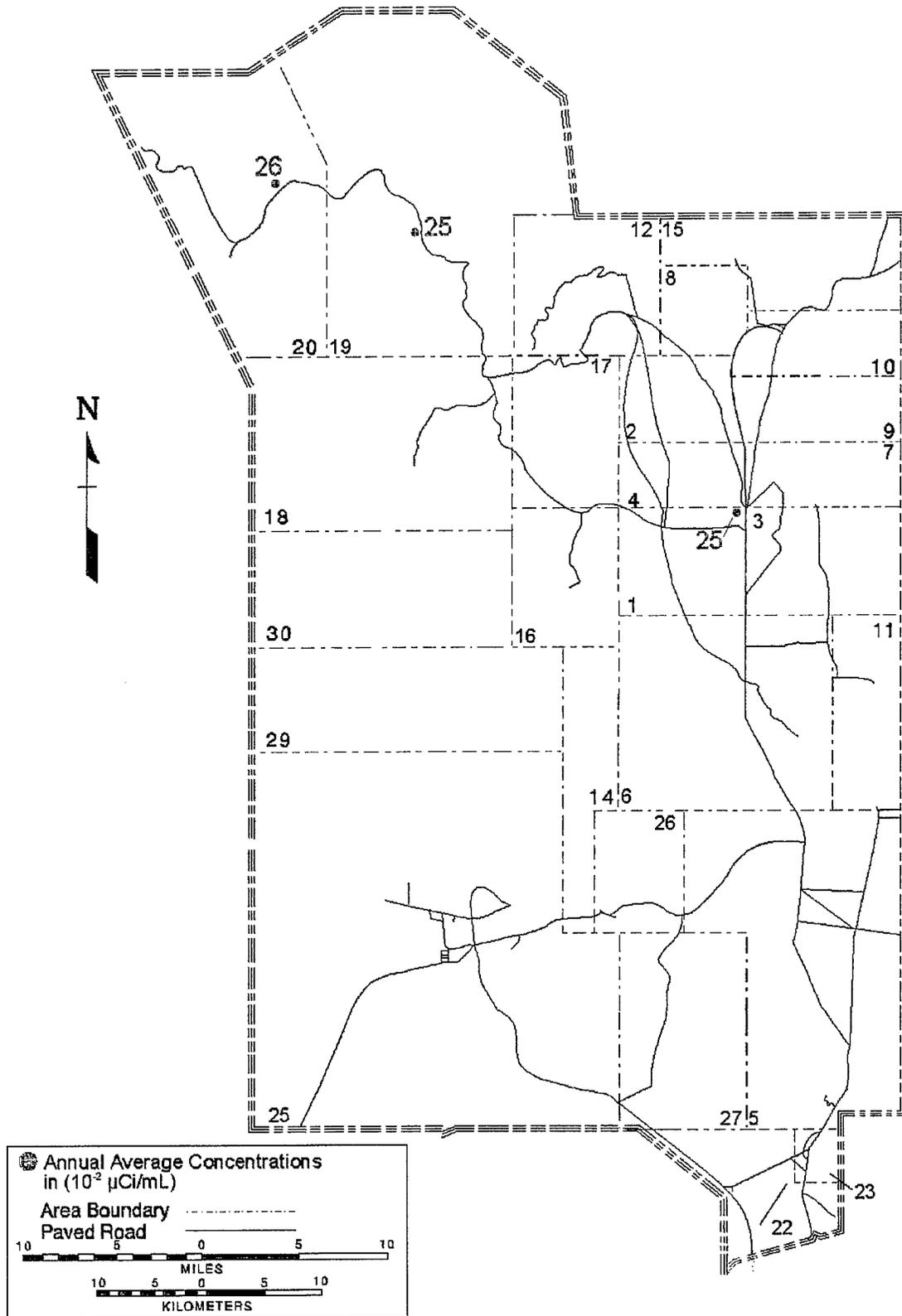


Figure 5.6 NTS ^{85}Kr Annual Average Concentrations - 1996



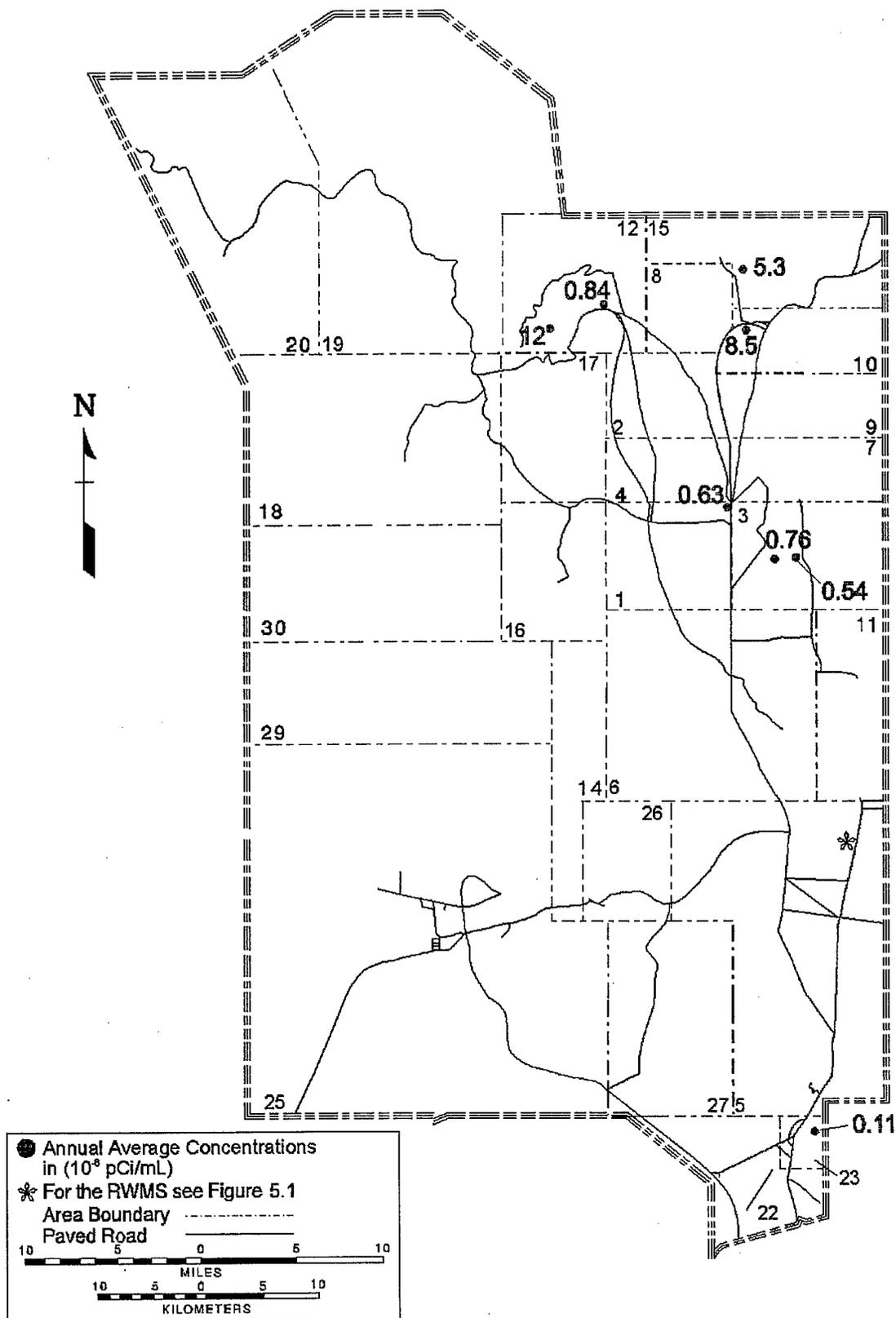
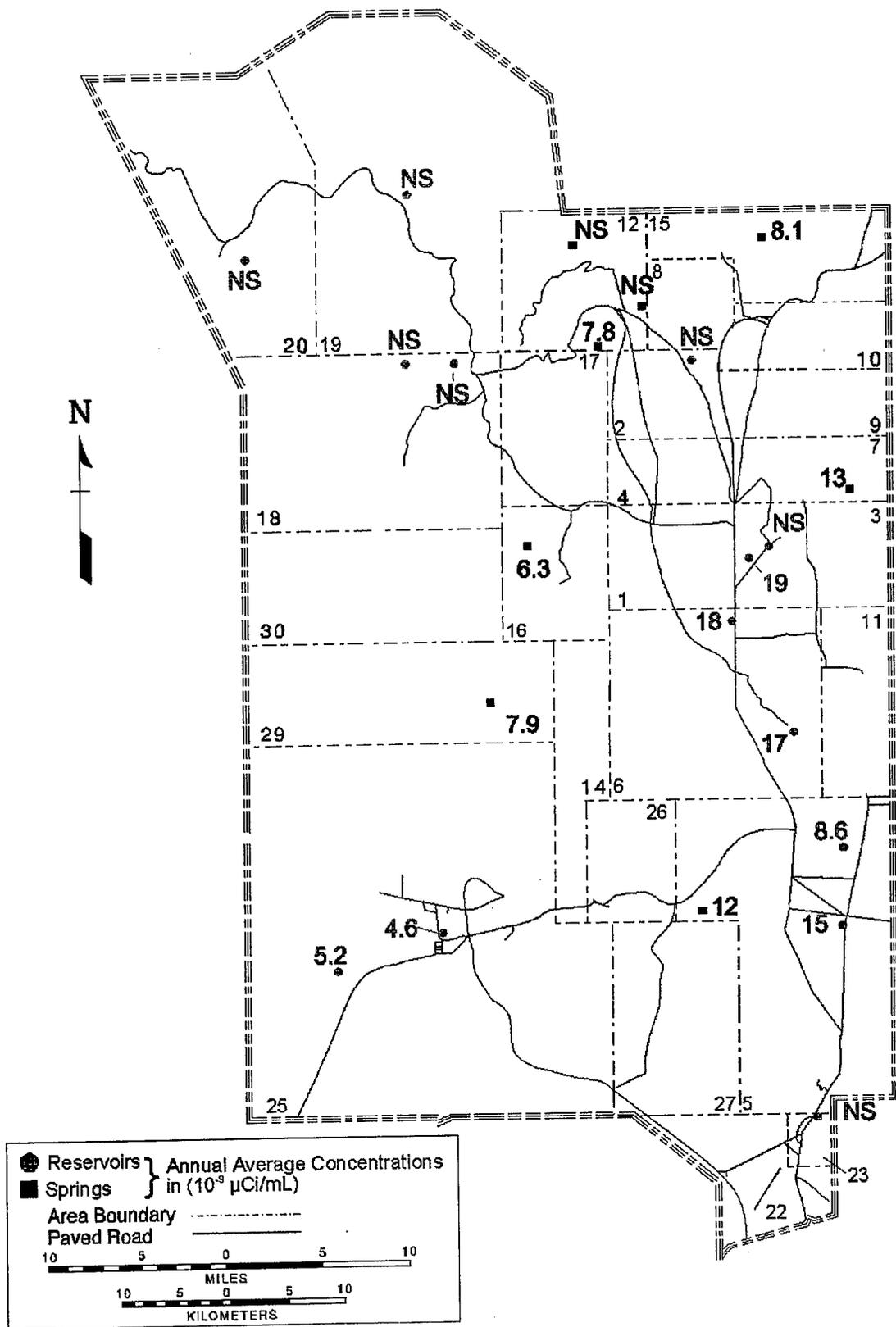


Figure 5.7 NTS HTO Vapor Annual Average Concentrations - 1996



gross beta were compared to the DCGs for ingested water listed in DOE Order 5400.5, even though there was no known consumption of these waters. The appropriate data are shown in Table 5.10.

NATURAL SPRINGS

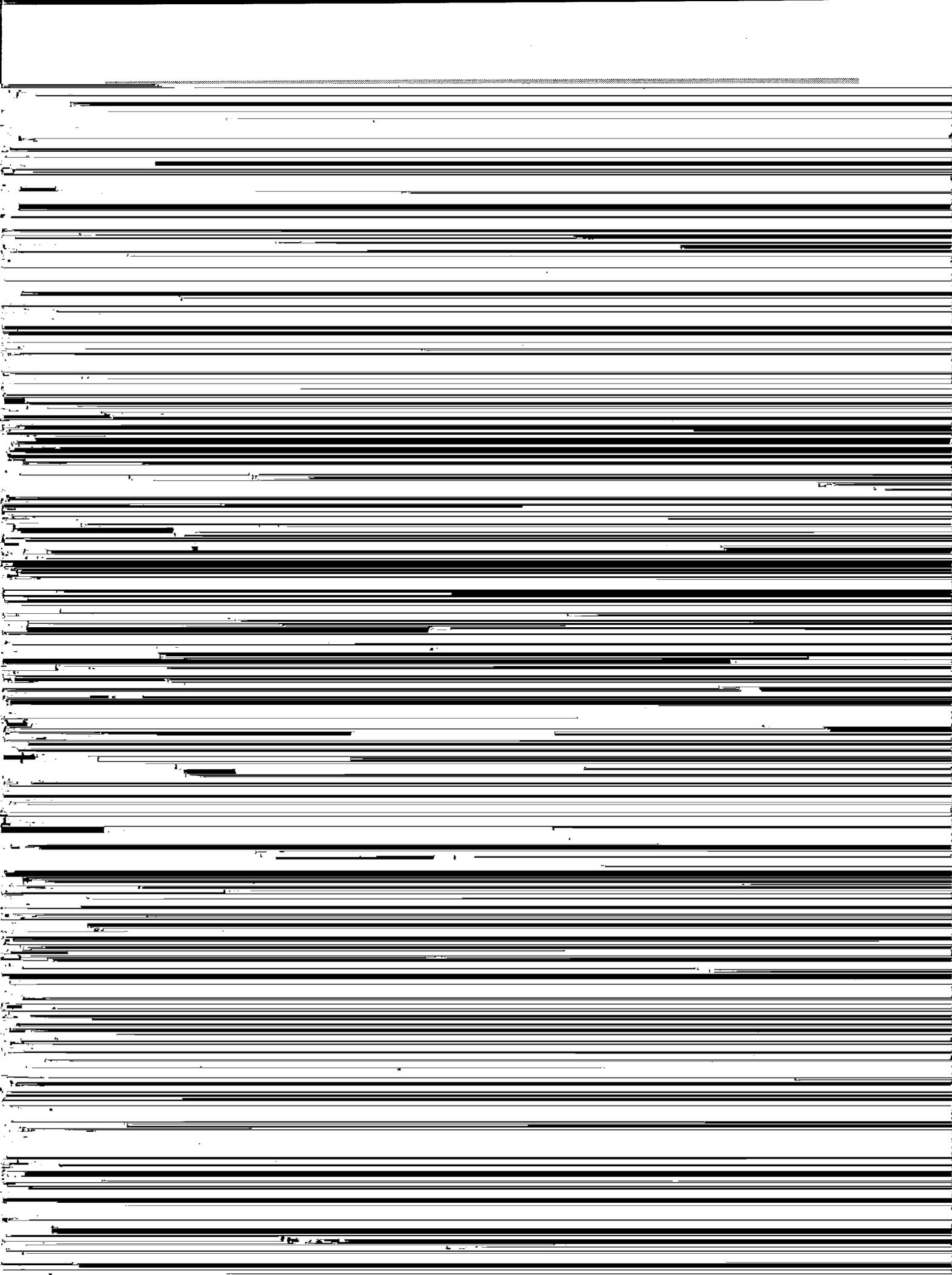
Of the nine natural springs found onsite, (i.e., spring-supplied pools located within the NTS), only seven had enough water to be sampled. These springs were a source of drinking water for wild animals on the NTS. The annual average gross beta results for each spring are shown in Table 5.11 and compared to the ^{90}Sr DCG for drinking water, although the water is not used for drinking. The highest result was for Area 7, Reitman Seep, but it was still below the DCG.

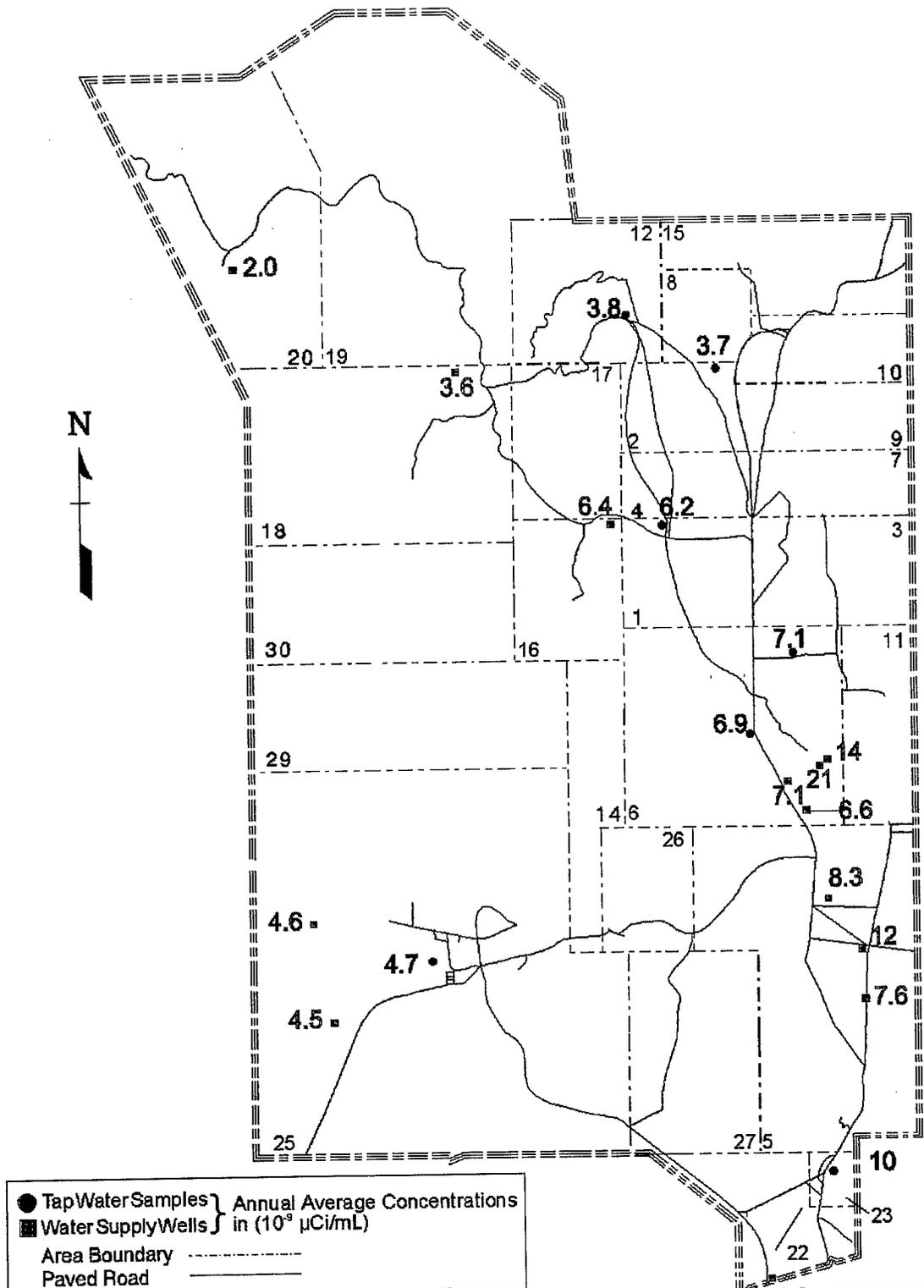
CONTAINMENT PONDS

Due to the sealing of the tunnels by the end of the year 1993, liquid effluents ceased at all except E Tunnel. The E Tunnel containment pond was 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 ^3H , ^{90}Sr , ^{238}Pu , $^{239+240}\text{Pu}$, gross beta, and gamma activity in accordance with

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. There was no known contact by the working population during the year. The annual gross beta concentration averages for all lagoons ranged between 7.7 and $33 \times 10^{-9} \mu\text{Ci/mL}$ (0.28 to 1.2 Bq/L). No radioactivity was detected above the MDCs for ^3H or ^{90}Sr . No event-related radioactivity was detected by gamma spectrometric analyses.

Concentrations of ^{238}Pu and $^{239+240}\text{Pu}$ above the MDC were found in the February 13 sample from the Area 23 Sewage Lagoon. The respective concentrations were 6.3×10^{-11} and $3.3 \times 10^{-9} \mu\text{Ci/mL}$ (0.0023 and 0.12 Bq/L). This was attributed to accumulation of old fallout (from tests in the atmosphere in the 1950s and 1960s) in the sewer-line sediments, which became loosened when the lines were flushed with water. Sediment samples collected from the sewage lagoon, after this finding was noted, also had detectable levels of plutonium. The radiochemistry laboratory that uses the same sewer system was eliminated as a source since the ratio of $^{239+240}\text{Pu}$ to ^{238}Pu in the sediment was 50. (the range of that ratio





quality, seven water system end-points (labeled tap water in Figure 5.9) were sampled. In order 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 was found to consist of five drinking water systems. The components of the five are shown in Table 5.13. These systems, fed by ten potable supply wells, are the source of the water for seven end-points. Table 5.15 lists the annual concentration averages for all the analyses performed on the end-point samples. No event-related radionuclides were detected by gamma spectrometry.

GROSS BETA

As in previous years, the gross beta concentration averages for all end-points were above the median MDC of the measurements. The highest annual average occurred in the Area 23 Cafeteria, 10×10^{-9} $\mu\text{Ci/mL}$ (0.37 Bq/L). This annual average was 3.3 and 25 percent of the DCG for ^{40}K and ^{90}Sr , respectively, adjusted to an annual 4 mrem EDE.

TRITIUM

GROSS ALPHA

In accordance with the National Primary Drinking Water Regulations (Title 40 C.F.R. 141), gross alpha measurements were made on quarterly samples from the drinking water systems, namely the potable supply wells reported in the previous section of this report. 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 on quarterly samples from the end-points. As shown in Table 5.15, the annual concentration averages for gross alpha radioactivity in tap water samples collected at five locations, exceeded the screening level at which ^{226}Ra analysis is required, 5 pCi/L (0.19 Bq/L). Samples from the supply wells were collected and analyzed for both ^{226}Ra and ^{228}Ra . As shown by the radium results in Table 5.16, the sum of the average concentrations for ^{226}Ra and ^{228}Ra were all less than 5 pCi/L so the onsite systems were in compliance with drinking water regulations.

STRONTIUM

As indicated by Table 5.15, the ^{90}Sr results for samples collected from all the selected

per location. Water was distilled at low temperatures from the samples and analyzed by the standard tritium-in-air procedures (2.5 mL counted for 70 minutes). Summary results are shown in Table 5.17.

Six of the samples with higher concentration (10^{-4} $\mu\text{Ci/mL}$ range) came from *Tamarix* sp. trees growing in the CAMBRIC ditch, used to determine if there were diurnal fluctuations in plant tritium content. No diurnal variation was seen, so sampling could occur all day. Sources probably responsible for most of the higher values are SEDAN crater throw out, infiltrated water from the CAMBRIC ditch, the Rainier Mesa tunnel ponds (dried up now), and the SCHOONER-CABRIOLET-PALANQUIN area. Plants at some locations had low concentrations of tritium, the source of which was unidentified.

EXTERNAL GAMMA EXPOSURES - ONSITE AREA

The TLD network at the NTS in 1996 began with 169 TLDs at fixed locations. Each TLD is fixed on a stake about one meter above the ground to measure ambient beta and gamma radiation. There were 17 TLD locations discontinued, 4 that were relocated, and 8 added at new locations. The year ended with 160 TLD stations. Fifteen of the existing stations had been established as the boundary locations and were reachable by truck as stated in the previous year's report.

Environmental monitoring is done with the UD-814 dosimeters of special design. The

results for boundary locations are given in Table 5.18. The annual rates ranged from 61 mR/yr to 166 mR/yr.

A group of locations which were not, to the best available knowledge, influenced by radiological contamination, and had been monitored for many years served as controls for the NTS. The data from these locations are presented in Table 5.19. The annual rates ranged from 50 mR/yr to 124 mR/yr, with an overall network average exposure rate of 0.23 mR/day or 84 mR/yr.

An investigation of historical trends in onsite environmental gamma levels, as measured by the TLD network, showed no significant differences among years until 1993, except for data from 1987 (dosimetry system changed) and 1988 (due to a calibration problem). A change in procedure introduced an additional significant change in historical trend data in 1994. A description of this analysis is published separately and may be found in the "Environmental Data Report for the Nevada Test Site - 1996" (DOE/NV/11718-138, in prep.).

OFFSITE ENVIRONMENTAL SURVEILLANCE

The R&IE-LV offsite environmental surveillance program was operated to detect any releases of radioactivity related to current NTS activities which could potentially result in human exposure. Monitoring was concentrated on possible human exposure pathways. Monitoring locations were generally selected to represent inhabited

(ASN), which included 20 continuously operating stations around the NTS. Noble gas and atmospheric moisture samplers were discontinued in 1994. Groundwater and some surface water supplies were sampled regularly in the Long-Term Hydrological Monitoring Program (LTHMP). Water sampling locations included 37 wells on the NTS, or immediately outside its borders and 32 locations in the offsite area. Not all locations are sampled every year. The Milk Surveillance Network (MSN) consisted of annual collections from 11 locations in the immediate offsite area, of which 10 were sampled this year. The network included family-owned cows and goats and commercial dairies.

External gamma radiation was monitored by the Pressurized Ion Chamber (PIC) Network and the TLD Network. The PIC network included 27 stations that were connected by satellite telemetry to the NTS for real-time data collection. Approximately 26 local residents voluntarily participated in the TLD network and another 51 TLDs were located at fixed environmental stations.

The results of monitoring conducted in 1996 are discussed in the following subsections for each of the environmental surveillance networks mentioned above. No major accidental releases of radionuclides from the NTS were reported in 1996. All individual sample data are published separately, but summary data are included herein.

AIR MONITORING NETWORKS

The following sections describe results for the ASN. The atmospheric monitoring network measures the major radionuclides which could potentially be emitted from activities on the NTS, as well as naturally occurring radionuclides. This network represents the possible inhalation exposure pathway for the general public.

AIR SURVEILLANCE NETWORK

Gamma spectrometry was performed promptly on all ASN high- and low-volume

samples. The majority of the samples were gamma-spectrum negligible (i.e., no gamma-emitting radionuclides detected). Naturally occurring ^7Be was detected occasionally by the low-volume network of samplers. It was detected consistently by the high-volume sample method with an average annual activity of 2.4×10^{-13} $\mu\text{Ci/mL}$.

As in previous years, the gross beta results from the low-volume sampling network consistently exceeded the analytical MDC. The annual average gross beta activity was $1.42 \pm 0.58 \times 10^{-14}$ $\mu\text{Ci/mL}$ ($5.3 \pm 2.1 \times 10^{-4}$ Bq/m^3). Summary results for the ASN are in Table 5.20. Individual results are published separately and may be found in the "Environmental Data Report for the Nevada Test Site - 1996," (DOE/NV/11718-138, in prep.).

Gross alpha analysis was performed on all low-volume network samples. The average annual gross alpha activity was 1.3×10^{-15} $\mu\text{Ci/mL}$ ($48 \mu\text{Bq/m}^3$). Summary results for the ASN are shown in Table 5.21.

Samples collected at high-volume sampling sites were composited by month and analyzed for plutonium isotopes. Due to a lower limit of detection for high-volume sampling and analysis methods, environmental levels of plutonium were occasionally detected at all six of the sampling sites. This report contains results for samples collected during the third and fourth quarter of 1995 and throughout calendar year 1996 (CY96) (Table 5.22). The maximum average concentration of plutonium was in a sample from Amargosa Valley (Lathrop Wells), but was just 1.3 percent of the DCG.

WATER MONITORING

Environmental surveillance of water in the offsite areas is conducted as part of the LTHMP. Results are discussed in Chapter 9 of this report.

MILK SURVEILLANCE NETWORK

The average total potassium concentration derived from naturally occurring ^{40}K activity was 1.5 g/L for samples analyzed by gamma spectrometry. Selected MSN milk samples were analyzed for ^{89}Sr and ^{90}Sr , and the results are similar to those obtained in previous years; neither increasing nor decreasing trends are evident. The MSN network average values are shown in Table 5.23 for ^{89}Sr and ^{90}Sr .

THERMOLUMINESCENT DOSIMETRY NETWORK

OFFSITE STATION NETWORK

There were 51 offsite environmental stations monitored using TLDs. Figure 4.7 shows current fixed environmental monitoring locations. Total annual exposure for 1996 ranged from 59 mR (0.59 mSv) per year at St. George, Utah, to 133 mR (1.3 mSv) per year at Manhattan, Nevada, with a mean annual exposure of 93 mR (0.93 mSv) per year for all operating locations. The next highest annual exposure was 130 mR (1.3 mSv) per year at Queen City Summit, Nevada. These results are consistent with those for 1995.

OFFSITE PERSONNEL NETWORK

Twenty-five offsite residents were issued TLDs to monitor their annual dose equivalent. Locations of personnel monitoring participants are also shown in Figure 4.7. Annual whole body dose equivalents ranged from a low of 48 mrem (0.48 mSv) to a high of 125 mrem (1.2 mSv) with a mean of 96 mrem (0.96 mSv) for all monitored personnel during 1996. These results are similar to those for 1995.

PRESSURIZED ION CHAMBER NETWORK

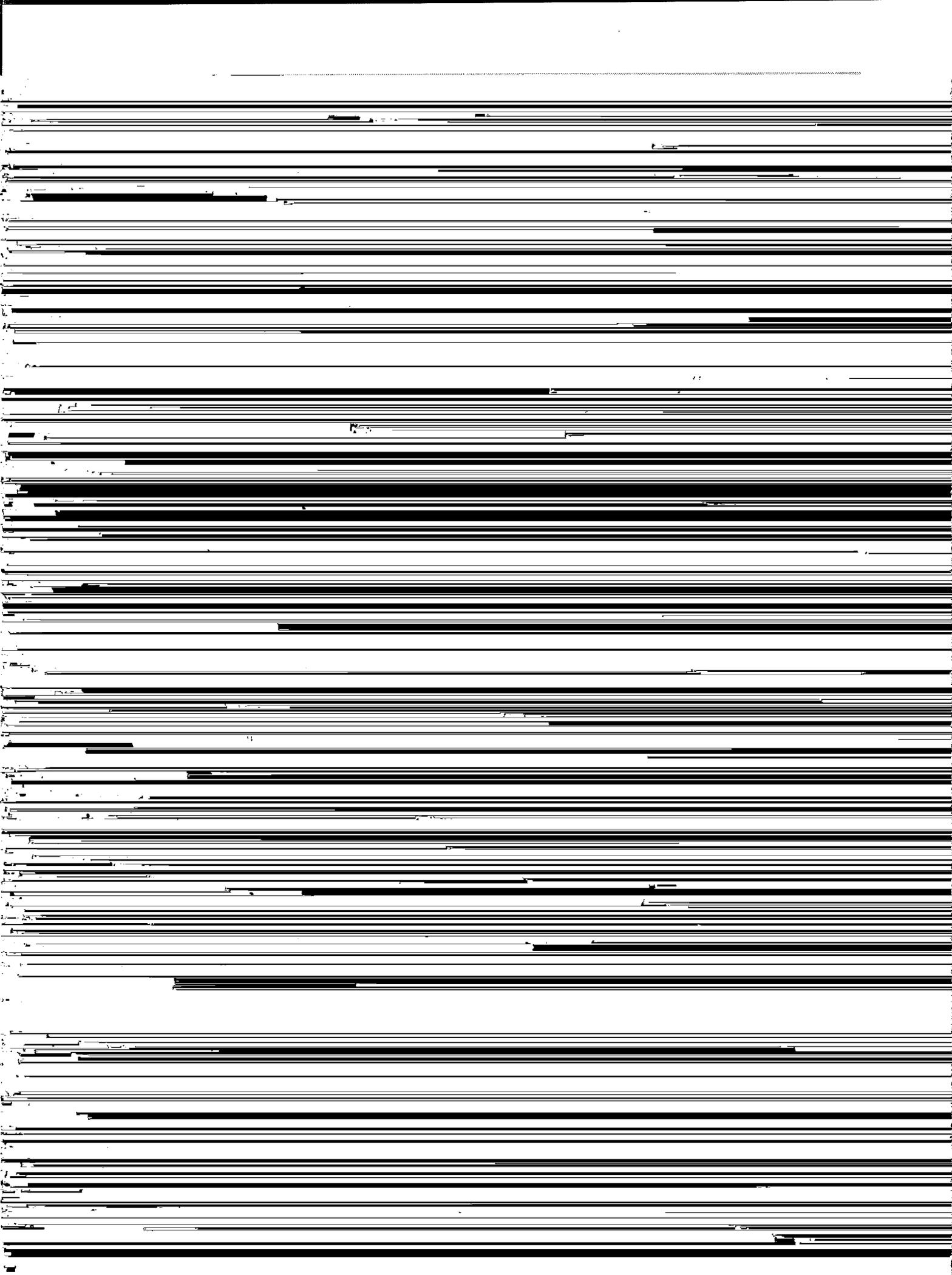
The PIC data presented in this section are based on monthly averages of gamma exposure rates from each station. Table 5.24 contains the number of monthly averages available from each station and

the maximum, minimum, mean, standard deviation, and median of the monthly averages. The mean ranged from 8.0 $\mu\text{R/hr}$ at Pahrump, Nevada, to 17.7 $\mu\text{R/hr}$ at Tonopah, Nevada, or annual exposures from 71 to 156 mR (18 to 40 $\mu\text{C/kg}$). The table shows the total mR/yr (calculation based on the mean of the monthly averages) and the average gamma exposure rate for each station. Background levels of environmental gamma exposure rates in the United States (from the combined effects of terrestrial and cosmic sources) vary between 49 and 247 mR/yr (13 to 64 $\mu\text{C/kg-yr}$) (BEIR III 1980). The annual exposure levels observed at each PIC station are well within these United States background levels. Figure 5.10 shows the distribution of the monthly averages from each PIC station. The horizontal lines extend from the mean value (\blacklozenge) to the minimum and maximum values. The vertical lines are the approximate United States background range.

The data from Milford, Rachel, Twin Springs, and Uhalde's Ranch stations show the greatest range and the most variability. These data are within a few tenths $\mu\text{R/hr}$ from those of last year.

NON-NTS BN FACILITY MONITORING

BN facilities which use radioactive sources or radiation producing equipment with the potential to expose the general population outside the property line to direct radiation are as follows: the Special Technologies Laboratory (STL) during operation of the Sealed Tube Neutron Generator, STL during operation of the Febetron, the Remote Sensing Laboratory (RSL) at Nellis Air Force Base, the North Las Vegas Facility (NLVF) Atlas A-1 Source Range, and the Washington Aerial Measurements Operation (WAMO). Sealed sources are tested every six months to ensure there is no leakage of radioactive material and the data are kept in the BN Radiation Protection Records.



RADIOLOGICAL MONITORING RESULTS

File Emissions - 1996

Curies ^(a)				
³ H	⁹⁰ Sr	¹³⁷ Cs	²³⁸ Pu	²³⁹⁺²⁴⁰ Pu
1.1 x 10 ¹	4.4 x 10 ⁻⁵	1.5 x 10 ⁻³	3.4 x 10 ⁻⁶	2.7 x 10 ⁻⁵
1.1 x 10 ²				
<u>8.2 x 10⁰</u>				
1.3 x 10 ²	4.4 x 10 ⁻⁵	1.5 x 10 ⁻³	3.4 x 10 ⁻⁶	2.7 x 10 ⁻⁵

Curies ^(a)	
³ H ^(b)	²³⁹⁺²⁴⁰ Pu
3.5 x 10 ⁻¹	0.036
5.2 x 10 ⁻³	
1.4 x 10 ²	
	<u>0.24</u>
1.2 x 10 ⁻⁰	0.28

to obtain Bq. Calculated releases from laboratory spills and losses are included in Table 1.1.
 water vapor, primarily HTO.
 down surface deposits.
 sampler data.

Table 5.2 Airborne Gross Alpha Concentrations on the NTS - 1996

Gross Alpha Concentration (10^{-15} μ Ci/mL)

<u>Location</u>	<u>Number</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Arithmetic Mean</u>	<u>Standard Deviation</u>
Area 1, BJY	25	3.1	0.96	1.8	0.58
Area 2, Complex	26	3.7	0.81	1.9	0.63
Area 2, 2-1 Substation	25	4.3	0.28	1.7	0.83
Area 3, Mud Plant	25	4.3	0.70	2.3	1.1
Area 3, Well ER-3-1	27	4.5	0.87	2.2	0.89
Area 4, Bunker T-4	25	3.3	0.93	1.9	0.52
Area 5, WEF North	3	2.8	1.7	2.2	0.59
Area 5, WEF South	4	3.0	1.7	2.4	0.57
Area 5, DOD Yard	27	4.0	0.90	2.1	0.70
Area 5, Well 5B	27	3.6	0.88	2.2	0.62
Area 6, Yucca	24	3.1	0.89	2.0	0.56
Area 6, CP-6	27	3.1	0.92	2.1	0.54
Area 6, Well 6	27	3.1	0.92	2.1	0.54

Table 5.3 (Airborne Gross Beta Concentrations on the NTS - 1996, cont.)

<u>Location</u>	<u>Gross Beta Concentration (10^{-14} μCi/mL)</u>					
	<u>Number</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Arithmetic Mean</u>	<u>Standard Deviation</u>	<u>Mean as %DCG</u>
Area 3, U3ah/at S	50	2.6	0.70	1.5	0.43	1.7
Area 3, U3ah/at E	50	3.0	0.75	1.7	0.53	1.9
Area 3, U3ah/at N	45	3.2	0.81	1.7	0.57	1.9
Area 3, U3ah/at W	50	2.6	0.69	1.6	0.51	1.8
Area 3, Mud Plant	51	4.8	0.85	2.1	0.78	2.3
Area 3, Well ER-3-1	49	3.7	0.60	1.9	0.70	2.1
Area 4, Bunker T-4	50	3.5	0.86	1.9	0.56	2.1
Area 5, DWMS B# 5	50	2.1	0.68	1.8	0.51	2.0

Table 5.4 Airborne $^{239+240}\text{Pu}$ Concentrations on the NTS - 1996

<u>Location</u>	<u>$^{239+240}\text{Pu}$ Concentration (10^{-17} $\mu\text{Ci/mL}$)</u>					
	<u>Number</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Arithmetic Mean</u>	<u>Standard Deviation</u>	<u>Mean as %DCG</u>
Area 1, BJY	4	75	2.3	22	36	11
Area 2, Complex	4	1.1	0.23	0.66	0.39	0.33
Area 2, 2-1 Substation	4	5.8	0.13	2.5	2.7	1.2
Area 3, U3ah/at South	10	25	1.9	11	7.2	5.5
Area 3, U3ah/at East	10	31	2.5	13	10	6.5
Area 3, U3ah/at North	10	80	3.9	26	23	13
Area 3, U3ah/at West	10	36	5.0	16	10	8.0
Area 3, Mud Plant	4	26	0.08	12	11	6.0
Area 3, Well ER-3-1	4	5.4	0.35	2.6	2.4	1.3
Area 4, Bunker T-4	4	8.1	2.1	4.8	2.5	2.4
Area 5, RWMS Pit 5	10	1.0	-0.076	0.32	0.37	0.16

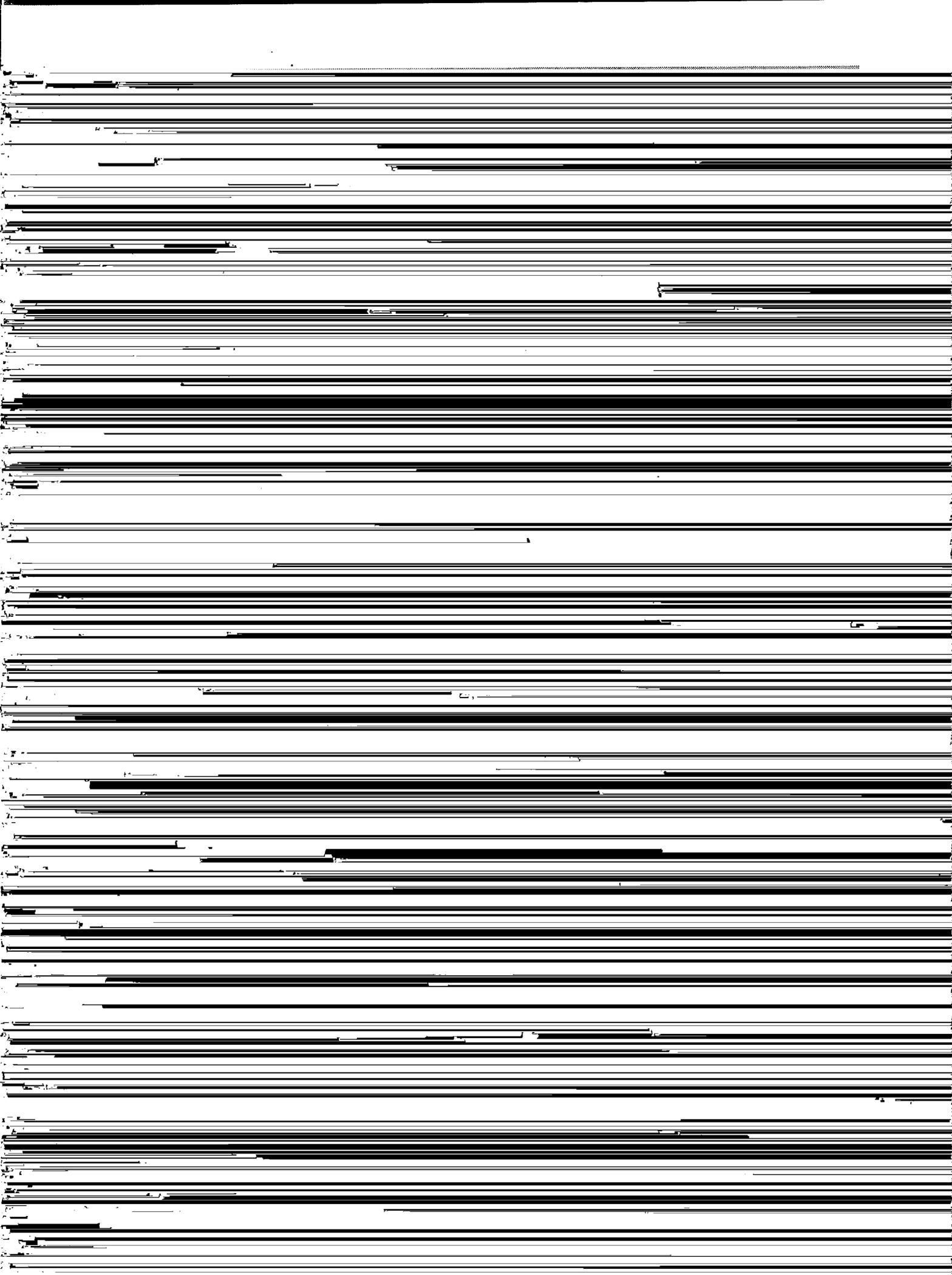


Table 5.6 Derived Limits for Radionuclides in Air and Water

Radionuclide	<u>μCi/mL</u>		
	<u>DAC (Air)^(a)</u>	<u>DCG (Air)^(b)</u>	<u>DCG (Water)^(c)</u>
³ H	2 x 10 ⁻⁵	1 x 10 ⁻⁸	8 x 10 ⁻⁵
⁴⁰ K	2 x 10 ⁻⁷	9 x 10 ⁻¹¹	3 x 10 ⁻⁷
⁸⁵ Kr (d)	1 x 10 ⁻⁴	3 x 10 ⁻⁷	-
⁸⁹ Sr	6 x 10 ⁻⁸	3 x 10 ⁻¹¹	8 x 10 ⁻⁷
⁹⁰ Sr	2 x 10 ⁻⁹	9 x 10 ⁻¹³	4 x 10 ⁻⁸
¹³³ Xe	1 x 10 ⁻⁴	5 x 10 ⁻⁸	-
¹³⁷ Cs	5 x 10 ⁻⁵	4 x 10 ⁻¹¹	1 x 10 ⁻⁷
²²⁶ Ra	3 x 10 ⁻¹⁰	1 x 10 ⁻¹³	4 x 10 ⁻⁹
²³⁸ Pu ^(a)	7 x 10 ⁻¹²	3 x 10 ⁻¹⁵	2 x 10 ⁻⁹
²³⁹⁺²⁴⁰ Pu ^(a)	6 x 10 ⁻¹²	2 x 10 ⁻¹⁵	1 x 10 ⁻⁹

(a) DAC - The Derived Air Concentration used for limiting radiation exposures of workers. The values are based on either a stochastic effective dose equivalent of 5 rem or a nonstochastic organ dose of 50 rem, which ever is more limiting (DOE Order 5480.11). Class Y is used for plutonium.

(b) DCG - Derived Concentration Guides are reference values for conducting radiological protection programs at operational DOE facilities and sites. The DCG values are for an effective dose equivalent of 10 mrem (0.1 mSv) (inhalation) for a year as required by 40 C.F.R. 61.92 and DOE Order 5400.5.

(c) The values listed for beta and photon emitters in the table are based on 4 mrem committed effective dose equivalent for the radionuclide taken into the body by ingestion of water during one year (730 L).

(d) Nonstochastic value.

Table 5.7 Summary of NTS ⁸⁵Kr Concentrations - 1996

Location	<u>⁸⁵Kr Concentration (10⁻¹² μCi/mL)</u>					
	<u>Number</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Arithmetic Mean</u>	<u>Standard Deviation</u>	<u>Mean as % DCG</u>
Area 1, BJY	43	46	6.2	25	7.2	<0.01
Area 19, Pahute Substa. ^(a)	38	40	2.8	25	7.8	<0.01
Area 20, Dispensary	43	42	2.3	26	10	<0.01
All Stations	124	46	2.3	25	8.6	<0.01

Average MDC was 6.4 x 10⁻¹² μCi/mL

(a) Excludes anomalous value of 96 in weekly sample collected July 17, 1997.

Table 5.8 Airborne Tritium Concentrations on the NTS - 1996

<u>Location</u>	<u>³H Concentration (10⁻⁶ pCi/mL)</u>					
	<u>Number</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Arithmetic Mean</u>	<u>Standard Deviation</u>	<u>Mean as %DCG</u>
Area 1, BJY	25	3.1	-2.0	0.63	0.89	<0.01
Area 3, Mud Plant	24	3.1	-0.81	0.76	0.88	<0.01
Area 3, U-3ah/at N	13	5.0	-2.7	0.54	5.8	<0.01
Area 5, RWMS No. 1	26	5.4	-2.0	2.3	1.7	0.023
Area 5, RWMS No. 3	21	7.6	-0.054	2.7	2.0	0.027
Area 5, RWMS No. 4	27	17	0.22	5.4	4.1	0.054
Area 5, RWMS No. 5	21	65	0.59	6.1	2.1	0.061
Area 5, RWMS No. 6	26	9.3	-0.30	2.8	2.4	0.028

Table 5.10 NTS Open Reservoir Gross Beta Analysis Results - 1996

<u>Location</u>	<u>Gross Beta Concentration (10^{-9} μCi/mL)</u>	
	<u>Concentration</u>	<u>Concentration as %DCG^(a)</u>
Area 2, Mud Plant Reservoir	5.3	13
Area 2, Well 2 Reservoir ^(b)	-	-
Area 3, Mud Plant Reservoir ^(b)	-	-
Area 3, Well A Reservoir	19	48
Area 5, UE-5c Reservoir	8.6	22
Area 5, Well 5B Reservoir	15	38
Area 6, Well 3 Reservoir	18	45
Area 6, Well C1 Reservoir	17	43
Area 18, Camp 17 Reservoir	15	38
Area 18, Well 8 Reservoir ^(b)	-	-
Area 19, UE-19c Reservoir ^(b)	-	-
Area 20, Well 20A Reservoir ^(b)	-	-
Area 23, Swimming Pool ^(b)	-	-
Area 25, Well J-11 Reservoir	4.6	12
Area 25, Well J-12 Reservoir	5.2	13

(a) DCG based on ⁹⁰Sr value for drinking water (4 mrem EDE).

(b) Reservoir was dry.

Table 5.11 NTS Natural Spring Gross Beta Analysis Results - 1996

<u>Location</u>	<u>Gross Beta Concentration (10^{-9} μCi/mL)</u>	
	<u>Concentration</u>	<u>Concentration as %DCG^(a)</u>
Area 5, Cane Spring	12	30
Area 7, Reitmann Seep	13	33
Area 12, Captain Jack	7.8	20
Area 12, Gold Meadows ^(b)	---	
Area 12, White Rock Spring	9.0	23
Area 15, Tub Spring	8.1	20
Area 16, Tippipah Spring	6.3	16
Area 29, Topopah Spring	7.9	20

Note: Annual samples only.

(a) DCG based on ⁹⁰Sr value for drinking water (4 mrem EDE).

(b) Pool was dry.

Table 5.12 NTS Containment Pond Gross Beta Analysis Results - 1996

Gross Beta Concentration (10^{-9} μ Ci/mL)

Location	Number	Maximum	Minimum	Arithmetic Mean	Standard Deviation	Mean as % DCC(a)
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Table 5.15 Radioactivity Averages for NTS Consumption Points - 1996

Description	$\mu\text{Ci/mL}$					
	Gross Beta	^3H	$^{239+240}\text{Pu}$	^{238}Pu	Gross Alpha	$^{90}\text{Sr}^{(a)}$
Area 1, Bldg. 101 ^(b)	6.2×10^{-9}	-1.2×10^{-7}	-2.8×10^{-12}	-2.7×10^{-12}	7.5×10^{-9}	-1.2×10^{-10}
Area 2, Restroom	3.7×10^{-9}	-1.3×10^{-9}	-3.5×10^{-12}	-1.4×10^{-12}	1.0×10^{-9}	-1.6×10^{-10}
Area 6, Cafeteria	6.9×10^{-9}	-5.2×10^{-8}	-2.4×10^{-12}	-1.5×10^{-12}	8.8×10^{-9}	-8.3×10^{-11}
Area 6, Bldg. 6-900	7.1×10^{-9}	1.3×10^{-8}	-1.7×10^{-12}	-2.0×10^{-12}	8.2×10^{-9}	-5.5×10^{-11}
Area 12, Bldg. 12-23	3.8×10^{-9}	2.0×10^{-7}	-3.8×10^{-12}	-1.3×10^{-12}	7.7×10^{-10}	-3.6×10^{-11}
Area 23, Cafeteria	1.0×10^{-8}	6.3×10^{-8}	-4.1×10^{-12}	-3.8×10^{-12}	6.5×10^{-9}	-5.1×10^{-11}
Area 25, Bldg. 4221	4.7×10^{-9}	-2.0×10^{-8}	9.8×10^{-13}	-3.2×10^{-13}	1.7×10^{-9}	9.2×10^{-12}
Median MDC	1.2×10^{-9}	7.2×10^{-7}	1.9×10^{-11}	1.8×10^{-11}	1.4×10^{-9}	3.1×10^{-10}

(a) ^{90}Sr values are for one sample.

(b) One sample collected from Area 1 Ice House when Building 101 inaccessible.

Table 5.16 Radium Analysis Results for NTS Potable Water Supply Wells - 1996

Location	Number	Concentrations ($10^{-9} \mu\text{Ci/mL}$)			
		^{226}Ra Arithmetic Mean	Standard Deviation	^{228}Ra Arithmetic Mean	Standard Deviation
Area 5, Well 5B	4	1.3	1.1	0.14	0.31
Area 5, Well 5C	4	-0.23	1.4	0.23	0.46
Area 6, Well 4	4	1.5	2.0	-0.094	0.31
Area 6, Well 4A	3	1.1	0.62	0.12	0.17
Area 6, Well C ^(a)	---	---	---	---	---
Area 6, Well C-1	4	2.5	2.2	0.46	0.34
Area 16, Well UE-16d	4	2.3	1.7	0.40	0.43
Area 18, Well 8	4	1.1	1.6	-0.45	0.70
Area 23, Army Well No. 1	4	0.21	0.88	0.43	0.82
Area 25, Well J-12	4	0.96	0.67	0.14	0.40
Area 25, Well J-13	4	0.89	1.5	0.22	0.54
Median MDC		2.2		0.99	

Table 5.19 NTS TLD Control Station Comparison, 1990-1996

Area	Station	Exposure Rate (mR/day)						
		1990	1991	1992	1993	1994	1995	1996
5	Well 5B	0.34	0.36	0.31	0.39	0.34	0.30	0.30
6	CP-6	0.25	0.24	0.23	0.30	0.19	0.19	0.21
6	Yucca Oil Storage	0.22	0.22	0.21	0.27	0.27	0.22	0.22

Table 5.21 Gross Alpha Results for the Offsite Air Surveillance Network - 1996

Concentration (10^{-15} $\mu\text{Ci/mL}$ [$37 \mu\text{Bq/m}^3$])

<u>Sampling Location</u>	<u>Number</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Arithmetic Mean</u>	<u>Standard Deviation</u>
Alamo, NV	52	5.9	0.4	1.6	0.94
Amargosa Center, NV	52	6.6	0.0	1.6	1.1
Beatty, NV	52	2.8	0.2	1.1	0.64
Boulder City, NV	09	4.1	1.3	2.6	1.0
Clark Station, NV					
Stone Cabin Ranch	52	4.5	0.5	2.0	0.72
Goldfield, NV	51	3.2	0.2	1.0	0.60
Henderson	13	3.6	0.8	2.3	0.84
Indian Springs, NV	50	3.9	0.2	1.0	0.70
Las Vegas, NV	52	2.9	0.2	1.5	0.74
Overton, NV	50	6.3	-0.1	1.2	1.1

Table 5.22 (Offsite High Volume Airborne Plutonium Concentrations - 1996, cont.)

Composite Sampling Location	Number	²³⁹⁺²⁴⁰ Pu Concentration (10 ⁻¹⁸ μCi/mL)		Arithmetic Mean	Standard Deviation	Mean as %DCG ^(a)
		Maximum	Minimum			
Alamo, NV	18	4.9	0.07	1.5	1.2	0.05
Goldfield, NV	17	9.7	0.06	1.7	2.2	0.06
Las Vegas, NV	11	2.2	0.00	0.86	0.64	0.03
Lathrop Wells, NV	4	115	0.70	38	46	1.3
Tonopah, NV	15	2.9	0.19	0.95	0.73	0.03
Rachel, NV	7	66	0.39	13	22	0.42
Amargosa Center, NV	10	1.6	0.23	0.69	0.42	0.02

Mean MDC: 0.53 x 10⁻¹⁸ μCi/mL

Standard Deviation of Mean MDC: 0.90 x 10⁻¹⁸ μCi/mL

(a) Derived Concentration Guide; Established by DOE Order as 3 x 10⁻¹⁵ μCi/mL.

(b) Not applicable, result less than MDC.

Note: To convert from μCi/mL to Bq/m³ multiply by 3.7x10¹⁰ (e.g., [1.8x10⁻¹⁸] x [37x10⁹] = 67 nBq/m³).

Table 5.23 Summary of Radionuclides Detected in Milk Samples

	Milk Surveillance Network No. of samples with results > MDC (Network average concentration in pCi/L)		
	1996	1995	1994
³ H	Not Analyzed	0(37)	0(85)
⁸⁹ Sr	0(0.01)	0(0.03)	0(0.22)
⁹⁰ Sr	0(0.63)	0(0.61)	2(0.44)

Table 5.24 (Summary of Gamma Exposure Rates as Measured by PIC - 1996, cont.)

Station	Number of Weekly Averages	<u>Gamma Exposure Rate ($\mu\text{R/hr}$)</u>					Median	mR/yr	1996 Mean ($\mu\text{R/hr}$)
		Maximum	Minimum	Arithmetic Mean	Standard Deviation				
Caliente, NV	262	15.1	13.6	14.2	0.48	14.0	125	14.3	
Cedar City, UT	277	12.3	10.8	11.5	0.83	12.0	102	11.6	
Complex I, NV	275	16.0	14.5	15.3	0.86	15.0	134	15.3	
Delta, UT	266	12.7	11.2	12.0	0.71	12.0	105	12.0	
Furnace Creek, CA	267	10.3	9.1	9.7	0.64	10.0	85	9.7	
Goldfield, NV	242	15.8	14.4	15.2	1.16	15.0	133	15.2	
Indian Springs, NV	253	11.9	10.8	11.2	1.06	11.0	99	11.3	
Las Vegas, NV	359	10.7	8.7	9.4	0.16	9.4	82	9.4	
Medlin's Ranch, NV	276	17.0	15.8	16.3	0.68	16.0	143	16.3	
Milford, UT	275	18.6	17.0	17.7	0.93	18.0	155	17.7	
Nyala, NV	223	12.8	11.3	12.0	0.21	12.0	105	12.0	
Overton, NV	270	10.3	9.2	9.8	0.62	10.0	87	9.9	
Pahrump, NV	269	8.9	7.9	8.0	0.41	8.0	71	8.1	
Pioche, NV	248	12.1	10.8	11.5	2.03	12.0	101	11.5	
Rachel, NV	255	17.2	15.9	16.4	1.37	17.0	145	16.5	
St. George, UT	266	9.1	7.9	8.1	0.75	8.0	72	8.2	
Stone Cabin Ranch, NV	274	18.4	16.9	17.5	1.22	18.0	154	17.6	
Terrell's Ranch, NV	276	16.9	15.7	16.1	0.84	16.0	141	16.1	
Tonopah, NV	275	18.5	17.1	17.7	1.22	18.0	156	17.8	
Twin Springs, NV	262	17.7	15.7	17.6	1.0	16.0	144	16.4	
Uhalde's Ranch, NV	276	18.0	16.6	17.2	0.73	17.0	152	17.3	

Note: Multiply $\mu\text{R/hr}$ by 2.6×10^{-4} to obtain $\mu\text{C} \cdot \text{kg}^{-1} \cdot \text{hr}^{-1}$.

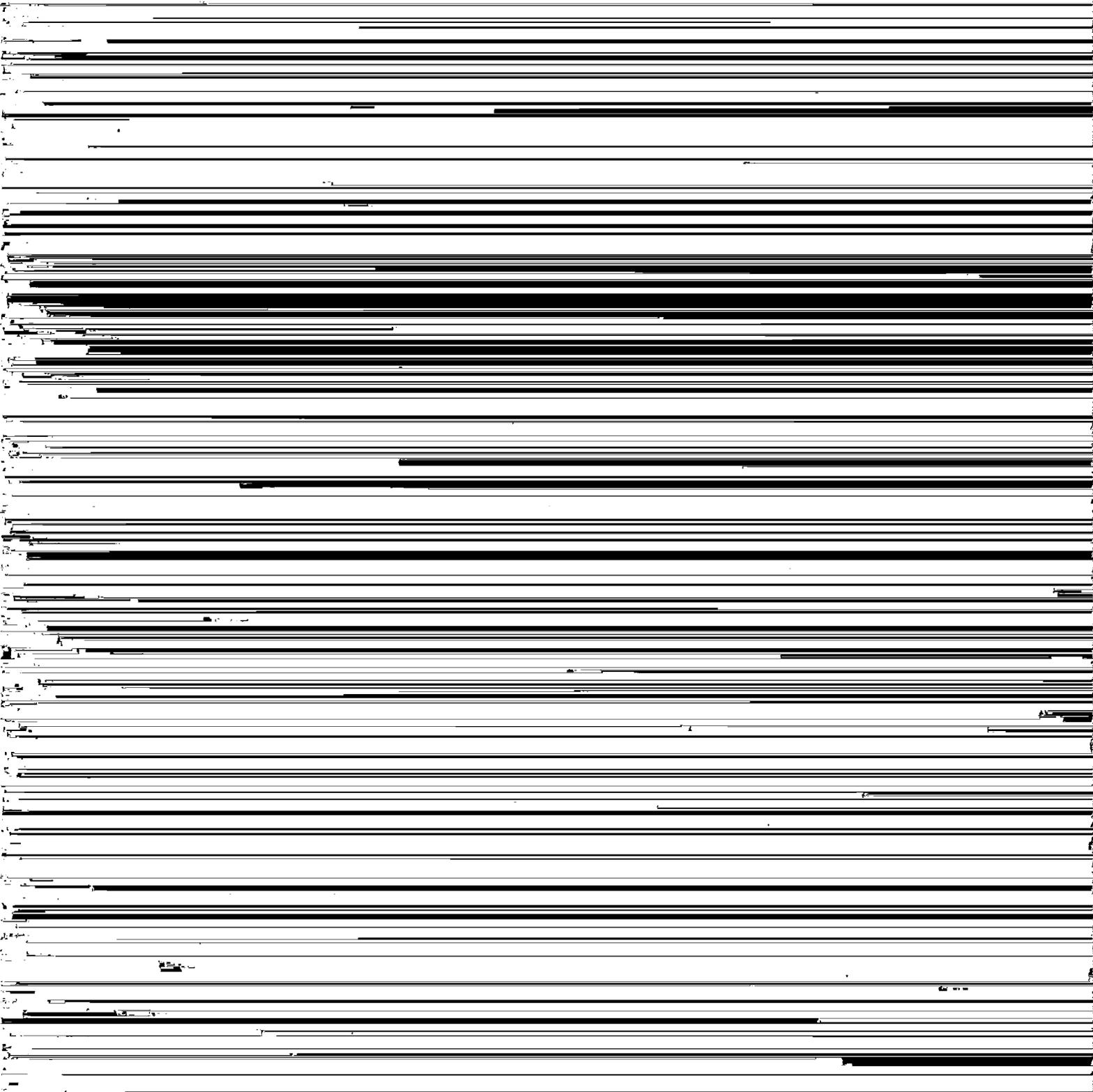
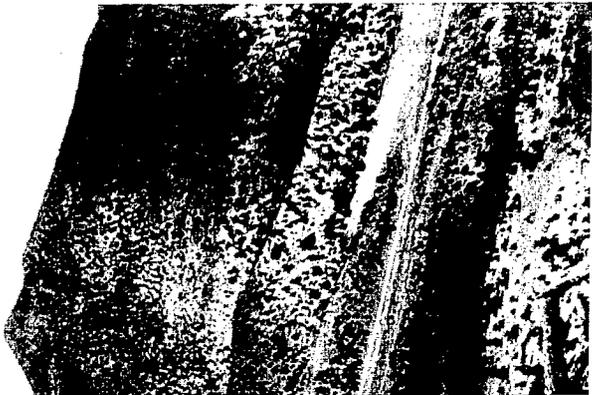
Table 5.25 BN Offsite Boundary Line Monitoring Data - 1996

		<u>Remote Sensing Laboratory/Nellis</u>					
Station ID#	Description	1st Qtr. (mR)	2nd Qtr. (mR)	3rd Qtr. (mR)	4th Qtr. (mR)	CY-96 (mR)	
RS-022	SE Fence--Near Gate	21.3	19.3	19.1	20.9	81	
RS-023	SE Fence--Near Gate	21.0	19.3	18.7	20.8	80	
RS-024	S Fence--Center	19.5	(a)	16.7	18.7	55	
RS-025	S Fence--Center	19.3	17.5	16.7	18.6	72	
RS-026	SW Fence--Near Gate	17.2	15.4	14.3	15.2	62	
RS-027	SW Fence--Near Gate	16.9	15.1	13.7	15.5	61	
RS-028	NW Fence--Near Gate	19.8	15.7	14.0	16.4	66	
RS-029	NW Fence--Near Gate	17.8	15.7	14.0	15.8	63	
RS-030	N Fence--Center	20.7	18.1	23.6	19.4	82	
RS-031	N Fence--Center	20.1	18.7	17.3	19.4	76	
RS-032	NE Fence--Near Corner	16.6	14.8	13.1	15.5	60	
RS-033	NE Fence--Near Corner	17.5	14.5	13.7	15.8	61	
RS-098	Control - 1	26.0	27.4	24.7	28.6	107	
RS-099	Control - 2	26.3	26.8	25.0	29.0	107	

(a) Not available, missing data.

Table 5.25 (BN Offsite Boundary Line Monitoring Data - 1996, cont.)

		<u>North Las Vegas Facility</u>				
<u>Station</u>		<u>1st Qtr.</u>	<u>2nd Qtr.</u>	<u>3rd Qtr.</u>	<u>4th Qtr.</u>	<u>CY-96</u>
<u>ID#</u>	<u>Description</u>	<u>(mR)</u>	<u>(mR)</u>	<u>(mR)</u>	<u>(mR)</u>	<u>(mR)</u>
LV-055	NW Corner Fence/Gate C6	19.7	19.4	21.6	19.6	80
LV-056	NW Corner Fence/Gate C6	20.6	18.8	20.1	19.6	79
LV-057	N Fence--West End A-12	18.5	14.5	16.1	15.1	64
LV-058	N Fence--West End A-12	23.1	15.4	16.1	15.9	70
LV-059	N Fence--West End A-4	18.8	14.8	16.1	15.6	65
LV-060	N Fence--West End A-4	19.1	14.8	16.6	15.9	66
LV-061	NE Corner Fence/A-12	17.0	13.3	14.6	13.6	59
LV-062	NE Corner Fence/A-12	16.5	13.9	15.8	13.6	60
LV-063	E Fence/Center A-Complex	16.7	13.0	15.5	14.2	59
LV-064	E Fence/Center A-Complex	17.0	13.3	15.5	13.7	60
LV-065	NLV Badge Off (A-7)/A-2	16.2	12.7	14.6	13.1	57
LV-066	NLV Badge Off (A-7)/A-2	15.9	12.7	15.2	13.1	57
LV-067	E Fence/North End B-Complex	17.3	^(a)	15.8	14.5	48
LV-068	E Fence/North End B-Complex	17.3	14.5	16.1	14.5	62
LV-069	E Fence/South End B-Complex	17.9	14.8	16.9	15.1	65
LV-070	E Fence/South End B-Complex	26.6	14.8	18.7	14.8	75
LV-071	S Fence/Center/Next to Sub	17.9	14.8	16.9	15.3	65
LV-072	S Fence/Center/Next to Sub	18.2	14.8	16.6	15.4	65
LV-073	SW Corner/Gate C-1	19.7	14.2	15.8	14.2	64
LV-074	SW Corner/Gate C-1	17.6	14.2	16.3	14.5	63
LV-075	C-1 W End Guard Gate	22.0	18.0	20.1	^(a)	60
LV-076	C-1 W End Guard Gate	21.8	17.7	19.0	18.8	77
LV-077	W Fence/Gate C-3	18.2	14.8	16.9	15.4	65
LV-078	W Fence/Gate C-3	18.8	14.8	16.3	^(a)	50
LV-079	NW End A-13/Double G	18.8	15.0	16.3	14.8	65
LV-080	NW End A-13/Double G	19.4	14.5	16.9	15.9	67
LV-098	Control - 1	18.8	10.4	11.1	9.7	50



6.0 DOSE ASSESSMENT

The offsite environmental surveillance system, operated around the Nevada Test Site (NTS) by the U.S. Environmental Protection Agency's (EPA's) Radiation and Indoor Environments National Laboratory in Las Vegas (R&IE-LV), measured no radiation exposures attributable to recent NTS operations. However, using onsite emission measurements, estimates provided by U.S. Department of Energy (DOE) and calculated resuspension data as input to the EPA's Clean Air Package 1988 (CAP88)-PC model, a potential effective dose equivalent (EDE) to the maximally exposed individual (MEI) was calculated to be 0.11 mrem (1.1×10^{-3} mSv) to a hypothetical resident of Springdale, Nevada, located 58 km (36 mi) west-northwest of Control Point 1 (CP-1) on the NTS. The calculated population dose (collective EDE) to the approximately 32,210 residents living within 80 km (50 mi) from each of the NTS airborne emission sources was 0.34 person-rem (3.4×10^{-3} person-Sv). Monitoring network data indicated a 1996 exposure to the MEI of 144 mrem (1.44 mSv) from normal background radiation. The calculated dose to this individual from worldwide distributions of radioactivity as measured from surveillance networks was 0.023 mrem (2.3×10^{-4} mSv). These maximum dose estimates, excluding background, are less than 1 percent of the most restrictive standard.

6.1 ESTIMATED DOSE FROM NTS ACTIVITIES

The potential EDE to the offsite population due to NTS activities is estimated annually. Two methods are used to estimate the EDE to residents in the offsite area in order to determine the community potentially most impacted by airborne releases of radioactivity from the NTS. In the first method, effluent release estimates, based on monitoring data or calculated resuspension of deposited radioactivity, and meteorological data are used as inputs to EPA's CAP88-PC model which then produces estimated EDEs. The second method entails using data from the Offsite Radiological Safety Program (ORSP) with documented assumptions and conversion factors to calculate the committed effective dose equivalent (CEDE). The latter method provides an estimate of the EDE to a hypothetical individual continuously present outdoors at the location of interest that includes both NTS emissions and worldwide fallout. In

addition, a collective EDE is calculated by the first method for the total offsite population residing within 80 km (50 mi) of each of the NTS emission sources. Background radiation measurements are used to provide a comparison with the calculated EDEs. In the absence of detectable releases of radiation from the NTS, the Pressurized Ion Chamber (PIC) network provides a measurement of background gamma radiation in the offsite area.

There are four sources of possible radiation exposure to the population of Nevada, some of which were monitored by EPA's offsite monitoring networks during 1996. These were:

- Background radiation due to natural sources such as cosmic radiation, radioactivity in soil, and ^7Be in air.
- Worldwide distributions of man-made radioactivity, such as ^{90}Sr in milk and plutonium in soil.

- Operational releases of radioactivity from the NTS, including those from drill-back and purging activities when they occur.
- Radioactivity that was accumulated in migratory game animals during their residence on the NTS.

Operational releases and calculated sources of radioactive emissions from the NTS are used as input data for CAP88-PC to provide estimates of exposures to offsite populations. The other three sources of exposure listed above are discussed below.

ESTIMATED DOSE USING REPORTED NTS EMISSIONS

Onsite source emission measurements, as provided by DOE, are listed in Chapter 5, Table 5.1, and include tritium, radioactive noble gases, and plutonium. These are estimates of releases made at the point of origin. Meteorological data collected by the Air Resources Laboratory Special Operations and Research Division (ARL/SORD) were used to construct wind roses and stability arrays for the following areas: Mercury, Area 12, Area 20, Yucca Flat, and the Radioactive Waste Management Site (RWMS) in Area 5. A calculation of estimated dose from NTS effluents was performed using EPA's CAP88-PC model (EPA 1992). The results

dose within 80 km (50 mi) from each of these sources was calculated to be 0.34 person-rem (3.4×10^{-3} person-Sv). Activity concentrations in air that would cause these calculated doses are much higher than actually detected by the offsite monitoring network. For example, 0.107 mrem of the calculated EDE to the MEI is due to plutonium. The annual average plutonium concentration in air that would cause this EDE is 4.1×10^{-17} $\mu\text{Ci/mL}$. This is about 20 times the annual average plutonium in air measured in Goldfield, Nevada, (nearest community) of 0.19×10^{-17} $\mu\text{Ci/mL}$ (Chapter 5, Table 5.22). Table 6.1 summarizes the annual contributions to the EDEs due to 1996 NTS operations as calculated by use of CAP88-PC and the radionuclides listed in Chapter 5, Table 5.1.

Input data for the CAP88-PC model included meteorological data from ARL/SORD and effluent release data calculated from monitoring results and from resuspension estimates. These release data are known to be estimates and the meteorological data are mesoscale; e.g., representative of an area approximately 40 km (25 mi) or less around the point of collection. However, these data are considered sufficient for model input, primarily because the model itself is not designed for complex terrain such as that on and around the NTS. Errors introduced by the use of the effluent and meteorological data are small compared to the errors inherent in the model. The model

minimum detectable concentration (MDC). No krypton or tritium in air data were collected offsite, so the onsite krypton for this year, and an average value for previous year's offsite tritium were used. No vegetable or animal samples were collected in 1996, so calculations for these intakes are not done.

Data quality objectives (DQOs) for precision and accuracy are, by necessity, less stringent for values near the MDC, so confidence intervals around the input data are broad. The concentrations of radioactivity detected by the monitoring networks and used in the calculation of potential CEDEs are shown in Table 6.2.

The concentrations given in Table 6.2 are expressed in terms of activity per unit volume. These concentrations are converted to a dose by using the assumptions and dose conversion factors described below. The dose conversion factors assume continuous presence at a fixed location and no loss of radioactivity in storage or handling of ingested materials.

- Adult respiration rate = 8400 m³/yr (ICRP 1975)
- Milk intake (average for 20 and 40 yr old) = 110 L/yr (ICRP 1975)
- Water consumption = 2 L/day (ICRP 1975)

The EDE conversion factors are derived from Federal Guidance Report No. 11 (EPA 1988). Those used here are:

- ³H:
6.4 x 10⁻⁸ mrem/pCi (ingestion or inhalation)
- ⁷Be:
2.6 x 10⁻⁷ mrem/pCi (inhalation)

- ⁸⁵Kr:
1.5 x 10⁻⁵ mrem/yr per pCi/m³ (submersion)
- ^{238,239+240}Pu:
3.7 x 10⁻⁴ mrem/pCi (ingestion, f₁=10⁻⁴)
3.1 x 10⁻¹ mrem/pCi (inhalation, Class Y)

The algorithm for the internal dose calculation is:

- (concentration) x (intake in volume [mass]/unit time) x (CEDE conversion factors) = CEDE

As an example calculation, the following is the result of breathing a concentration of tritium in air of 0.2 pCi/m³:

- (2 x 10⁻¹ pCi/m³) x (8400 m³/yr) x (6.4 x 10⁻⁸ mrem/pCi) = 1.1 x 10⁻⁴ mrem/yr

However, in calculating the inhalation CEDE from ³H, the value must be increased by 50 percent to account for skin absorption (ICRP 1979). The total dose in one year, therefore, is 1.1 x 10⁻⁴ x 1.5 = 1.6 x 10⁻⁴ mrem/yr. Dose calculations from ORSP data are summarized in Table 6.2.

The individual CEDEs, from the various pathways, added together give a total of 0.015 mrem/yr. Total EDEs can be calculated based on different combinations of data. If the interest was in just one area, for example, the concentrations from those stations closest to that area could be substituted into the equations used herein.

In 1996, because of budget cuts and the standby status of nuclear device testing, samples of game animals and garden vegetables were not collected. Also, the noble gas and tritium sampling network was discontinued in the offsite locations, and the air sampling network was reduced. In order to calculate an EDE for a resident of Springdale, Nevada, using the MEI from the CAP88-PC operation, it is necessary to

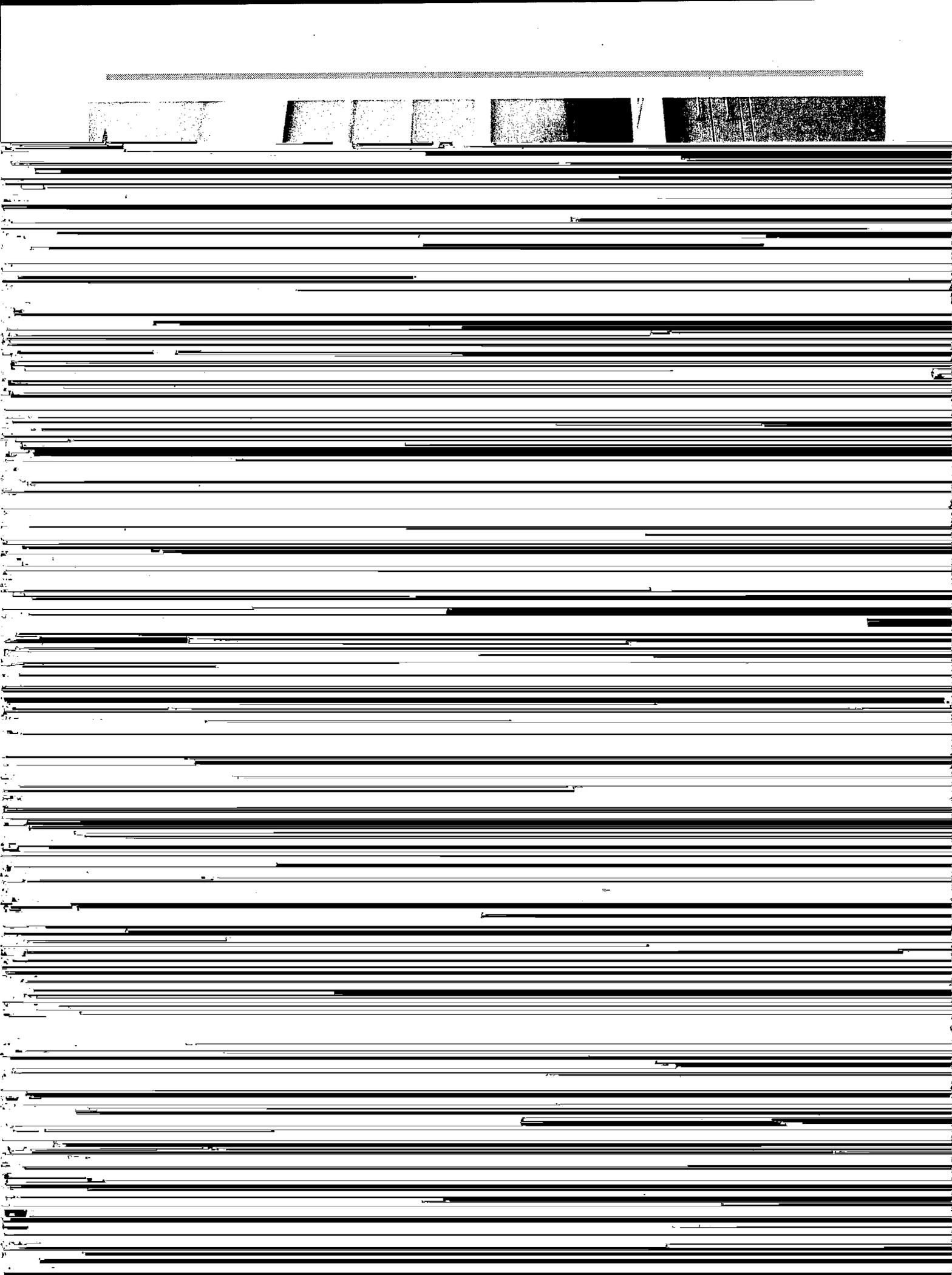
statewide levels so it can be used. Also, tritium in air does not change much from year to year so previous data for that can be used. Finally, Goldfield, Nevada, has the nearest air sampler to Springdale, Nevada, so its plutonium concentration is used to calculate the EDE.

6.2 DOSE (EDE) FROM BACKGROUND RADIATION

In addition to external radiation exposure due to cosmic rays and gamma radiation from naturally occurring radionuclides in soil (e.g., ^{40}K , U, and Th and their progeny), there is a contribution from ^7Be that is formed in the atmosphere by cosmic ray interactions with oxygen and nitrogen. The annual average ^7Be concentration measured by the offsite surveillance network was 0.24 pCi/m^3 . With a dose conversion factor for inhalation of $2.6 \times 10^{-7} \text{ mrem/pCi}$, and a breathing volume of $8,400 \text{ m}^3/\text{yr}$, this equates to a dose of $5.2 \times 10^{-4} \text{ mrem}$ as calculated in Table 6.2. This is a negligible quantity when compared with the PIC

using estimated or calculated effluents from the NTS during 1996, resulted in a maximum dose of 0.11 mrem ($1.1 \times 10^{-3} \text{ mSv}$) to a hypothetical resident of Springdale, Nevada, 14 km (9 mi) west of the NTS boundary. Based on monitoring network data, this dose is calculated to be 0.005 mrem . This latter EDE is about 5 percent of the dose obtained from CAP88-PC calculation. This maximum dose estimate is less than 1 percent of the International Commission on Radiological Protection (ICRP) recommendation that an annual EDE for the general public not exceed 100 mrem/yr (ICRP 1985). The calculated population dose (collective EDE) to the approximately 32,210 residents living within 80 km (50 mi) of each of the NTS airborne emission sources was 0.34 person-rem ($3.4 \times 10^{-3} \text{ person-Sv}$). Background radiation yielded a CEDE of $3,064 \text{ person-rem}$ (30.6 person-Sv).

Data from the PIC gamma monitoring indicated a 1996 dose of 144 mrem from background gamma radiation measured in the Springdale area. The CEDE calculated from the monitoring networks or the model, as discussed above, is a negligible amount



7.0 NONRADIOLOGICAL MONITORING RESULTS

Nonradiological monitoring of the Nevada Test Site (NTS) operations was confined to onsite monitoring as there were no nonradiological discharges to the offsite environment. Types of monitoring conducted included (1) drinking water distribution systems for Safe Drinking Water Act (SDWA) compliance, (2) sewage influents to lagoons for state of Nevada permit requirements, (3) polychlorinated biphenyls (PCBs) as part of Toxic Substance Control Act compliance, (4) asbestos monitoring for asbestos removal and renovation projects, (5) groundwater monitoring under the waste site in Area 5 for Resource Conservation and Recovery Act (RCRA) compliance, and (6) environmental media for hazardous characteristics and constituents. Wild horses and chukar were also monitored as components of an NTS ecological monitoring program that is being reviewed and redesigned.

7.1 ENVIRONMENTAL SAMPLES

SAFE DRINKING WATER ACT

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 taken at various locations throughout all drinking water distribution systems on the NTS. Common sampling points were restroom and cafeteria sinks (see Chapter 4, Figure 4.3). 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 445 and Title 40 Code of Federal Regulations (C.F.R.) Part 141.

BACTERIOLOGICAL SAMPLING

Samples were submitted to the state-approved Associated Pathologists Laboratories in Las Vegas, Nevada, for coliform analyses. All water distribution systems were tested once a month, with the number of people being served determining

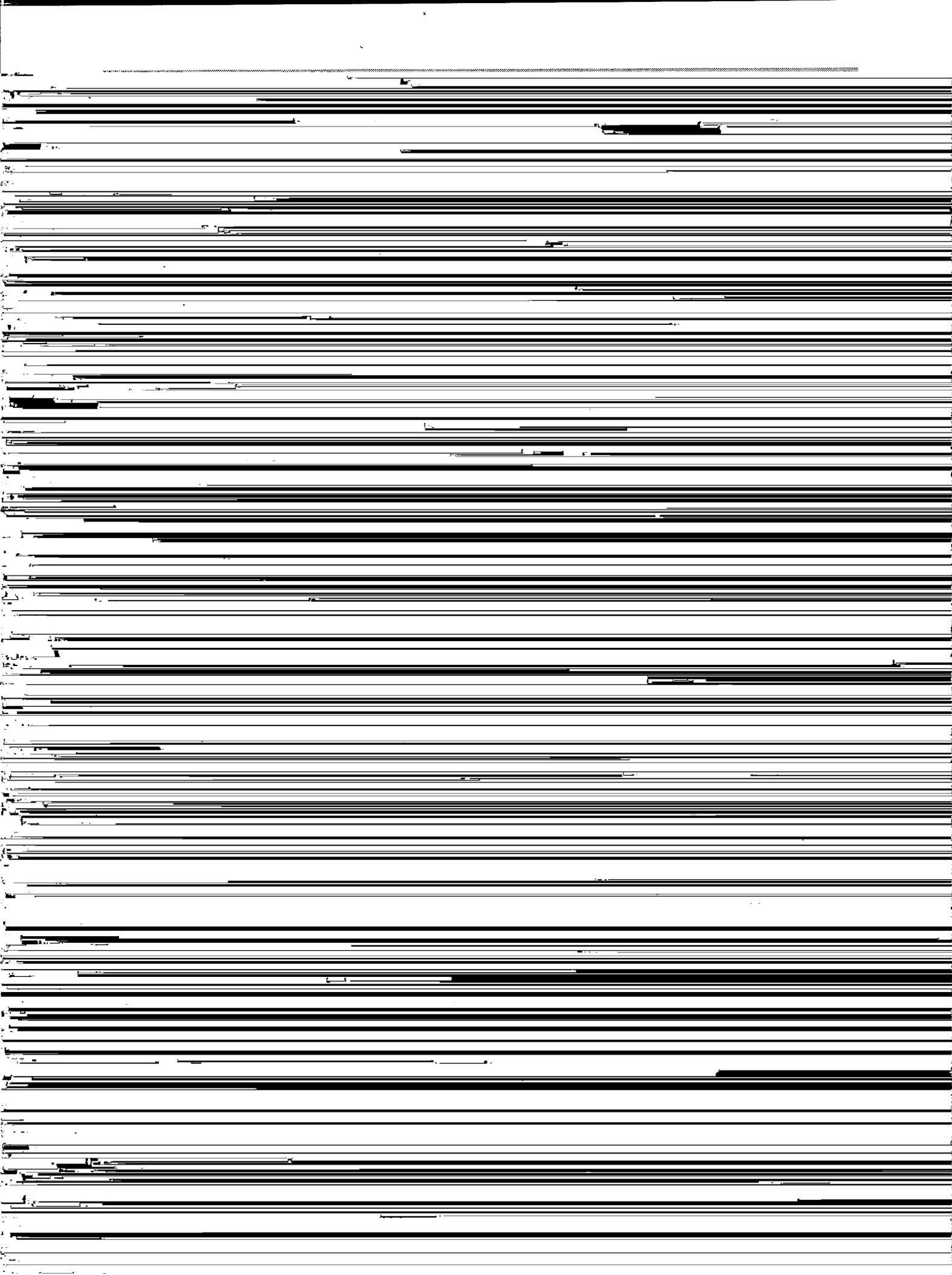
the number of samples collected. If coliform bacteria are present, the system must be shut down and chlorinated. In order to reopen the system, three or four consecutive samples must meet state requirements, depending again on the number of people served. There were no incidents of positive coliform bacteria results during 1996.

Residual chlorine and pH levels were determined at the collection point by using colorimetric methods approved by the state. The results were recorded in Bechtel Nevada's (BN's) drinking water sample logbook, and the chlorine residual level was recorded on an analysis form.

Samples from each truck which hauled potable water from NTS wells to work areas were also analyzed for coliform bacteria. During 1996, the state relaxed the requirement to test every truck load of water, to testing each of the three trucks weekly. There were no positive coliform sample results in 1996 that required superchlorination and resampling.

CHEMICAL ANALYSIS

Chemical analysis in 1996 consisted of (1) VOCs, (2) synthetic organic chemicals (SOCs), and (3) inorganics.



renovation projects at the NTS. The sample volume was divided equally between bulk and general area air samples.

RESOURCE CONSERVATION AND RECOVERY ACT

A total of 1,350 chemical analyses were performed in 1996 in support of waste management and environmental compliance activities at the NTS. Groundwater monitoring, included in these analyses, is described in the following paragraphs.

During 1992, three pilot wells (UE5PW-1, UE5PW-2, UE5PW-3) were drilled through the vadose zone into the uppermost aquifer under the Area 5 Radioactive Waste Management Site (RWMS-5). The principal purpose of these wells was to characterize the hydrogeology of the vadose zone under the waste disposal cells at RWMS-5. This characterization is consistent with the leakage-detection requirements for interim treatment, storage, and disposal (TSD) facilities required by the U.S. Environmental Protection Agency (EPA) and the state of Nevada.

In accordance with Title 40 C.F.R. 265 - Subpart F, operators of interim status TSD facilities are required to collect quarterly samples for one year from a minimum of one upgradient and three downgradient wells for characterization of background water quality. The first collection of these characterization data were performed in 1993. In 1994, and subsequently, the frequency was reduced to semi-annual and results were statistically compared with the initial characterization data.

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. Water was withdrawn from each well with dedicated submersible double piston pumps for the purpose of purging and collecting samples. Temperature, pH, and specific

conductance were monitored during purging and until the conclusion of sampling. Samples were collected and analyzed in accordance with written procedures that specified sample collection methodology, sample preservation, sample shipment, analytical procedures, and chain-of-custody control. Preservative measures were applied in the field to all samples at the time of removal from each well. Based on characterization results during 1993, and detection monitoring results for 1994 through 1996, the uppermost aquifer beneath the RWMS-5 disposal cells is suitable for use as drinking water or for agricultural purposes. The analyses performed for these samples can be found in Table 7.7. No chemical or radiological contaminants attributable to either U.S. Department of Energy, Nevada Operations Office's (DOE/NV's) weapons testing or waste management activities have been detected in the three wells.

SPECIAL STUDIES

Four series of tests were conducted involving 28 different chemicals at the Hazardous Materials Spill Center (HSC) in 1996. Pursuant to the agreement between HSC and the state of Nevada, the EPA is invited to participate in both the spill test advisory panels and the field monitoring. Although substantial amounts of the chemicals were released during the tests, no hazardous concentrations were detected at the NTS boundary by EPA monitors.

7.2 ECOLOGICAL CONDITIONS

All components of the DOE/NV-sponsored Basic Environmental Compliance and Monitoring Program were evaluated in 1995 for their ability to meet current DOE/NV objectives given changes in NTS missions and DOE policy. Work began on developing a comprehensive NTS ecological monitoring program focused on site-specific compliance with the National Environmental Policy Act and the new Federal Land and Facility Use Management Policy. During data evaluations and program development

efforts, field data on annual and perennial plants, reptiles, small mammals, and deer were not collected. Data collection was resumed in part, as necessary, under the revised monitoring program initiated in 1996. The revised program and an adaptable guidance document for ecological monitoring were completed in May 1996. The new program is designated as the Ecological Monitoring and Compliance Program. The ecological monitoring tasks which were selected for 1996 included vegetation mapping within the range of the desert tortoise, characterizing the natural springs on the NTS, censuring horse and chukar populations, and periodically monitoring man-made water sources to assess their affects on wildlife. In addition, the Environmental Assessment for the HSC calls for ecological monitoring of certain spill tests, and a monitoring plan was developed and implemented in 1996.

FLORA

In January, BN published and distributed the DOE/NV topical report titled, "Current Distribution, Habitat, and Status of Category 2 Candidate Plant Species on and near the U.S. Department of Energy's Nevada Test Site." This report represents the culmination of several years of intensive field surveys and literature reviews on 11 Category 2 candidate plant species. The results of these surveys and a previous report on the Category 1 species, Beatley's milkvetch (*Astragalus beatleyae*), contributed to the removal of these species from the U.S. Fish and Wildlife Service candidate list in February 1996.

HABITAT MAPPING

Several spatial coverages or vegetation maps of plant communities and tortoise habitats at the NTS were developed during 1996. The first was a geo-referenced (i.e., corrected for Universal Transverse Mercator

NTS. This map, although relatively generalized, permits usage with GIS software and correlation to other GIS data collected on the NTS. The second mapping effort involved refining the classification of vegetation on the NTS to identify habitat and nonhabitat for desert tortoises and other sensitive species. Using regular and multi-spectral aerial photographs of the NTS, ecological landform units (ELUs) were identified. These are areas with similar slope, aspect, soil, hydrology, vegetation, and wildlife. These areas were then described during field surveys. Within each ELU, one or more 200-m transects were sampled for the frequency of perennial shrubs by species. At each sample transect, UTM coordinates were taken to establish their location, and photographs of the ground-level landscape were taken. This information was entered into computer databases for ease of access. The locations of the nearly 500 vegetation sampling transects were then linked to database tables and site photographs. This information database can display the distribution of every plant species identified along the transects within the southern third of the NTS, which roughly corresponds to the range of the desert tortoise on the NTS. The ELU data will also facilitate correlation of tortoise sign and presence with vegetation, soils, geology, and other site features that may be important to identify habitats that sustain tortoise populations or other sensitive species.

FAUNA

Field surveys were conducted in 1996 for some of these former candidate animal species to determine their abundance and distribution. Information gathered will be helpful to prevent possible listing of the species in the future. These species included the chuckwalla (*Sauromalus obesus*), western burrowing owl (*Speotyto cunicularia*), and seven species of bats. The

NONRADIOLOGICAL MONITORING RESULTS

volans), big free-tailed bat (*Nyctinomops macrotis*), pale Townsend's big-eared bat (*Plecotus townsendii pattescens*), and the spotted bat (*Euderma maculatum*). A GIS map of this year's survey sites and survey data was prepared in September 1996.

HORSE SURVEYS

during years when NDOW personnel request permission to trap and remove them.

FIELD SURVEYS FOR FORMER CANDIDATE SPECIES

Chuckwalla surveys were conducted every month from May through August of 1996. Seventeen chuckwallas were observed in

by biologists listening for bat vocalizations. These are the first capture records of this species on the NTS, and historically only a few capture records exist for southern Nevada. A total of 1,083 bats, representing ten species, were captured across all sites. Six of the species captured are former Category 2 candidate species. A GIS map of the trap locations and trap results was prepared in September 1996. A detailed report of survey findings will be prepared in 1997.

OTHER MONITORING

A total of three coyotes and five mule deer were found dead as a result of drowning or entrapment in plastic-lined sumps. Of the three canines, one was found in a sump at drill site ER-6-1, one in a sump at ER-20-5, and one in a sump at ER-20-6. The mule deer were found in sumps at ER-20-6. All of these sumps had one animal ladder (made of plastic fencing). The sumps at ER-20-5 and ER-20-6 are ponds which contain tritiated groundwater. The fences around the sumps at these sites are in good condition, yet they do not deter coyotes or mule deer from entry. No animal mortalities were observed in any of the earthen or cement-lined sumps or ponds. It was recommended that an ecological risk

assessment be conducted to evaluate risks associated with wildlife exposure to tritiated water versus those associated with entrapment and the cost of preventing entrapment. The following mitigation measures are being considered: (1) To prevent wildlife access or death from entrapment, chain link fences ten-feet high will be constructed around sumps of contaminated water to effectively exclude mule deer and coyotes; (2) To prevent wildlife death from entrapment, fill material will be dumped on top of the lining along one side of lined sumps to form a gradual earthen access and escape ramp.

Selected water sources on the NTS were surveyed to evaluate their effect on the distribution of horses. Camp 17 Pond in Area 18, and Captain Jack Spring in Area 12 received the heaviest use by horses in 1996. Well 2 Pond was dry during 1996, and 12 horses appeared to shift their major summer use to Captain Jack Spring. Limited use was made of the Area 2 Mud Plant Pond. An estimated 30 horses appear dependent on Camp 17 Pond during summer and fall in years when Gold Meadows Spring becomes dry. Monitoring of horse use of selected springs and well reservoirs at the NTS suggests that the distribution of horses in 1996 has not changed significantly from that observed in previous years.

Table 7.1 Influent Quality - 1996

Facility	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter	
	BOD5 ^(a) (mg/L)	S.C. ^(b) (µmhos/cm)	BOD5 (mg/L)	S.C. (µmhos/cm)	BOD5 (mg/L)	S.C. (µmhos)	BOD5 (mg/L)	S.C. (µmhos/cm)
Gate 100	294	1.58	476	1.40	159	1.00	313	1.13
Mercury	173	0.80	98	0.80	137	0.87	194	0.64
Yucca Lake	392	0.73	98	0.86	75	0.77	95	0.38
Tweezer	199	1.16	81	0.76	214	1.54	308	1.09
CP-6	0	0	0	0	0	0	0	0
CP-72	0	0	0	0	0	0	0	0
DAF	120	1.50	20	1.22	132	0.97	76	0.81
Reactor Control	350	0.94	0	0	0	0	60	0.30
Test Stand 1	0	0	0	0	0	0	0	0
Base Camp 25	264	0.80	164	0.91	44	0.68	92	0.61
Base Camp 12	20	0.29	13	0.48	6	0.30	6	0.28
Test Cell C	0	0	0	0	0	0	0	0
RWMS Site 5	1236	1.21	391	1.30	80	0.68	60	0.95

(a) Biochemical Oxygen Demand - 5-day Incubation.

(b) Specific Conductance.

Table 7.2 Organic Loading Rates - 1996

Facility	Limit (Kg/day)	Metered Rates			
		(Jan-Mar) Mean Daily Load	(Apr-June) Mean Daily Load	(Jul-Sept) Mean Daily Load	(Oct-Dec) Mean Daily Load
Mercury	172	51.24	38.14	34.49	49.17
LANL on Tweezer	5.0	3.06	0.92	0.92	2.99
Yucca Lake	8.6	9.62 ^(a)	4.48	1.73	4.64
Base Camp 12	54	0.21	0.04	0.04	0.06
RWMS Site 5	0.995	1.88 ^(a)	0.56	0.15	0.02
Calculated Rates					
CP-6	8.7	0	0	0	0
CP-72	1.1	0	0	0	0
DAF	7.6	0.51	0.25	2.51	0.27
Reactor Control	4.2	2.08	0	0	0.15
Eng Test Stand	2.3	0	0	0	0
Test Cell C	1.3	0	0	0	0
Base Camp 25	7.4	2.41	1.19	0.81	0.14
Gate 100	2.4	0.60	1.77	0.32	1.07

(a) Considered to be an anomalous value.

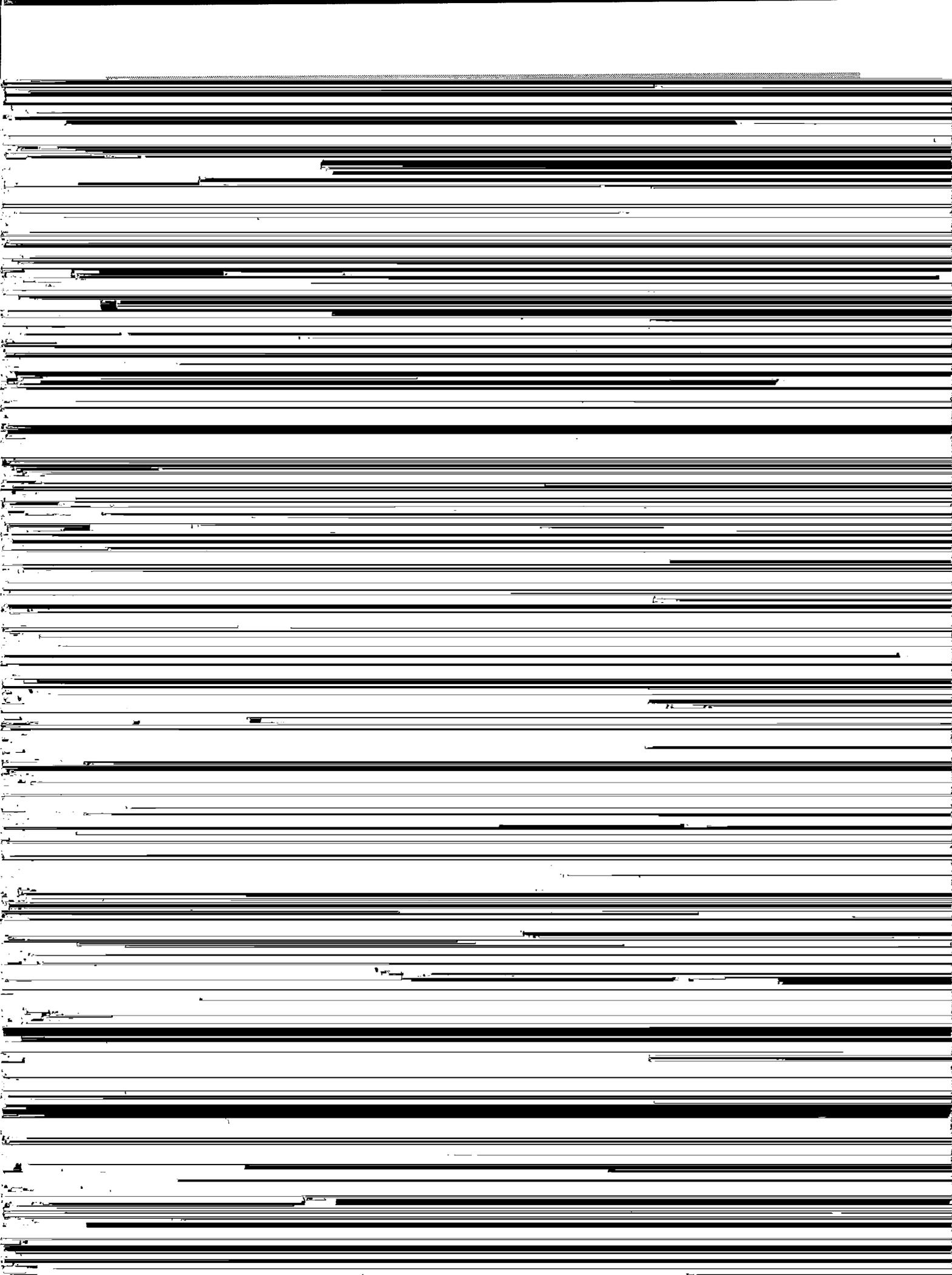


Table 7.4 Influent Toxics for Facilities that Received Industrial Wastewater - 1996

Parameter	Compliance Limit (mg/L)	Mercury Measurement (mg/L)	Area 25		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)
			Base Camp Measurement (mg/L)	Yucca Lake Measurement (mg/L)				
Arsenic	5.0	0.0205 (a)	0.0183 (a)	0.0139 (a)	0.0104 (a)	(a)	(a)	(a)
Barium	100	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Cadmium	1.0	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Chromium	5.0	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Lead	5.0	0.0051 (a)	(a)	(a)	(a)	(a)	(a)	0.0143 (a)
Mercury	0.2	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Selenium	1.0	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Silver	5.0	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Benzene	0.5	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Carbon Tetrachloride	0.5	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Chlorobenzene	100	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Chloroform	6.0	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1,4-dichlorobenzene	7.5	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1,2-dichlorobenzene	0.5	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1,1-dichloroethylene	0.7	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Methylethyl Ketone	200	(a)	(a)	(a)	(a)	(a)	(a)	(a)

(a) Not Detected.

Note: Volatile samples were taken from each primary lagoon as they can not be composited. No volatiles were detected during this reporting period. Future measurements for volatile samples from facilities with multiple primary lagoons will be average values.

4 (Influent Toxics for Facilities that Received Industrial Wastewater - 1996, cont.)

Parameter	Compliance Limit (mg/L)	Mercury Measurement (mg/L)	Area 25			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)
			Base Camp Measurement (mg/L)	Area 6 DAF Measurement (mg/L)	Area 5 RWMS Measurement (mg/L)				
1,1-Dichloroethylene	5.0	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1,2-Dichloroethylene	0.7	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1,1,1-Trichloroethylene	0.5	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1,1,2-Trichloroethylene	0.2	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Total	200	0.012	(a)	(a)	(a)	(a)	0.061	0.013	(a)
1,2,4-Trichlorobenzene	0.13	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1,2,4-Trichlorobenzene	0.13	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1,2-Dichlorobenzene	0.5	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1,2,4-Trichlorobenzene	2.0	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1,2,4-Trichlorobenzene	100	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1,2,4-Trichlorobenzene	400	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1,2,4-Trichlorobenzene	2.0	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1,2,4-Trichlorobenzene	0.03	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1,2,4-Trichlorobenzene	0.02	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1,2,4-Trichlorobenzene	0.008	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1,2,4-Trichlorobenzene	0.4	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1,2,4-Trichlorobenzene	10.0	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1,2,4-Trichlorobenzene	0.5	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1,2,4-Trichlorobenzene	10.0	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
P (Silvex)	1.0	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)

Detected.

Volatile samples were taken from each primary lagoon as they can not be composited. No volatiles were detected during this reporting period. Future measurements for volatile samples from facilities with multiple primary lagoons will be average values.

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Table 7.5 Sampling Data for Infiltration Ponds Containing 30 cm or More - 1996

<u>Parameter</u>	<u>Action Level</u> <u>mg/L</u>	<u>A-6 Yucca Lake</u> <u>Q1 Result</u> <u>mg/L</u>	<u>A-6 Yucca Lake</u> <u>Q2 Result</u> <u>mg/L</u>
Arsenic	0.5	0.0099	0.0086
Cadmium	0.1	<0.001	(b)
Chromium	0.5	0.0424	(b)
Lead	0.5	0.0079	(b)
Selenium	0.1	<0.003	(b)
Silver	0.5	0.0065	(b)
Nitrate Nitrogen	100	<0.02	(b)
Sulfate	5000	100	110
Chloride	1000	160	110
Fluoride	40	1.7	2.1
Tritium ^(a)	Monitor Only	(b)	(b)

(a) Unit for tritium is 10^{-7} $\mu\text{Ci/cc}$.

(b) Not Detected.

Table 7.6 Quantity of Waste Disposed of in Landfills - 1996

Table 7.7 Groundwater Monitoring Parameters at the RWMS-5 - 1996

Parameters Determining Suitability of Groundwater

Total and Dissolved Metals - As, Ba, Cd, Cr, Hg, Ag, Pb, Se
Total and Dissolved Gross Alpha/Beta

Parameters Establishing Water Quality

Chloride
Total and Dissolved Fe, Mn, Na
Phenols
Sulfate

Indicators of Contamination

pH
Conductivity
Total Organic Carbon
Total Organic Halogen

Additional Selected Parameters

Volatile Organics (8270)
Tritium

8.0 RADIOACTIVE AND MIXED WASTE STORAGE AND DISPOSAL

Disposal of low-level radioactive waste (LLW) from the U.S. Department of Energy (DOE)-approved generators occurs at two areas on the Nevada Test Site (NTS). Disposal of packaged LLW at the Radioactive Waste Management Site, Area 5 (RWMS-5) is in shallow pits and trenches. LLW packaged in large bulk waste containers, and unpackaged bulk waste (only from the NTS) are buried in selected subsidence craters at the RWMS, Area 3 (RWMS-3).

Hazardous waste and specific categories of radioactive waste are stored above ground in Area 5. Transuranic (TRU) waste categorized as mixed waste, i.e., radioactive material mixed with hazardous waste, is stored in a covered building on a specially constructed Resource Conservation and Recovery Act (RCRA)-designed pad. The TRU waste will be characterized for proposed disposal at the Waste Isolation Pilot Plant (WIPP) in New Mexico. Low-level radioactive mixed waste is currently being stored on the TRU waste storage pad before permanent disposal. Uranium ore residues are stored north of the RWMS-5. Hazardous wastes generated on the NTS are accumulated at the Hazardous Waste Accumulation Site (HWAS) east of the RWMS-5 before shipment to an offsite treatment, storage, and disposal (TSD) facility.

During 1996, environmental monitoring involved air sampling, radiation dose rate surveys, groundwater analysis, and environmental sampling. Air samples were collected at RWMS-3 and RWMS-5 for analysis of gross beta radiation, photon-emitting radionuclides, plutonium, and tritium. Tritium arising from the disposal of LLW was the only airborne radionuclide detected at the RWMS-5. All radionuclide concentrations were well below derived concentration guides (DCGs). Gamma radiation fields were monitored by thermoluminescent dosimeters (TLDs). Gamma doses greater than background were detected at the RWMS-5 in areas where waste is stored or disposed. Neutron radiation fields at the perimeter of the TRU waste storage pad were monitored by proton recoil dosimeters. Radiation exposure rates were consistent with historical ranges.

8.1 WASTE DISPOSAL OPERATIONS

Radioactive waste disposal was initiated at Area 5 on the NTS in 1961. By July 1976, six out of nine developed trenches had been filled with LLW. In 1978, waste disposal operations were expanded when the DOE established the Radioactive Waste Management Project for the disposal of defense-related LLW,

from the NTS, from offsite DOE generators, and from U.S. Department of Defense facilities.

In 1987, the state of Nevada granted the NTS interim status for the disposal of low-level mixed waste in Pit 3 of the RWMS-5. LLW disposed prior to 1986 may contain low levels of constituents that would be regulated as hazardous waste under RCRA (Title 40 C.F.R. 260-281). Mixed waste disposal was curtailed in 1990 by the DOE

"The presence of lead

across borders of the DWMC 5 to prevent

containers is stored on concrete pads that are surrounded by a control fence. Required inspections are performed routinely to ensure that the integrity of the waste containers is maintained. Opening of the cargo containers for inspection is controlled following established as low as reasonably achievable (ALARA) principles to reduce radiation exposure to personnel.

The original management plan for this material was treatment and disposal. During 1996, DOE/NV determined that transferring this material to a mill for additional uranium extraction will expedite the handling of this material by two years and will recycle approximately 260 m³ of the material. For further information on managing this material, please refer to the "NTS Site Treatment Plan" (DOE 1996a).

TRANSURANIC WASTE STORAGE

The TRU waste storage pad is located in the southeast corner of the RWMS-5. The pad is used for interim storage of TRU waste previously received from Lawrence Livermore National Laboratory. During 1992, all of the mixed TRU waste packaged in 55-gal drums was overpacked into 85-gal steel drums with carbon filter vents. This waste is stored in a covered building that is located on a curbed asphalt pad surrounded by a security fence. The pad and waste storage configuration comply with RCRA, Title 40 C.F.R. 265, Subpart I.

Inspections of all mixed TRU waste containers are performed weekly, while inspections of the TRU waste storage pad are performed monthly. The current inventory is awaiting permanent disposal at the WIPP. This waste will be characterized and packaged for certification according to WIPP criteria. DOE/NV plans to examine this waste in the Waste Examination Facility scheduled to be completed in 1997 at RWMS-5. Further information on this material is contained in the "NTS Site Treatment Plan" referred to above.

8.2 ENVIRONMENTAL MONITORING AT WASTE STORAGE AND DISPOSAL SITES

The Analytical Services Laboratory, Environmental Monitoring Group is responsible for collection of samples and verifying sample results. The Radioanalytical Section is responsible for analysis of the samples. Collection and analysis of samples are performed in accordance with approved operating procedures. The Waste Management Project reviews the sampling results for any unexpected trends.

AIR MONITORING

Air sampling is conducted at eight (reduced to four in the fourth quarter) stations along the perimeter of the RWMS-5 fence for both particulates and tritiated water (HTO), at two stations inside the TRU waste storage cover, and at one station in Pit 5 for particulates. Two samplers inside the TRU cover building along with the perimeter samplers were determined to provide adequate monitoring for the TRU waste storage facility. Originally, there were six stations that surrounded the TRU waste storage facility. Air sampling is also conducted for particulates at four stations along the perimeter of the U-3ah/at craters and for HTO at one station north of the craters at RWMS-3.

Air samplers operate at an air flow rate of approximately 140 L (5.0 ft³) per minute. Sampling media is a 9-cm (approximately 4-in) glass-fiber filter. Filters are exchanged on a weekly basis. Each filter is analyzed for gross beta/gamma radiation. The filters are composited quarterly for samplers located at the perimeter of RWMS-5 and monthly for all other sample locations and analyzed for ²³⁸Pu and ²³⁹⁺²⁴⁰Pu. Samplers for HTO in air are located with the particulate

samplers along the perimeter of the RWMS-5. Sampling for radioiodine was discontinued in 1995, because radioiodine is not expected to be produced from LLW disposal operations. Radioiodine was measured in the past because of its production during nuclear testing.

RWMS-5 AIR MONITORING

Tritium, ^{238}Pu , $^{239+240}\text{Pu}$, and gross beta activity were measured in air at the RWMS-5 during 1996. Composite data for the first three radionuclides (see Table 8.5) include both RWMS-5 onsite and perimeter air sampling. The 1996 airborne plutonium levels were generally lower than those in 1995. The range was from <0 to 73×10^{-18} $\mu\text{Ci/mL}$ with a network average concentration of 4.9×10^{-18} $\mu\text{Ci/mL}$ (0.18 $\mu\text{Bq/m}^3$). The maximum annual average concentration was 1.2×10^{-17} $\mu\text{Ci/mL}$ (0.44 $\mu\text{Bq/m}^3$). That maximum average concentration is only 0.6 percent of the 10 mrem per year modified DCG for $^{239+240}\text{Pu}$ (2×10^{-15} $\mu\text{Ci/mL}$ [74 Bq/m^3]) (DOE Order 5400.5). The average air concentration of ^{238}Pu was approximately a factor of 30 lower than the airborne concentration of $^{239+240}\text{Pu}$. Airborne plutonium in Area 5 is probably due to resuspension of contaminated soils and not attributable to the waste disposed of in this LLW site.

The average HTO concentration was 3.2×10^{-12} $\mu\text{Ci/mL}$ (0.12 Bq/m^3) and the highest annual average was 5.4×10^{-12} $\mu\text{Ci/mL}$ (0.2 Bq/m^3). The high value is less than 0.06 percent of the 10 mrem per year modified DCG for HTO (1×10^{-8} $\mu\text{Ci/mL}$ [370 Bq/m^3]). Tritium is associated with waste disposal operations. The levels of tritium have remained consistent with historical averages. The average HTO air concentration in 1996 was in the range of the 1994 average concentration of 4.9×10^{-12} $\mu\text{Ci/mL}$ (0.18 Bq/m^3) and the 1995 average concentration of 5.8×10^{-12} $\mu\text{Ci/mL}$ (0.21 Bq/m^3). Gross beta air concentration results are

used as a screening tool to check if a significant release occurred and if other radionuclides warrant analysis. The results were in the range of 10^{-14} and 10^{-15} $\mu\text{Ci/mL}$. These levels are consistent with levels for previous years and with the sitewide average gross beta concentration.

RWMS-3 AIR MONITORING

Traces of plutonium (^{238}Pu and $^{239+240}\text{Pu}$) were detected in air at all of the RWMS-3 samplers in 1996. The average air concentration of $^{239+240}\text{Pu}$ in 1996 was 1.65×10^{-16} $\mu\text{Ci/mL}$ (6.1 $\mu\text{Bq/m}^3$), which was slightly more than the 1995 average of 0.89×10^{-16} $\mu\text{Ci/mL}$ (3.3 $\mu\text{Bq/m}^3$). The average air concentration of ^{238}Pu was approximately a factor of 150 lower than the average concentration of $^{239+240}\text{Pu}$. The highest average concentration of $^{239+240}\text{Pu}$ detected in 1996 was 26×10^{-17} $\mu\text{Ci/mL}$ (9.6 $\mu\text{Bq/m}^3$), which is far below the Derived Air Concentration for $^{239+240}\text{Pu}$. Airborne plutonium is most likely due to resuspension of soils contaminated by atmospheric weapons testing and is not attributable to the waste being disposed of at this site. Gross beta air concentrations were consistent with the RWMS-5 results.

The HTO in air average concentration was 0.54×10^{-12} $\mu\text{Ci/mL}$ (20 mBq/m^3), and the maximum concentration was 5.0×10^{-12} $\mu\text{Ci/mL}$ (0.18 Bq/m^3), both less than the RWMS-5 results.

RADIATION EXPOSURE RATES

Areas where disposal operations take place are radiologically controlled through engineering and administrative controls to ensure radiation exposures are ALARA. Workers are thoroughly trained in exposure reduction techniques and ALARA practices. Worker radiation doses have remained below ALARA administrative goals that are considerably less than the DOE occupational limit.

GAMMA EXPOSURE

TLDs were deployed at 44 locations at RWMS-5 and at 5 locations at RWMS-3 disposal site U-3ah/at to measure the gamma radiation exposure (see Table 8.6).

Ten TLDs were placed within the perimeter of RWMS-5, including six TLDs around the TRU waste storage pad, two TLDs in Pit 3, and two TLDs in the operational disposal Pits 4 and 5. The TLDs in the pits were about 100 ft (30 m) from the waste stacks. Fifteen TLDs were located at the perimeter of the RWMS-5 site and one was placed at the facility office. All the TLDs were exchanged and analyzed quarterly.

The TLDs located at the perimeter of RWMS-3 and RWMS-5 had exposures that were at or slightly above background levels (see Table 8.6). Exposure rates at the TRU pad, in the operational disposal pits of RWMS-5 and at the Strategic Materials Storage Yard were above background due to their proximity to the radioactive waste containers. No significant increases were identified when comparing the 1996 exposure rates with historical levels.

NEUTRON DOSE EQUIVALENTS

Neutron dose equivalents were measured at six locations at the perimeter of the TRU waste storage pad. The dose equivalents for 1996 ranged from the detection limit of 80 mrem to 168 mrem per year. Neutron doses for 1996 were consistent with previous results.

VADOSE ZONE MONITORING FOR MIXED WASTE DISPOSAL

A vadose zone monitoring program has been implemented to allow earlier detection of potential contaminant migration from the mixed waste disposal pit (Pit 3) at the RWMS-5 and under U-3ah/at and U-3ax/bl craters at RWMS-3. Monitoring is conducted in 24 access tubes. Tubes are installed through the operational cover (approximately 8 ft), waste zone (20 - 30 ft), and ten feet of soil below the pit floor. Drill casings are angled under the disposal craters in RWMS-3. Tubes are monitored quarterly with neutron moisture meters to detect wetting fronts from precipitation. Wetting fronts that progressed through the operational cap and into the waste zone could indicate that contaminant migration might have occurred. In 1996, as in the past, no wetting fronts have been detected below the operational cap.

TRITIUM MIGRATION STUDIES AT THE RWMS-5

The results of the tritium migration study at the GCD site have shown that the waste buried between depths of 70 and 120 ft has remained isolated from the accessible environment (i.e., the land surface). In addition, sampling of plants and near surface soil above shallow land disposal cells in RWMS-5 have shown a seasonal variation in tritium concentration. The results have indicated that worker and public radiation exposures are negligible.

Table 8.3 Low-Level Waste Disposed of at the RWMS-3, 1993 - 1996

<u>Calendar Year</u>	<u>Volume of LLW Disposed (m³)</u>	<u>Activity of LLW Disposed (Ci)</u>
1996	7033	5.7
1995	11073	3.1
1994	10550	0.21
1993	9848	0.24

Table 8.4 Radionuclides Disposed of at the RWMS-3 - 1996

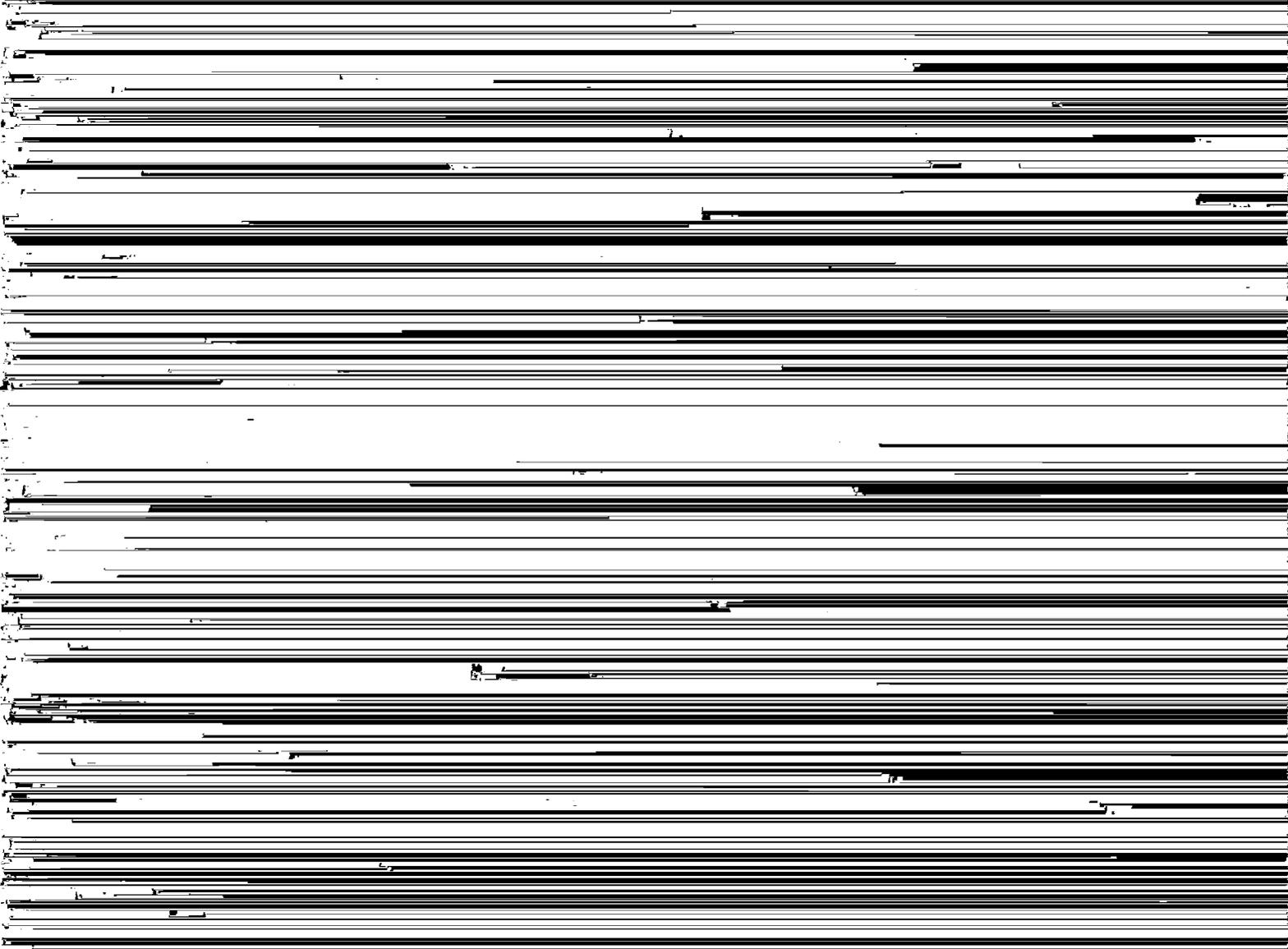
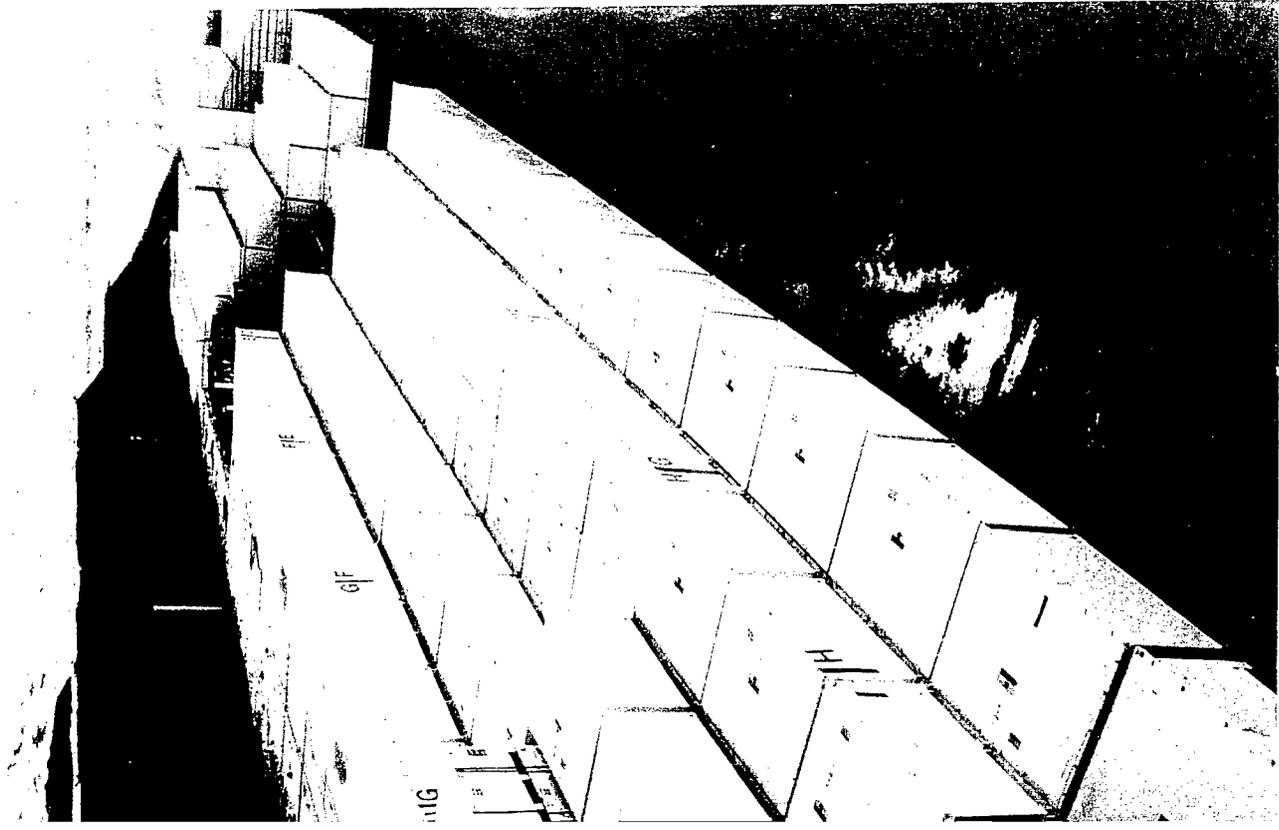
<u>Radionuclide</u>	<u>Activity (Ci)</u>	<u>Percent of Total Activity</u>
²³⁹ Pu	3.160	55.00
²⁴¹ Pu	1.419	24.70
²³⁸ U	0.359	6.25
²⁴⁰ Pu	0.299	5.20
²³⁴ U	0.249	4.33
²⁴¹ Am	0.213	3.71
⁹⁹ Tc	0.021	0.37
²³⁵ U	0.013	0.23
²³⁶ U	<u>0.012</u>	<u>0.21</u>
Total	5.7	100

Table 8.5 Air Monitoring Results for Various Radionuclides at the RWMS-5, 1994 - 1996

<u>Year</u>	<u>²³⁹⁺²⁴⁰Pu (x 10⁻¹⁷ μCi/mL)</u>	<u>²³⁸Pu (x 10⁻¹⁷ μCi/mL)</u>	<u>Tritium (x 10⁻⁶ pCi/mL)</u>
Average 1996	0.51	0.02	3.2
High Average 1996	1.2	0.06	5.4
Average 1995	0.6	0.013	5.7
High Average 1995	3.4	0.11	15
Average 1994	1.1	0.038	4.9
High Average 1994	5.9	0.15	14
Derived Concentration Guide (10 mrem for nonworkers)	200	300	10 ⁴

Table 8.6 External Gamma Exposure Measured by TLDs at the RWMS - 1996

<u>Calendar Year</u>	<u>Number of Dosimeters</u>	<u>Average (mR/y)</u>	<u>Standard Deviation (mR/y)</u>
RWMS-5, perimeter	16	121	7.1
RWMS-5, TRU pad, Pit 3 and 5	10	376	401
RWMS-3, U-3ah/at perimeter	9	147	24.2
Strategic Material Storage Yard	18	1948	1201



9.0 GROUNDWATER PROTECTION

The primary mission of the U.S. Department of Energy, Nevada Operations Office (DOE/NV) at the Nevada Test Site (NTS) has been the testing of nuclear devices and their components. The DOE/NV's Environmental Protection Policy Statement outlines a general policy of preventing

hydrocolloid units of the NTS occur in

component of lateral movement of

aquitard. These aquifers lie well above the test depth. The alluvial aquifer is the primary source of groundwater in the area with flow to the northeast toward the Piceance Creek. Recharge to the alluvial aquifer occurs by downward infiltration of precipitation and surface water, and by upward leakage from underlying aquifers. The "A" aquifer is larger in areal extent than the overlying alluvial aquifer with the permeability in the "A" aquifer controlled by a vertical fracture system. The "B" aquifer exhibits minimal communication with the "A" aquifer.

GRAND VALLEY, COLORADO

Project RULISON is located in the Mesa Verde Sandstone which is overlain by alluvium, the Green River Formation (shale and marlstone), the Wasatch Formation (clay and shale), and the Ohio Creek Formation (conglomerate). The direction of groundwater flow is thought to be northward. The principal groundwater resources of the area are in the alluvial aquifer, which is separated from the test horizon by great thicknesses of low-permeability formations. Pressure tests of deep water-bearing zones indicated very little mobile water.

BAXTERVILLE, MISSISSIPPI

Project DRIBBLE and the Miracle Play Program were conducted in the Tatum Salt Dome (also known as the SALMON Site). The Tatum Salt Dome interrupts and deforms the lower units of coastal marine deposits in the area, has low permeability, and allows little water movement. Seven hydrologic units are recognized in the area, exclusive of the salt dome and its anhydrite caprock. These are, from the surface downward, the Surficial Aquifer, the Local Aquifer, and Aquifers 1, 2, 3, 4, and 5.

lack of data result in uncertainties in groundwater flow directions.

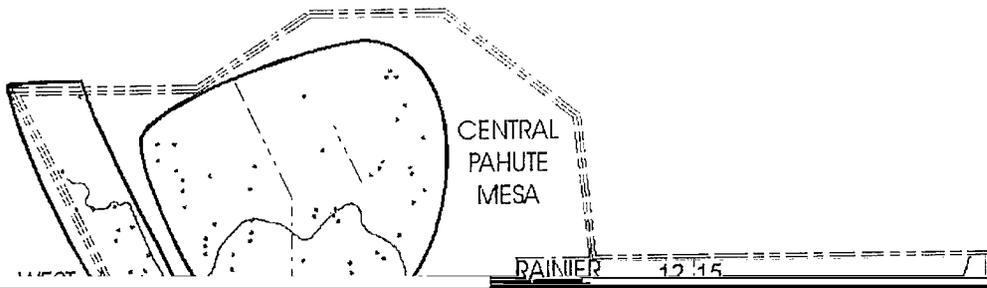
GOBERNADOR, NEW MEXICO

Project GASBUGGY is located on the eastern side of the San Juan Basin. The direction of groundwater movement is not well known, but is thought to be to the northwest in the Ojo Alamo sandstone toward the San Juan River. The test was conducted in the underlying Pictured Cliffs sandstone and Lewis Shale, which are not known to yield substantial amounts of water. The rate of groundwater movement in the Ojo Alamo sandstone is estimated to be approximately 0.01 m/yr.

MALAGA, NEW MEXICO

The Project GNOME site is located in the northern part of the Delaware Basin which contains sedimentary rocks and a thick sequence of evaporites. The test was conducted in the halites of the Salado Formation which is overlain by the Rustler Formation, the Dewey Lake Redbeds, and alluvial deposits. The Rustler Formation contains three water-bearing zones; a dissolution residue at its base, the Culebra Dolomite, and the Magenta Dolomite. The Culebra Dolomite is the most regionally extensive aquifer in the area. The groundwater in the Culebra is saline, but is suitable for domestic and stock uses. Groundwater in the Culebra flows to the west and southwest toward the Pecos River.

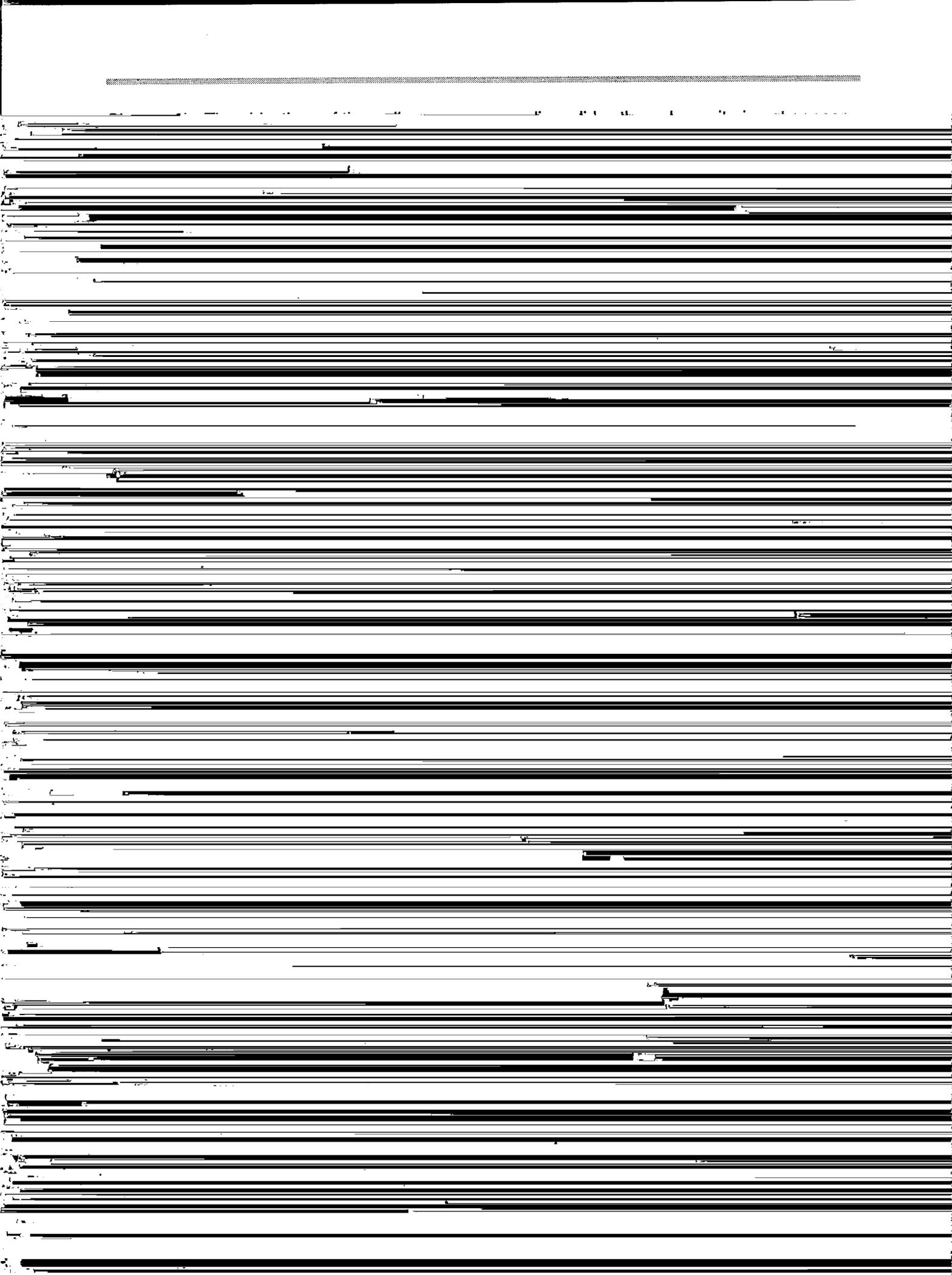
AREAS OF POSSIBLE GROUNDWATER CONTAMINATION AT THE NTS



radionuclides with differing half-lives and decay products. Detonations within, or near, the regional water table have contaminated the local groundwater with uranium.

GROUNDWATER MONITORING

GROUNDWATER QUANTITY



SITING FOR UNDERGROUND NUCLEAR TESTS

The draft DOE/NV Procedural Instruction "Siting Criteria for Protection of Groundwater at the Nevada Test Site" (NV PI 97-001) defines five criteria for siting underground nuclear tests based upon the current understanding of the effects of testing on the groundwater environment. Before an emplacement hole or emplacement drift can be used for a test, documentation must be submitted by the sponsoring user to the DOE/NV Assistant Manager for National Security to show compliance with these criteria, which are:

- Future testing should utilize previously used areas of testing.
- Tests with working points at or below the water table should be minimized. Testing

the NTS are stored at a Hazardous Waste Accumulation Site in Area 5 until shipped offsite to EPA-approved commercial disposal facilities. Uranium-ore residues designated as strategic materials are stored north of the RWMS-5. The Area 3 RWMS (RWMS-3) is used for the disposal of nonstandard packaged LLW from offsite and unpackaged bulk wastes from the NTS.

In 1996, one mixed waste shipment, a Nevada-generated shipping cask, was disposed of at RWMS-5. The disposal was in the Pit 3 facility, a Resource Conservation and Recovery Act (RCRA) interim status permitted facility.

In accordance with Title 40 C.F.R. 265 - Subpart F, operators of interim status treatment, storage, and disposal facilities are required to collect quarterly samples for one year from one upgradient and three downgradient wells for characterization of

1996. The 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 TEST AREA (UGTA) SITES

The UGTA Project focused on drilling, testing, and sampling wells near underground nuclear tests. The drilling program was conducted in order to determine radiochemical and hydrogeologic conditions near tests in support of modeling at the scale of Corrective Action Units.

and sampling of two wells at the TYBO underground nuclear test and three wells at the BULLION test on Pahute Mesa. Other activities included the development and sampling of one zone in well ER-3-1 in Yucca Flat and two zones in well ER-30-1 on Buckboard Mesa. In general, results show no evidence of man-made radionuclides in the Yucca Flat and Buckboard Mesa wells, and expected levels of contamination in the near-event wells on Pahute Mesa. Results are scheduled for publication in 1997.

INDUSTRIAL SITES AND DECONTAMINATION AND DECOMMISSIONING

CLOSURE IN PLACE OF CORRECTIVE ACTION UNIT NO. 90: AREA 2 BITCUTTER AND POSTSHOT CONTAINMENT SHOPS INJECTION WELLS

The Bitcutter and Postshot Containment Shop injection wells are located in Area 2 at the NTS. Three wells were installed for disposal of fluids used during shop operations for several years during the early 1980s. Two wells are associated with the Bitcutter shop (one inside and one outside) and one is associated with the Postshot Containment Shop.

In 1995, DOE/NV ERP concluded characterization activities which included drilling 15 investigative boreholes, downhole video inspection within the inside Bitcutter Shop well, and sampling the sludge contained in the Postshot Injection well. The

The method of closure for the Postshot Injection well was to remove any liquid or sludge from the hole, grout the casing, and place a concrete cap on top of the well. The inside Bitcutter Shop well was plugged with cement and a concrete cap was placed above the well. No further action was taken on the outside Bitcutter Shop well since the casing and TPH-impacted soil were removed during characterization. The well caps are six inches above the ground surface and sloped to promote runoff of precipitation.

At the Project SHOAL site, an investigation plan was completed and approved, four monitoring wells were installed, and shallow soil sampling in the mudpits was completed.

At the Project RULISON site, an assessment of radionuclide movement from the site was completed by the Desert Research Institute (DRI) (Earman et al., 1996a). A voluntary, interim remedial action was completed in cooperation with the state of Colorado.

Approximately 14,000 m³ (2.7 million gal) of

9.4 LONG-TERM HYDROLOGICAL MONITORING PROGRAM (LTHMP)

The EPA's Radiation and Indoor
Environments National Laboratory in Las
Vegas (R&IE-LV) is responsible for
operation of the LTHMP, including sample

Johns et al., 1979 and are summarized in
Table 9.4. 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:
conventional and electrolytic enrichment.
The samples were initially analyzed for
tritium by the conventional method followed
by enrichment analysis if the results were

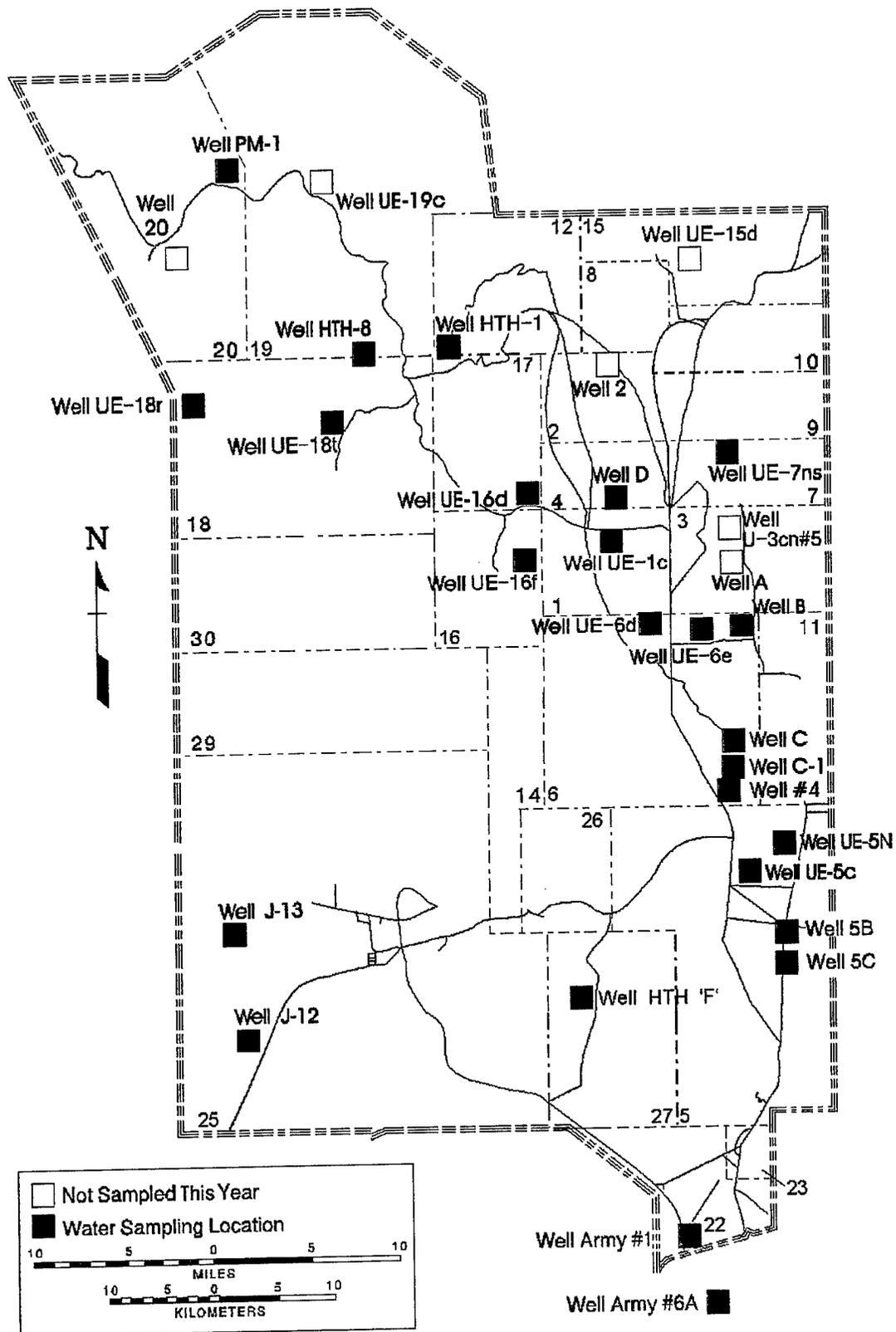


Figure 9.2 Wells on the NTS Included in the LTHMP - 1996

collects samples from 10 percent of the potable wells sampled by BN. A total of 21 wells was scheduled to be sampled, but only 19 wells were sampled for various reasons.

All samples were analyzed by gamma spectrometry and for tritium. No gamma-emitting radionuclides were detected in any of the NTS samples collected in 1996

activity in this spring represents environmental levels that have been decreasing over time. All results for this project for 1996 are shown in Table 9.6.

9.5 LTHMP AT OFF-NTS NUCLEAR DEVICE TEST

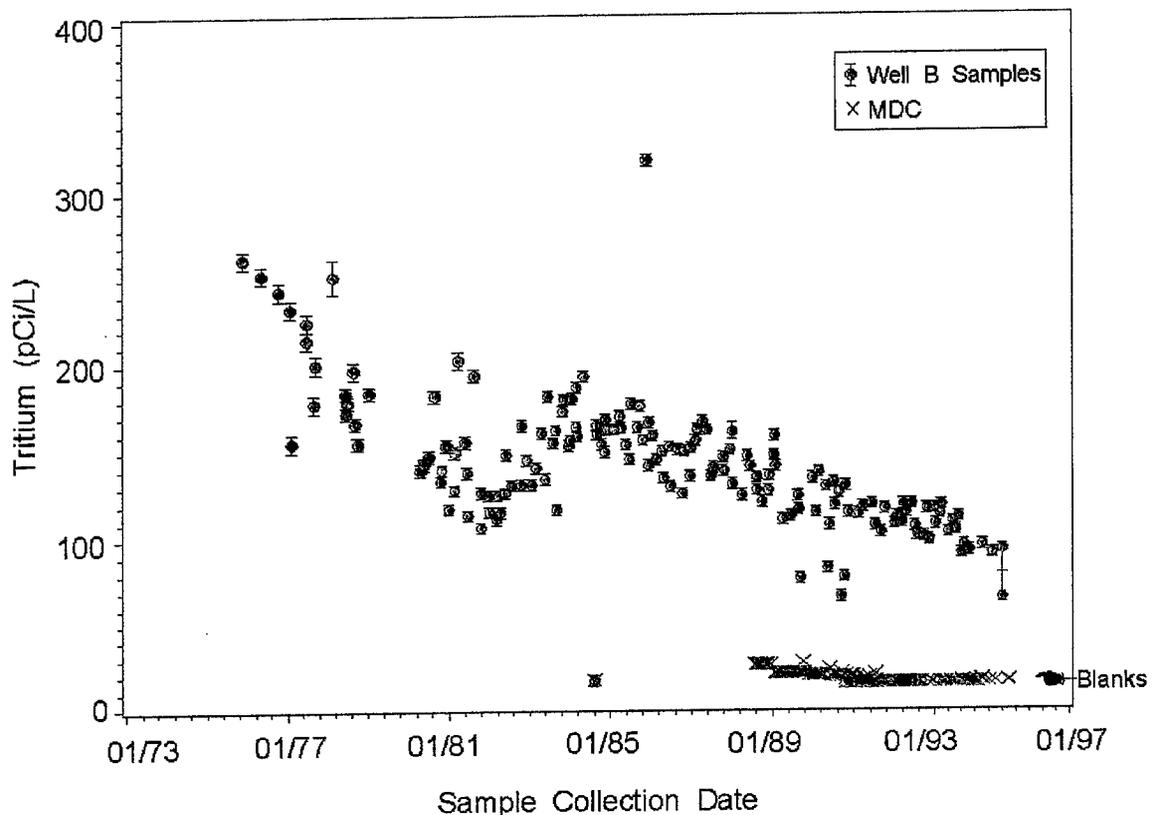


Figure 9.3 Tritium Concentration Trends in Test Well B on the NTS

PROJECT FAULTLESS

Project FAULTLESS was a "calibration test" conducted on January 19, 1968, in a sparsely populated area near Blue Jay Maintenance Station, Nevada. The test had a yield between 200 and 1,000 kt and was designed to test the behavior of seismic waves and to determine the usefulness of the site for high-yield tests. The emplacement depth was 975 m (3,199 ft). A surface crater was created, but as an irregular block along local faults rather than as a saucer-shaped depression. The area is characterized by basin and range topography, with alluvium overlying tuffaceous sediments. The working point of the test was in tuff. The groundwater flow is generally from the highlands to the valley and through the valley to Twin Springs Ranch and Railroad Valley (Chapman and Hokett 1991).

Sampling was conducted on March 6 and 7, 1996, at locations shown in Figure 9.5. Routine sampling locations include one spring and five wells of varying depths. The Bias Well was not sampled because the ranch was closed and Six Mile Well was not sampled because the pump was removed. A new sampling location (site C Complex) was established to replace the Bias Ranch Well. This site is approximately 8 mi from Blue Jay Maintenance Station and is approximately 20 mi from surface ground zero (SGZ).

At least two wells (HTH-1 and HTH-2) are positioned to intercept migration from the test cavity, should it occur (Chapman and Hokett 1991). All samples yielded negligible gamma activity.

Tritium concentrations were less than the MDC. These results are all consistent with results obtained in previous years. The

■ Sharp's Ranch

■ Actaven Springs

■ Twin Springs Rn.

■ Tonopah City Well

TTR Well 6

■ Klondike Well 2

NELLIS AIR
FORCE RANGE

■ Penoyer Culinary Well

■ Crystal Springs

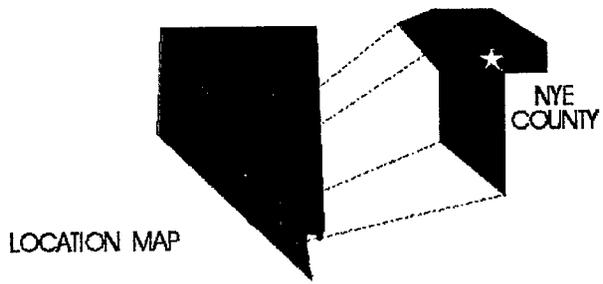
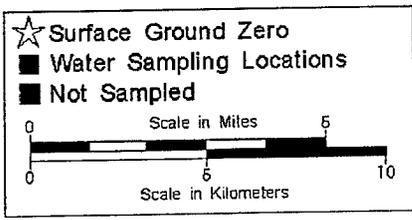
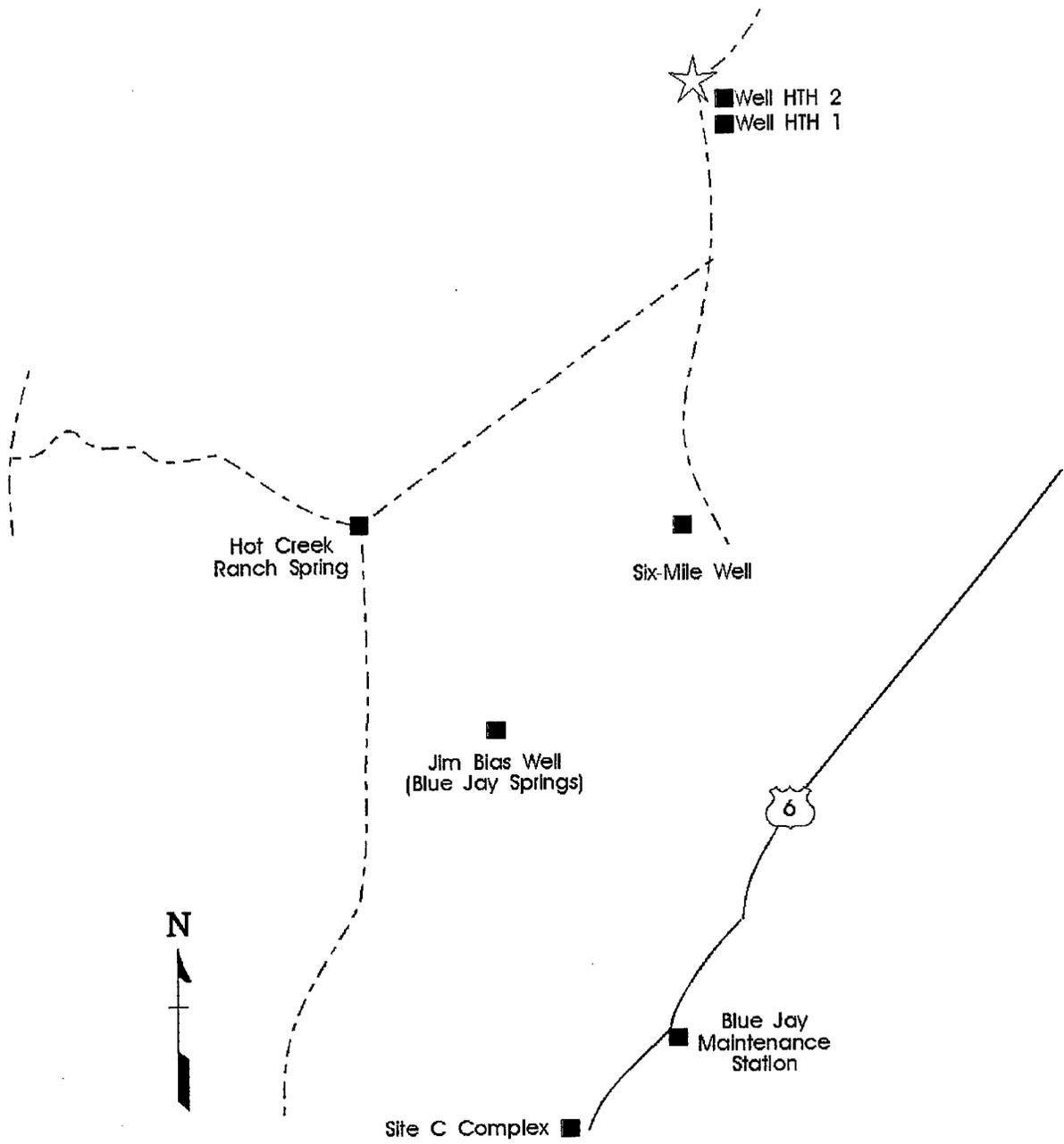


Figure 9.5 LTHMP Sampling Locations for Project FAULTLESS - 1996

results for tritium indicate that to date

emplaced at a depth of 2.568 m (8.425 ft)

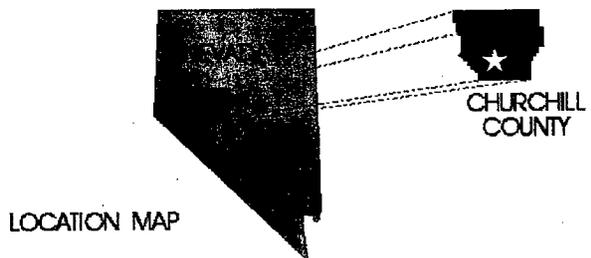
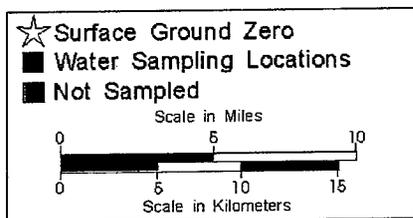
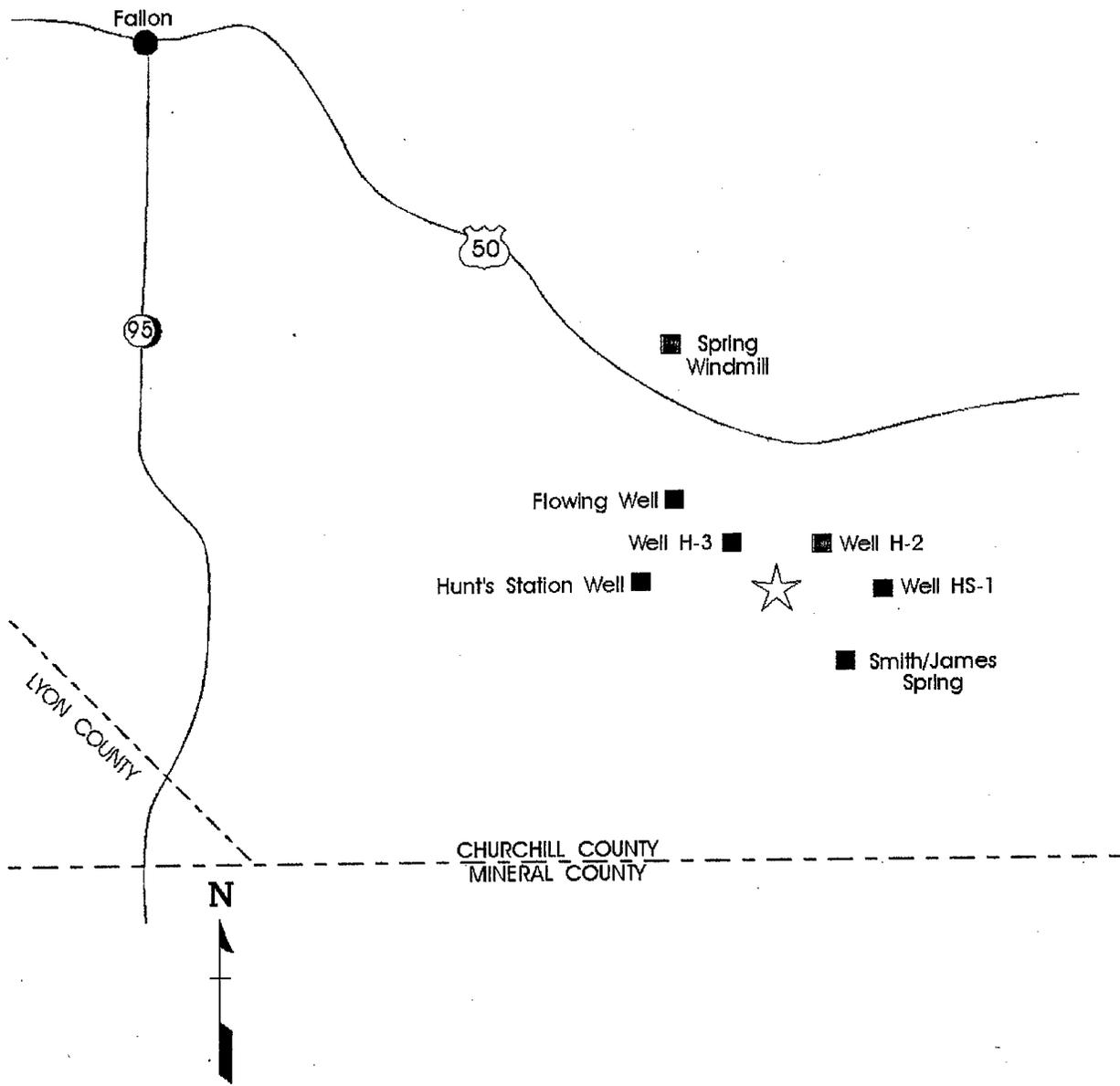
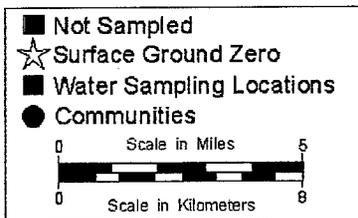
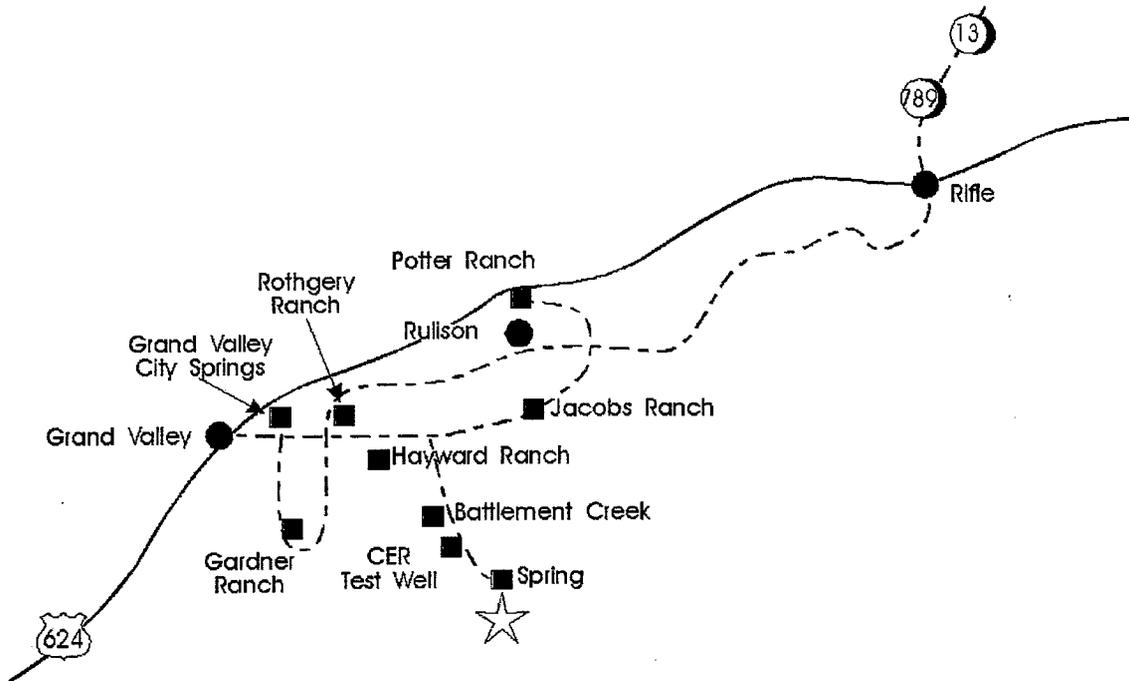


Figure 9.6 LTHMP Sampling Locations for Project SHOAL - 1996



LOCATION MAP



Figure 9.7 LTHMP Sampling Locations for Project RULISON - 1996

PROJECT RIO BLANCO

Project RIO BLANCO a joint government-industry test designed to stimulate natural gas flow was conducted under the Plowshare Program. The test was conducted on May 17, 1973, at a location between Rifle and Meeker Colorado. Three nuclear explosives with a total yield of 99 kt were emplaced at 1780-, 1920-, and 2040-m (5840-, 6299-, and 6693-ft) depths in the Ft. Union and Mesa Verde formations. Production testing continued to 1976 when cleanup and restoration activities were completed. Tritiated water produced during testing was injected to 1710 m (5610 ft) in a nearby gas well.

formation. A slightly more than 3-kt nuclear explosive was emplaced at 371 m (1217 ft) depth in the Salado salt formation. Radioactive gases were unexpectedly vented during the test. The USGS conducted a tracer study in 1963, involving injection of 20 Ci ^3H , 10 Ci ^{137}Cs , 10 Ci ^{90}Sr , and 4 Ci ^{131}I (740, 370, 370, and 150 GBq, respectively) into Well USGS-8 and pumping water from Well USGS-4. During cleanup activities in 1968-69, contaminated material was placed in the test cavity access well. More material was slurried into the cavity and drifts in 1979.

Sampling at Project GNOME was conducted June 22 - 25, 1996. The routine sampling

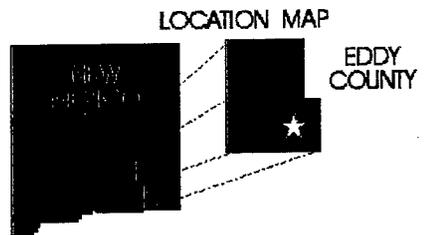
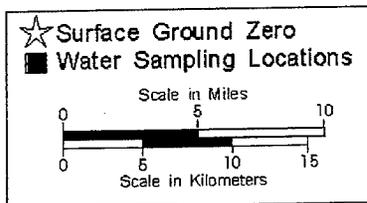
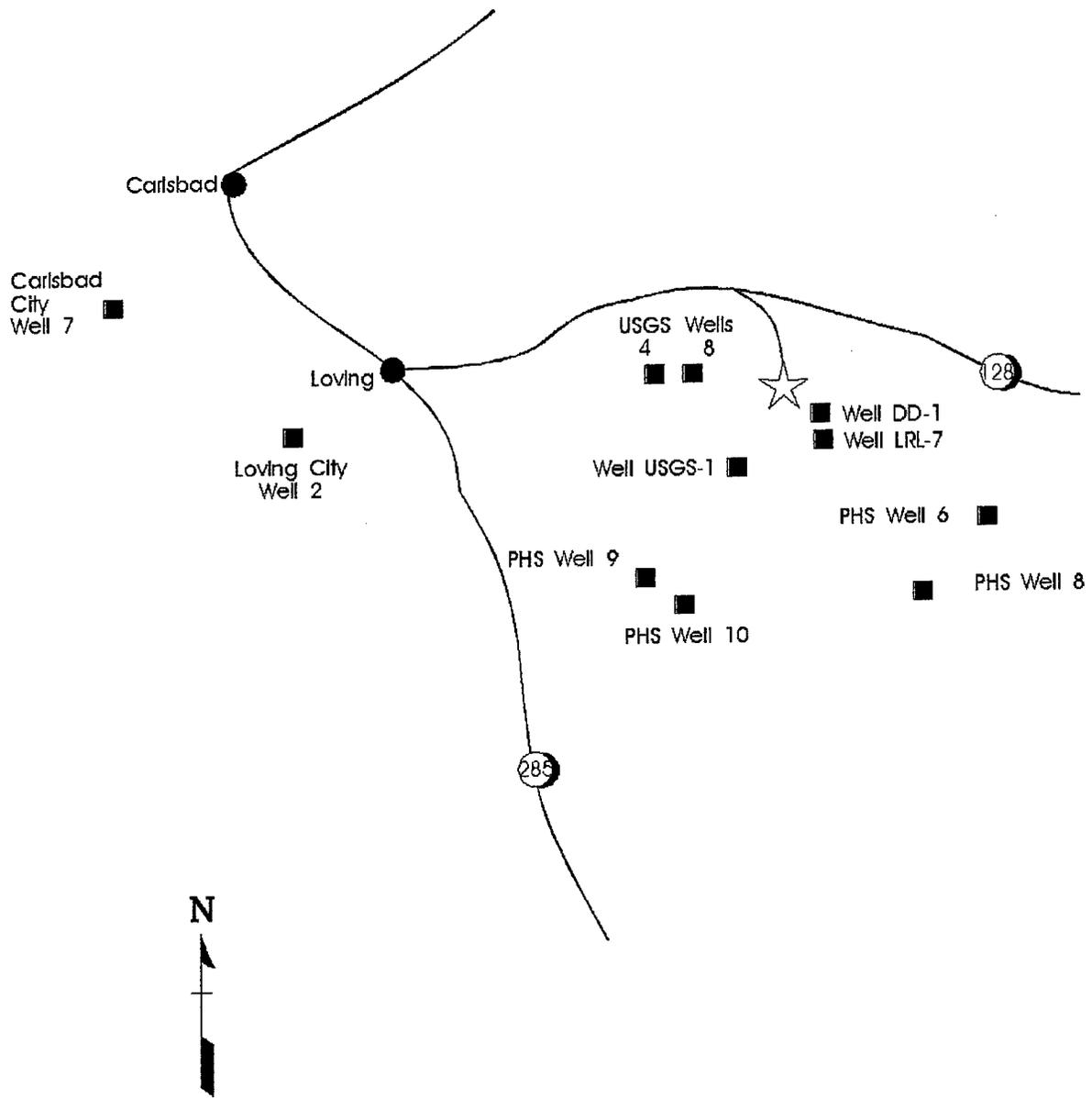


Figure 9.9 LTHMP Sampling Locations for Project GNOME - 1996

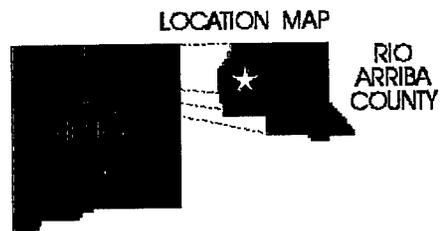
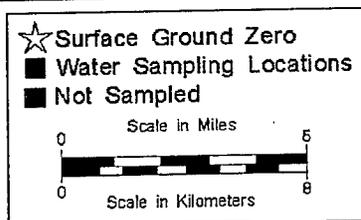
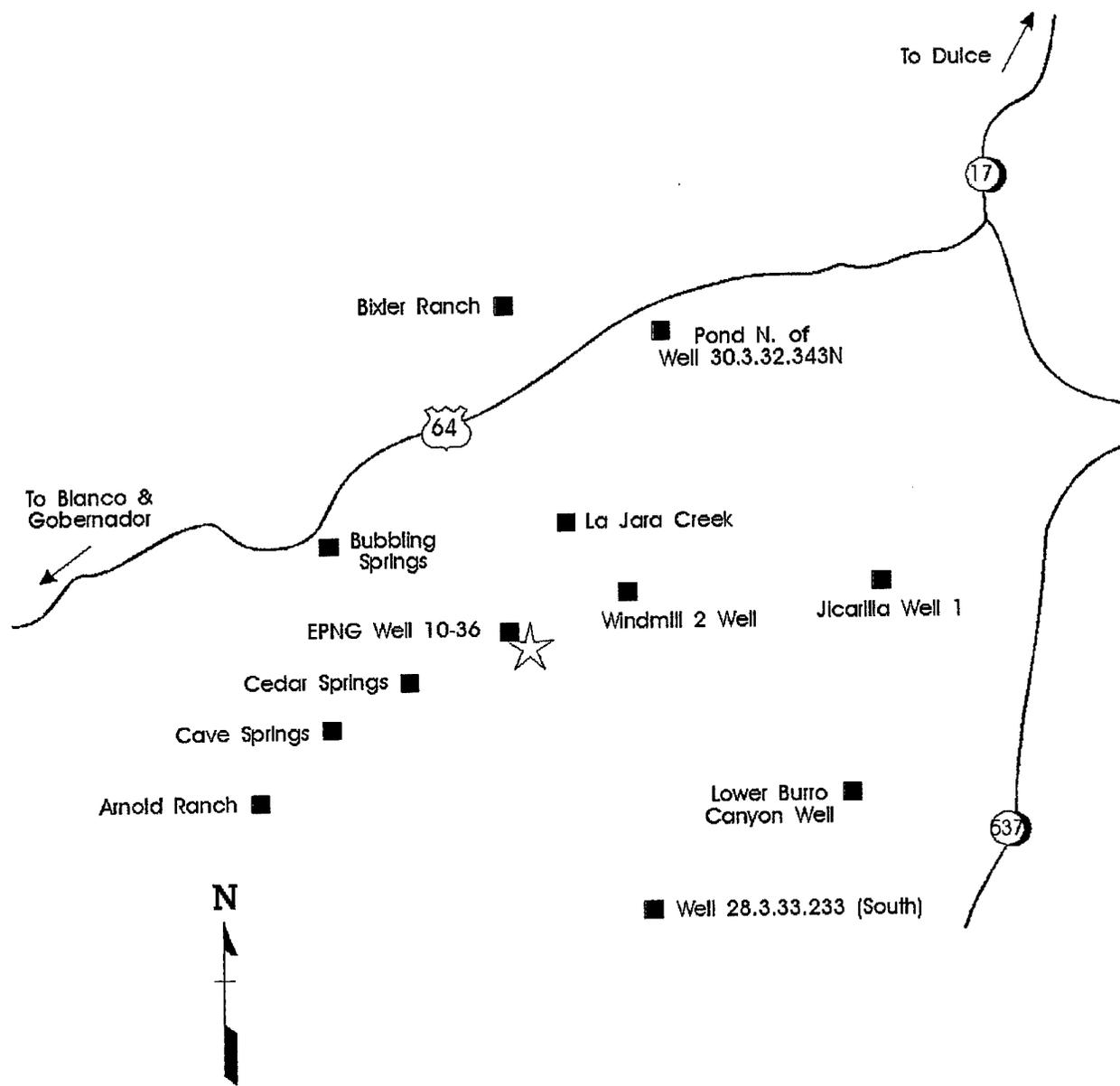
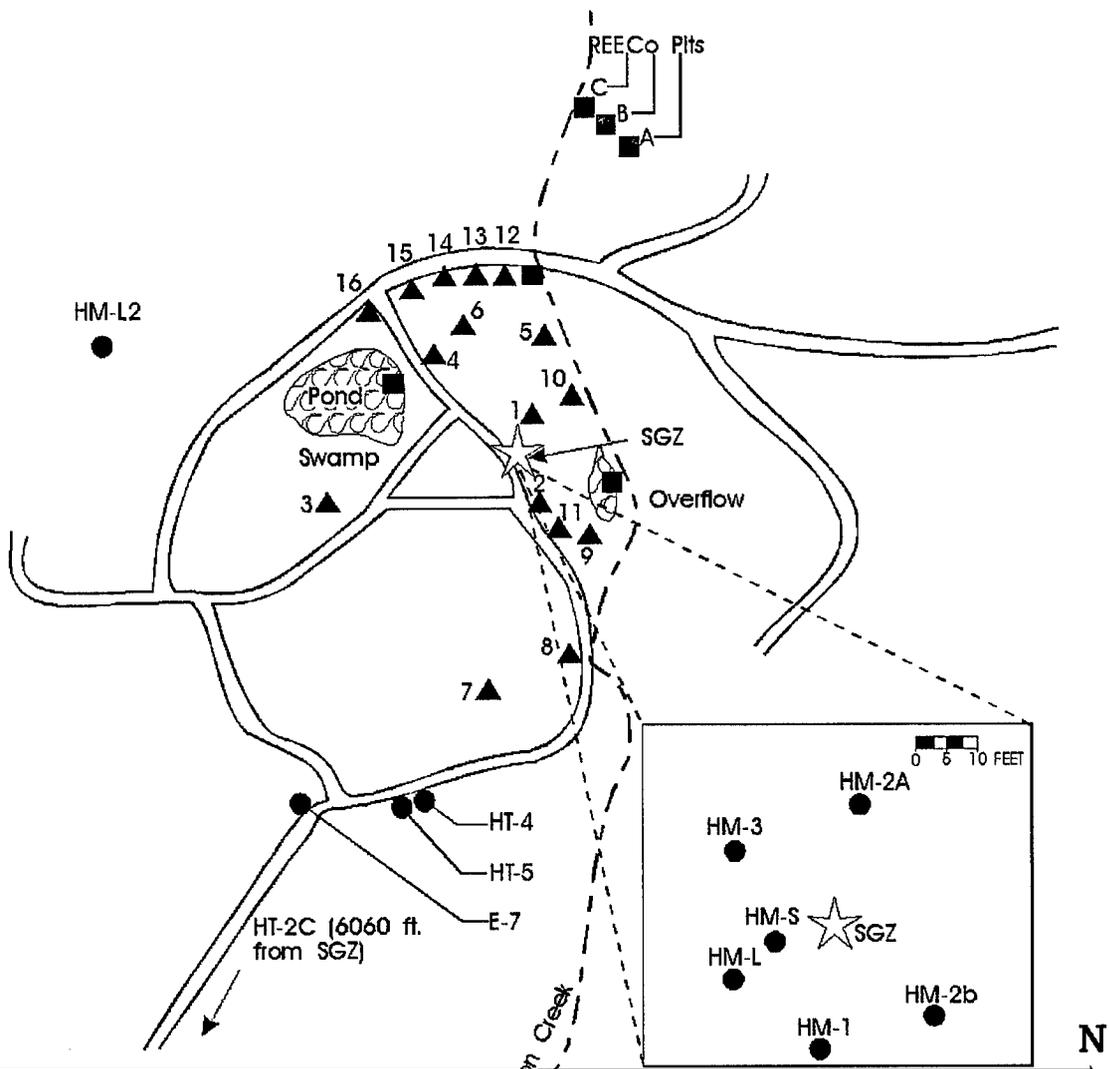


Figure 9.10 LTHMP Sampling Locations for Project GASBUGGY - 1996



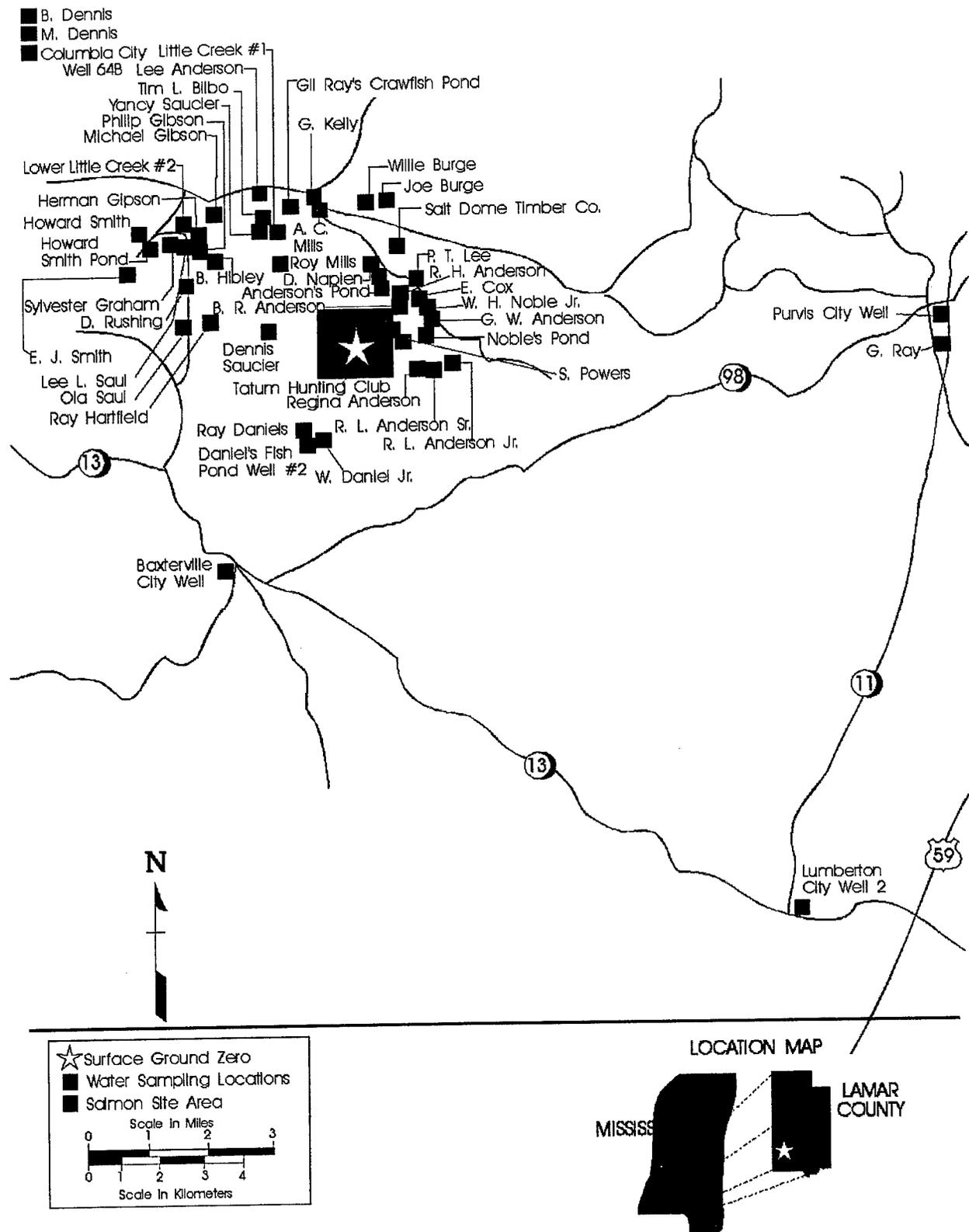


FIG. 2-10. LUMBER COUNTY Sampling Locations for Project DRIPPLE (SALMON). Towns and

Of the twenty-eight wells that are sampled on the SALMON test site, five regularly have tritium values above those expected in surface water samples. In the 52 samples collected from offsite sampling locations, tritium activities ranged from less than the MDC to 28 pCi/L (1.0 Bq/L), 0.02 percent of the DCG. These results do not exceed the natural tritium activity expected in rainwater in the area. In general, results for each location were similar to results obtained in previous years. Long-term decreasing trends in tritium concentrations are evident only for those locations that had detectable

[2.2 Bq/L]) as shown in Table 9.1. The locations where the highest tritium activities were measured generally correspond to areas of known contamination. Decreasing trends are evident for the wells where high tritium activities have been found, such as Well HM-S depicted in Figure 9.14. No tritium concentrations above normal background values were detected in any offsite samples. Man-made gamma-ray emitting radionuclides were not detected in any sample collected in this study.

Results of sampling related to Project

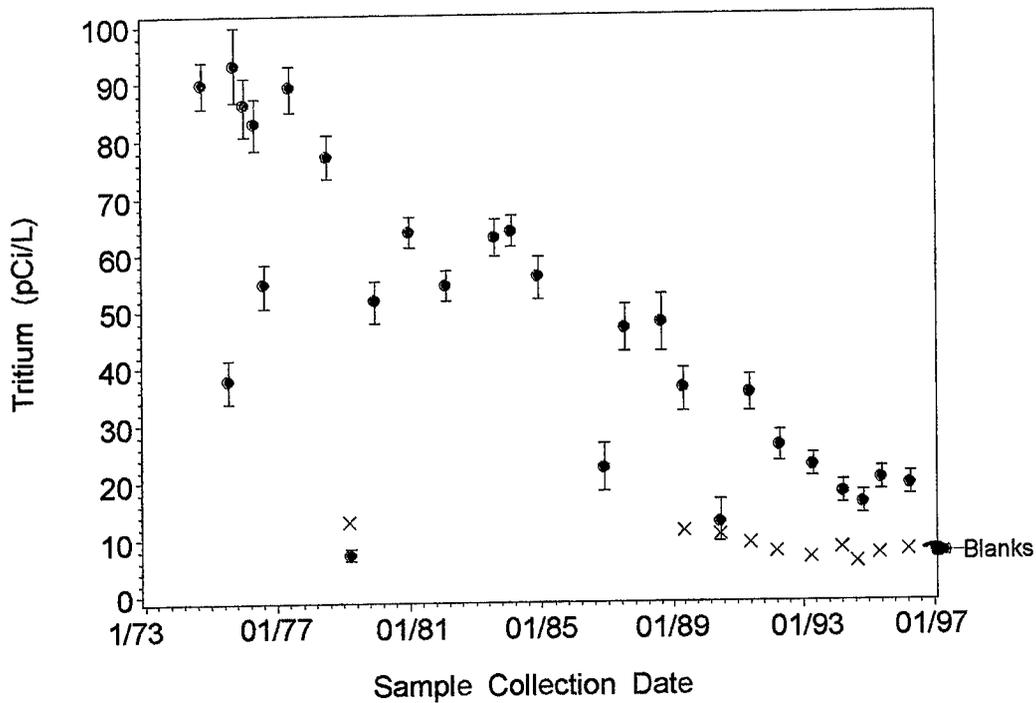


Figure 9.13 Tritium Results Trends in Baxterville, Public Drinking Water Supply - 1996

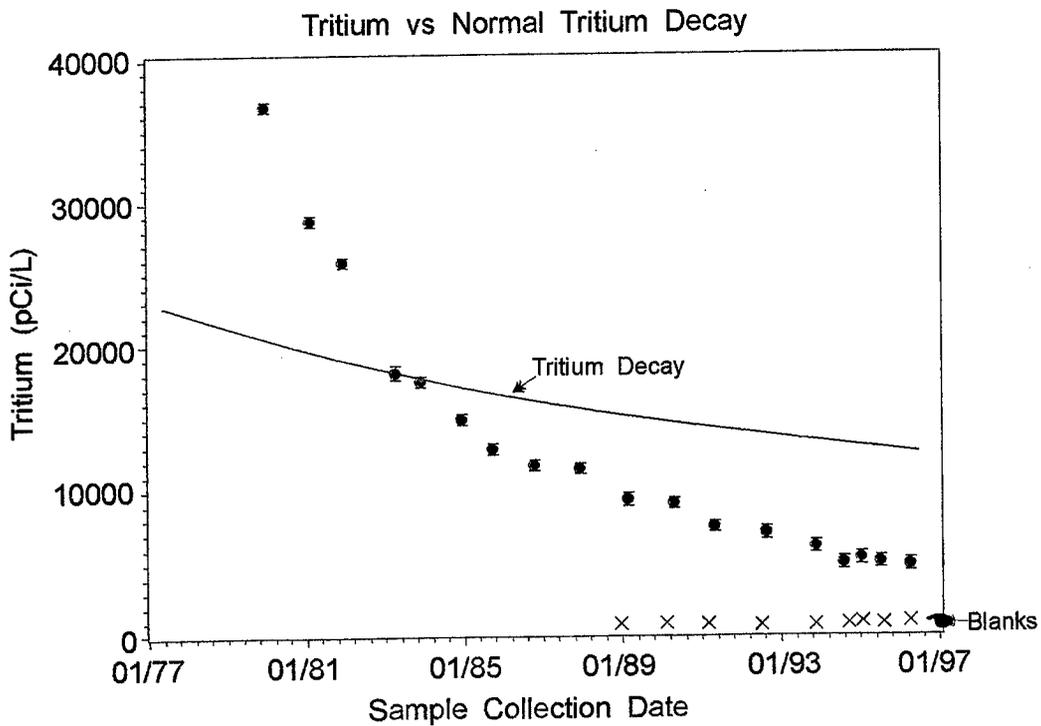


Figure 9.14 Tritium Results in Well HM-S, SALMON Site, Project DRIBBLE - 1996

Table 9.1 Locations with Detectable Man-Made Radioactivity - 1996^(a)

<u>Sampling Location</u>	<u>Radionuclide</u>	<u>Concentration</u> <u>x 10⁻⁹ μCi/mL</u>
NTS Onsite Network		
Well PM-1	³ H	200
Well UE-5n	³ H	45,000
Well UE-6d	³ H	700
Well UE-7ns	³ H	500
Well UE-18t	³ H	200

Project DRIBBLE, Mississippi (B)

Table 9.2 Groundwater Monitoring Parameters at the RWMS-5

Parameters Determining Suitability of Groundwater

Total and Dissolved Metals - As, Ba, Cd, Cr, Hg, Ag, Pb, Se
Total and Dissolved Gross Alpha/Beta

Parameters Establishing Water Quality

Chloride
Total and Dissolved Fe, Mn, Na
Phenols
Sulfate

Indicators of Contamination

pH
Conductivity
Total Organic Carbon
Total Organic Halogen

Additional Selected Parameters

Volatile Organics (8270)
Tritium

Table 9.3 NTS Facilities with RCRA Closure Plans

<u>Area</u>	<u>Designation</u>
Area 2	Bitcutter Shop & LLNL Post Shot Shop
Area 2	U-2bu Subsidence Crater
Area 3	U-3fi Injection Well (closed)
Area 6	Decontamination Facility Evaporation Pond
Area 6	Steam Cleaning Effluent Pond
Area 23	Building 650 Leachfield
Area 23	Hazardous Waste Trenches (closed)
Area 27	Explosive Ordnance Disposal Facility (closed)

Table 9.4 Summary of EPA Analytical Procedures - 1996

Type of Analysis	Analytical Equipment	Counting Period (Min)	Analytical Procedures	Sample Size	Approximate Detection Limit ^(a)
HpGe Gamma ^(b)	HpGe detector calibrated at 0.5 keV/ channel	100	Radionuclide concentration quantified from gamma spectral data by online computer program.	3.5L	Varies with radionuclides and detector used, ¹³⁷ Cs 7 pCi/L
³ H	Automatic liquid scintillation counter	300	Sample prepared by distillation.	5-10 mL	300 to 700 pCi/L
³ H+ Enrichment	Automatic liquid scintillation counter	300	Sample concentrated by electrolysis followed by distillation.	250 mL	5 pCi/L

(a) The detection limit is defined as the smallest amount of radioactivity that can be reliably detected, i.e., probability of Type I and Type II error at 5 percent each (DOE 1981).

(b) Gamma spectrometry using a high purity intrinsic germanium (HpGe) detector.

Table 9.5 LTHMP Summary of Tritium Results for NTS Network - 1996

Tritium Concentration (pCi/L)

Location	Number	Maximum	Minimum	Arithmetic Mean	1 Sigma	Mean as %DCG ^(a)	Mean MDC
Test Well B	1	230	230	230	70	0.26	220
Test Well D	1	38	38	38	70	^(b)	220
Well UE-6d	2	724	633	680	180	0.75	110
Well UE-6e	2	190	170	180	67	^(b)	210
Well UE-7ns	2	496	466	480	160	0.53	210
Well UE-16f	1	8.1	8.1	8.1	1.7	0.01	5.5
Well UE-18r	2	230	28	130	67	^(b)	210
Well UE-18t	1	220	220	220	3.5	0.24	7.0
Well 6A Army	2	3.3	-1.3	1.0	0.35	^(b)	4.2
Well HTH-1	1	-77	-77	-77	70	^(b)	230
Well PM-1	1	210	210	210	3.1	0.23	6.0
Well U3CN-5	0	Packer In Hole					
Well UE-1c	2	114	93	100	62	^(b)	210
Well UE-15d		Pump Inoperative					
Well HTH "F"	1	93	93	93	65	^(b)	240
Well C-1	1	270	270	270	68	0.30	220
Well 1 Army	1	-77	-77	-77	68	^(b)	230
Well 5B	2	1.8	77	39	20	^(b)	110
Well 5C	2	38	0.18	19	10	^(b)	110
Well UE-5n	2	52500	38100	45000	13000	50	210
Well J-13	1	77	77	77	70	^(b)	230

Note: Conventional and/or enrichment tritium analysis techniques were used for the samples summarized in this table.

(a) DCG - Derived Concentration Guide; established by DOE Order as 90,000 pCi/L for water.

(b) NA - Not applicable; percent of concentration guide is not applicable as the tritium result is less than the MDC or the water is known to be nonpotable.

Table 9.6 LTHMP Summary of Tritium Results for Wells Near the NTS - 1996

Location	Tritium Concentration (pCi/L)						Mean MDC
	Number of Samples ^(a)	Max.	Min.	Mean	1 s.d.	% of DCG ^(b)	
Adaven							
Adaven Spring	2	28	19	22	1.7	0.02	5.1
	2	110	0	55	67	^(c)	220
Alamo							
Well 4 City	1	--	--	-2.3	3.0	^(c)	10
	1	--	--	39	68	^(c)	220
Ash Meadows							
Crystal Pool	3	2.9	-2.9	-0.3	1.9	6.3	
	1	--	--	150	67	^(c)	210
Fairbanks Spring	2	0.33	-1.1	-0.8	1.7	^(c)	5.8
	0						
17S-50E-14cac	1	--	--	0.8	1.8	^(c)	5.8
	1	--	--	0	68	^(c)	220
Well 18S-51E-7db	1	--	--	1.0	1.4	^(c)	4.3
	1	--	--	39	68	^(c)	220
Beatty							
Low Level Waste Site	1	--	--	6.2	1.8	<0.01	5.9
	3	190	0	94	65	^(c)	220
Tolicha Peak	1	--	--	-2.8	1.6	^(c)	5.4
	3	110	0	57	66	^(c)	220
11S-48E-1dd Coffe's	1	--	--	-0.6	1.6	^(c)	5.4
	3	150	38	110	67	^(c)	220
12S-47E-7dbd City	1	--	--	-1.0	2.2	^(c)	7.5
	1	--	--	0	68	^(c)	220
Younghans Ranch House Well	0						
	3	190	-77	59	67	^(c)	220
Boulder City							
Lake Mead Intake	1	--	--	40	1.8	0.04	4.9
	0						
Clark Station							
TTR Well 6	0						
	2	56	39	48	67	^(c)	220
Goldfield							
Klondike #2 Well	0						
	2	39	-38	0.5	140		220

(a) For each sample: First row is from enrichment analysis, second row from conventional analysis.

(b) DCG - Derived Concentration Guide. Established by DOE Order as 90,000 pCi/L.

(c) Not applicable. Percent of concentration guide is not applicable because the result is less than the MDC or the water is known to be nonpotable.

Table 9.6 (LTHMP Summary of Tritium Results for Wells Near the NTS - 1996, cont.)

<u>Location</u>	<u>Tritium Concentration (pCi/L)</u>						<u>% of DCG</u>	<u>Mean MDC</u>
	<u>Number of Samples^(a)</u>	<u>Max.</u>	<u>Min.</u>	<u>Mean</u>	<u>1 s.d.</u>			
Hiko								
Crystal Springs	1	--	--	-1.7	3.1	(c)	10	
	1	--	--	0	68	(c)	220	
Indian Springs								
Sewer Co. Well 1	0							
	1	--	--	0	68	(c)	220	
Air Force Well 2	1	--	--	2.6	1.3	(c)	4.3	
	1	--	--	0	68	(c)	220	
Lathrop Wells								
15S-50E-18cdc City	1	--	--	-0.08	1.2	(c)	4.0	
	1	--	--	0	68	(c)	220	
Nyala								
Sharp's Ranch	1	--	--	2.0	3.2	(c)	10	
	1	--	--	0	68	(c)	220	
Oasis Valley								
Goss Springs	DRY							
Rachel								
Penoyer Culinary	1	--	--	1.2	1.4	(c)	4.8	
	3	150	56	95	67	(c)	210	
Tonopah								
City Well	0							
	2	39	-19	10	66	(c)	220	
Warm Springs								
Twin Springs Ranch	1	--	--	0.6	1.3	(c)	4.3	
	3	470	56	320	67	(c)	220	

(a) For each sample: First row is from enrichment analysis, second row from conventional analysis.

(b) DCG - Derived Concentration Guide. Established by DOE Order as 90,000 pCi/L.

(c) Not applicable. Percent of concentration guide is not applicable because the result is less than the MDC or the water is known to be nonpotable.

10.0 LABORATORY QUALITY ASSURANCE

It is the policy of U.S. Department of Energy Nevada Operations Office (DOE/NV) that all data produced for its environmental surveillance and effluent monitoring programs be of known quality. Therefore, a quality assurance (QA) program is used for collection and analysis of samples for radiological and nonradiological parameters to ensure that data produced by the laboratory meets customer- and regulatory-defined requirements. Data quality is assured through process-based QA, procedure-specific QA, data quality objectives (DQOs), and performance evaluation programs. The external QA program for radiological data consists of participation in the U.S. Department of Energy (DOE) Quality Assessment Program (QAP) administered by the DOE Environmental Measurements Laboratory (EML), and the Environmental Radiological Performance Evaluation Studies Program (PESP) conducted by the U.S. Environmental Protection Agency (EPA) National Exposure Research Laboratory in Las Vegas. The radiological external QA program also consists of participation in the DOE Laboratory Accreditation Program (DOELAP) Radiobioassay In-Vitro study administered by DOE; and the Oak Ridge National Laboratories (ORNL) radiobioassay study conducted by ORNL in Oak Ridge, Tennessee. The QA program for nonradiological data was accomplished by using commercial laboratories with appropriate certification or accreditation by state or government agencies.

The environmental surveillance program off the Nevada Test Site (NTS) was conducted by EPA's Radiation and Indoor Environment National Laboratory-Las Vegas (R&IE-LV). The QA program developed by R&IE-LV for the Offsite Radiological Safety Program (ORSP) meets all requirements of EPA policy, and also includes applicable elements of the DOE/NV QA requirements and regulations. The ORSP QA program defines DQOs, which are statements of the quality of data a decision maker needs to ensure that a decision based on that data is defensible.

10.1 POLICY

Environmental surveillance, conducted onsite by Bechtel Nevada (BN) and offsite by EPA's R&IE-LV, is governed by DOE QA policy as set forth in DOE Order 5700.6C. The Order outlines ten specific elements that must be considered for compliance with the QA policy. These elements are:

1. Program
2. Personnel Training & Qualification
3. Quality Improvement
4. Documents and Records
5. Work Processes

6. Design
7. Procurement
8. Data Acceptance and Review
9. Management Assessment
10. Independent Assessment

In addition, R&IE-LV meets the EPA policy which states that all decisions which are dependent on environmental data must be supported by data of known quality. EPA policy requires participation in a centrally managed QA Program by all EPA elements as well as those monitoring and measurement efforts supported or mandated through contracts, regulations, or other formalized agreements. Further, EPA policy

requires participation in a QA Program by all EPA organizational units involved in environmental data collection. The QA policies and requirements of R&IE-LV are summarized in the "Quality Management Plan" (EPA/ORIA 1996). The QA policies and requirements specific to the ORSP are documented in the "Quality Assurance Program Plan for the Nuclear Radiation Assessment Division Offsite Radiation Safety Program" (EPA 1992 [in revision]). The requirements of these documents establish a framework for consistency in the continuing application of quality assurance standards and implementing procedures in support of the ORSP. Administrative and technical implementing procedures based on these QA requirements are maintained in appropriate manuals or are described in standard operating procedures (SOPs) of the R&IE-LV.

10.2 OVERVIEW OF THE LABORATORY QA PROGRAM

The BN Analytical Services Laboratory (ASL) implements the requirements of DOE Order 5700.6C, "Quality Assurance" through integrated quality procedures. The quality of data and results is ensured through both

An essential component of process-based QA is data review and verification to assess data usability. Data review requires a systematic, independent review against pre-established criteria to verify that the data are valid for their intended use. Initial data processing is performed by the analyst or health physicist generating the data. An independent review is then performed by another analyst or health physicist to ensure that data processing has been correctly performed and that the reported analytical results correspond to the data acquired and processed. Data checks are made for internal consistency, proper identification, transmittal errors, calculation errors, and transcription errors. Supervisory review of data is required prior to release of the data to sample management personnel for data verification. Data verification ensures that the reported results correctly represent the sampling and/or analyses performed, and includes assessment of quality control sample results. Data processing by sample management personnel ensures that analytical results meet project requirements. Data discrepancies identified during the data review and verification process are documented on data discrepancy reports (DDRs). DDRs are reviewed and compiled

10.3 DATA AND MEASUREMENT QUALITY OBJECTIVES

DATA QUALITY OBJECTIVES

DQOs delineate the circumstances under which measurements are made, and define the acceptable variability in the measured data. DQOs are based on the decision(s) to be made, the range of sampling possibilities, what measurements will be made, where the samples will be taken, how

the NTS because of the depth of aquifers, negligible horizontal or vertical transport, lack of surface water flows and little rain, very sparse vegetation and animal populations, lack of food grown for human consumption, and large distances to the nearest member of the public, the airborne pathway is by far the most important for a possible EDE to a member of the public.

Decisions made based on nonradiological data are related to waste characterization, extent and characterization of spills, compliance with regulatory limits for environmental contaminants, and possible

water, soil, and sludge samples are analyzed and reported by commercial laboratories under contract to BN. Methods and procedures used to measure possible worker exposures to nonradiological hazards are defined by Occupational Safety and Health Administration or National Institute of Occupational Safety and Health protocols. Typical contaminants for which ESS&H personnel collect samples and request analyses are asbestos, solvents, and welding metals. Sample media which are

CALCULATIONS TO BE PERFORMED

The EDE of greatest interest is the EDE to the maximally exposed individual (MEI). The MEI is located where, based on measured radioactivity concentrations and distances from all contributing NTS sources, the calculational model gives the greatest potential EDE for any member of the public. The assumptions used in the calculational model are conservative; i.e., the calculated EDE to the MEI most certainly exceeds the

environmental data. Factors which were considered in designing this monitoring plan include locations of known and potential sources, historical and operational knowledge of isotopes and pathways of concern, hydrological, and topographical data, and locations of human populations.

COMPARABILITY

Comparability refers to the degree of confidence and consistency we have in our analytical results, or defined as "the confidence with which one data set can be compared to another" (Stanley and Verner 1985). To achieve comparability in measurement data, sample collection and handling, laboratory analyses, and data analysis and validation are performed in

Term Hydrological Monitoring Program is 80 percent and for the other networks is 90 percent.

Completeness for inorganic and organic analyses is based on the number of valid results received versus the number requested.

PRECISION

Precision refers to "the degree of mutual agreement characteristic of independent measurements as the result of repeated application of the process under specified conditions" (Taylor 1987). Practically, precision is determined by comparing the results obtained from performing the same analysis on split samples, or on duplicate

measured value with the true or expected value of the quantity of concern" (Taylor 1987). For practical purposes, assessments of accuracy for ASL are done by performing measurements on special quality assurance samples prepared, using stringent quality control, by laboratories which specialize in preparing such samples. The values of the activities of these samples are not known by the staff of the ASL until several months after the measurements are made and the results sent back to the quality assurance laboratory. These sample values are unknown to the analysts and serve to measure the accuracy of the analytical procedures. The accuracy of these measurements, which is assumed to extend to other similar measurements performed by

involves a three-part, single blind, performance testing program followed by an independent onsite assessment of the overall program. Both BN and R&IE-LV participate in this program.

Once the data have been finalized, they are compared to the MQOs. Completeness, accuracy, and precision statistics are calculated. If data fail to meet one or more of the established MQOs, they may still be used in data analysis; however, the data and any interpretive results must be qualified. Current and historical data are maintained in an access-controlled database.

All sample results exceeding the traditional natural background activity range are

found to be invalid for other reasons. Had objectives not been met for some analyses, other factors would be used to assess acceptability, e.g., fit of the data to a trend or consistency with results from samples collected before and after.

The completeness of MQOs for the onsite networks were met or exceeded in all cases. For the offsite networks, the MQOs were met or exceeded except for the high volume and pressurized ion chamber networks, where field equipment malfunction prevented complete collections.

PRECISION

From replicate samples collected and analyzed throughout the year, the %RSD was calculated for various types of analyses and sampling media. The results of these calculations are shown in Table 10.4 for both the onsite and offsite networks. In addition to examination of %RSDs for individual duplicate pairs, an overall precision estimate was determined by calculating the pooled standard deviation, based on the algorithm given in Taylor (1987). To convert to a unitless value, the pooled standard deviation was divided by the grand mean and multiplied by 100 to yield a %RSD. The table presents the pooled data and estimates of overall precision. The pooled standard deviations and %RSD indicate the estimated achieved precision for samples.

For the R&IE-LV, the samples not meeting the precision MQO were low activity, air particulate samples in which ⁷Be was detected. The precision data for all other analyses were well within their respective MQOs. The R&IE-LV data presented in Table 10.4 include only those duplicate pairs that exceeded the minimum detectable concentration (MDC).

For the ASL, there was one analysis that failed to meet the MQO, namely, gross alpha in air. Subsequent investigation of the

analytical procedure revealed equipment and procedure problems for part of the year that have since been corrected. A reason for the low precision in some of the analyses was the low activity in these environmental samples, e.g., for tritium in air, the few that were useful for calculation of precision barely exceeded the MDC.

ACCURACY

The ASL and R&IE-LV accuracy objectives were measured through participation in the interlaboratory comparison and quality assessment programs discussed below.

RADIOLOGICAL PERFORMANCE EVALUATION RESULTS

The external radiological PESP consisted of participation in the QAP conducted by DOE/EML and the PESP conducted by EPA. These programs serve to evaluate the performance of the radiological laboratory and to identify problems requiring corrective actions.

Summaries of the 1996 results of the interlaboratory performance evaluation and quality assessment programs conducted by the EPA and DOE/EML are provided in Tables 10.5 and 10.6. The last column in each table (percent Bias) is the accuracy of analysis and may be compared to the objectives listed in Table 10.2. The individual radionuclide recoveries are listed in tables which are being published separately in the "Environmental Data Report for the Nevada Test Site - 1996" (DOE/NV/11718-138, in prep.).

Accuracy, as percent difference or percent bias is calculated by:

$$\%BIAS = \left(\frac{C_m - C_a}{C_a} \right) 100$$

where:

$\%BIAS$ = percent bias
 C_m = measured sample activity
 C_a = known sample activity

The R&IE-LV failed the accuracy MQO in only 1 of the 24 analyses attempted in the EPA PE Study. In the EML QAP, 14 of the 42 analyses performed exceeded the DQO of ± 20 percent. In 1996, R&IE-LV maintained accreditation by DOELAP for the personnel TLD program. Quality Assurance checks are routinely performed to ensure compliance with applicable performance standards. Software and hardware changes have been implemented that will increase the Panasonic TLD systems report capability and reader sensitivity to lower energy radiation. When final performance testing and accreditation is completed, the new hard- and software will then be used for dose of record.

BN's ASL results exceeded the three normalized deviation limits in 7 of the 58 analyses attempted. The MQOs for accuracy in analysis of DOE/EML samples were not met in only 2 of the 25 samples supplied.

CORRECTIVE ACTIONS IMPLEMENTED IN RESPONSE TO PERFORMANCE EVALUATION PROGRAMS

BN results were generally within the control limits determined by the program sponsors. Results which were not within acceptable performance limits were investigated, and corrective actions taken to prevent reoccurrence. Corrective actions included a new process for preparing and including

COMPARABILITY

The EPA PESP and the EML/QAP provide results to each laboratory participating in each study that include a grand average for all values, excluding outliers. A normalized deviation statistic compares each laboratory's result (mean of three replicates) to the known value and to the grand average. If the value of this statistic (in multiples of standard normal deviate, unitless) lies between control limits of -3 and +3, the accuracy (deviation from known value) or comparability (deviation from grand average) is within normal statistical variation.

Data from the 1996 intercomparison studies for all variables measured were compared with the grand average to calculate a normalized deviation for the R&IE-LV results. With the exception of one gamma spectroscopy sample, all analyses were within three standard normal deviate units of the grand mean, and most were within two normalized deviate units. This indicates acceptable comparability of the R&IE-LV results with the 98 to 186 laboratories participating in the EPA PESP.

One of the two EML studies for 1996 was reported outside of acceptable limits for gamma spectroscopy in both air and water matrices. Follow up investigation established a volume data entry error in both cases. Corrective actions were implemented.

R&IE-LV began participating in the DOE

outliers) in its report to participants. Using the formula for percent bias described above, the percent bias of the ASL results as compared to the grand average was calculated for each analysis. The outcome for this calculation did not differ from the accuracy results reported above. Thus comparability of the ASL results is the same as its accuracy on PE samples as reported above.

SPIKE AND REAGENT BLANK DATA

Reagent blanks prepared by ASL were analyzed for the same radionuclides as the

samples. All 242 reagent blank results were less than the MDC of the analysis for which the blanks were designed.

A similar number of spike samples were prepared by ASL. The accuracy (as percent recovery) varied from 67 to 117 percent for the eight different analyses. The standard deviations of these percent recoveries is a measure of precision. These ranged from 3.5 to 14.6 percent for seven of the analyses. The uranium analysis procedure had a standard deviation of 58 percent, because of three spikes that were just barely above the MDC.

Table 10.1 Precision Objectives Expressed as Percents

<u>Analysis</u>	<u>ASL</u>	
	<u>Conc. > 10 MDC</u>	<u>4 MDC ≤ Conc.10 ≤ MDC</u>
Gross Alpha	±30	±60
Gross Beta	±30	±60
Gamma Spectrometry	±30	±60
Scintillation Counting	±30	±60
Alpha Spectrometry	±20	±50
Noble Gas Analysis	±30	±40

Note: The precision objective for TLDs at environmental levels is 10 percent.

	<u>R&IE-LV</u>	
	<u>Conc. > 10 MDC</u>	<u>4 MDC ≤ Conc.10 ≤ MDC</u>
Conventional Tritium	±10	±30
Strontium (in milk)	±10	±30
Thorium	±10	±30
Uranium	±10	±30
Enriched Tritium	±20	±30
Strontium (in other media)	±20	±30
Plutonium	±20	±30

Table 10.2 Accuracy Objectives Expressed as Percent Bias

<u>Analysis</u>	<u>ASL</u>	
	<u>Conc. > 10 MDC</u>	<u>4 MDC ≤ Conc.10 ≤ MDC</u>
Gross Alpha	±20	±50
Gross Beta	±20	±50
Gamma Spectrometry	±20	±50
Scintillation Counting	±20	±50
Alpha-Spectrometry	±20	±50
Noble Gas Analysis	±30	±60

Note: The objective for TLDs is 20 percent for exposures <10 mR and 10 percent for ≥10 mR.

	<u>R&IE-LV</u>	
	<u>Conc. > 10 MDC</u>	<u>4 MDC ≤ Conc.10 ≤ MDC</u>
Tritium, Conventional	±10	±30%
Strontium (Milk)	±10	±30%
Thorium	±10	±30%
Uranium	±10	±30%
Tritium, Enriched	±20	±30%
Strontium (other media)	±20	±30%
Plutonium	±20	±30%
TLDs	Meet DOELAP Criteria	

Table 10.3 Analysis Completeness Data for Calendar Year - 1996

<u>Analysis</u>	<u>Medium</u>	<u>Completeness Percent</u>	
		<u>BN</u>	<u>R&IE-LV</u>
Gross Alpha/Beta	Low Volume Particulate Air Filter	97.3	95.5
Plutonium	High Volume Particulate Air Filter	--	85.3
Plutonium	Low Volume Particulate Air Filter	97.8	--
Gamma Spectrometry	Low Volume Particulate Air Filter	98.0	95.5
Gamma Spectrometry	Low Volume Charcoal Air Filter	(a)	95.5

Table 10.5 Accuracy of R&IE-LV Radioanalyses (EML QAP and PESP) - 1996

Water Samples Range of Results - pCi/L

<u>Analysis</u>	<u>No.</u>	<u>PESP</u>	<u>R&IE-LV</u>	<u>% Bias</u>
Gross Alpha	5	10 - 75	12 - 71	-4.2 - 20
Gross Beta	5	7 - 167	13 - 162	-3.2 - 13
Gamma Spec. ^(a)	5	10 - 745	12 - 6300	-9 - 790
Strontium	2	10 - 25	12 - 24	-4 - 23
Alpha Spec.	5	5 - 58	5 - 55	-6 - 3
Tritium	2	10880 - 22000	10800 - 21300	3.1 - -0.4

(a) One group of samples submitted for gamma spectrometric evaluation included an incorrect dilution factor, thus a reporting error. Positive % Bias for the remaining samples was a maximum of 12 for the 1996 reporting period.

% Bias Range for Analysis of EML QAP Samples

<u>Analysis</u>	<u>No.</u>	<u>Air</u>	<u>Soil</u>	<u>Vegetation</u>	<u>Water</u>
Plutonium	13	-3.1 - 6.5	-30 - 1.9	-11 - 13	0.5 - 1.3
Uranium	4	(a)	(a)	(a)	0.8 - 20
Strontium	5	(a)	-100	-100 - -91	-11 - 15
Tritium	2	(a)	(a)	(a)	-16 - -11
Gamma Spec.	19	-5.2 - 18	(a)	(a)	25 - 28

(a) No sample.

% Bias Range for Analysis of MAPEP QAP Samples

Plutonium	4	(a)	1.4 - 3.9	(a)	-4.0 - -4.8
Strontium	1	(a)	(a)	(a)	-15
Gamma Spec.	3	(a)	(a)	(a)	-5.6 - 4.6

(a) No sample.

Table 10.6 Accuracy of ASI Radioanalyses (EPA PESP and EML QAP) - 1996

Table 10.6 (Accuracy of ASL Radioanalyses [EPA PESP and EML QAP] - 1996, cont.)

Analysis <u>Water Samples</u>	No.	BN/ASL <u>Average pCi/L</u>	EPA QA Normalized Deviation ^(a)	
			<u>Known</u>	<u>Grand Avg.</u>
¹³⁷ Cs	5	31.3 - 200	0.46 - 4.62 ^(b)	-0.08 - 4.15 ^(b)
¹³³ Ba	2	70 - 717	-0.65 - 1.73	-0.07 - 2.48
⁸⁹ Sr	5	13.3 - 68	-1.73 - 1.15	-0.89 - 1.03
⁹⁰ Sr	4	10.3 - 18.7	-2.19 - 0.12	-1.74 - 0.05
¹³¹ I	2	40 - 74	1.65 - 3.75 ^(b)	1.27 - 3.58 ^(b)
Tritium	2	10060 - 22800	-1.30 - 0.65	-0.84 - 0.89
²²⁶ Ra	4	6.9 - 27.2	-1.19 - 13.4 ^(b)	-0.85 - 13.3 ^(b)
²²⁸ Ra	5	3.4 - 22.6	-2.22 - 3.26 ^(b)	-2.62 - 3.38 ^(b)
U (nat.)	5	10.0 - 41.2	^(b) -5.13 - -0.04	^(b) -4.27 - 0.29
Gross Alpha	6	10.0 - 85.5	-1.95 - -0.09	-0.33 - 0.41
Gross Beta	6	6.6 - 151	-2.57 - 0.17	-2.61 - -0.06

(a) ± 3 Normalized Deviation is acceptable.

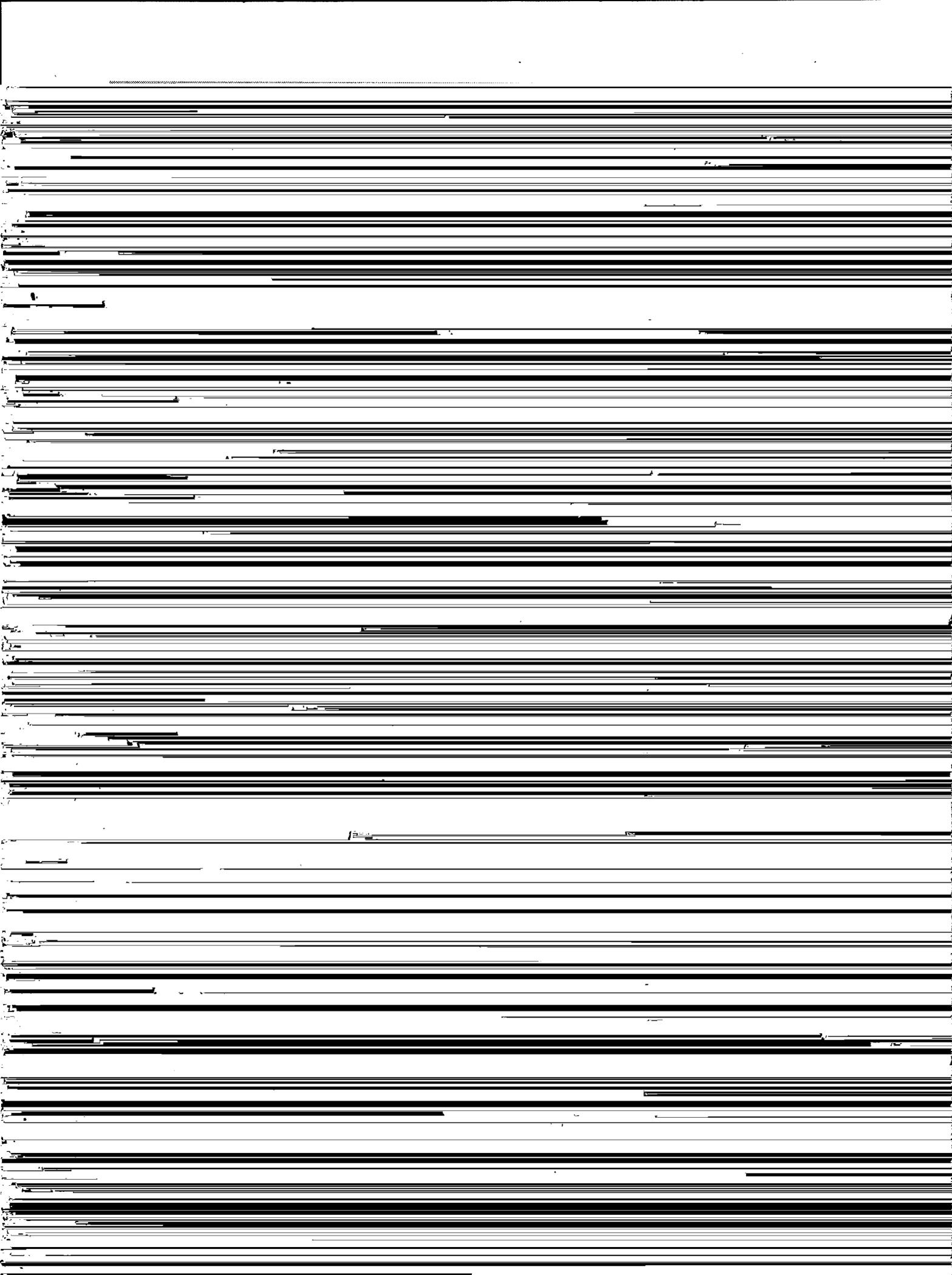
(b) Results exceed 3 Normalized Deviations.

% Bias Range for Analysis of EML QAP Samples

<u>Analysis</u>	<u>No.</u>	<u>Air</u>	<u>Soil</u>	<u>Vegetation</u>	<u>Water</u>
Americium	2	-26 - -14	(a)	-10 - 28	-2.1 - 7
Plutonium	4	-23 - 0	-8 - -2.6	-15 - 0	-12 - 2
Uranium	5	-8 - 7.5	-3 - -10	(a)	1 - 10
Strontium	2	-11 - -5.1	-16 - -3	-9 - -5	0 - 1.4
Tritium	2	(a)	(a)	(a)	-17 - -14
Gamma Spec.	6	-51 - 8.4	-20 - 4	1 - 79	-20 - 9
Gross Alpha	2	-19 - 63	(a)	(a)	3 - 5.4
Gross Beta	2	4 - 202	(a)	(a)	-17 - 13

(a) No sample.





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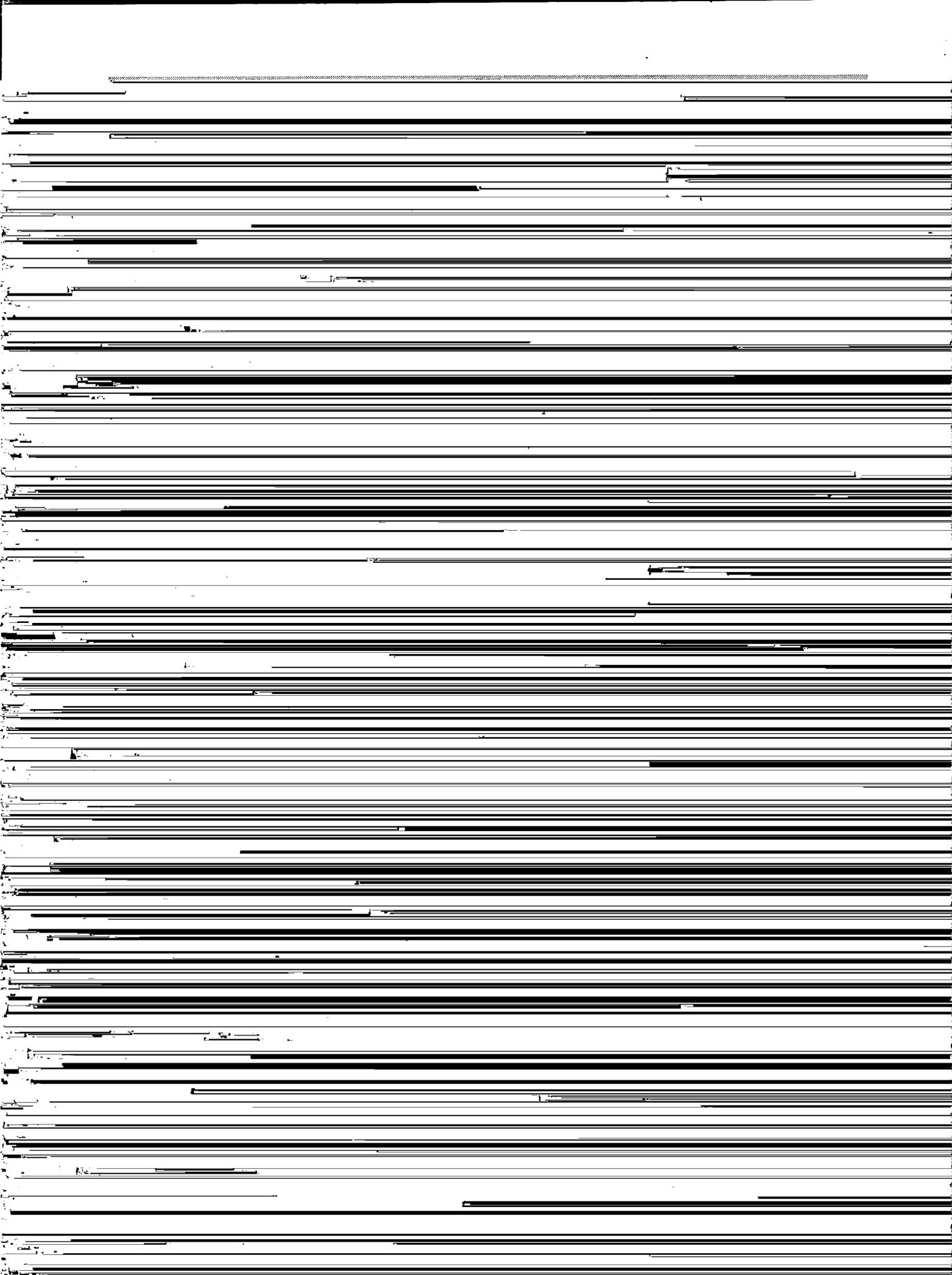
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