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Radiation monitoring around United States nuclear test areas, calendar year 1982

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OFFSITE ENVIRONMENTAL MONITORING REPORT
Radiation monitoring around United States nuclear test areas, calendar year 1982

compiled by

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NOTICE

This report has been reviewed in accordance with the U.S. Environmental Protection Agency's peer and administrative review policies and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

PREFACE

The U.S. Atomic Energy Commission (AEC) used the Nevada Test Site (NTS) from January 1951 through January 19, 1976, for conducting nuclear weapons tests, nuclear rocket-engine development, nuclear medicine studies, and other nuclear and non-nuclear experiments. Beginning January 19, 1976, these activities became the responsibility of the newly formed U.S. Energy Research and Development Administration (ERDA). On October 1, 1977 the ERDA was merged with other energy-related agencies to form the U.S. Department of Energy (DOE). Atmospheric nuclear tests were conducted periodically from January 27, 1951, through October 30, 1958, after which a testing moratorium was in effect until September 1, 1961. Since September 1, 1961, all nuclear detonations have been conducted underground with the expectation of containment, except for four slightly above-ground or shallow underground tests of Operation Dominic II in 1962 and five nuclear earth-cratering experiments conducted under the Plowshare program between 1962 and 1968.

Prior to 1954, an offsite surveillance program was performed by the Los Alamos Scientific Laboratory and the U.S. Army. From 1954 through 1970 the U.S. Public Health Service (PHS), and from 1970 to the present the U.S. Environmental Protection Agency (EPA) have provided an Offsite Radiological Safety Program under an Interagency Agreement. The PHS or EPA has also provided offsite surveillance for U.S. nuclear explosive tests at places other than the NTS.

Since 1954, an objective of this surveillance program has been to measure levels and trends of radioactivity, if present, in the environment surrounding testing areas to ascertain whether the testing is in compliance with existing radiation protection standards. Offsite levels of radiation and radioactivity are assessed by sampling milk, water, and air; by deploying dosimeters; and by sampling food crops, soil, etc., as required. To implement protective actions, provide immediate radiation monitoring, and obtain environmental samples rapidly after any release of radioactivity, personnel with mobile monitoring equipment are placed in areas downwind from the test site prior to each test. Since 1962, aircraft have also been deployed to rapidly monitor and sample releases of radioactivity during nuclear tests. Monitoring data obtained by the aircraft crew immediately after a test are used to position mobile radiation monitoring personnel on the ground. Data from airborne sampling are used to quantify the amounts, diffusion, and transport of the radionuclides released.

Prior to 1964 a report was published for each test series or test project. Beginning in 1959 for reactor tests, and in 1962 for weapons and plowshare tests, surveillance data were published for each test that released significant radioactivity off site. From January 1964, through December

1970, semi-annual summaries of these reports for nuclear tests were also published.

In 1971, the AEC implemented a requirement, now referred to as the DOE Order 5484.1, that each contractor or agency involved in major nuclear activities provide a comprehensive annual radiological monitoring report. This is the eleventh annual report in this series; it summarizes the activities of the EPA during CY 1982.

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ABBREVIATIONS, SYMBOLS AND CONVERSIONS

a	annum (year)
ASN	Air Surveillance Network
CG	Concentration Guide
Ci	Curie
CP-1	Control Point One
CY	Calendar Year
d	day
DOE	U.S. Department of Energy
DOE/NV	Department of Energy, Nevada Operations Office
EMSL-LV	Environmental Monitoring Systems Laboratory, Las Vegas
EPA	U.S. Environmental Protection Agency
eV	electron volt
g	gram
GZ	Ground Zero
h	hour
HTO	tritiated water
L	liter
LTHMP	Long-Term Hydrological Monitoring Program
m	meter
MDC	Minimum Detectable Concentration
MSL	Mean Sea Level
MSN	Milk Surveillance Network
NGTSN	Noble Gas and Tritium Surveillance Network
NTS	Nevada Test Site
Pa	Pascal - unit of pressure
R	Roentgen
rad	unit of absorbed dose, 100 ergs/g
rem	the rad adjusted for biological effect
TLD	thermoluminescent dosimeter

PREFIXES

a	atto	$= 10^{-18}$
f	femto	$= 10^{-15}$
p	pico	$= 10^{-12}$
n	nano	$= 10^{-9}$
μ	micro	$= 10^{-6}$
m	milli	$= 10^{-3}$
k	kilo	$= 10^{3}$
M	Mega	$= 10^{6}$

CONVERSIONS

Multiply	By	To Obtain
Concentration Guides		
μCi/mL	10^{9}	pCi/L
μCi/mL	10^{12}	pCi/m^{3}
SI Units		
rad	10^{-2}	Gray (Gy = 1 Joule/kg)
rem	10^{-2}	Sievert (Sv)
pCi	0.037	Becquerel

ACKNOWLEDGEMENT

Jaci L. Hopper, a health physicist for the Reynolds Electrical and Engineering Co., performs the calibration and readout of the TLD's used in the Dosimetry Network as described in Section 5 of this report. These services plus a summary of the results and preliminary interpretation for the TLD and Pressurized Ion Chamber networks are supplied under contract to the Nuclear Radiation Assessment Division, EMSL-LV.

SECTION 1

SUMMARY

PURPOSE

It is U.S. Environmental Protection Agency policy to protect the general public and the environment from pollution caused by human activities. This includes radioactive contamination of the biosphere and concomitant radiation exposure of the population. To this end and in concordance with U.S. Department of Energy policy of keeping radiation exposure of the general public as low as reasonably achievable, the EMSL-LV conducts an Offsite Radiological Safety Program centered on the DOE's Nevada Test Site. This program is conducted under an Interagency Agreement between EPA and DOE.

A principal activity of the Offsite Radiological Safety Program is routine environmental monitoring for radioactive materials in various media and for radiation in areas which may be affected by nuclear tests. It is conducted to document compliance with standards, to identify trends, and to provide information to the public. This report summarizes these activities for CY 1982.

Locations

Most of the radiological safety effort is applied in the areas around the Nevada Test Site in south-central Nevada. The principal activity at the NTS is testing of nuclear devices, though other related projects are also conducted. This portion of Nevada is sparsely settled, 0.5 person/km^2, and has a continental arid climate. The largest town in the near offsite area is Beatty, located about 65 km west of the NTS with a population of about 900.

Underground tests have been conducted in several other States for various purposes. At these sites in Alaska, Colorado, New Mexico and Mississippi, a long-term hydrological monitoring program (LTHMP) is conducted to detect any possible contamination of potable water and aquifers near these sites.

Pathways Monitoring

The pathways leading to human exposure to radionuclides, namely air, water and food, are monitored by networks of sampling stations. The networks are designed not only to detect radiation from DOE/NV nuclear test areas but also to detect increases in population exposure from other sources.

In 1982 the air surveillance network (ASN) consisted of 29 continuously operating stations surrounding the NTS and 92 standby stations (operated 1 or

2 weeks each quarter) in all States west of the Mississippi. Other than naturally occurring beryllium-7, the only activity detected by this network was plutonium-239 from worldwide fallout.

The noble gas and tritium sampling network (NGTSN) consisted of 16 stations offsite (off the NTS and exclusion areas) in 1982. No NTS-related radioactivity was detected at any offsite station. Tritium concentration in air remained below MDC levels and krypton-85 concentration continued the upward trend which started in 1960, reflecting the worldwide increase in nuclear technology.

The long-term hydrological monitoring of wells and surface waters near sites of nuclear tests showed only background tritium and other radionuclide concentrations except for those wells that enter the test cavity or those that were previously spiked with radionuclides for hydrological tests.

The milk surveillance network (MSN) consisted of 25 sampling locations within 300 km of the NTS and about 140 standby locations in the Western U.S. The tritium concentration in milk was at background levels, and strontium-90 from worldwide fallout continued the slow downward trend observed in recent years.

Other foods analyzed have been mainly meat from domestic or game animals and garden vegetables. The radionuclide most frequently found in the edible portion of the sampled animals is cesium-137. Its concentration has been low since 1968. Meat from deer that reside on the NTS has not had markedly higher concentrations of radionuclides than meat from deer that reside in other areas of Nevada.

External Exposure

External exposure is monitored by a network of TLD's at 82 locations surrounding the NTS and by TLD's worn by 48 offsite residents. In a few cases, small exposures of a few mrem above the average for the person or location were measured. Except for one case of occupational exposure, all such net exposures were very low and were not related to NTS activities. The range of exposures measured, varying with altitude and soil constituents, is similar to the range of such exposures found in other areas of the U.S.

Internal Exposure

Internal exposure is assessed by whole-body counting supplemented by phoswich detectors to measure lung burdens of radioactivity. In 1982, counts were made on 70 offsite residents and about 275 EPA and EG&G employees. Natural potassium-40 was found as expected, but no nuclear test related radioactivity was detected. In addition, physical examinations of the offsite residents revealed only a normally healthy population consonant with the age and sex distribution of that population.

Community Monitoring Stations

The 15 Community Monitoring Stations became operational in 1982. Each station is operated by a resident of the community who is trained to collect samples and interpret some of the data. Each station is an integral part of the ASN, NGTSN and TLD networks and is also equipped with a pressurized ion chamber system and recording barograph. Samples and data from the stations are analyzed by EMSL-LV and are also interpreted and reported by the Desert Research Institute, University of Nevada. Data from these stations are reported herein as part of the networks in which they participate.

Dose Assessment

Doses were calculated for an average adult living in Nevada based on the Kr-85, Sr-90, Cs-137 and Pu-239 detected by the monitoring networks. Using conservative assumptions, the estimated dose would have been less than 0.3 mrem per year, a small fraction of the variation of 10 mrem per year due to the natural radionuclide content of the body. Since no radioactivity originating on the NTS was detectable offsite, no dose assessment related to NTS activities could be made. However, atmospheric dispersion calculations, based on known emissions from the NTS, indicate that the population dose within 80 km of CP-1 was about 10^{-5} man-rem for 1982.

SECTION 2

INTRODUCTION

The EMSL-LV operates an Offsite Radiological Safety Program around the NTS and other sites as requested by the Department of Energy (DOE) under an Interagency Agreement between DOE and EPA. This report, prepared in accordance with the guidelines in DOE/EP-0023 (DOE 1981), covers the program activities for calendar year 1982. It contains descriptions of pertinent features of the NTS and its environs, summaries of the EMSL-LV dosimetry and sampling methods, analytical procedures, and the analytical results from environmental measurements. Where applicable, dosimetry and sampling data are compared to appropriate guides for external and internal exposures of humans to ionizing radiation.

SECTION 3

DESCRIPTION OF THE NEVADA TEST SITE

Historically, the major programs conducted at the NTS have been nuclear weapons development, proof-testing and weapons safety and effects, testing peaceful uses of nuclear explosives (Plowshare Program), reactor engine development for nuclear rocket and ramjet applications (Projects Pluto and Rover), high-energy nuclear physics research, seismic studies (Vela Uniform), and studies of high-level waste storage. During 1982, nuclear weapons development, proof-testing and weapons safety, nuclear physics programs, and studies of high-level waste storage were continued at the NTS. Project Pluto was discontinued in 1964; Project Rover was terminated in January 1973; Plowshare tests were terminated in 1970; Vela Uniform studies ceased in 1973. All nuclear weapons tests since 1962 have been conducted underground. More detail and pertinent maps for the portions of this section are included in Appendix A. Only selected information is presented in this Section.

SITE LOCATION

The NTS is located in Nye County, Nevada, with its southeast corner about 90 km northwest of Las Vegas (Figure 1). It has an area of about 3,500 square km and varies from 40 to 56 km in width (east-west) and from 64 to 88 km in length (north-south). This area consists of large basins or flats about 900 to 1,200 m above mean sea level (MSL) surrounded by mountain ranges rising 1,800 to 2,300 m above MSL.

The NTS is surrounded on three sides by exclusion areas, collectively named the Nellis Air Force Range, which provide a buffer zone between the test areas and public lands. This buffer zone varies from 24 to 104 km between the test area and land that is open to the public. Depending upon wind speed and direction at the time of testing, from 2 to more than 6 hours will elapse before any release of airborne radioactivity could pass over public lands.

CLIMATE

The climate of the NTS and surrounding area is variable, due to its variations in altitude and its rugged terrain. Generally, the climate is referred to as continental arid. Throughout the year, there is insufficient precipitation to support the growth of common food crops without irrigation.

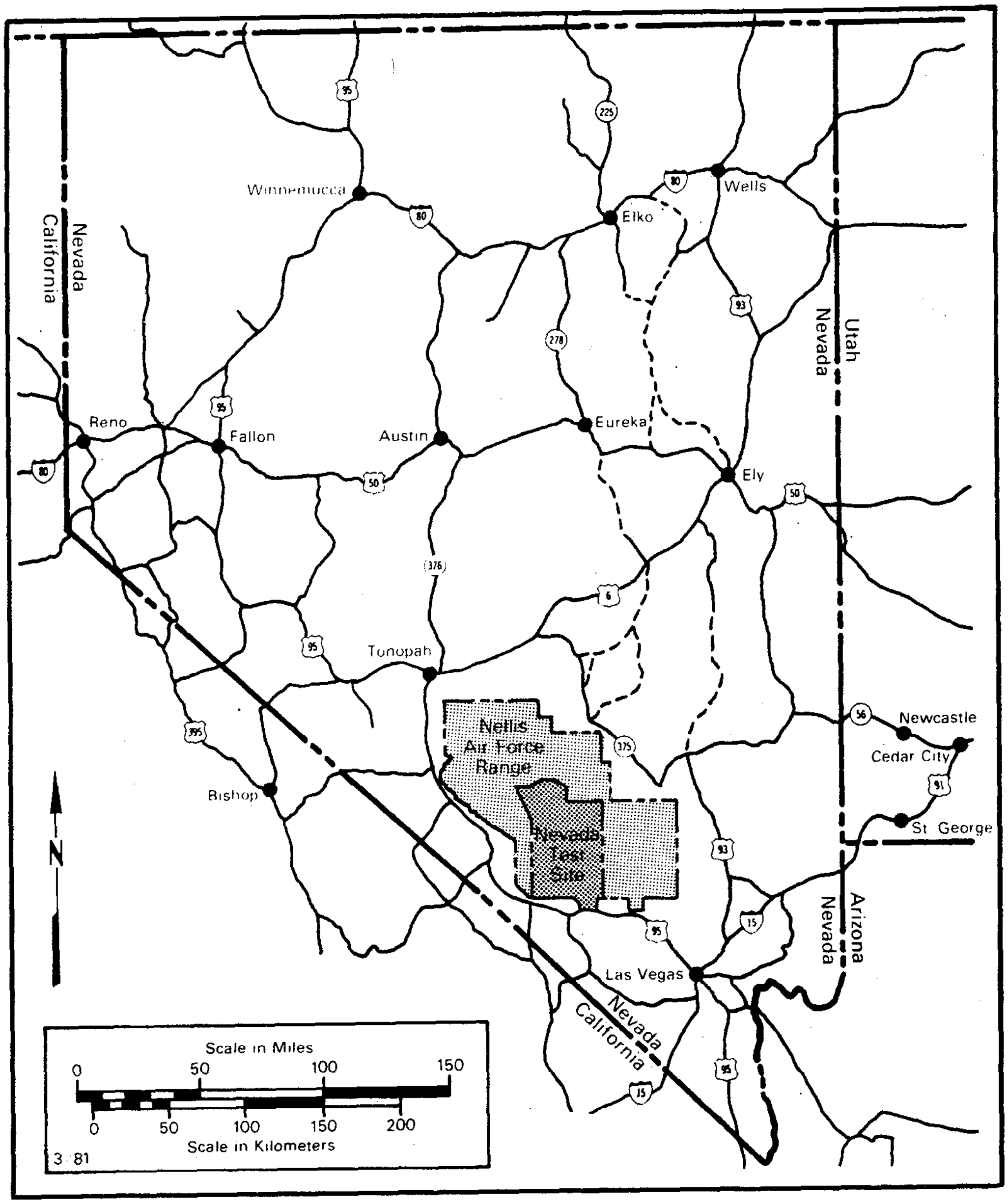

Figure 1. Location of the Nevada Test Site (NTS).

As Houghton et al. (1975) point out, 90 percent of Nevada's population lives in areas with less than 25 cm of rainfall per year or in areas that would be classified as mid-latitude steppe to low-latitude desert regions.

The wind direction, as measured on a 30-m tower at an observation station about 9 km NNW of Yucca Lake near CP-1, is predominantly northerly except during May through August when winds from the south-southwest predominate (Quiring 1968). Because of the prevalent mountain/valley winds in the basins, south to southwest winds predominate during daylight hours of most months. During the winter months southerly winds have only a slight edge over northerly winds for a few hours during the warmest part of the day. These wind patterns are often quite different at other locations on the NTS because of local terrain effects and differences in elevation.

GEOLOGY AND HYDROLOGY

Geological and hydrological studies of the NTS have been in progress by the U.S. Geological Survey and various other organizations since 1956. Because of this continuing effort, including subsurface studies of numerous boreholes, the surface and underground geological and hydrological characteristics for much of the NTS are known in considerable detail (see Figure A-1). This is particularly true for those areas in which underground experiments are conducted. A comprehensive summary of the geology and hydrology of the NTS by Winograd and Thordarson was published in 1975.

The aquifers underlying the NTS vary in depths from about 200 m beneath the surface of valleys in the southeastern part of the site to more than 500 m beneath the surface of highlands to the north. Although much of the valley fill is saturated, downward movement of water is retarded by various tuffs and is extremely slow. The primary aquifer in these formations consists of Paleozoic carbonates that underlie the more recent tuffs and alluviums.

LAND USE OF NTS ENVIRONS

Industry within the immediate off-NTS area includes approximately 40 active mines and mills, oil fields in the Railroad Valley area, and several industrial plants in Henderson, Nevada. The number of employees for these operations may vary from one person at several of the small mines to several hundred workers for the oil fields north of the NTS and the industrial plants in Henderson. Most of the individual mining operations involve less than 10 workers per mine; however, a few operations employ 100 to 250 workers.

The major body of water close to the NTS is Lake Mead (120 km southeast, Figure A-2), a manmade lake supplied by water from the Colorado River. Lake Mead supplies about 60 percent of the water used for domestic, recreational, and industrial purposes in the Las Vegas Valley. Some Lake Mead water is used in Arizona, southern California, and Mexico. Smaller reservoirs and lakes located in the area are used primarily for irrigation, for watering livestock, and for wildlife refuges.

Dairy farming is not extensive within 300 km of the NTS. A survey of milk cows during the summer of 1981 showed 11,800 dairy cows, 920 family milk cows and 530 family milk goats in the area (Figures A-4 and A-5). The family cows and goats are distributed in all directions around the NTS, whereas most dairy cows are located to the southeast (Moapa River, Nevada; Virgin River Valley, Nevada; and Las Vegas, Nevada), northeast (Lund), and southwest (near Barstow, California).

Grazing is the most common land use within 300 km of the site. Approximately 280,000 cattle and 180,000 sheep are distributed within the area as shown in Appendix Figures A-6 and A-7, respectively. The estimates are based on information supplied by the California county agents during 1982, from 1982 agricultural statistics supplied by the Nevada Department of Agriculture and from 1982 census information supplied by the Utah Department of Agriculture.

POPULATION DISTRIBUTION

Excluding Clark County, the major population center (approximately 462,000 in 1980), the population density within a 150 km radius of CP-1 on the NTS is about 0.5 persons per square kilometer. For comparison, the 48 contiguous states (1980 census) had a population density of approximately 29 persons per square kilometer. The estimated average population density for all of Nevada in 1980 was 2.8 persons per square kilometer.

The offsite area within 80 km of the NTS (the area in which the dose commitment must be determined for the purpose of this report) is predominantly rural, Figure A-3. Several small communities are located in the area, the largest being in the Pahrump Valley. This growing rural community, with an estimated population of about 3,600, is located about 72 km south-southwest of the NTS CP-1. The Amargosa Farm Area, which has a population of about 1,600, is located about 50 km southwest of CP-1. The largest town in the near-offsite area is Beatty, which has a population of about 900 and is located approximately 65 km to the west of CP-1.

AIRBORNE RELEASES OF RADIOACTIVITY AT THE NTS DURING 1982

All nuclear detonations during 1982 were conducted underground and were contained, although occasional releases of low-level radioactivity occurred during re-entry drilling. Table 1 shows the total quantities of radionuclides released to the atmosphere, as reported by the DOE Nevada Operations Office (1983). Because these releases occurred throughout the year, and because of the distance from the points of releases to the nearest sampling station, none of the radioactive nuclides listed in this table were detected offsite.

TABLE 1. TOTAL AIRBORNE RADIONUCLIDE EMMISIONS AT THE NTS DURING 1982

Radionuclide	Half-Life (days)	Quantity Released (Ci)
Tritium	4,500	165
Iodine-131	8.04	0.0001
Xenon-133	5.29	74
Xenon-133m	2.33	2.5
Xenon-135	0.38	4.2

SECTION 4

QUALITY ASSURANCE

GOALS

The goals of the EMSL-LV quality assurance program are to assure the collection and analysis of environmental samples with the highest degree of accuracy and precision obtainable with state-of-the-art instrumentation and to achieve the best possible completeness and comparability given the extent and type of networks from which samples are collected. To meet these goals, it is necessary to devote strict attention to both the sample collection and sample analysis procedures.

SAMPLE COLLECTION

The collection of samples is governed by a detailed set of Standard Operating Procedures (SOP's). These SOP's prescribe the frequency and method of collection, the type of collection media, sample containment and transport, sample preservation, sample identification and labeling, and operating parameters for the instrumentation. Sample control is an important segment of these activities as it enables tracking from collection to analysis for each sample and governs the selection of duplicate samples for analysis and the samples chosen for replicate analysis.

These procedures provide assurance that sample collection, labeling and handling are standardized to minimize sample variability due to inconsistency among these variables.

SAMPLE ANALYSIS

All of the networks operated by the EMSL-LV have individual Quality Assurance Project Plans that assure the results of analysis will be of high accuracy and precision and will be comparable to results obtained elsewhere with equivalent procedures. These Plans are summarized in the following sections.

External QA

External QA provides the data from which the accuracy of analysis (a combination of bias and precision) can be determined. Bias is assessed from the results obtained on intercomparison study samples and on samples "spiked" with known amounts of radionuclides. The Offsite Radiological

Safety Program participates in Intercomparison Study Programs that include environmental sample analysis, TLD dosimetry, and whole-body counting. Also, samples unknown to the analyst are spiked by adding known amounts of radionuclides and entered into the normal chain of analysis.

Data for precision are collected from duplicate and replicate analyses. At least 10 percent of all samples are collected in duplicate. When analyzed, the data indicate the precision of both sample collection and analysis. Replicate counting of at least 10 percent of all samples yield data from which the precision of counting can be determined.

If the accuracy and precision data are of sufficient quality (i.e., normalized deviation in Table C-3 is less than 2), then comparability, i.e., comparison of the data with those of other analytical laboratories, can be assessed with confidence. The results of external QA procedures are shown in Appendix C.

Internal QA

Internal QA consists of those procedures used by the analyst to assure proper sample preparation and analysis. The principal procedures used are the following:

- Instrument background counts
- Blank reagent analyses
- Instrument calibration with known nuclides
- Laboratory control standards analysis
- Performance check-source analysis
- Maintenance of control charts for background and check-source data
- Scheduled instrument maintenance

These procedures ensure that the instrumentation is not contaminated, that calibration is correct, and that standards carried through the total analytical procedure are accurately analyzed.

VALIDATION

After the results are produced, supervisory personnel examine the data to determine whether or not the analysis is valid. This includes checking all procedures from sample receipt to analytical result with particular attention to the internal QA data and comparison of the results with previous data from similar samples at the same location.

Any variant result or failure to follow internal QA procedures during sample analysis will trigger an internal audit of the analytical procedures and/or a re-analysis of the sample or its duplicate.

SECTION 5

RADIOLOGICAL SAFETY ACTIVITIES

The radiological safety activities of the EMSL-LV are divided into two major areas: special test support and routine environmental surveillance. Both of these activities are designed to detect any increase in environmental radiation which might cause exposure to individuals or population groups so that protective actions may be taken, to the extent feasible. These activities are described in the following portions of this report.

SPECIAL TEST SUPPORT

Before each nuclear test, mobile monitoring personnel are positioned in the offsite areas most likely to be affected should a release of radioactive material occur. They ascertain the locations of residents, work crews and animal herds and obtain information relative to controllability of residents in communities and remote areas. These monitors, equipped with radiation survey instruments, gamma exposure-rate recorders, thermoluminescent dosimeters (TLD's), portable air samplers, and supplies for collecting environmental samples, are prepared to conduct a monitoring program as directed from the NTS Control Point (CP-1) via two-way radio communications.

For those tests which might cause ground motion detectable offsite, EPA monitors were stationed at locations where hazardous situations might ensue. At these locations, e.g., mines and specific buildings, occupants are notified of potential hazard so they can take precautionary measures.

Professional EPA personnel serve as members of the Test Controller's Advisory Panel to provide advice on possible public and environmental impact of each test and feasible protective actions in case accidental releases of radioactivity should occur.

An EG&G cloud sampling and tracking aircraft is flown over the NTS to obtain samples, assess total cloud volume, and provide long-range tracking in the event of a release of airborne radioactivity. A second EG&G aircraft is flown to gather meteorological data and to perform cloud tracking. Information from these aircraft can be used in positioning the radiation monitors.

During CY 1982 none of the tests conducted at the NTS released radioactivity that was detected offsite.

PATHWAYS MONITORING

The offsite radiation monitoring program includes pathways monitoring consisting of air, water and milk surveillance networks surrounding the NTS and a limited animal sampling project. These are explained in detail below.

Air Surveillance Network (ASN)

Network Design--

The ASN monitors an important route of human exposure to radionuclides: inhalation of airborne materials. Not only the concentration but also the source must be determined if appropriate corrective actions are to be taken. Thus the ASN is designed to circumscribe the NTS with a 200 km circle, is limited only by the availability of electric power and a resident for operation, and has a slight concentration of sampling stations in the prevailing downwind direction as shown in Figure 2. This continuously operating network is reinforced by a standby network which covers the contiguous States west of the Mississippi River, Figure 3.

Methods--

During 1982 the ASN consisted of 29 continuously operating sampling stations and 92 standby stations. Each sampler was equipped to collect both particulate and gaseous radionuclides.

Samples of airborne particulates were collected at each active station on 4-cm diameter glass-fiber filters at a flow rate of about 81 m^3 per day. Filters were changed after sampler operation periods of 2 or 3 days (160 to 240 m^3). Activated charcoal cartridges placed directly behind the filters to collect gaseous radioiodine were changed at the same time as the filters. The standby network was activated for 1 to 2 weeks per quarter. The samplers use 10-cm Microsorban filters and charcoal cartridges. They sample air at about 350 m^3 per day. The stations were operated by State and municipal health department personnel or by local residents. All air filters and charcoal cartridges were analyzed by the EMSL-LV.

Results--

Throughout the network, beryllium-7 was the only nuclide detected by gamma spectroscopy. The principal means of beryllium-7 production is from spallation of oxygen-16 and nitrogen-14 in the atmosphere by cosmic rays. Appendix Tables E-1 and E-2 summarize the data from the ASN samples. All time-weighted averages (Avg in the tables) are less than 1 percent of the Concentration Guide (Appendix D) for exposure to the general public. These guides do not apply to naturally-occurring radionuclides.

During 1982, no airborne radioactivity related to nuclear testing at the NTS was detected on any sample from the ASN.

A plot of the logarithm of the individual concentrations for all stations during the year versus probits indicates that the air data are approximately lognormally distributed. The distribution for the individual nuclide that

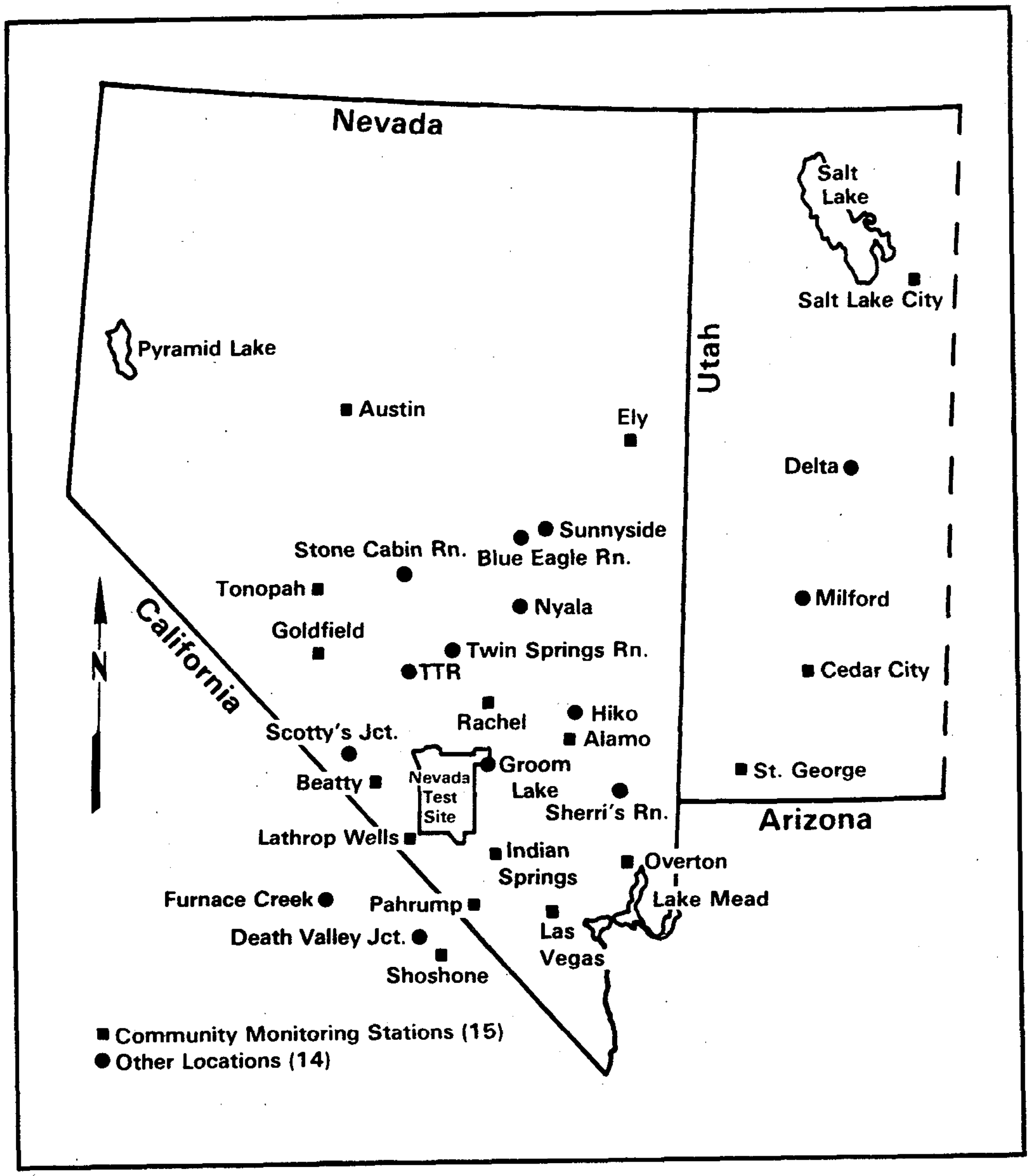

Figure 2. Air Surveillance Network stations (1982).

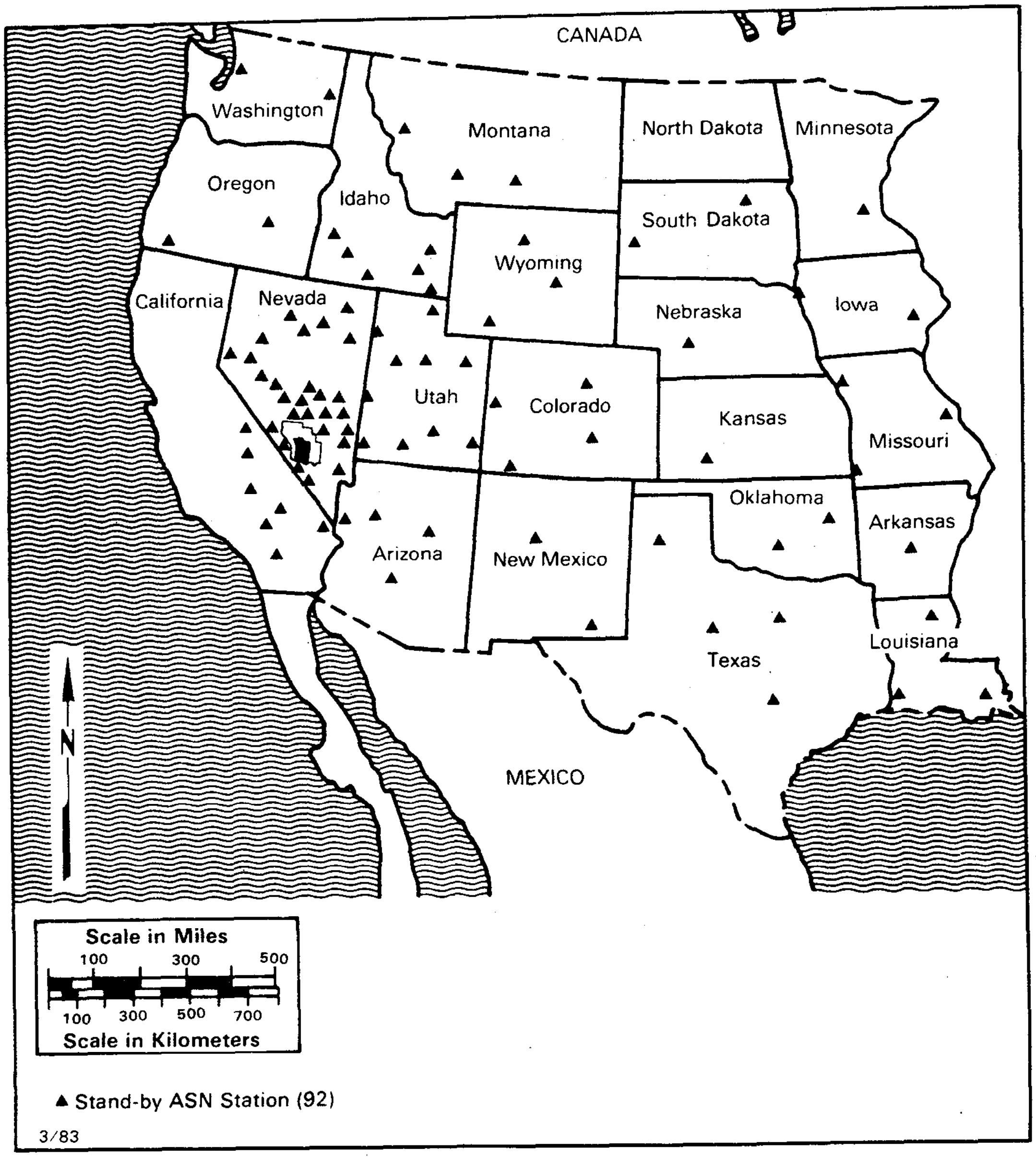

Figure 3. Standby Air Surveillance Network stations (1982).

was detected indicated that there was a single source, assumed to be worldwide, because all stations were affected similarly.

Two special studies are performed on the samples from the ASN: a gross beta analysis of the filters from 5 stations, and plutonium-238 and plutonium-239 analysis of composited filters from 17 States.

The gross beta analysis is used to detect trends in atmospheric radioactivity more quickly than is possible with gamma spectrometry. For this study, three stations north and east of the NTS, and two stations south and west of the NTS are used. The three filters per week from each station are analyzed for gross beta activity after a 7-day delay to decrease the contribution from radon daughter activity. The data suggest little significant difference among stations and show the normal trend of decreased activity to be expected after the rainout which occurs each spring (Figure 4). The maximum concentration measured was 0.09 pCi/m^3, the minimum was <0.002 pCi/m^3, and the arithmetic average was 0.011 pCi/m^3. A summary of the data is shown in Appendix Table E-4.

The plutonium study uses the filters from 32 standby ASN stations distant from the NTS, and from three ASN stations near the NTS. The filters from two standby stations in each State (operated 1 or 2 weeks per quarter) are composited quarterly, and those from the ASN stations are composited monthly. The composites are analyzed radiochemically as indicated in Appendix B.

The peak plutonium concentrations occurred in the spring and summer, as they did in 1981. The weighted annual average for the standby stations was 23 aCi/m^3, and for all stations was 30 aCi/m^3. This latter average is 0.15% of the CG for an individual in the general population.

Noble Gas and Tritium Surveillance Network

Network Design--

There are several sources of the radionuclides monitored by this network. Noble gases are emitted from nuclear power plants, propulsion reactors, reprocessing facilities and nuclear explosions. Tritium is emitted from the same sources and is also produced naturally. The monitoring network will be affected by all these sources, but must be able to detect NTS emissions. For this purpose some of the samplers are located close to the NTS and particularly in drainage-wind channels leading from the test areas. In 1982 this network consisted of 16 stations as shown in Figure 5.

Methodology--

Samples of air are collected by either of two methods; by directly compressing or by liquefying air using cryogenic techniques. Either type of equipment continuously samples air over a 7-day period and stores approximately 1 cubic meter of air in pressure tanks. The tanks are exchanged weekly and returned to the EMSL-LV where their contents are analyzed. Analysis starts

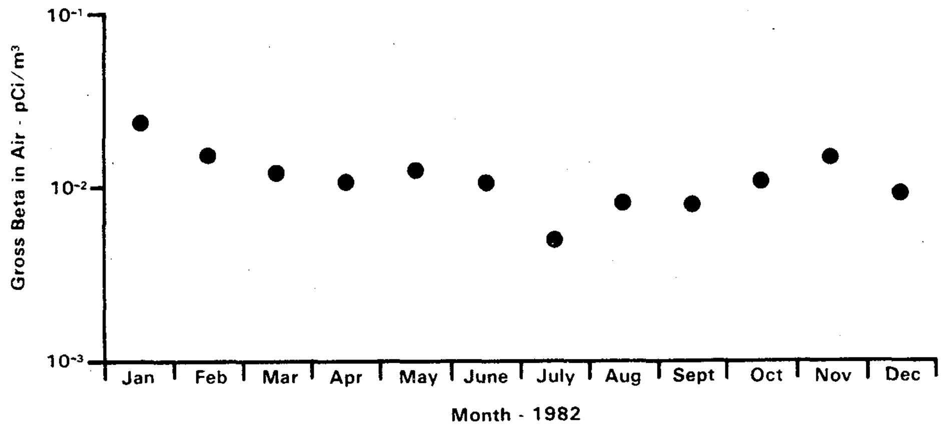

Figure 4. Monthly average gross beta in air samples, 1982.

by condensing the samples at liquid nitrogen temperature and using fractional distillation to separate the gases. The separate fractions of radioxenon and radiokrypton are dissolved in scintillation cocktails and counted in a liquid scintillation counter (see Appendix B).

For tritium sampling, a molecular sieve column is used to collect water from air. A prefilter is used to remove particles before air passes through the molecular sieve column. Up to 10 cubic meters of air are passed through each column over a 7-day sampling period. Water absorbed on the molecular sieve column is recovered, and the concentration of tritium in the water (HTO) is determined by liquid scintillation counting techniques (see Appendix B).

Results--

All results are shown in Appendix Table E-3 as the maximum, minimum and average concentration for each station. These data indicate that no radioactivity from NTS tests was detected offsite by the Noble Gas and Tritium Surveillance Network during 1982. The average concentrations at all network stations ranged from 24 to 26 pCi/m^3. Additional samples were collected at Canfield's Ranch (Adaven), Reveille Project (near Warm Springs), Twin Springs Ranch, and Hiko to monitor a deliberate release of gaseous radioactivity from a tunnel experiment on the NTS on September 24, 1982. However, no radioactivity was detected.

As shown in Figure 6, the concentrations of krypton-85 within the whole network appeared to have a skewed distribution. The lognormal distribution had a geometric mean of 24 pCi/m^3 and a geometric standard deviation of 1.15.

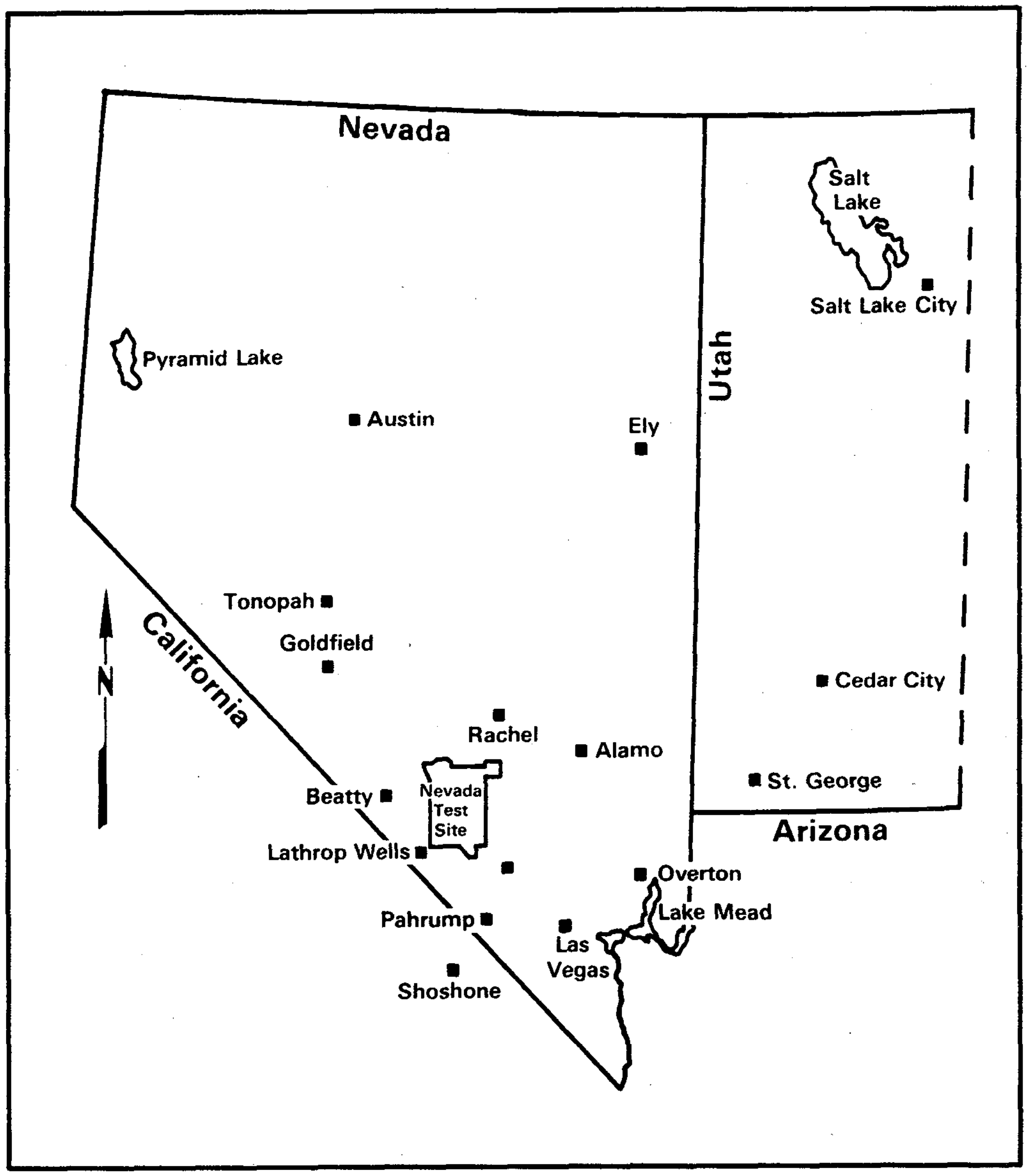

Figure 5. Noble Gas and Tritium Surveillance Network sampling locations.

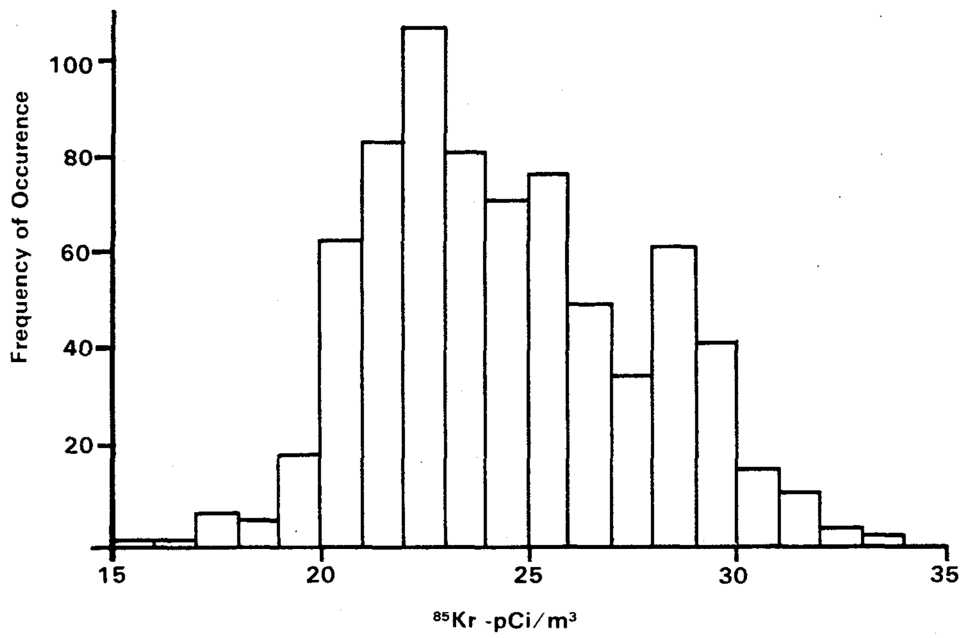

Figure 6. Frequency distribution of krypton-85 conentration in air, 1982 data.

As shown in Table 2 and Figure 7, the average concentration of krypton-85 for the whole network has gradually increased since sampling began in 1972. This increase, observed at all stations, reflects the worldwide increase in ambient concentrations resulting from the increased use of the nuclear technology. The increase in ambient krypton-85 concentration was projected by Bernhardt, et al., (1973). However, the measured network average in 1982 is only about 25 percent of the 99 pCi/m^3 predicted by Bernhardt. Since nuclear fuel reprocessing is the primary source of krypton-85, the decision of the United States to defer fuel reprocessing may be one reason why krypton-85 levels have not increased as fast as predicted.

Using published data for krypton-85 concentration in air (NCRP 1975) and the data from our network (Table 2), the change over time was plotted as shown in Figure 7. Linear correlation analysis indicates that the krypton concentration/time relation is pCi/m^3 = 5.7 + 0.82t where t is number of years after 1960. The correlation coefficient, R, was 0.98.

As in the past, tritium concentrations in atmospheric moisture samples from the off-NTS stations were generally below the minimum detectable concentration (MDC) of about 400 pCi/L water (Appendix Table E-3). The tritium

TABLE 2. ANNUAL AVERAGE KRYPTON-85 CONCENTRATIONS IN AIR, 1973-1982

Sampling Locations	Kr-85 Concentrations (pCi/m^3)									
	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Alamo, Nev†	--	--	--	--	--	--	--	--	27	24
Austin, Nev.†	--	--	--	--	--	--	--	--	--	24
Beatty, Nev.	16	17	19	20	20	20	19	21	24	25
Diablo and Rachel, Nev.‡	16	17	18	19	19	20	19	21	24	26
Ely, Nev.†	--	--	--	--	--	--	--	--	--	24
Goldfield, Nev.†	--	--	--	--	--	--	--	--	--	25
Hiko, Nev.	16	17	17	17	19	20	19	21	24	26
Indian Springs, Nev.	--	--	20	20	20	20	19	21	24	24
NTS, Mercury, Nev.*	16	18	18	19	20	20	19	21	23	--
NTS, Area 51, Nev.*	16	17	18	20	19	20	19	21	24	--
NTS, BJY, Nev.*	18	19	19	20	21	22	21	23	26	--
NTS, Area 12, Nev.*	16	18	18	20	19	20	19	21	24	--
Tonopah, Nev.	16	18	17	19	19	20	18	21	25	24
Las Vegas, Nev.	16	17	18	18	20	20	--	--	24	24
Death Valley Jct., Calif.*	15	18	17	20	20	20	19	--	--	--
NTS, Area 15, Nev.*	--	--	--	--	--	--	19	21	25	--
NTS, Area 400, Nev.*	--	--	--	--	--	--	18	21	23	--
Lathrop Wells, Nev.	--	--	--	--	--	--	19	22	24	24
Pahrump, Nev.	--	--	--	--	--	--	--	--	23	24
Overton, Nev.	--	--	--	--	--	--	--	--	26	24
Cedar City, Ut.†	--	--	--	--	--	--	--	--	--	25
St. George, Ut.†	--	--	--	--	--	--	--	--	--	24
Salt Lake City, Ut.†	--	--	--	--	--	--	--	--	--	25
Network Average	16	18	18	19	20	20	19	21	24	24

*Stations discontinued
†New stations
‡Station at Diablo was moved to Rachel in March 1979.

concentrations observed at off-NTS stations were considered to be representative of environmental background. The geometric mean of the tritium concentrations for all offsite stations was evaluated as 0.051 pCi/mL of moisture, which is below the minimum detectable concentration of about 0.4 pCi/mL. The geometric standard deviation for the mean was determined to be 1.45.

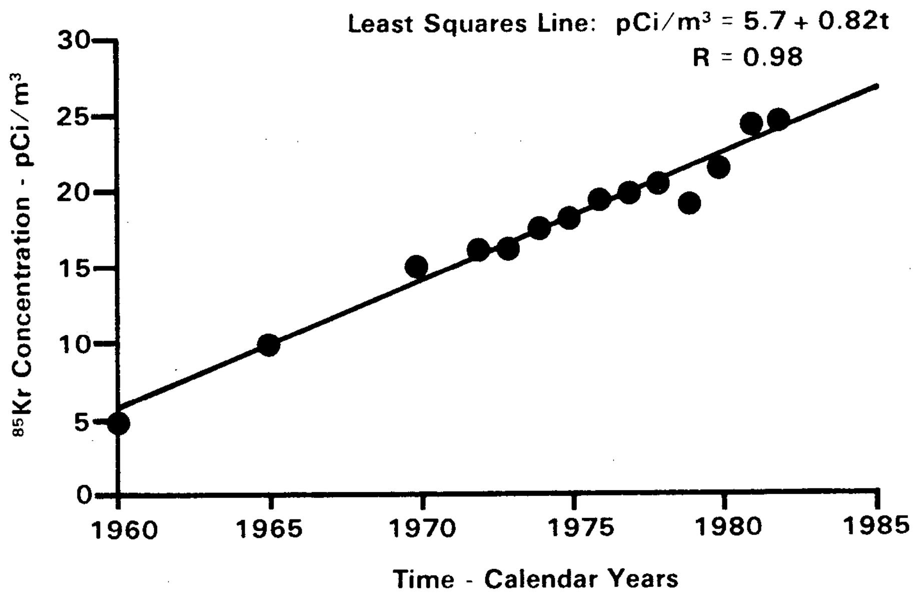

Figure 7. Trend in annual average krypton-85 concentration.

Long-term Hydrological Monitoring Program

Network Design--

A major pathway for transport of radionuclides to individuals is via potable water. This program monitors possible radioactive contamination of potable water sources. The design is for a system to monitor the aquifers underlying, and surface waters on or near, sites where nuclear explosions have occurred. For aquifers, monitoring is limited by the availability of wells that tap those sources. For the sites considered herein, a suitable number of wells is present so that sufficient monitoring data are obtained.

The monitored locations for the NTS and nearby offsite areas are shown in Figures 8 and 9. For Projects Cannikin, Longshot and Milrow in Alaska; for Projects Rio Blanco and Rulison in Colorado; for Projects Dribble and Miracle Play in Mississippi; for Projects Faultless and Shoal in Nevada; and for Projects Gasbuggy and Gnome in New Mexico, the sampling locations are shown in Figures E-1 through E-12 in Appendix E.

Methods--

At each sampling location, four samples are collected. Two samples are collected in 500-mL glass bottles; one is used for tritium analysis and the other stored for use as a duplicate sample or to replace the original sample if it is lost in analysis. Two 3.5-L samples are filtered through 10 cm diameter membrane filters into cubitainers and acidified with HNO_3. One sample and the filter are gamma-scanned, the other sample is stored for duplicate analysis or for reanalysis as required.

Tritium and gamma spectrometric analyses are described in Appendix B. If the tritium concentration detected by the conventional analysis is less than 700 pCi/L, then the sample is reanalyzed using the enrichment method.

Results--

Table 3 lists the locations at which water samples were found to contain man-made radioactivity. Radioactivity in samples collected at these locations has been reported in previous years, The data for all samples analyzed are compiled in Appendix Tables E-6 through E-9 together with the percent of the relevant CG listed in Appendix D.

None of the radionuclide concentrations found at the locations listed in Table 3 are expected to result in radiation exposures to residents in the areas where the samples were collected. Well UE7NS is located on the NTS, and it is not used as a source of domestic water.

USGS Wells 4 and 8, which were contaminated with the reported nuclides during tracer studies years ago, are on private land at the Project Gnome site in New Mexico and are closed and locked to prevent their use. Well DD-1 enters the Gnome cavity, to which Well LRL-7 is connected by a shaft used for the disposal of contaminated soil and salt. As a result, both of these wells are expected to produce contaminated water.

The Project Dribble wells in Mississippi are about 1 mile from the nearest residence and are not sources of drinking water.

The shallow wells at the Project Long Shot site on Amchitka Island in Alaska are in an isolated location and are not sources of drinking water.

No man-made gamma-emitting radionuclides were detected in any of the other water samples analyzed. The Cs-137 in the sample from USGS Well 4 reported last year is attributed to contamination of the sampling gear; it has never been detected in samples collected in the past and was not detected in the sample collected this year.

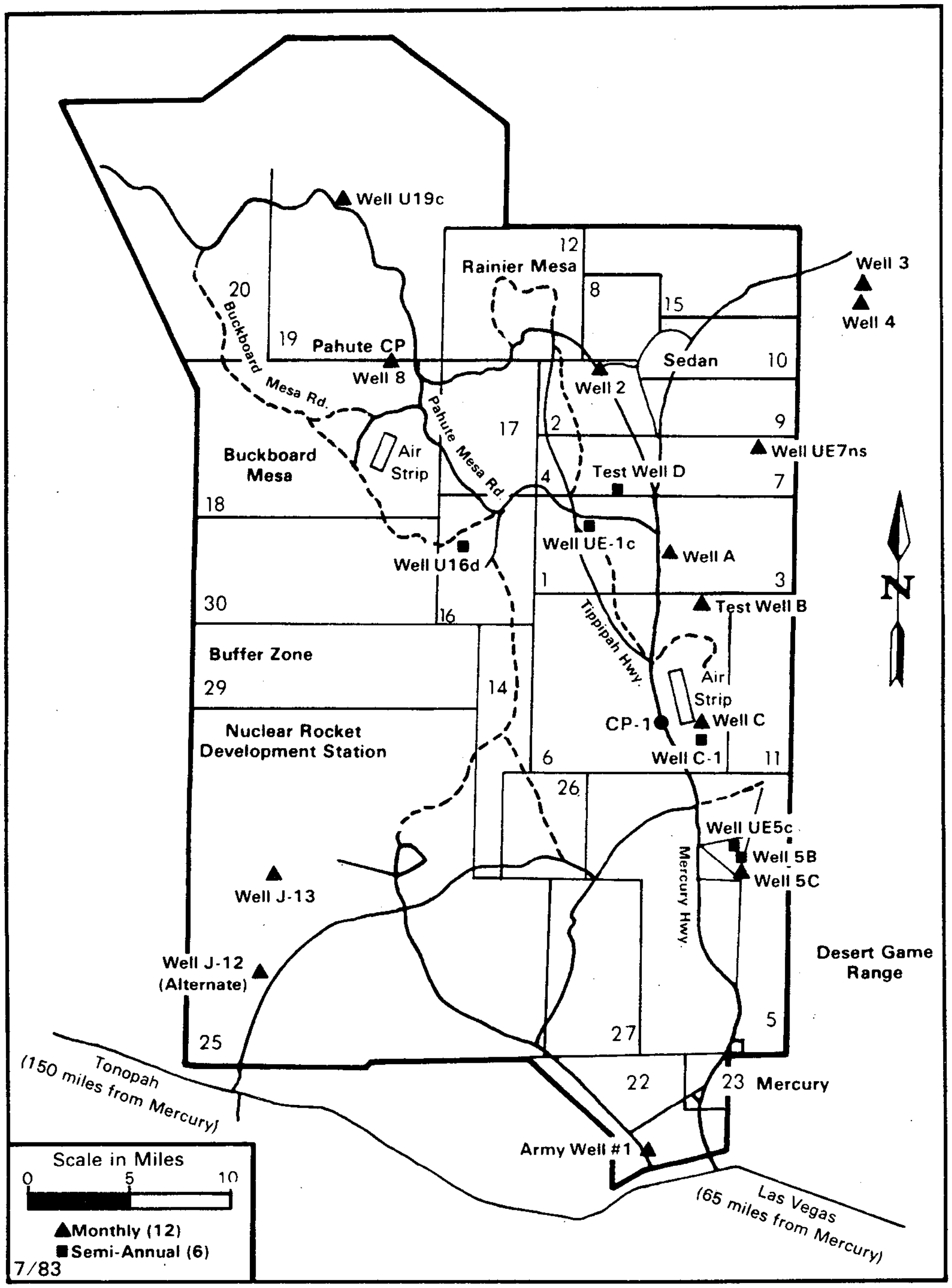

Figure 8. LTHMP sampling locations on the NTS.

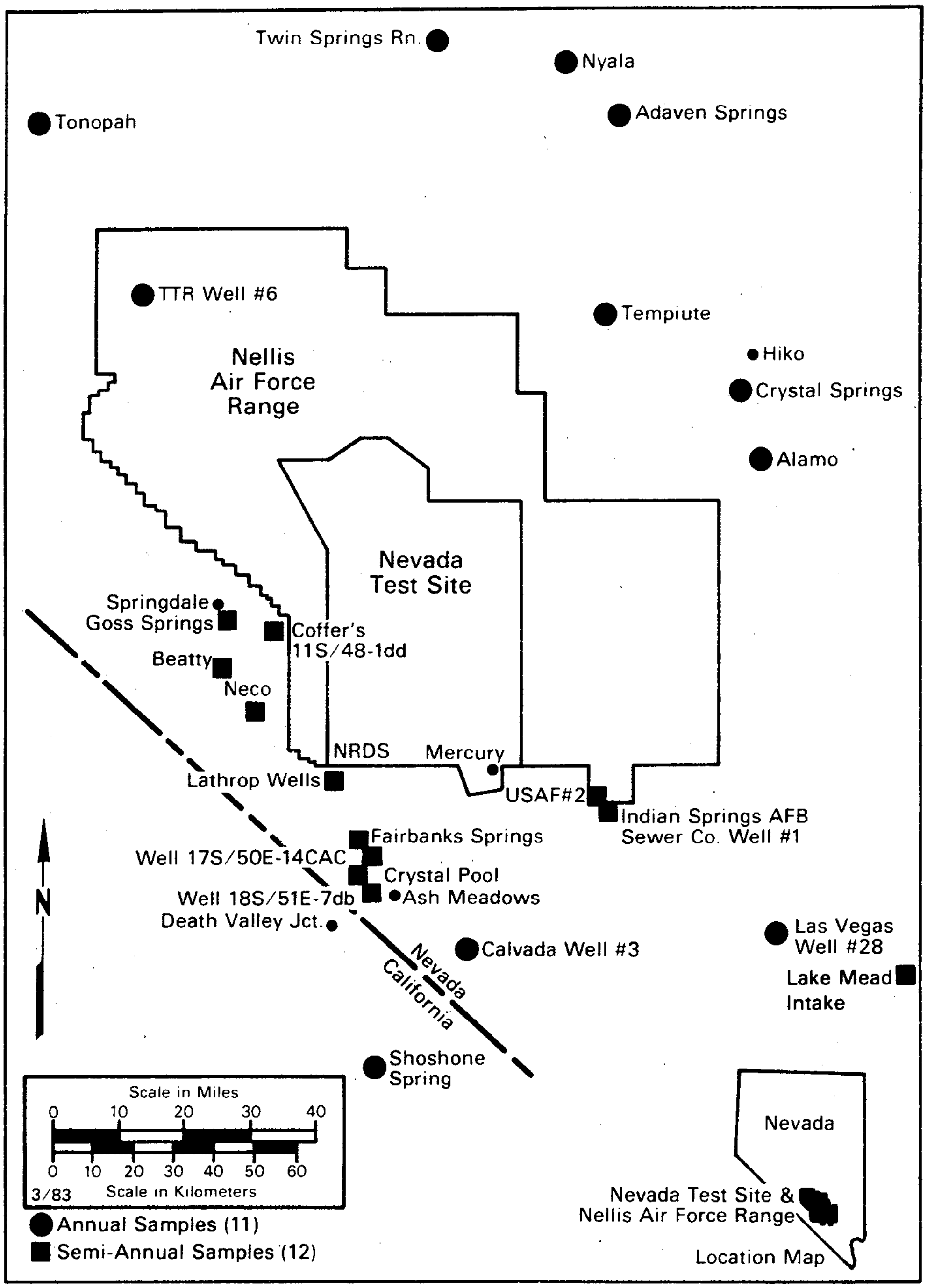

Figure 9. LTHMP sampling locations near the NTS.

TABLE 3. WATER SAMPLING LOCATIONS WHERE SAMPLES CONTAINED MAN-MADE RADIOACTIVITY*

Sampling Location	Type of Radioactivity	Concentration (pCi/L)
NTS (Nev.)		
Well UE7NS	Hydrogen-3	1400-1500
PROJECT GNOME (N. Mex.)		
USGS Well 4	Hydrogen-3	360,000
	Strontium-90	8,500
USGS Well 8	Hydrogen-3	290,000
	Strontium-90	6,900
	Cesium-137	18
Well LRL-7	Hydrogen-3	22,000
	Strontium-90	10
	Cesium-137	250
Well DD-1	Hydrogen-3	15×10^7
	Strontium-90	Lost
	Cesium-137	970,000
PROJECT DRIBBLE (Miss.)		
Well HMH-1 through 11	Hydrogen-3	29-10,000
Well HM-S	Hydrogen-3	24,000
Well HM-L	Hydrogen-3	2,000
REECo Pit Drainage-B	Hydrogen-3	1,400
REECo Pit Drainage-C	Hydrogen-3	1,200
PROJECT LONG SHOT (Alaska)		
Well WL-2	Hydrogen-3	310
Well GZ, No. 1	Hydrogen-3	3,800
Well GZ, No. 2	Hydrogen-3	210
Mud Pit No. 1	Hydrogen-3	690
Mud Pit No. 2	Hydrogen-3	850
Mud Pit No. 3	Hydrogen-3	1,000

*Water not available for domestic use.

Milk Surveillance Network (MSN)

Network Design--

An important pathway for transport of radionuclides to humans is the air-forage-cow-milk chain. This pathway is monitored by EMSL-LV through analysis of milk. The design of the network is based on collections from areas likely to be affected by accidental releases from the NTS as well as from areas unlikely to be so affected. Additional considerations are: 1) a complete ring of stations to cover any eventuality, 2) samples from major milksheds as well as from family cows, and 3) availability of milk cows.

Methods--

The network consists of two major portions, the MSN at locations within 300 km of the NTS from which samples are collected quarterly (Figure 10) and the standby network (SMSN) at locations in all major milksheds west of the Mississippi River from which samples are collected annually. One exception to the latter portion of the network is Texas; the State Health Department performs the surveillance of the milksheds in that State.

The quarterly raw milk samples are collected by EPA monitors in 4-liter plastic containers (cubitainers) and preserved with formaldehyde. The annual milk samples are also collected in cubitainers and preserved with formaldehyde but they are collected by contacting State Food and Drug Administration Representatives, after notification of the Regional EPA offices by telephone, and mailed to EMSL-LV for analysis.

All the milk samples are analyzed first for gamma-emitting nuclides by high-resolution gamma spectrometry and then for strontium-89 and strontium-90 by the methods outlined in Appendix B, after a portion is removed for tritium analysis. Occasionally a milk sample will turn sour thus preventing the strontium analysis, but the other analyses can generally be performed.

Results--

The analytical results from the 1982 milk samples are summarized in Appendix Table E-10 and Table E-11 where the maximum, minimum, and average concentrations of tritium, strontium-89 and strontium-90 are shown for each sampling location. As shown in Table 4, the average concentrations of tritium and strontium-90 for the whole network are similar to the network averages for previous years. However, from the results of intercomparison samples used for quality assurance, the strontium results for 1982 are considered to be low by about 15 to 30 percent.

Other than naturally occurring potassium-40, radionuclides were not detected by gamma spectrometry in any of the samples from the MSN. One SMSN sample, from Flensburg, Minn., contained 16 ± 8 pCi/L of cesium-137. This radionuclide is attributed to past atmospheric fallout and has a concentration that is comparable to what has been observed previously.

The tritium and strontium-90 concentrations for the whole milk network were plotted versus probits. The tendency of the data to fit one straight line indicates that the data represent a single source, which appears to

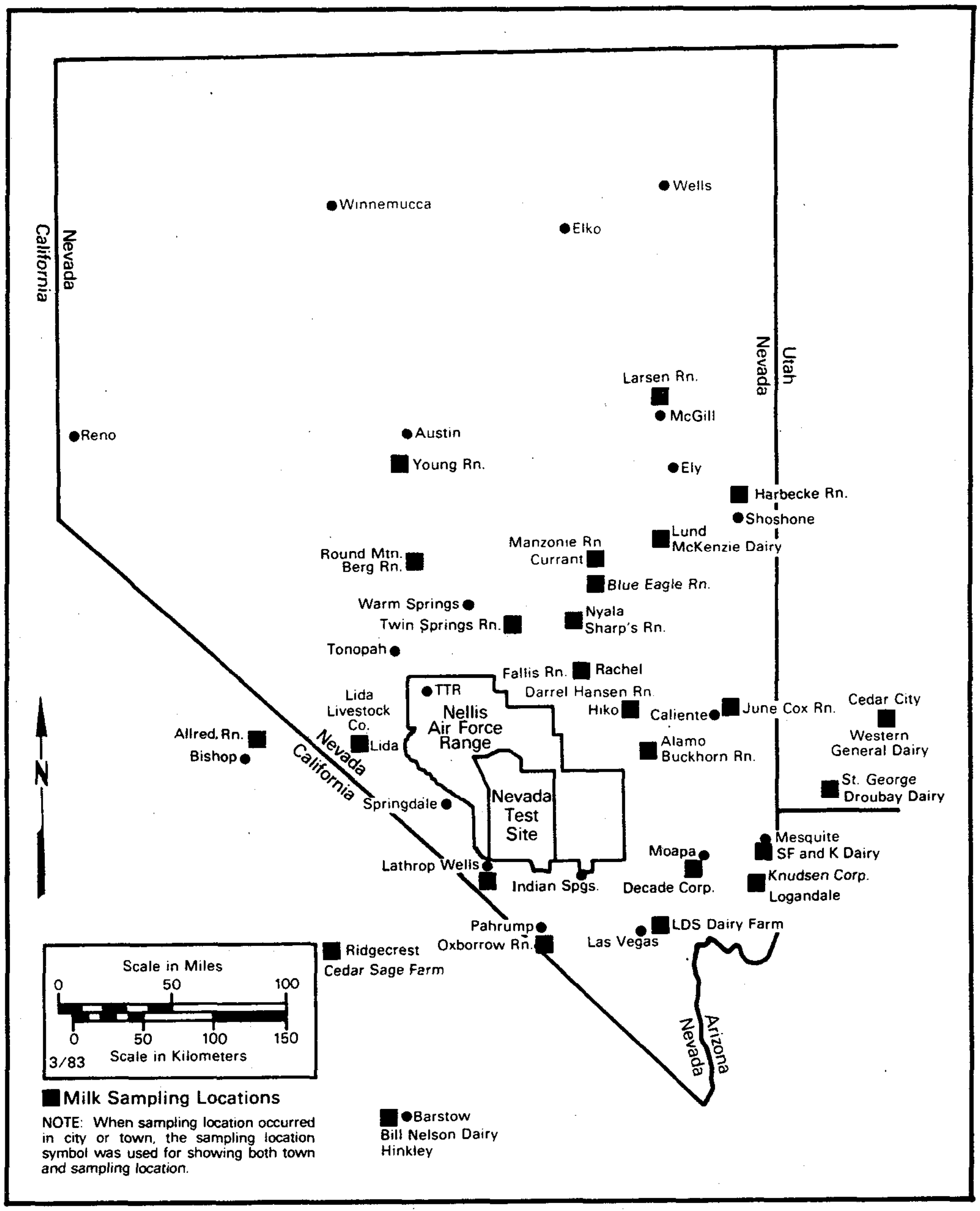

Figure 10. Milk sampling locations within 300 km of the NTS.

TABLE 4. NETWORK ANNUAL AVERAGE CONCENTRATIONS OF TRITIUM AND STRONTIUM-90 IN MILK, 1975 - 1982

	Average Concentrations - pCi/L	
Year	H-3	Sr-90
1975	<400	<3
1976	<400	<2
1977	<400	<2
1978	<400	1.2
1979	<400	<3
1980	<400	<2
1981	<400	1.9
1982	<400	1.2

be atmospheric deposition. These results are consistent with the results obtained for the Pasteurized Milk Network shown in Figure 11. This network is operated by the Eastern Environmental Radiation Laboratory in Montgomery, Alabama.

Biomonitoring Program

Objective--

This program began about 1957 and most recently was known as the Animal Investigation Program (AIP). The program had two major objectives: to measure the tissue concentration of radionuclides in beef cattle maintained life-long in an area used for above-ground nuclear tests and to measure radionuclides in the tissues of game animals (deer, bighorn sheep) which might become a source of exposure to humans. The NTS beef herd was transferred to the University of Nevada, Reno, in 1981. Since then, cattle have been purchased from a commercial herd maintained in the Tikaboo Valley northeast of the NTS.

Methods--

The beef herd of about 70 cattle had been maintained in Area 18, NTS, since the early 1960's. Each spring and fall the herd was collected and 3 to 6 animals sacrificed, including both yearling and aged animals. The samples collected from each animal included: liver, lung, tracheobronchial lymph node, muscle, thyroid, kidney, (fetus, if present) and rumen contents for gamma spectrometric analysis; blood (or tissue water) for tritium analysis; and femur or hock bone for strontium and plutonium analyses. The same analyses are performed on the commercial cattle samples. Other animals found dead on the NTS, such as deer or sheep, were necropsied, examined for suspicious lesions, and samples taken for histopathological examination in addition to the samples taken for radionuclide analyses.

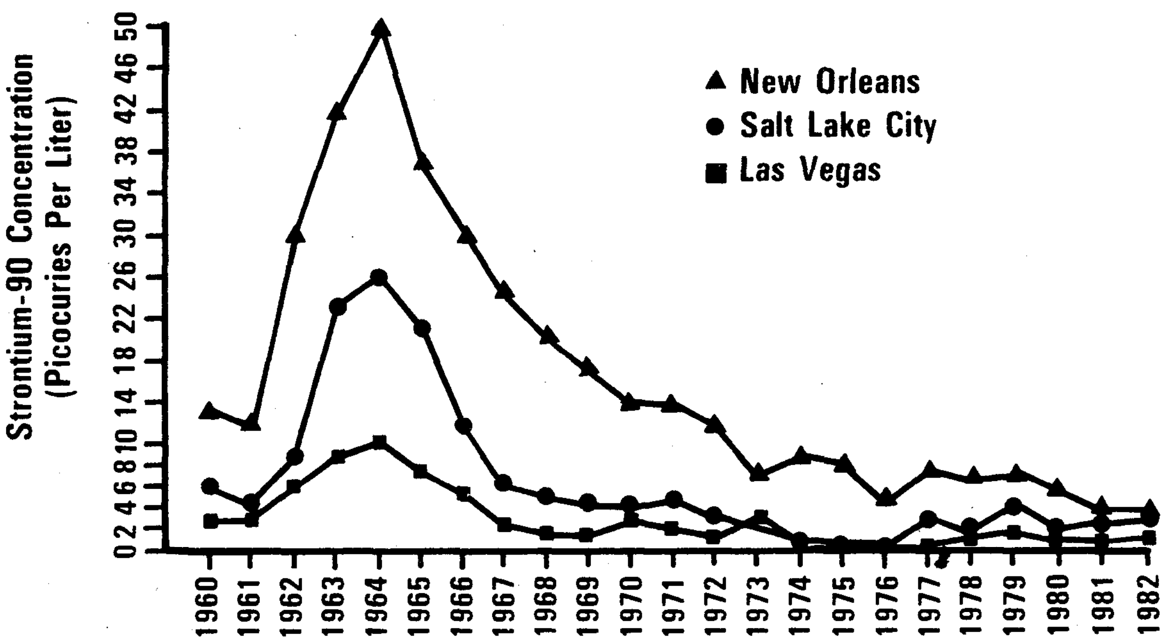

Figure 11. Strontium-90 concentration in Pasteurized Milk Network samples.

A sizeable mule deer herd resides in the mountainous regions of the NTS during the summer. If they move to unrestricted lands, these deer may be hunted by members of the public. A study designed to determine migration patterns of the herd by tracking individual deer wearing collars containing miniature radio transmitters was begun in 1975 and continued through 1982. Limited tagging was done during 1982 and only five deer were captured. Three of these animals were given visual markers and two were fitted with radios recovered from deer that died. These two newly installed transmitters brought to ten the total number of working transmitters in the field. Laboratory personnel monitored the movements of the deer weekly with hand-held receivers and directional antennae. The animals were tracked until the end of December 1982 to complete the field portion of the Deer Migration Study.

A program of sampling garden vegetables was started and vegetables from Alamo, Rachel, Adaven, and Las Vegas were analyzed for gamma, tritium, strontium, and plutonium. Kilogram samples of a leafy, root, and fruiting vegetable were collected at each location.

Results--

Available tissue sample analytical results are listed in Table 5.

TABLE 5. RADIONUCLIDES IN ANIMAL TISSUE SAMPLES - 1982

Animal Number	Muscles	Lungs	Liver	Kidneys	Blood	Rumen Content	Bone
	K (g/kg*) Cs-137 (pCi/kg*) Pu-239 (pCi/kg*)	K (g/kg*) Pu-239 (pCi/kg*)	K (g/kg*) Pu-239 (pCi/kg*)	K (g/kg*) H-3 (pCi/l†)	H-3 (pCi/l)	K (g/kg*) Be-7 (pCi/kg*) Pu-239 (pCi/kg*)	Sr-90 (pCi/g ash) Pu-239 (pCi/g ash)
				Medlin Ranch, July 1982			
BOV-1	3.6 ± 0.3 <26 NA	2.9 ± 0.4 NA	3.8 ± 0.3 0.3 ± 0.2	2.0 ± 0.3 NA	<460	NS	0.7 ± 0.2 0.0011 ± 0.26♦
BOV-2	5.2 ± 0.3 14.0 ± 9.2 NA	3.1 ± 0.5 NA	3.9 ± 0.3 0.04 ± 0.07♦	2.0 ± 0.3 NA	440 ± 290	NS	0.8 ± 0.2 0.0007 ± 0.0027♦
BOV-3	6.2 ± 0.4 15.0 ± 8.9 NA	2.6 ± 0.5 NA	3.6 ± 0.3 0.06 ± 0.12♦	4.4 ± 0.3 NA	620 ± 290	NS	1.3 ± 0.2 0.0000 ± 0.0033♦
BOV-4	5.1 ± 0.4 <26 NA	2.5 ± 0.6 NA	3.7 ± 0.3 0.09 ± 0.16♦	3.0 ± 0.3 NA	480 ± 290	NS	0.7 ± 0.1 0.0007 ± 0.0025♦
				Nevada Test Site, October 1982			
BOV-5	3.5 ± 0.3 <30 0.064 ± 0.066♦	3.4 ± 0.3 0.41 ± 0.16	4.4 ± 0.4 0.5 ± 1.1♦	3.9 ± 0.4 <430	NS	2.7 ± 0.3 1400 ± 220 2.3 ± 0.7	2.2 ± 0.3 NA
BOV-6	3.5 ± 0.4 <26 0.035 ± 0.038♦	1.2 ± 0.5 0.10 ± 0.017	3.8 ± 0.3 0.40 ± 0.08♦	2.3 ± 0.3 <430	NS	2.9 ± 0.3 1300 ± 240 3.1 ± 1.1	1.8 ± 0.3 NA
DEER-1	5.6 ± 0.3 <27 0.018 ± 0.048♦	2.2 ± 0.6 0.093 ± 0.11♦	5.3 ± 0.3 0.073 ± 0.1♦	4.0 ± 0.5 <430	NS	3.3 ± 0.3 370 ± 185 1.1 ± 0.22	1.4 ± 0.2 1.0 ± 2.0♦
DEER-2	3.4 ± 0.3 <28 0.031 ± 0.1♦	3.0 ± 0.7 5.0 ± 1.8	4.2 ± 0.3 0.93 ± 2.9♦	3.5 ± 0.5 <430	NS	2.6 ± 0.1 720 ± 140 3.2 ± 0.68	1.3 ± 0.2 0.0 ± 1.1♦

* Wet weight
† Aqueous portion of kidney tissue
♦ Counting error exceeds reported activity
NS Not sampled
NA Not analyzed or analysis not complete

Other than the naturally occurring potassium-40 and beryllium-7, gamma-emitting radionuclides were infrequently reported. Very low concentrations of cesium-137 (14 and 15 pCi/kg) were found in two muscle samples from the Tikaboo Valley cattle. Tritium levels were either below detectable limits or in the range (400-600 pCi/L of blood) comparable with air concentrations reported by the Noble Gas and Tritium Surveillance Network. The strontium-90 results are consistent with previous data as shown in Figure 12.

Other than potassium-40, gamma-emitting radionuclides were not detected in any of the vegetables collected from the four Nevada locations. Tritium concentrations were also below detectable limits. Strontium and plutonium analyses are shown in Table 6.

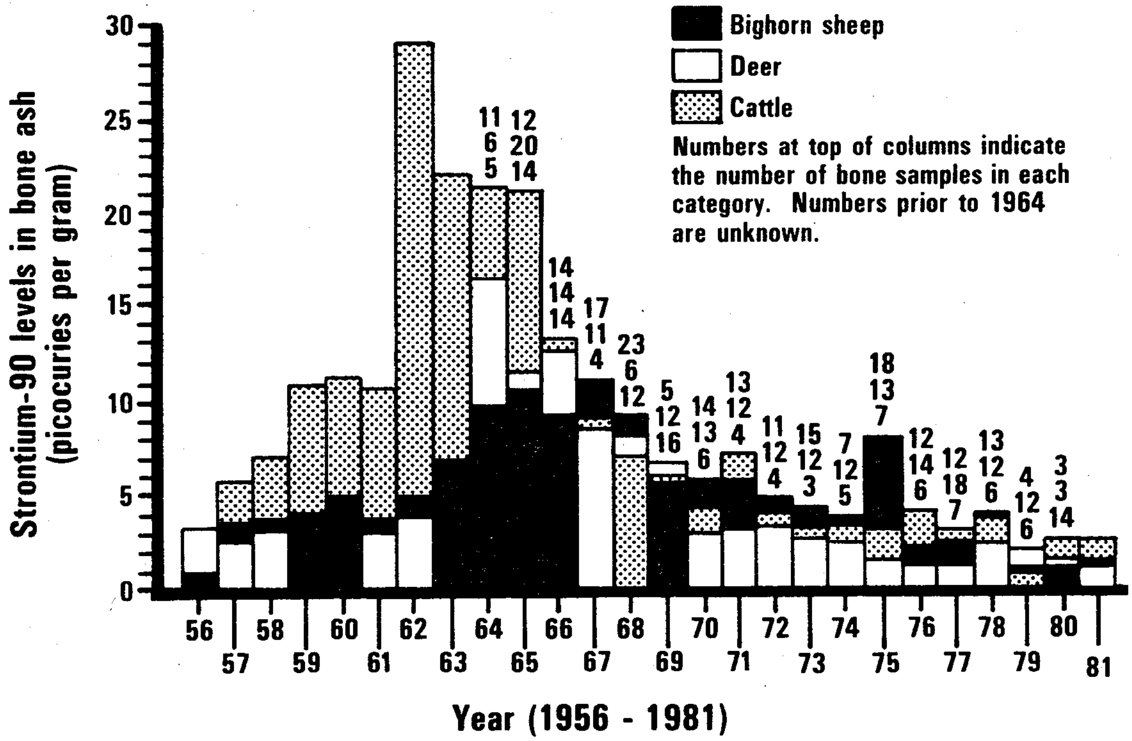

Figure 12. Strontium-90 concentration trends in animal bone.

The majority of marked deer (tagged or radio-equipped) from the Echo Peak herd moved to the Timber Mountain and 40-Mile Canyon areas by February. They remained in this general area the remainder of the winter and spring. By mid-July, they returned to the Pahute Mesa area and were mainly concentrated around the water sources.

The Rainier Mesa herd moved south to Shoshone Mountain and 40-Mile Canyon areas with the exception of about three marked animals that stayed around the northern and eastern sides of Rainier Mesa at or just below the snow line. As warmer weather approached, they moved to the higher elevations where they remained until tracking operations ceased in December 1982.

EXTERNAL EXPOSURE MONITORING

Thermoluminescent Dosimetry Network

External radiation exposure of people is due primarily to medical sources and to natural sources such as cosmic radiation and naturally occurring radioactivity in soil. Radioactivity from fallout generated by past atmospheric nuclear testing causes approximately 0.6 percent of a person's total exposure. Until 1965, film badges were used to document external exposure, but TLD's gradually replaced film as the measurement instrument because of their greater

TABLE 6. RADIONUCLIDES IN SELECTED VEGETABLE CROPS - 1982

Vegetation Date	Sr-89 (pCi/g ash) (pCi/kg*)	Sr-90 (pCi/g ash) (pCi/kg*)	Pu-238 (pCi/g ash) (pCi/kg*)	Pu-239 (pCi/g ash) (pCi/kg*)
		Las Vegas		
Lettuce	0.65 ± 8.9**	0.15 ± 0.06	0.0009 ± 0.0029**	0.032 ± 0.0087
06-17-82	6.3 ± 87**	1.4 ± 0.58	0.008 ± 0.028**	0.32 ± 0.084
Zucchini	-3.1 ± 15.0**	0.13 ± 0.26**	-0.00044 ± 0.0016**	0.0044 ± 0.0058**
07-01-82	-18 ± 84**	0.11 ± 1.5**	-0.0019 ± 0.0089**	0.025 ± 0.033**
Turnips	-1.2 ± 7.7**	0.14 ± 0.24**	-0.0004 ± 0.0019**	0.022 ± 0.0066
08-04-82	-14 ± 87**	1.6 ± 2.6**	-0.0045 ± 0.021**	0.25 ± 0.07
		Hiko		
Lamb's Quarter	-4.3 ± 6.9**	0.33 ± 0.087	0.0006 ± 0.0027**	0.055 ± 0.015
08-04-82	-160 ± 250**	12 ± 3.2	0.022 ± 0.1**	2.0 ± 0.53
Zucchini	-3.7 ± 28**	0.31 ± 0.77**	0.0048 ± 0.0064**	0.0037 ± 0.0055**
08-04-82	-24 ± 180**	2.1 ± 5.0**	0.032 ± 0.042**	0.024 ± 0.037**
Beets	-70 ± 110**	3 ± 3.3**	0.0047 ± 0.0065**	0.0064 ± 0.0078**
08-04-82	-1200 ± 1800**	48 ± 52**	0.075 ± 0.1**	0.11 ± 0.12**
		Rachel		
Turnip Greens	0.41 ± 3.4**	5.9 ± 1.3	0.0065 ± 0.011**	0.011 ± 0.016**
10-24-82	7.0 ± 57**	10 ± 2.2	0.11 ± 0.21**	0.19 ± 0.28**
Zucchini	1.5 ± 9.0**	0.37 ± 0.11	-0.00032 ± 0.0015**	0.0016 ± 0.0034**
08-04-82	11 ± 65**	2.7 ± 0.76	-0.0023 ± 0.011**	0.011 ± 0.024**
Turnips	-2.0 ± 0.59**	0.5 ± 0.51**	0.06 ± 0.002**	0.0014 ± 0.0037**
10-24-82	-15 ± 45**	3.8 ± 3.9**	0.0 ± 0.16**	0.011 ± 0.028**
		Adaven		
Zucchini	-13 ± 58**	0.95 ± 2.4**	0.0037 ± 0.0062**	0.00093 ± 0.0031**
09-01-82	-64 ± 280**	4.6 ± 11**	0.018 ± 0.03**	0.0045 ± 0.015**

* Wet weight
** Counting error exceeds reported activity

sensitivity and precision. From 1970 to 1974 the EMSL-LV used the TLD-12 dosimeter but changed to the TLD-200 in 1975.

Network Design--

The TLD network is designed to measure environmental radiation exposure at a location rather than to an individual because of the many uncertainties associated with personal monitoring. Several individuals, some residing within and some residing without estimated fallout zones from past nuclear tests at the NTS, have been monitored so that any correlations that may exist between personal and environmental monitoring could be obtained. The network consists of 82 monitored locations encircling the NTS with some concentration in the area of the estimated fallout zones (Figure 13). This arrangement permits an estimate of average background exposure; yet any increase due to NTS activities can be detected.

Methods--

In 1982 the TLD Network consisted of 82 stations at both inhabited and uninhabited locations within a 300-km radius of the CP-1. Each station is equipped with three Harshaw thermoluminescent dosimeters (TLD's) to measure gamma exposures resulting from environmental background as well as accidental releases of gamma-emitting radioactivity. Within the area covered by the Network, 48 offsite residents wore dosimeters during 1982. All TLD's were exchanged quarterly.

The Harshaw Model 2271-G2 (TLD-200) dosimeter consists of two small "chips" of dysprosium-activated calcium fluoride mounted in a window of Teflon plastic attached to a small aluminum card. An energy compensation shield of 1.2-mm thick cadmium metal is placed over the card containing the chips, and the shielded card is then sealed in an opaque plastic card holder. Three of these dosimeters are placed in a secured, rugged, plastic housing 1 meter above ground level at each station to standardize the exposure geometry. One dosimeter is issued to each of 48 offsite residents who are instructed in its proper wearing.

After appropriate corrections were made for exposure accumulated during shipment between the laboratory and the monitoring location, and for the response factor, the six TLD chip readings for each station were averaged. The average value for each station was then compared to the values obtained during the previous four quarters at that station to determine whether the new value was within the range of previous background values for that station. The result from each of the personnel dosimeters was compared to the average background value measured at the nearest fixed station over the previous four quarters.

The smallest exposure above background radiation that can be determined from these TLD readings depends primarily on the magnitude of variations in the natural background exposure rate at the particular station. In the absence of other independent exposure rate measurements, the present exposure rate is compared with valid prior measurements of natural background. Typically, the smallest net exposure detectable at the 99 percent confidence level for a 90-day exposure period would be 1 to 5 mR above background.

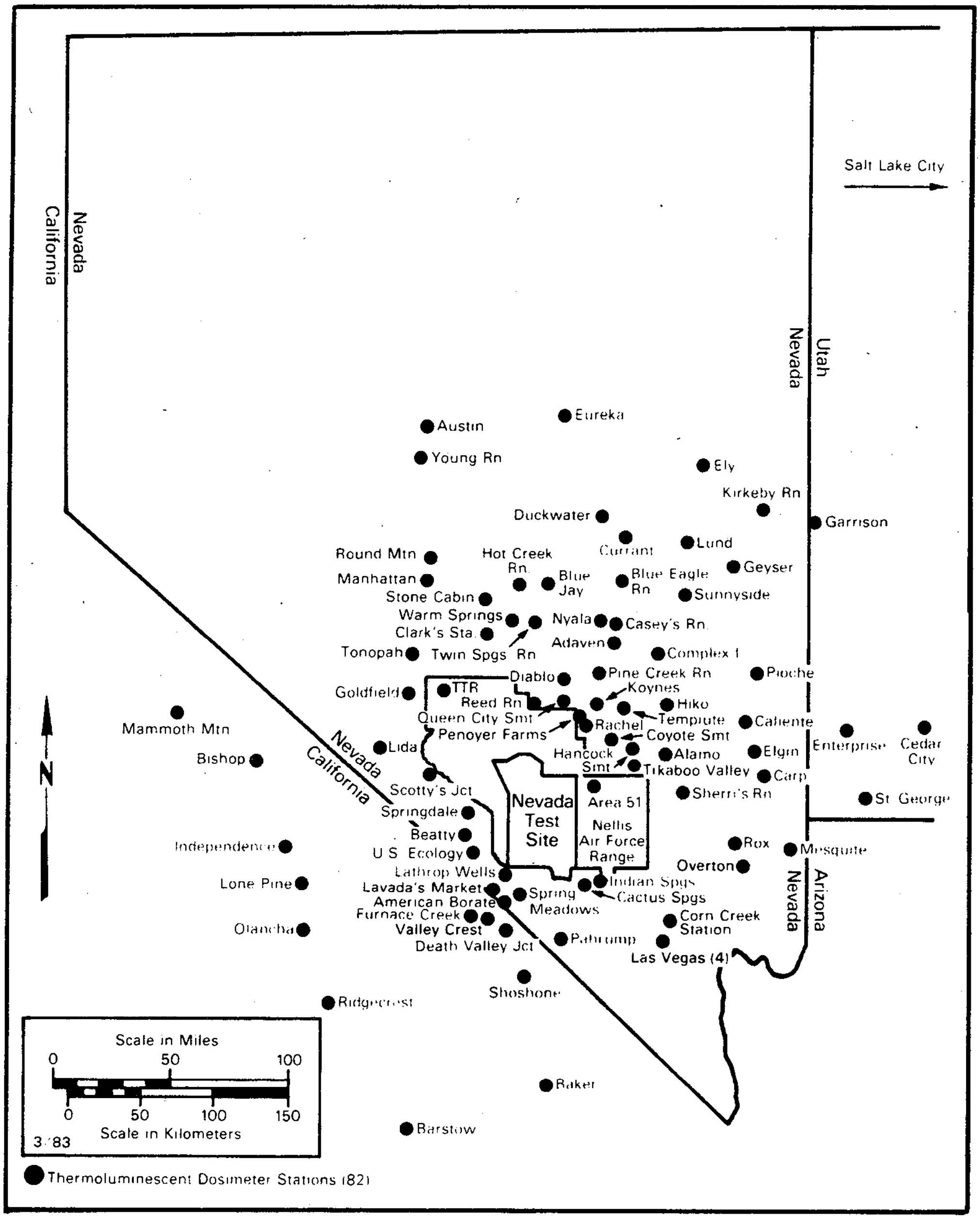

Figure 13. Locations monitored with TLD's.

Depending on location, the background ranges from 15 to 35 mR per quarter. The term "background," as used in this context, refers to naturally occurring radioactivity plus a contribution from residual manmade fission products, such as worldwide fallout.

Results--

Appendix Table E-12 lists the maximum, minimum, and average dose equivalent rate (mrem/day) and the annual adjusted dose equivalent rate (average in mrem/day times the number of days in the year) measured at each station in the Network during 1982. No allowance was made for the small additional exposure due to the neutron component of the cosmic ray spectrum. Four stations exhibited exposure in excess of background. They were the Austin, Mammoth Mountain, and Salt Lake City stations during the 3rd Quarter, 1982 and the Furnace Creek station during the 4th Quarter, 1982. Each exposure was investigated and the possible cause of exposure noted in the Quarterly Interim Report. None of the net exposures were attributed to NTS activities.

Appendix Table E-13 lists the personnel number; associated background station; the maximum, minimum, and average dose equivalent rate (mrem/d); and the annual dose equivalent (mrem) measured for each offsite resident monitored during 1982. Seven dosimeters worn by residents exhibited exposures in excess of background. These exposures are attributed to higher background levels in the residence than at the station location or to occupational exposure (resident No. 49). Usually, the average dose equivalent rates of the offsite residents is lower than their background stations due to the shielding provided by their homes or places of work.

Table 7 shows that the average annual dose rate for the Dosimetry Network is consistent with the Network average established in 1975. Annual doses decreased from 1971 to 1975 with a leveling trend since 1975, except for a high bias in the 1977 results attributed to mechanical readout problems. The trend shown by the Network average is indicative of the trend exhibited by individual stations.

Because of the great range in the results, 42 to 139 mrem, an average for the whole area monitored may be inappropriate for estimating individual exposure. This would be particularly true if the exposure of a particular resident were desired. Since environmental radiation exposure can vary markedly with both altitude and the natural radioactivity in the soil, and since the altitude of the TLD station location is relatively easy to obtain, the measured dose rates were plotted as a function of altitude. As most of Nevada lies between 2,000 and 6,000 feet above mean sea level, this range was used and was split into two sections for plotting purposes. The results, shown in Figure 14, indicate that the average exposure at altitudes between 4,000 and 6,000 feet is about 20 mrem/a higher than that at altitudes between 2,000 and 4,000 feet, although both curves follow the same trend as the overall averages listed in Table 7. Thus, if an individual does not live near a monitored location, an estimate of exposure could be based on the altitude of his residence rather than on the average for the whole area monitored.

TABLE 7. DOSIMETRY NETWORK SUMMARY FOR THE YEARS 1971 - 1981

Environmental Radiation Dose Rate (mrem/y)			
Year	Maximum	Minimum	Average
1971	250	102	160
1972	200	84	144
1973	180	80	123
1974	160	62	114
1975	140	51	94
1976	140	51	94
1977	170	60	101
1978	150	50	95
1979	140	49	92
1980	140	51	90
1981	142	40	90
1982	139	42	88

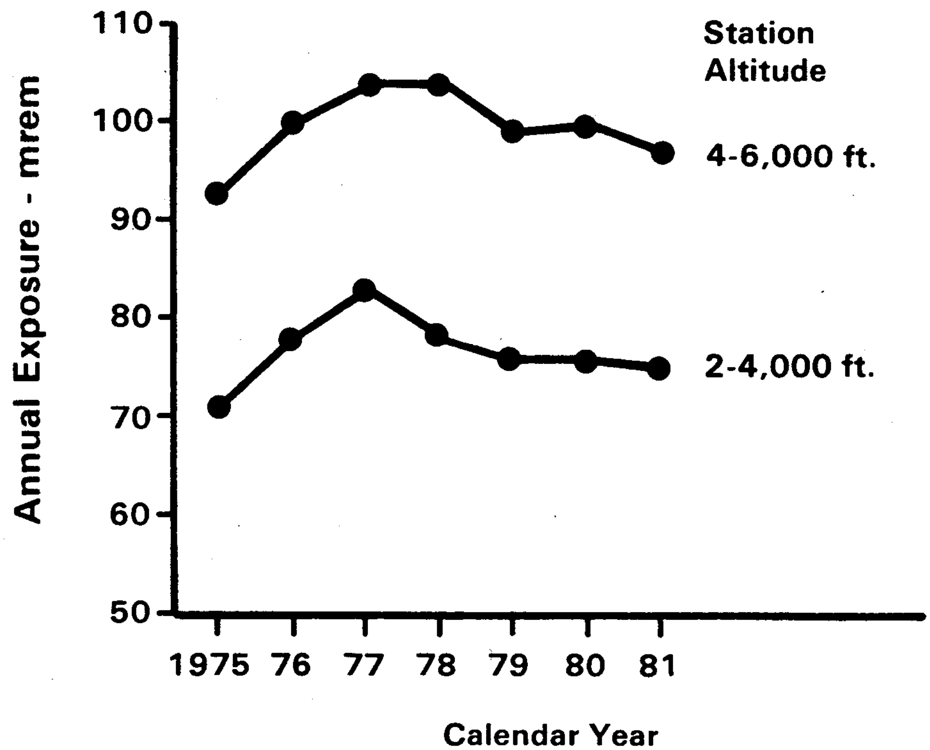

Figure 14. Average annual TLD exposure as a function of station altitude.

Pressurized Ion Chamber Network (PIC)

This network is located at the 15 Community Monitoring Stations identified on Figure 2 plus two others at Twin Springs Ranch and Lathrop Wells. The PIC used is manufactured by Reuter-Stokes and the output is recorded on both paper tape, so the station manager can observe the response, and on cassette tape. The cassette tapes are read into a computer at EMSL-LV each week. The computer output is a table containing hourly, daily, and weekly summaries of the maximum, minimum, average, and standard deviation of the ion chamber response.

The data for the last 6 months of 1982 are displayed in Table 8 as the average and standard deviation of the μR/hr from each station. When these data are compared to the TLD results for the same 17 stations, it is found that the PIC response is about 27% higher than the TLD response. This is attributed, primarily, to the difference in energy response (plateau) of the two instruments.

TABLE 8. PRESSURIZED ION CHAMBER READINGS - μR/HOUR

Location	Range of Dates	Annual Mean	Standard Deviation
Alamo, NV	07/21/82 - 12/28/82	14.1	0.5
Austin, NV	07/20/82 - 12/27/82	18.7	0.9
Beatty, NV	07/19/82 - 12/27/82	16.2	0.4
Cedar City, UT	07/21/82 - 12/28/82	10.1	0.5
Ely, NV	07/20/82 - 12/27/82	11.8	0.4
Fallini's	07/09/82 - 12/21/82	16.1	2.6
Goldfield, NV	07/19/82 - 12/27/82	14.3	0.8
Indian Springs, NV	07/19/82 - 12/27/82	7.9	0.3
Las Vegas (UNLV), NV	07/20/82 - 12/28/82	7.0	0.3
Lathrop Wells, NV	10/04/82 - 12/27/82	13.5	0.7
Overton, NV	07/20/82 - 12/28/82	8.2	0.4
Pahrump, NV	07/19/82 - 12/13/82	7.6	0.4
Rachel, NV	07/21/82 - 12/27/82	16.2	0.5
Salt Lake City, UT	07/27/82 - 12/27/82	11.0	0.6
Shoshone, CA	07/19/82 - 12/27/82	11.3	0.3
St. George, UT	02/08/82 - 12/28/82	8.6	0.6
Tonopah, NV	07/19/82 - 12/27/82	17.1	0.5

INTERNAL EXPOSURE MONITORING

Internal exposure is caused by ingested or inhaled radionuclides that remain in the body either temporarily or for longer times because of storage in tissues. At EMSL-LV two methods are used to detect such body-burdens: whole-body counting and urinalysis.

The whole-body counting facility has been maintained at EMSL-LV since 1966 and is equipped to determine the identity and quantity of gamma-emitting radioactive materials which may have been inhaled or ingested into the body. A single thallium-activated sodium iodide crystal, 28 x 10 centimeters, is used to measure gamma radiation having energies ranging from 0.1 to 2.5 MeV. Two phoswich detectors are available and can be placed on the chest to measure low-energy radiation - for example, 17 KeV X rays from plutonium-239. The most likely mode of intake for most alpha-emitting radionuclides is inhalation, and the most important of these also emit low-energy X rays which can be detected in the lungs by the phoswich detectors.

Network Design

This activity consists of two portions, an Offsite Human Surveillance Program and a Radiological Safety Program. The design for the Offsite Human Surveillance Program is to measure radionuclide body-burdens in a representative number of families who reside in areas that were subjected to fallout during the early years of nuclear weapons tests. A few families who reside in areas not affected by such fallout were also selected for comparative study. The principal constraint to the program is the cooperation received from the people in the area of study.

The Radiological Safety Program portion requires all employees who may be exposed to radioactive materials in the course of their work to undergo a periodic whole-body count.

Methods

The Offsite Human Surveillance Program was initiated in December 1970 to determine levels of radioactive nuclides in some of the families residing in communities and ranches surrounding the Nevada Test Site. Biannual counting is performed in the spring and fall. This program started with 34 families (142 individuals). In 1982, 16 of these families, 42 individuals, were still active in the program. The geographical locations of the families which have participated are shown in Figure 15.

These persons travel to the Environmental Monitoring Systems Laboratory where a whole-body count of each person is made to determine the body burden of gamma-emitting radionuclides. A urine sample is collected for analysis and a short medical history, complete blood count, thyroid profile and physical examinations are obtained on each participant. Results of the whole-body count are available before the families leave the facility and are discussed with the subjects. The results of the blood and urine tests are sent to the families, along with a letter of explanation from the examining physician.

In 1981, 15 new families were added to the surveillance program. These people are in charge of the community monitoring stations described on page 35. As with the first group of families, each person receives a whole-body count, medical history, complete blood count, thyroid profile, etc.

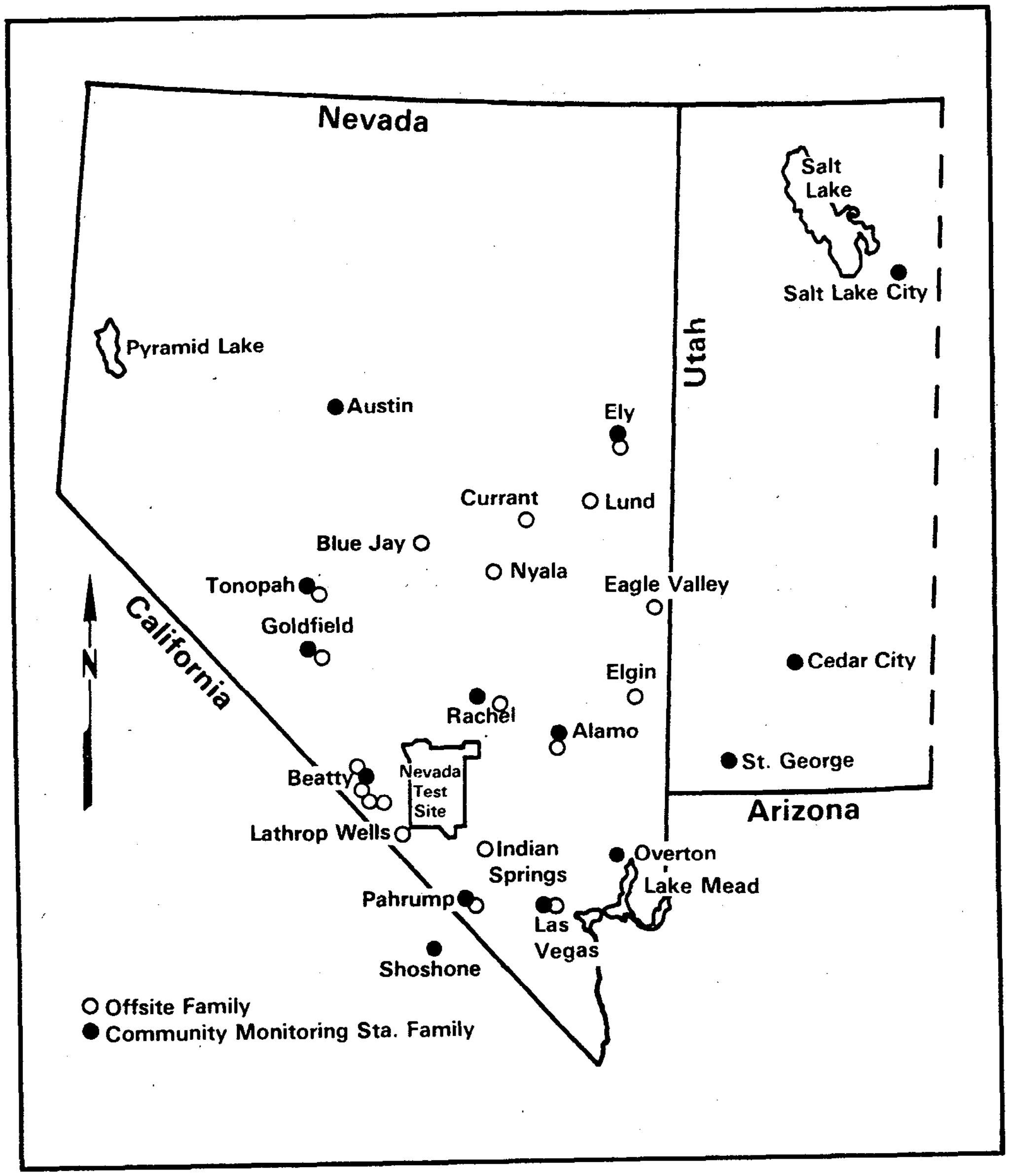

Figure 15. Location of families participating in the Offsite Human Surveillance Program.

In addition to these offsite families, counts are performed routinely on EPA and EG&G employees as part of the health monitoring programs. Selected individuals from the general population of Las Vegas and other cities are also counted to obtain comparative data.

Results

During 1982, a total of 441 whole-body and 596 phoswich spectra were obtained from individuals, of which 140 were from persons participating in the Offsite Human Surveillance Program. Also, about 1,400 spectra for calibrations and background were generated. Cesium-137 is generally the only fission product detected though none was found in the persons counted this year. Body burdens of Cs-137 in the offsite population detected in previous years were similar to those in other U.S. residents from California to New York. All spectra collected in 1982 were representative of normal background for people and showed only natural potassium-40. No plutonium was detected in any of the phoswich spectra.

The concentration of tritium in urine samples from the offsite residents varied from 0 to 2,250 pCi/L with an average value of 418 pCi/L. Nearly all the concentrations measured were in the range of background levels measured in water and reflect only natural exposure. The source for the high values (Salt Lake City residents) is unknown but is not attributed to NTS activities.

As reported in previous years, medical examination of the offsite families revealed a generally healthy population. In regard to the hematological examinations and thyroid profiles, no abnormal results were observed which could be attributed to past or present NTS testing operations. A report on data for these families, "Results of a Surveillance Program for Persons Living Around the Nevada Test Site - 1971 to 1980," was published in Health Physics (Patzer and Kaye 1982).

A summary report of significant findings from the beginning of whole-body counting at the Laboratory in 1963 has been prepared and is being reviewed.

COMMUNITY MONITORING STATIONS

To increase public knowledge about and participation in radiological surveillance activities as conducted by DOE and EPA; the DOE, through an Interagency Agreement with EPA and contracts with the Desert Research Institute (DRI) of the University of Nevada, and the University of Utah, has established a network of 15 Community Monitoring Stations in the off-NTS areas. Each station is operated by a local resident, preferably a science teacher, who is trained in radiological surveillance methods by the University of Utah. The stations are equipped and maintained, and samples are collected and analyzed by EMSL-LV. DRI provides data interpretation to the communities involved and pays the station operators for their services.

Each station contains one of the samplers for the ASN, NGTSN and Dosimetry networks discussed earlier, plus a pressurized ion chamber (PIC) and recorder for immediate readout of external gamma exposure, and a recording barograph. All of the equipment is mounted on a stand at a convenient location in each community so the residents are aware of the surveillance and, if interested, can have ready access to the data. The station locations are those indicated in Figure 2.

The data from these stations are included in the tables in Appendix E with the other data from the appropriate networks. Table 8 contains the PIC data.

CLAIMS INVESTIGATIONS

One of the public service functions of the EMSL-LV is to investigate claims of injury allegedly due to radiation originating from NTS activities. A physician and a veterinarian, qualified by education or experience in the field of radiobiology, investigate claims of radiation injury to determine whether or not radiation exposure may be involved.

Investigation of claims from people involves determining the type of illness, from examining physicians records and diagnoses, and determining the possibility of radiation exposure through residence history and examination of historical radiation surveillance data. These investigations can be conducted by the Medical Liaison Officers Network (MLON) or by the EMSL-LV physician, depending on where the claim is made. The MLON is composed of physicians, one from each state, who are trained in radiobiology.

An MLON Conference will be held at the Environmental Monitoring Systems Laboratory, Las Vegas, Nevada, during the fall of 1983. The purpose of the meeting will be to update current information on the biological effects of radiation, its diagnosis and treatment. During 1982 the MLON made 7 investigations of persons with alleged radiation claims, responded to seven inquires and completed seven evaluations.

The EMSL-LV veterinarian conducts similar investigations for claims of injury to domestic animals. In most cases the injuries investigated have been due to common causes such as bacterial infections or unusual events such as feeding on halogeton, a poisonous plant. In 1981 one potential claim was investigated; sudden death of two goat kids near Rachel, Nevada. By physical examination, histopathology and radionuclide analysis of samples, and from symptoms described by the owner, a diagnosis of enterotoxemia was made. Radiation exposure apparently played no role in this incident. No such claims were made in 1982.

PUBLIC INFORMATION PROGRAM

An important function of the Offsite Program has been to create and maintain, to the extent possible, public confidence that all reasonable safeguards are being employed to preserve public health and property from possible hazards resulting from nuclear testing. Much of this responsibility is carried out through personal contact with offsite residents by the radiation monitors who advise the residents of program developments and answer questions about test activities.

For any test where ground motion may be perceptible offsite, monitors visit remote locations and active mines beforehand to advise operators of possible problems. They also stand by on test day to advise of schedule changes. Mine operators are reimbursed for time lost due to these activities. After the test, monitors inform all their contacts that the test is over and whether or not any radiation was detected offsite.

To improve communications, the monitor's are being linked to a radio net used by sheepmen north of the NTS so herders and ranchers can be more readily contacted.

Town Hall type meetings were held in 13 communities of the Community Monitoring Station Program. In these evening meetings, the objectives and operation of the stations, their role in the Offsite Radiological Safety and nuclear testing programs, and data availability were explained. An open period for questions and free discussion was included.

Other activities included arranging NTS tours for residents of towns such as Alamo, Nev. and St. George, Utah and for miners, ranchers, etc. from the offsite areas. Talks were given to civic organizations in February and May and to high school students in October. In August, a complete Community Monitoring Station was displayed at the JC State Fair. Hundreds of fact sheets were distributed during these activities.

DOSE ASSESSMENT

Dose assessment calculations for NTS-related radioactivity are not possible because detectable levels of radioactivity from the 1982 nuclear testing program at the NTS were not observed offsite by any of the monitoring networks. However, an exposure can be calculated by using atmospheric dispersion and reported releases of radioactivity from the NTS (Table 1). This is shown below. Residual radioactivity was observed in waters from wells in other nuclear testing areas known to be contaminated during past nuclear tests at the Project Dribble Site near Hattiesburg, Mississippi; Project Gnome near Malaga, New Mexico; and at the Project Long Shot Site on Amchitka Island, Alaska. However, the waters from these contaminated wells are not used for drinking purposes.

An estimate of exposure of an average adult in Nevada due to worldwide radioactivity can be made based on the data from the monitoring networks. The principal data are strontium-90 in milk (1.2 pCi/L) from previous atmospheric tests; krypton-85 in air (24 pCi/m^3) from power reactors and reprocessing plants; and plutonium-239 in air (58 aCi/m^3) from previous atmospheric tests.

Assumptions:
1) Breathing rate = 7,300 m^3/a
2) Water intake = 438 L/a, milk = 1/2 of water or 219 L/a
3) 8,766 hr/a

From DOE/EP-0023 Appendix B (DOE 1981a); first-year Dose Factors are:

1) Kr-85 (immersion) 2,200 mrem/hr per µCi/mL, whole body (µCi/mL = 10^{12} pCi/m^3),

2) Sr-90 (ingestion) 45 mrem/µCi intake, whole body, and

3) Pu-239 (inhalation) 48,000 mrem/µCi to lung.

Calculated annual dose:

Kr-85: $2{,}200 \text{ mrem/hr} \times 8{,}766 \text{ hr/a} \times \dfrac{24 \text{ pCi/m}^3}{10^{12} \text{ pCi/m}^3} = 4.63 \times 10^{-4} \text{ mrem/a}$

Sr-90: $45 \text{ mrem/}\mu\text{Ci} \times 10^{-6}\ \mu\text{Ci/pCi} \times 1.2 \text{ pCi/L} \times 219 \text{ L/a} = 0.0118 \text{ mrem/a}$

Pu-239: $4.8 \times 10^4 \text{ mrem/}\mu\text{Ci} \times 30 \text{ aCi/m}^3 \times 10^{-12}\ \mu\text{Ci/aCi} \times 7{,}300 \text{ m}^3\text{/a} = 0.01 \text{ mrem/a}$

The total annual dose to the average adult in Nevada from worldwide radioactivity detected by EMSL-LV monitoring networks is then 0.022 mrem. Natural radioactivity in the body (K-40, C-14, Ra-226, etc.) causes annual internal doses ranging from 26 to 36 mrem per year (FRC 1960), and the calculated internal dose is only 0.2 percent of this 10 mrem variation.

The external exposures to Nevadans range from 40 to 142 mrem/a as measured by the TLD network. In the U.S., reported external exposures range from 63 to 200 mrem/a, depending on elevation (sea coast or Rocky Mountains) and on the natural radioactivity in the soil (NCRP 1971). The exposures measured by the TLD's compare favorably with that range as the TLD station's altitude varies from 500 to over 7,000 feet above MSL and the uranium content in soil probably also varies markedly among stations.

The highest postulated annual dose estimate to man, from the results of the 1980 Biomonitoring Program, was calculated to be 0.17 mrem. This would result from the Cs-137 content of muscle from the NTS beef herd if an individual ate 0.5 kg per day for the whole year and if the muscle tissue had the maximum measured cesium concentration all year. The highest postulated annual dose from Pu-239 was calculated to be 0.0016 mrem to the skeleton if 1/2 lb of the leafy vegetable, Lamb's Quarter, were eaten each day.

No radioactivity released at the NTS was measured offsite, therefore, the dose to the offsite population from these releases was calculated by using average weather data and atmospheric diffusion equations. Wind direction and speed data were available for a 12-year period as were 25,000 hourly observations of Pasquill stability class. Based on noble gas releases shown in Table 1, the estimated population dose to the 4600 people within 80 km of CP-1 was 9.9×10^{-6} man-rem. The highest estimated dose was 3×10^{-6} mrem/yr to an individual living in Rachel, with lesser amounts to individuals in Armogosa, Beatty, Lathrop Wells and Indian Springs, Nevada.

SECTION 6

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APPENDIX A. SITE DATA

SITE DESCRIPTION

A summary of the uses of the NTS and its immediate environs is included in Section 3 of this report. More detailed data and descriptive maps are contained in this Appendix.

Location

The NTS is located in Nye County, Nevada, with its southeast corner about 90 km northwest of Las Vegas (Figure 1 in main report). It has an area of about 3,500 square km and varies from 40 to 56 km in width (east-west) and from 64 to 88 km in length (north-south). This area consists of large basins or flats about 900 to 1,200 m above mean sea level (MSL) surrounded by mountain ranges rising 1,800 to 2,300 m above MSL.

The NTS is surrounded on three sides by exclusion areas, collectively named the Nellis Air Force Range, which provide a buffer zone between the test areas and public lands. This buffer zone varies from 24 to 104 km between the test area and land that is open to the public. Depending upon wind speed and direction, from 2 to more than 6 hours will elapse before any release of airborne radioactivity could pass over public lands.

Climate

The climate of the NTS and surrounding area is variable, due to its variations in altitude and its rugged terrain. Generally, the climate is referred to as continental arid. Throughout the year, there is insufficient water to support the growth of common food crops without irrigation.

Climate may be classified by the types of vegetation indigenous to an area. According to Houghton et al. (1975), this method of classification of dry condition, developed by Doppen, is further subdivided on the basis of temperature and severity of drought. Table A-1 (Houghton et al. 1975) summarizes the characteristics of climatic types for Nevada.

According to Quiring (1968), the NTS average annual precipitation ranges from about 10 cm at the lower elevations to around 25 cm on the higher elevations. During the winter months, the plateaus may be snow-covered for a period of several days or weeks. Snow is uncommon on the flats. Temperatures vary considerably with elevation, slope, and local air currents. The average daily high (low) temperatures at the lower altitudes are around 50F (25F) in January and 95F (55F) in July, with extremes of 110F and -15F. Corresponding temperatures on the plateaus are 35F (25F) in January and 80F (65F) in July with extremes of 100F and -20F. Temperature extremes as low as -30F and higher than 115F have been observed.

TABLE A-1. CHARACTERISTICS OF CLIMATIC TYPES IN NEVADA (from Houghton et al. 1975)

Climate Type	Mean Temperature °C (°F) Winter	Mean Temperature °C (°F) Summer	Annual Precipitation cm (inches) Total*	Annual Precipitation cm (inches) Snowfall	Dominant Vegetation	Percent of Area
Alpine tundra	-18° to -9° (0° to 15°)	4° to 10° (40° to 50°)	38 to 114 (15 to 45)	Medium to heavy	Alpine meadows	--
Humid continental	-12° to -1° (10° to 30°)	10° to 21° (50° to 70°)	64 to 114 (25 to 45)	Heavy	Pine-fir forest	1
Subhumid continental	-12° to -1° (10° to 30°)	10° to 21° (50° to 70°)	30 to 64 (12 to 25)	Moderate	Pine or scrub woodland	15
Mid-latitude steppe	-7° to 4° (20° to 40°)	18° to 27° (65° to 80°)	15 to 38 (6 to 15)	Light to moderate	Sagebrush, grass, scrub	57
Mid-latitude desert	-7° to 4° (20° to 40°)	18° to 27° (65° to 80°)	8 to 20 (3 to 8)	Light	Greasewood, shadscale	20
Low-latitude desert	-4° to 10° (40° to 50°)	27° to 32° (80° to 90°)	5 to 25 (2 to 10)	Negligible	Creosote bush	7

*Limits of annual precipitation overlap because of variations in temperature which affect the water balance.

The wind direction, as measured on a 30-m tower at an observation station about 9 km NNW of Yucca Lake, is predominantly northerly except during the months of May through August when winds from the south-southwest predominate (Quiring 1968). Because of the prevalent mountain/valley winds in the basins, south to southwest winds predominate during daylight hours of most months. During the winter months southerly winds have only a slight edge over northerly winds for a few hours during the warmest part of the day. These wind patterns may be quite different at other locations on the NTS because of local terrain effects and differences in elevation.

Geology and Hydrology

Two major hydrologic systems shown in Figure A-1 exist on the NTS (ERDA 1977). Ground water in the northwestern part of the NTS or in the Pahute Mesa area has been reported to flow at a rate of 2 m to 180 m per year to the south and southwest toward the Ash Meadows Discharge Area in the Amargosa Desert. It is estimated that the ground water to the east of the NTS moves from north to south at a rate of not less than 2 m nor greater than 220 m per year. Carbon-14 analyses of this eastern ground water indicate that the lower velocity is nearer the true value. At Mercury Valley in the extreme southern part of the NTS, the eastern ground water flow shifts southwestward toward the Ash Meadows Discharge Area.

Land Use of NTS Environs

Figure A-2 is a map of the off-NTS area showing a wide variety of land uses, such as farming, mining, grazing, camping, fishing, and hunting within a 300-km radius of the NTS. For example, west of the NTS, elevations range from 85 m below MSL in Death Valley to 4,420 m above MSL in the Sierra Nevada Range. Parts of two major agricultural valleys (the Owens and San Joaquin) are included. 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 Valley and Moapa Valley, supporting irrigation for small-scale but intensive farming of a variety of crops. Grazing is also common in this area, particularly to the northeast. The area north of the NTS is also mid-latitude steppe, where the major agricultural activity is grazing of cattle and sheep. Minor agriculture, primarily the growing of alfalfa hay, is found in this portion of the State within 300 km of the NTS Control Point-1 (CP-1). Many of the residents grow or have access to locally grown fruits and vegetables.

Many recreational areas, in all directions around the NTS (Figure A-2) are used for such activities as hunting, fishing, and camping. In general, the camping and fishing sites to the northwest, north, and northeast of the NTS are utilized throughout the year except for the winter months. Camping and fishing locations to the southeast, south, and southwest are utilized throughout the year. The hunting season is from September through January.

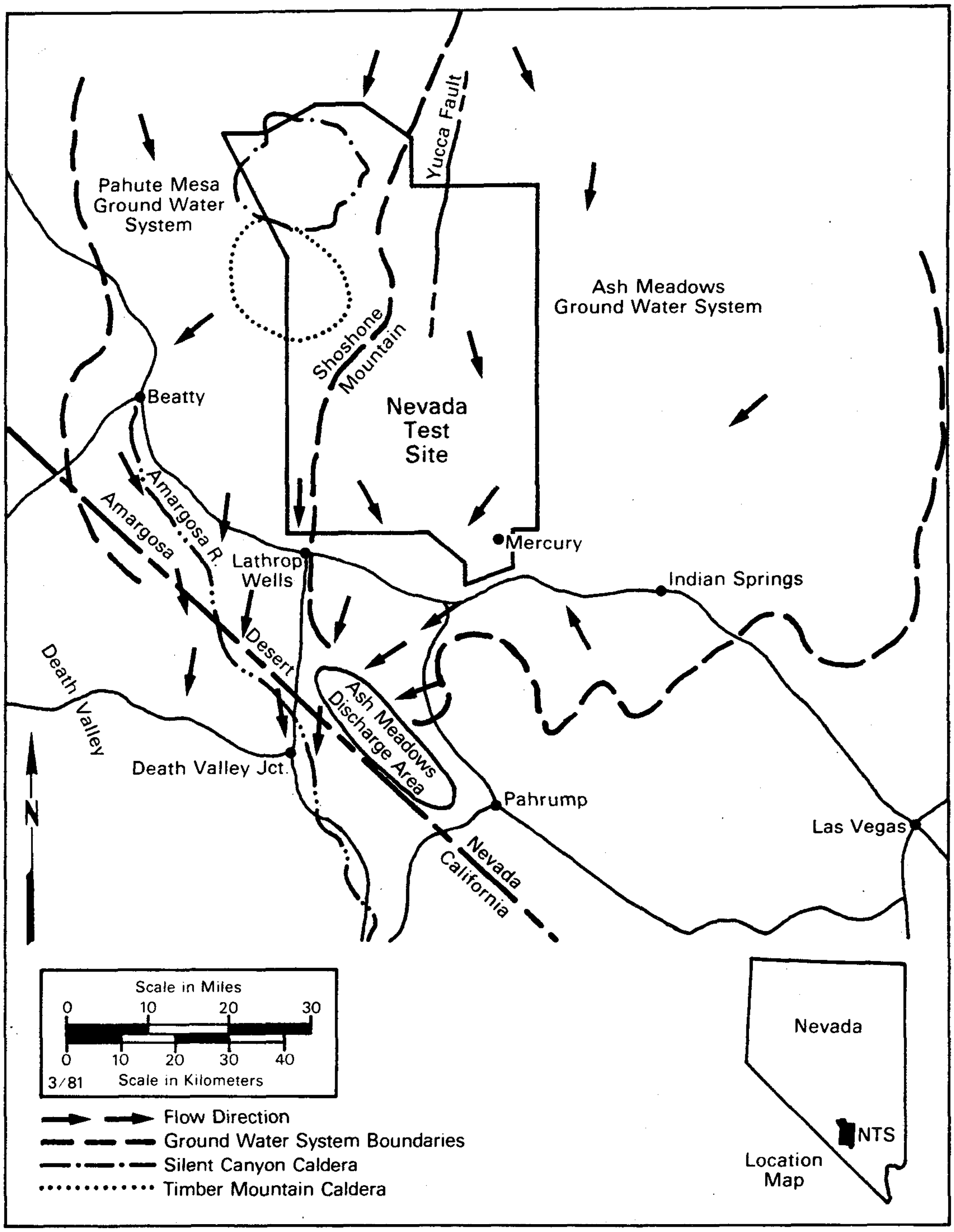

Figure A-1. Groundwater flow systems around the Nevada Test Site.

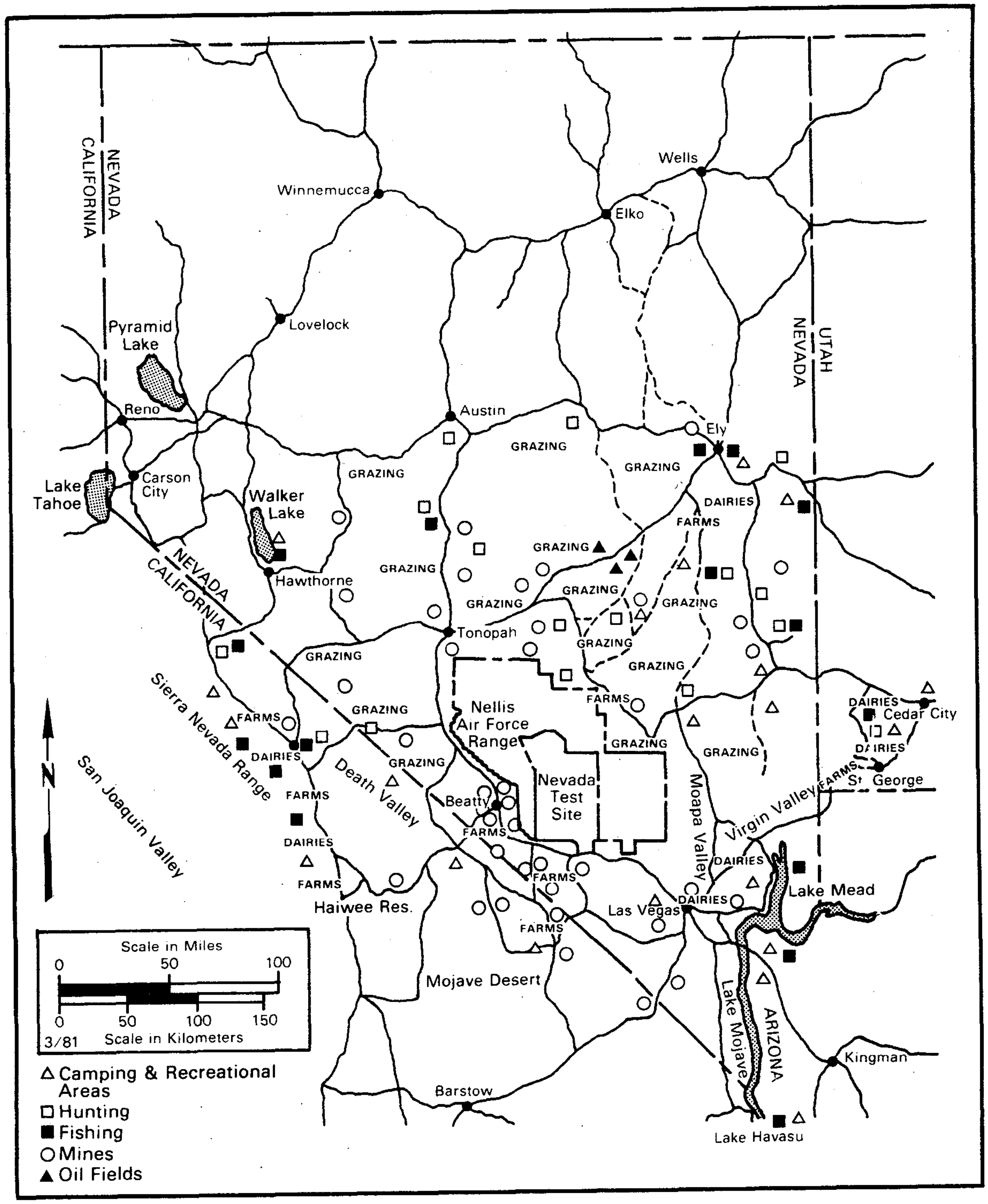

Figure A-2. General land use within 300 km of the Nevada Test Site.

Population Distribution

Figure A-3 shows the current population of counties surrounding the NTS based on preliminary 1980 census figures. Excluding Clark County, the major population center (approximately 462,000 in 1980), the population density within a 150 km radius of the NTS is about 0.5 persons per square kilometer. For comparison, the 48 contiguous states (1980 census) had a population density of approximately 29 persons per square kilometer. The estimated average population density for Nevada in 1980 was 2.8 persons per square kilometer.

The offsite area within 80 km of the NTS (the area in which the dose commitment must be determined for the purpose of this report) is predominantly rural. Several small communities are located in the area, the largest being in the Pahrump Valley. This growing rural community, with an estimated population of about 3,600, is located about 72 km south-southwest of the NTS CP-1. The Amargosa Farm Area, which has a population of about 1,600, is located about 50 km southwest of CP-1. The largest town in the near-offsite area is Beatty, which has a population of about 900 and is located approximately 65 km 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 (1980) estimates that the population within the Monument boundaries ranges from a minimum of 900 permanent residents during the summer months to as many as 35,000 tourists and campers on any particular day during the major holiday periods in the winter months, and as many as 80,000 during "Death Valley Days" in the month of November. The largest town and contiguous populated area in the Mojave Desert is Barstow, located 265 km south-southwest of the NTS, with a population of about 17,600. The next largest populated area is the Ridgecrest-China Lake area, which has a population of about 20,000 and is located about 190 km southwest of the NTS. The Owens Valley, where numerous small towns are located, lies about 50 km west of Death Valley. The largest town in Owens Valley is Bishop, located 225 km west-northwest of the NTS, with a population of about 5,300 including contiguous populated areas.

The extreme southwestern region of Utah is more developed than the adjacent part of Nevada. The largest community is St. George, located 220 km east of the NTS, with a population of 11,300. The next largest town, Cedar City, with a population of 10,900, is located 280 km east northeast of the NTS.

The extreme northwestern region of Arizona is mostly range land except for that portion in the Lake Mead Recreation Area. In addition, several small communities lie along the Colorado River. The largest town in the area is Kingman, located 280 km southeast of the NTS, with a population of about 9,200. Figures A-4 through A-7 show the domestic animal populations in the counties near the NTS.

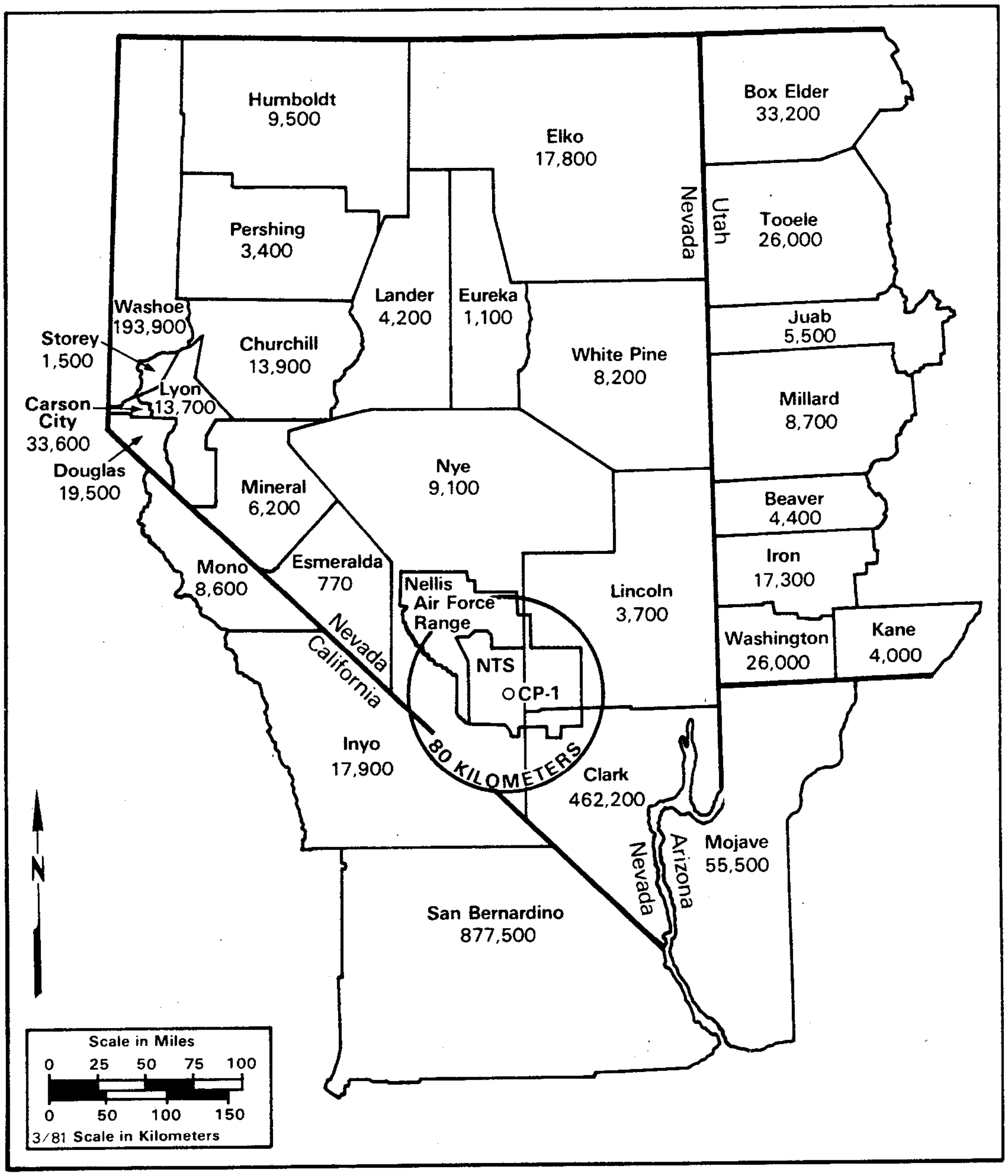

Figure A-3. Population of Arizona, California, Nevada, and Utah counties near the Nevada Test site (1980).

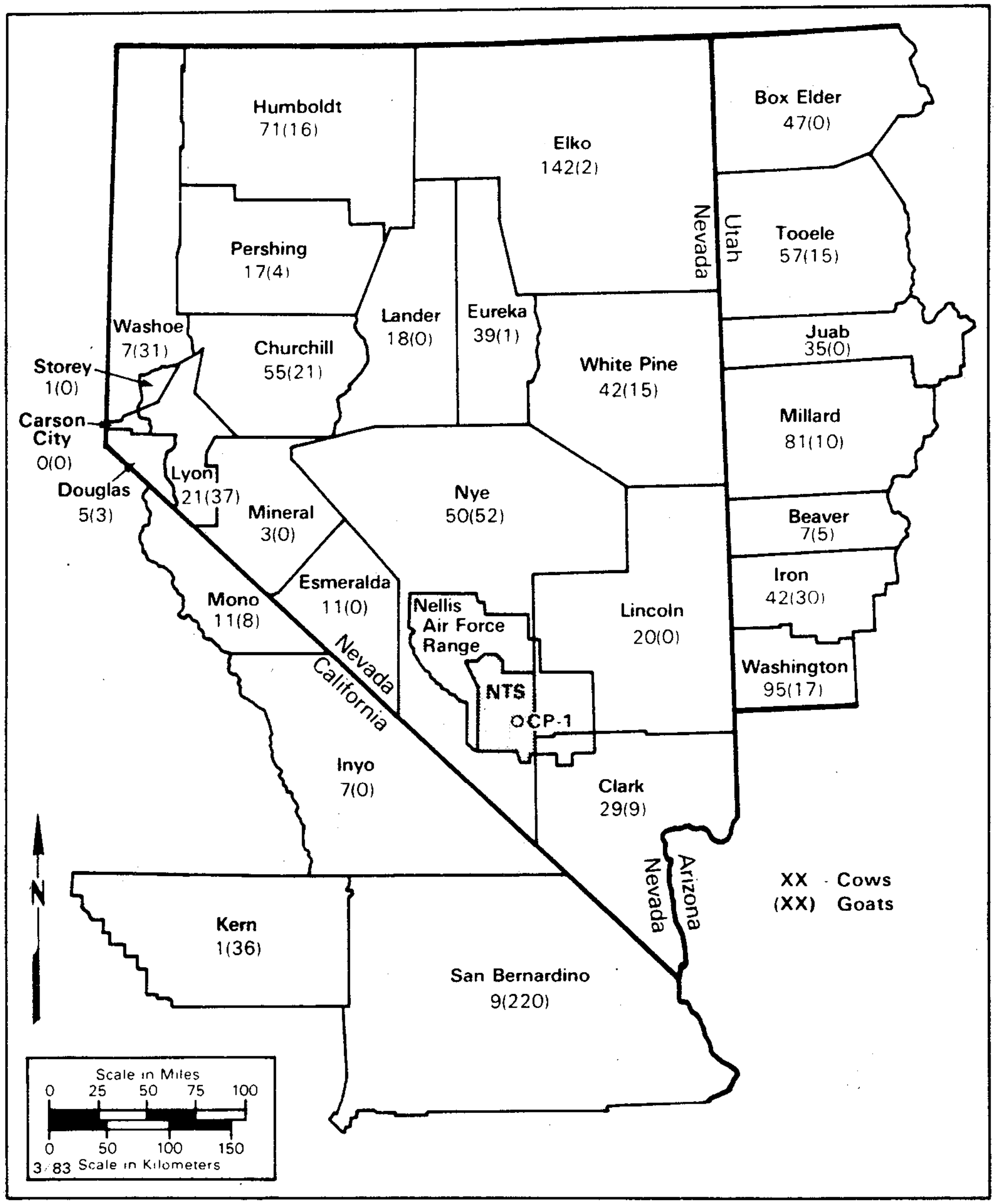

Figure A-4. Distribution of family milk cows and goats, by county (1981).

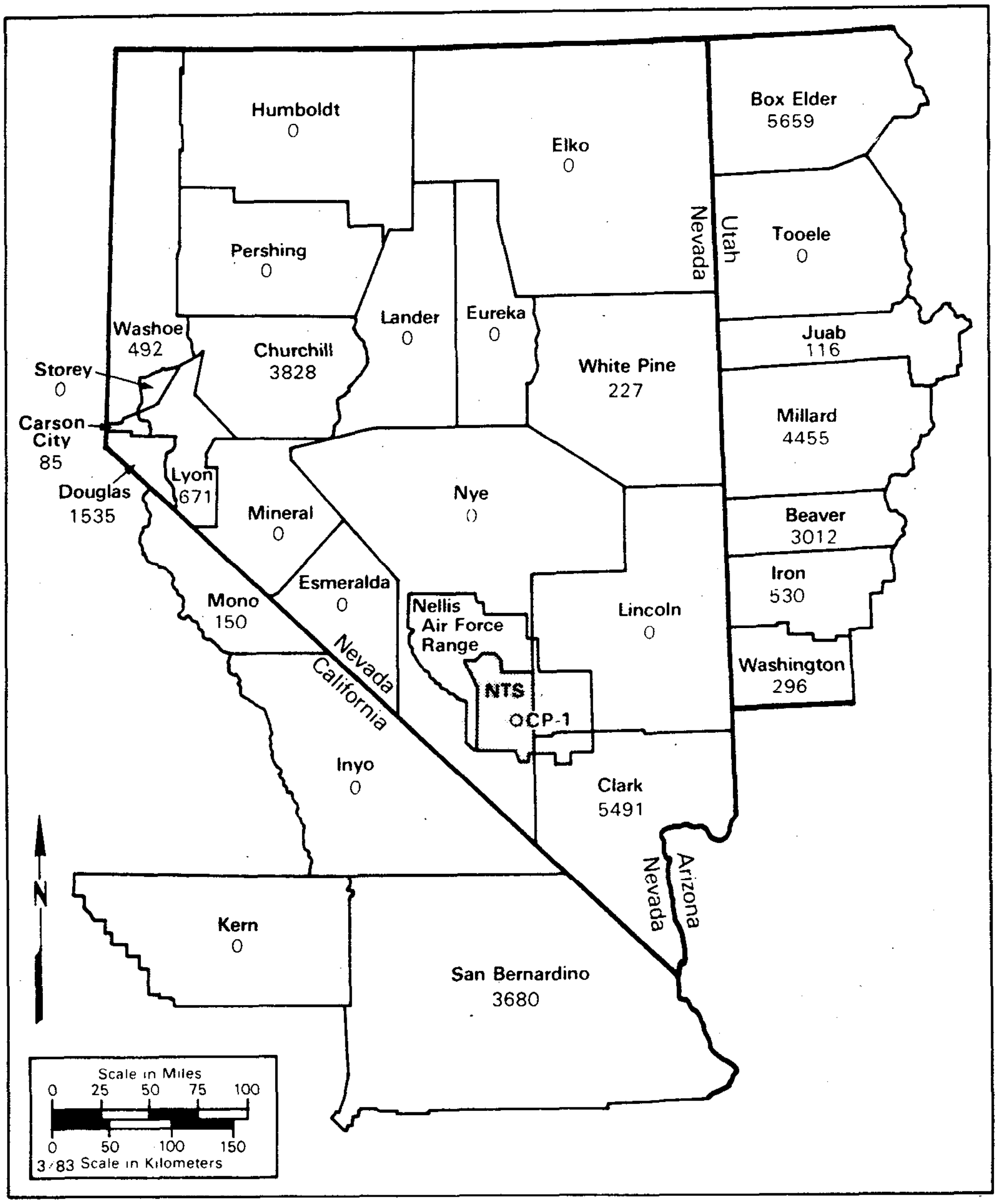

Figure A-5. Distribution of dairy cows, by county (1981).

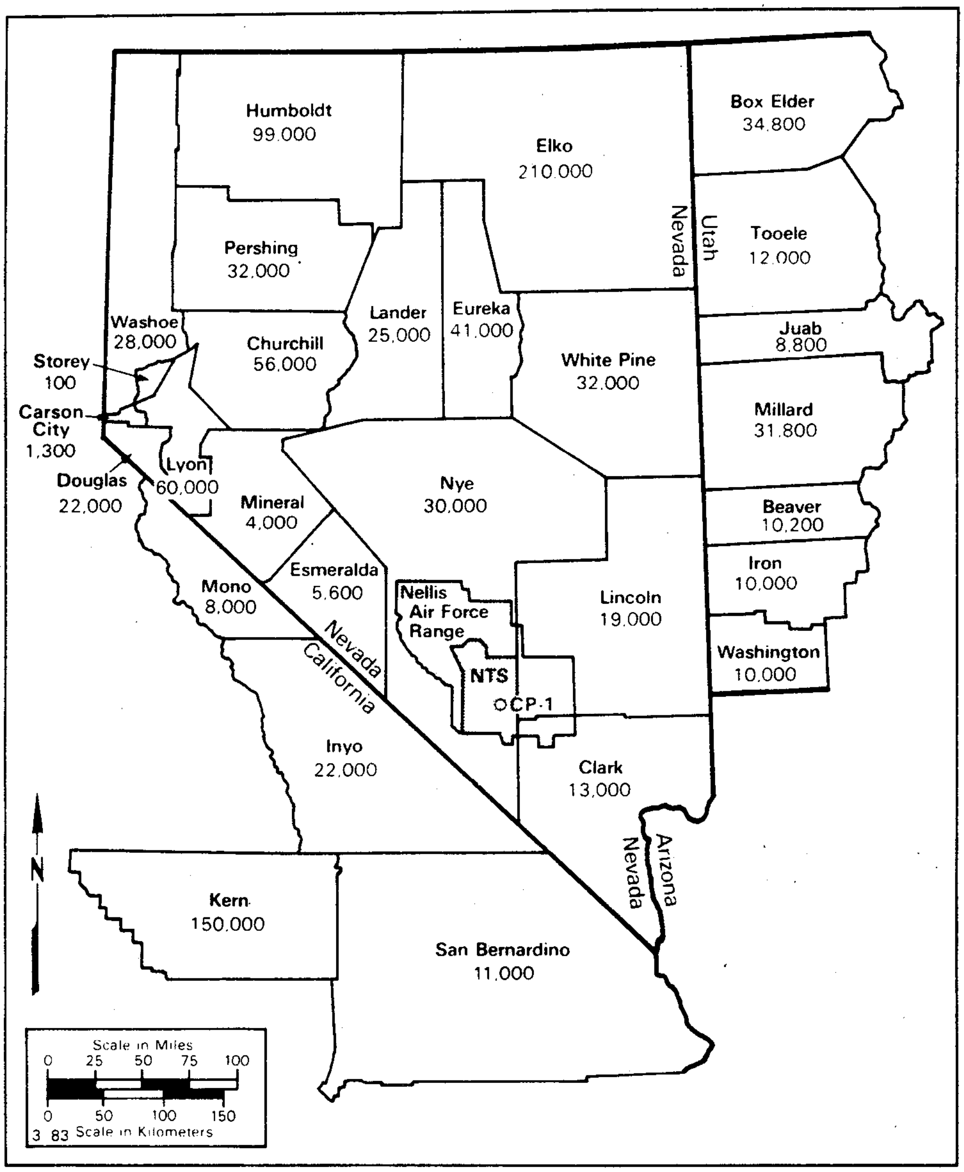

Figure A-6. Distribution of beef cattle, by county.

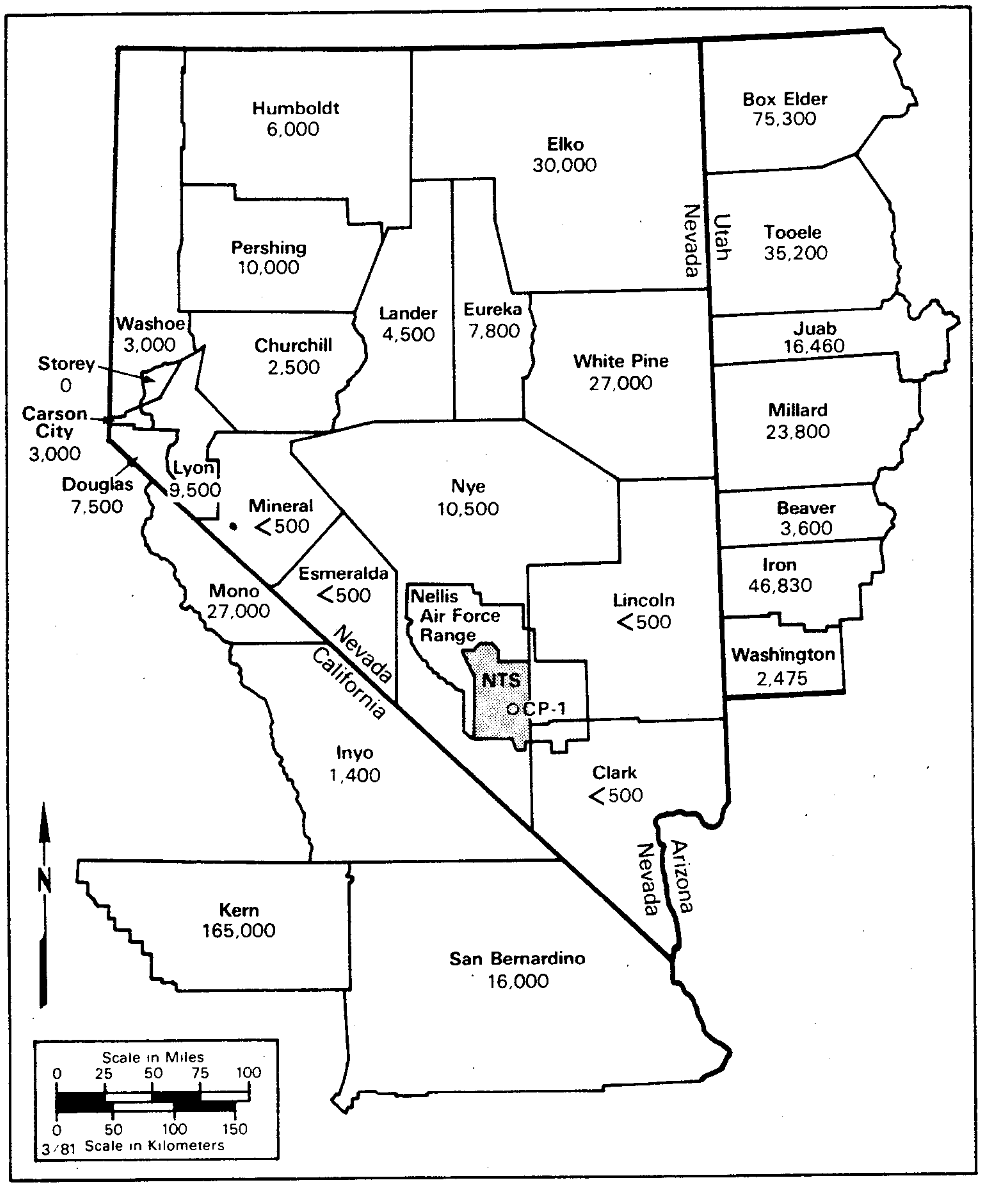

Figure A-7. Distribution of sheep, by county.

APPENDIX B. SAMPLE ANALYSIS PROCEDURES

ANALYTICAL PROCEDURES

The procedures for analyzing samples collected for offsite surveillance are described by Johns et al. in "Radiochemical Analytical Procedures for Analyses of Environmental Samples" (EMSL-LV-0539-17, 1979) and are summarized in Table B-1.

TABLE B-1. SUMMARY OF ANALYTICAL PROCEDURES

Type of Analysis	Analytical Equipment	Counting Period (min)	Analytical Procedures	Sample Size	Approximate Detection Limit*
NaI(Tl) Gamma Spectrometry**	NaI detector calibrated at 10 keV per channel (0.05-2.0 MeV range).	10 min. for air charcoal cartridges	Radionuclide concentrations quantified from gamma spectral data by computer using a least squares technique.	120-1200 m^3 for air charcoal cartridge samples.	0.04 pCi/m^3.
IG & Ge(Li) Gamma Spectrometry**	IG or Ge(Li) detector calibrated at 0.5 keV/channel (0.04 to 2 MeV range) individual detector efficiencies ranging from ~15% to 35%.	Individual air filters, 30 min; air filter composites, ~1200 min. 100 min for milk, water, suspended solids.	Radionuclide concentration quantified from gamma spectral data by on-line computer program. Radionuclides in air filter composite samples are identified only.	120-1200 m^3 for air filters; 3-1/2 liters for milk and water.	For routine milk and water generally, ~5 pCi/L for most common fallout radionuclides in a simple spectrum. Filters for LTHMP suspended solids, 6 pCi/L. Air filters, 0.04 pCi/m^3.
Gross beta on air filters	Low-level end window, gas flow proportional counter with a 12.7 cm diameter window (80 $\mu g/cm^2$)	30	Samples are counted after decay of naturally-occurring radionuclides and, if necessary extrapolated to mid-point of collection in accordance with $t^{-1.2}$ decay or an experimentally-derived decay.	120-1200 m^3	0.5 pCi/sample.

(continued)

TABLE B-1. (Continued)

Type of Analysis	Analytical Equipment	Counting Period (min)	Analytical Procedures	Sample Size	Approximate Detection Limit*
Sr-89-90	Low-background thin-window, gas-flow proportional counter with a 5.7-cm diameter window (80 μg/cm^2)	50	Separation of strontium by wet chemical method. After an ingrowth period, yttrium is separated and Sr-90 activity is calculated from the activity of the Y-90 daughter. Sr-89 activity is obtained by decay curve analysis.	1.0 liter for milk or water. 0.1-1 kg for tissue.	Sr-89 = 5 pCi/L Sr-90 = 2 pCi/L.
H-3	Automatic liquid scintillation counter with output printer.	200	Sample prepared by distillation.	4 ml for water	400 pCi/L.
H-3 Enrichment (Long-Term Hydrological Samples)	Automatic scintillation counter with output printer.	200	Sample concentrated by electrolysis followed by distillation.	250 ml for water	10 pCi/L.
Pu-238,239	Alpha spectrometer with 450 mm, 300-μm depletion depth, silicon surface barrier detectors operated in vacuum chambers.	1000-1400	Water sample or acid-digested tissue samples separated by ion exchange, electroplated on stainless steel planchet.	1.0 liter for water; 0.1-1 kg for tissue; 5,000-10,000 m^3 for air.	Pu-238 = 0.08 pCi/L Pu-239 = 0.04 pCi/L for water. For tissue samples, 0.04 pCi per total sample for all isotopes; 5-10 aCi/m^3 for plutonium on air filters.
Kr-85, Xe-133, Xe-135	Automatic liquid scintillation counter with output printer.	200	Physical separation by gas chromatography; dissolved in toluene "cocktail" for counting	0.4-1.0 m^3 for air	Kr-85, Xe-133, Xe-135 = 4 pCi/m^3.

*The detection limit for all samples received after January 1, 1978 is defined as 3.29 sigma where sigma equals the counting error of the sample and Type I error = Type II error = 5 percent. (J. P. Corley, D. H. Denham, R. E. Jaquish, D. E. Michels, A. R. Olsen, D. A. Waite, A Guide for Environmental Radiological Surveillance at U.S. Dept. of Energy Installations, July 1981, Office of Operational Safety Report DOE/EP-0023, U.S. DOE, Washington, D. C.)

**Gamma Spectrometry performed by thallium activated sodium iodide (NaI(Tl)), intrinsic germanium (IG), or lithium-drifted germanium diode (Ge(Li)) detectors.

APPENDIX C. QUALITY ASSURANCE PROCEDURES

PRECISION OF ANALYSIS

The duplicate sampling program was initiated for the purpose of routinely assessing the errors due to sampling, analysis, and counting of samples obtained from the surveillance networks maintained by the EMSL-LV.

The program involves the collection and analysis of duplicate samples from the ASN, the NGTSN, the LTHMP, and the MSN. Due to difficulties anticipated in obtaining sufficient quantities of milk for duplicate samples from the Milk Surveillance Network, duplicate samples are normally collected during the annual activation of the SMSN. In general, the NGTSN samples are split for analysis.

At least 30 duplicate samples from each network are normally collected and analyzed over the report period. Since three TLD cards consisting of two TLD chips each are used at each station of the Dosimetry Network, no additional samples were necessary. Table A-2 summarizes the sampling information for each surveillance network.

To estimate the precision of a methodology, the standard deviation of replicate results is needed. Thus, for example, the variance, s^2, of each

TABLE C-1. SAMPLES AND ANALYSES FOR DUPLICATE SAMPLING PROGRAM

Surveillance Network	Number of Sampling Locations	Samples Collected Per Year	Sets of Duplicate Samples Collected	Number Per Set	Sample Analysis
ASN	121	9,200	456	2	Gross beta, γ Spectrometry
NGTSN	16	779 (NG) 862 (H3)	44 6	2	Kr-85, H-3, H_2O, HTO
Dosimetry	82	320	320	4-6	Effective dose from gamma
SMSN	167	240	26	2	K-40, Sr-89, Sr-90
LTHMP	134	254	27	2	H-3

set of replicate TLD results (n=6) was estimated from the results by the standard expression,

$$s^2 = \sum_{i=1}^{k} (x_i - \overline{x})^2 / (k - 1)$$

where k = number of sets of replicates.

Since duplicate samples were collected for all other sample types, the variances, s^2, for these types were calculated from $s^2 = (0.886R)^2$, where R is the absolute difference between the duplicate sample results. For small sample sizes, this estimate of the variance is statistically efficient* and certainly more convenient to calculate than the standard expression. The standard deviation is obtained by taking the square root.

The principle that the variances of random samples collected from a normal population follow a chi-square distribution (x^2) was then used to estimate the expected population standard deviation for <u>each type of sample analysis</u>. The expression used is as follows:**

$$\tilde{s} = \left[\sum_{i=1}^{k} (n_i - 1) s_i^2 / \sum_{i=1}^{k} (n_i - 1) \right]^{1/2}$$

where n_i-1 = the degrees of freedom for n samples collected for the th replicate sample

s_i^2 = the expected variance of the th replicate sample

$\tilde{s}$ = the best estimate of sample standard deviation derived from the variance estimates of all replicate samples (the expected value of s^2 is σ^2).

For expressing the precision of measurement in common units, the coefficient of variation ($s/\overline{x}$) was calculated for each sample type. These are displayed in Table C-2 for those analyses for which there were adequate data.

To estimate the precision of counting, approximately 10 percent of all samples are counted a second time. These are unknown to the analyst. Since all such replicate counting gave results within the counting error, the precision data in Table C-2 represents errors principally in analysis.

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*Snedecor, G. W., and W. G. Cochran. Statistical Methods. The Iowa State University Press, Ames, Iowa. 6th Ed. 1967. pp. 39-47.

**Freund, J. E. Mathematical Statistics. Prentice Hall, Englewood, New Jersey. 1962. pp 189-235.

TABLE C-2. SAMPLING AND ANALYTICAL PRECISION

Surveillance Network	Analysis	Sets of Replicate Samples Evaluated	Coefficient of Variation (%)
ASN	Gross β	26	51
	Be-7	9	37
NGTSN	Kr-85	44	9.7
	H-3 (1981 data)	17	23
	H_2O	8	12
Dosimetry	γ(TLD)	328	3.2
SMSN	K-40	33	11
	Sr-89	26	45
	Sr-90	26	35
LTHMP	H-3 (conv. 1981)	6	10
	H-3 (enrich. 1981)	32	18

ACCURACY OF ANALYSIS

Data from the analysis of intercomparison samples are statistically analyzed and compared to known values and values obtained from other participating laboratories. A summary of the statistical analysis is given in Table C-3, which compares the mean of three replicate analyses with the known value. The normalized deviation is a measure of the accuracy of the analysis when compared to the known concentration. The determination of this parameter is explained in detail separately (Jarvis and Siu). If the value of this parameter (in multiples of standard normal deviate, unitless) lies between control limits of -3 and +3, the precision or accuracy of the analysis is within normal statistical variation. However, if the parameters exceed these limits, one must suspect that there is some cause other than normal statistical variations that contributed to the difference between the measured values and the known value. As shown by this table, the strontium-90 analysis for milk samples exceeded the control limit in two out of four cross-checks and nearly exceeded it on one other. The problem was attributed to contamination in the yttrium carrier for which an overcorrection was made. A new supply of uncontaminated yttrium carrier is now in use.

TABLE C-3. 1982 QUALITY ASSURANCE INTERCOMPARISON RESULTS

Analysis	Month	Mean of Replicate Analyses (x 10^{-9} µCi/ml)	Known Value (x 10^{-9}µCi/ml)	Normalized Deviation from: Known Conc.
H-3 in water	Feb	1735	1820	-0.4
	Apr	2557	2860	-1.5
	Jun	1681	1830	-0.8
	Aug	2866	2890	-0.1
	Oct	2349	2560	-1.0
H-3 in urine	May	1279	1330	-0.3
	Dec	3609	3830	-1.0
Co-60 in water	Feb	20	20	-0.1
	Jun	28	29	-0.2
	Oct	19	20	-0.3
Ru-106	Feb	<75	0	-
	Jun	<75	0	-
	Oct	<75	30	-
Cs-134 in water	Feb	21	22	-0.3
	Jun	30	35	-1.7
	Oct	17	19	-0.7
Cs-137 in water	Feb	23	23	-0.1
	Jun	24	25	-0.3
	Oct	19	20	-0.2
I-131 in milk	Apr	<5	0	-
	Oct	41	42	-0.4
Sr-89 in milk**	Jan	<24	12	-
	Apr	<36	25	-
	Jul	<50	42	-
	Oct	<37	0	-
Sr-90 in milk**	Jan	11	15	-4.9
	Apr	14	16	-2.9
	Jul	25	25	-0.2
	Oct	12	19	-8.1
137-Cs in milk	Apr	27	28	-0.3
	Oct	33	34	-0.4

(continued)

TABLE C-3. (Continued)

Analysis	Month	Mean of Replicate Analyses (x 10^{-9} µCi/ml)	Known Value (x 10^{-9} µCi/ml)	Normalized Deviation from: Known Conc.
Ba-140 in milk	Apr	<6	0	-
	Oct	<6	0	-
Cs-137 in air filters (pCi/filter)	Mar*	32	23	3.1
	Sep	24	27	-0.9
	Nov	36	Not available	-

*Grand average of all laboratories participating was 27 ± 6 (1s).
**These analyses were performed by Government contractor.

To measure the performance of the contractor laboratory for analysis of animal and vegetable samples, a known amount of activity was added to several samples. The reported activity is compared to the known amount in Table C-4. The Sr-90 results indicated a bias of - 35 percent.

QUALITY ASSURANCE-DOSIMETRY

Radioanalytical counting systems and TLD systems are calibrated using radionuclide standards that are traceable to the National Bureau of Standards (NBS). These standards are obtained from the Quality Assurance Division at EMSL-LV or from NBS. Each standard source used for TLD calibrations is periodically checked for accuracy in accordance with procedures traceable to NBS.

To determine accuracy of the data obtained from the TLD systems, dosimeters are periodically submitted to the University of Texas School of Public Health for intercomparisons of environmental dosimeters. Dosimeters were submitted to the Sixth International Intercomparison in July 1981. The results for which are not yet available. The results from the Fifth Intercomparison are shown in Table C-5. All TLD measurements are performed in conformance with standards proposed by the American National Standards Institute (ANSI 1975).

TABLE C-4. QUALITY ASSURANCE RESULTS FOR THE BIOENVIRONMENTAL PROGRAM

Sample Type and Shipment Number	Nuclide	Activity Added (pCi/kg*) Vegetable (pCi/g ash) Bone	Activity Reported (pCi/kg*) Vegetable (pCi/g ash) Bone	% Bias†	Precision No.‡
Vegetation					
Zucchini A	Pu-239	42.4	33 ± 4.3	-23	
No. 39	Sr-90	56.1	30 ± 4.4	-48	
Zucchini B	Pu-239	34	37 ± 5.2	+7	
No. 39	Sr-90	45	33 ± 5.1	-30	
Zucchini C	Pu-239	35	34 ± 4.5	-5	
No. 39	Sr-90	45	33 ± 5.1	-34	
Zucchini D	Pu-239	0	0.61 ± 0.17		
No. 39	Sr-90	0	1.3 ± 1.7		
Bone Ash					
Ash No. 6 No. 31	Sr-90	0	1.5 ± 0.26	--	
Ash No. 7 No. 31	Sr-90	3.12	3.4 ± 0.56	-39	
Ash No. 9 No. 31	Sr-90	10.8	9.4 ± 1.5	-27	
Hamburger Meat					
Bov E Muscle No. 39	Pu-239	1.26	1.5 ± 0.3	-19	
Bov F Muscle No. 39	Pu-239	1.26	1.1 ± 0.26	-13	
Bov G Muscle No. 39	Pu-239	0	0.00 ± 0.036	--	
Duplicate Samples					
MD-2 Bone	Pu-239	0	0.00 ± 10.33		--
No. 39	Sr-90	0	1.4 ± 0.21		.066
MD-Yellow Bone	Pu-239	0	0.00 ± 1.1		
No. 39	Sr-90	0	1.3 ± 0.21		

* Wet weight

† Bias (B) = Recovery -1; recovery is average recovery $\left(\frac{x_1}{u}\right)$

where x_1 = net activity reported
u = activity added

‡ Precision $(C_v) = 2 \frac{(x_1 - x_2)}{x_1 + x_2} \times \frac{1}{1.128}$ where x_1 = first value
x_2 = second value

TABLE C-5. SUMMARY RESULTS OF THE FIFTH INTERNATIONAL INTERCOMPARISON OF ENVIRONMENTAL DOSIMETERS

Quantity	Mean	Standard Deviation	Comments
Summary of "Beginning" Exposure Laboratory Results (mR):			
EMSL-LV Dosimeters	66.4	5.0	EMSL-LV results 12% lower than all dosimeters and 11.7% lower than the calculated exposure.
All Dosimeters	75.8	20.2	
Calculated Exposure	75.2	3.8	
Summary of "End" Exposure Laboratory Results (mR):			
EMSL-LV Dosimeters	80.2	6.0	EMSL-LV results 11.6% lower than all dosimeters and 9.3% lower than the calculated exposure.
All Dosimeters	90.7	15.6	
Calculated Exposure	88.4	4.4	
Summary of Field Results (mR):			
EMSL-LV Dosimeters	24.0	1.8	EMSL-LV results 20% lower than all dosimeters and 20% lower than the calculated exposure.
All Dosimeters	30.2	7.3	
Calculated Exposure	30.0	3.0	

APPENDIX D. RADIATION PROTECTION STANDARDS FOR EXTERNAL AND INTERNAL EXPOSURE

DOE ANNUAL DOSE COMMITMENT

The annual dose commitment tabulated below is from "Basic Radiation Protection Criteria" in NCRP Report No. 39.

Type of Exposure	Dose Limit to Individuals in Uncontrolled Area at Points of Maximum Probable Exposure (rem)	Dose Limit to Suitable Sample of the Exposed Population in an Uncontrolled Area (rem)
Whole body, gonads, or bone marrow	0.5	0.17
Other organs	1.5	0.5

DOE CONCENTRATION GUIDES

The concentration guides (CG's) in Table D-1 are from the DOE Order 5480.1, Chapter XI, "Requirements for Radiation Protection." All values are annual average concentrations. The Concentration Guides are based on a suitable sample of the exposed population in an uncontrolled area. The final column lists the Minimum Detectable Concentration from Appendix B as a percent of the CG.

EPA CONCENTRATION GUIDE

In 1976 the Environmental Protection Agency published concentration guides for drinking water (Part 141, CFR 40, Amended) which included 20,000 pCi/L for tritium. This concentration would result in 4 mrem/a to an individual from continuous exposure. The percent CG values for tritium in the tables of Appendix E may be multiplied by 50 if the relation to this guide is desired, e.g., a <0.01 would become <0.5.

TABLE D-1. DOE CONCENTRATION GUIDES

Network or Program	Sampling Medium	Radio-nuclide	CG	MDC as % of CG
			(pCi/m^3)	
Air Surveillance Network	air	Be-7	1.3×10^4	3.1×10^{-4}
		Zr-95	3.3×10^2	1.2×10^{-2}
		Nb-95	1.0×10^3	4.0×10^{-3}
		Mo-99	2.3×10^3	1.7×10^{-3}
		Ru-103	1.0×10^3	4.0×10^{-3}
		I-131	3.3×10^1	1.2×10^{-1}
		Te-132	1.3×10^3	3.1×10^{-3}
		Cs-137	1.7×10^2	2.4×10^{-2}
		Ba-140	3.3×10^2	1.2×10^{-2}
		La-140	1.3×10^3	3.1×10^{-3}
		Ce-141	1.7×10^3	2.4×10^{-3}
		Ce-144	6.7×10^1	6.0×10^{-2}
		Pu-239	2.0×10^{-2}	5.0×10^{-2}
Noble Gas and Tritium Surveillance Network	air	Kr-85	1.0×10^5	4.0×10^{-3}
		H-3	6.7×10^4	6.0×10^{-1}
		Xe-133	1.0×10^5	4.0×10^{-3}
		Xe-135	3.3×10^4	1.2×10^{-2}
			(pCi/L)	
Long-Term Hydrological Program	water	H-3	1.0×10^6	1.0×10^{-3}
		Sr-89	1.0×10^3	5.0×10^{-1}
		Sr-90	1.0×10^2	2.0×10^{-0}
		Cs-137	6.7×10^3	1.5×10^{-1}
		Ra-226	1.0×10^1	
		U-234	1.3×10^3	
		U-235	1.3×10^3	
		U-238*	2.0×10^2	
		Pu-238	1.7×10^3	4.7×10^{-3}
		Pu-239	1.7×10^3	2.4×10^{-3}
Milk Surveillance Networks	milk	H-3	1.0×10^6	1.0×10^{-3}
		Cs-137	6.7×10^3	1.5×10^{-1}
		Sr-89	1.0×10^3	5.0×10^{-1}
		Sr-90	1.0×10^2	2.0×10^{-0}

*Concentration based on chemical toxicity.

APPENDIX E. DATA SUMMARY FOR MONITORING NETWORKS

TABLE E-1. 1982 SUMMARY OF ANALYTICAL RESULTS FOR AIR SURVEILLANCE NETWORK CONTINUOUSLY OPERATING STATIONS

SAMPLING LOCATION	NO. DAYS DETECTED /SAMPLED	RADIO-NUCLIDE	RADIOACTIVITY CONC. (pCi/m^3) MAX	MIN	AVG
DEATH VALLEY JCT CA	2.0/362.1	Be-7	0.58	0.58	0.0032
FURNACE CREEK CA	10.0/341.8	Be-7	0.44	0.24	0.0086
SHOSHONE CA	20.7/327.4	Be-7	0.56	0.21	0.023
ALAMO NV	14.0/354.8	Be-7	0.63	0.28	0.016
AUSTIN NV	12.1/236.2	Be-7	0.58	0.40	0.024
BEATTY NV	17.9/343.1	Be-7	0.71	0.14	0.022
STONE CABIN RANCH NV	6.9/336.4	Be-7	0.60	0.28	0.0086
CURRANT NV - BLUE EAGLE RANCH	17.8/360.1	Be-7	0.65	0.22	0.022
ELY NV	18.5/347.8	Be-7	0.47	0.30	0.019
GOLDFIELD NV	14.5/362.3	Be-7	0.77	0.35	0.021
NTS NV - AREA 51	10.0/318.0	Be-7	0.51	0.36	0.014
HIKO NV	13.0/357.1	Be-7	0.63	0.37	0.020
INDIAN SPRINGS NV	16.2/363.7	Be-7	0.41	0.25	0.015
LAS VEGAS NV	13.0/362.5	Be-7	0.50	0.29	0.013
NYALA NV	11.0/365.8	Be-7	0.64	0.33	0.014
OVERTON NV	11.6/355.9	Be-7	0.52	0.34	0.013

(CONTINUED)

TABLE E-1. (CONTINUED)

SAMPLING LOCATION	NO. DAYS DETECTED /SAMPLED	RADIO-NUCLIDE	RADIOACTIVITY CONC. (pCi/m^3) MAX	MIN	AVG
PAHRUMP NV	17.0/353.5	Be-7	0.63	0.21	0.020
SCOTTY'S JCT NV	10.0/350.3	Be-7	0.56	0.46	0.014
SUNNYSIDE NV	13.2/336.3	Be-7	0.53	0.39	0.018
RACHEL NV - ROBINSON TRAILER	6.9/354.8	Be-7	0.60	0.46	0.010
TONOPAH NV	17.6/365.3	Be-7	0.84	0.18	0.024
TTR NV	22.9/227.8	Be-7	0.62	0.19	0.036
FALLINI'S (TWIN SPGS) RANCH NV	8.9/362.7	Be-7	0.38	0.36	0.0091
CEDAR CITY UT	17.0/357.2	Be-7	0.69	0.19	0.021
DELTA UT	122.1/354.6	Be-7	0.58	0.15	0.096
MILFORD UT	106.3/329.7	Be-7	0.51	0.15	0.089
ST GEORGE UT	8.0/363.0	Be-7	0.54	0.31	0.0085
SALT LAKE CITY UT	35.0/306.5	Be-7	0.51	0.27	0.046

THE FOLLOWING STATION HAD NEGLIGIBLE GAMMA-SPECTRA:

LATHROP WELLS NV

TABLE E-2. 1982 SUMMARY OF ANALYTICAL RESULTS FOR ASN STANDBY STATIONS - OPERATED 1 OR 2 WEEKS PER QUARTER

SAMPLING LOCATION	NO. DAYS DETECTED /SAMPLED	RADIO-NUCLIDE	RADIOACTIVITY CONC. (pCi/m^3) MAX	MIN	AVG
KINGMAN AZ	2.0/28.0	Be-7	0.29	0.29	0.021
PHOENIX AZ	18.2/31.3	Be-7	0.97	0.17	0.21
SELIGMAN AZ	2.0/28.0	Be-7	0.36	0.36	0.026
WINSLOW AZ	14.0/28.0	Be-7	0.35	0.13	0.13
BAKER CA	6.0/19.3	Be-7	0.17	0.16	0.052
BARSTOW CA	12.0/50.8	Be-7	0.36	0.22	0.067
BISHOP CA	4.6/27.7	Be-7	0.36	0.25	0.051
INDIO CA	4.0/23.1	Be-7	0.22	0.19	0.036
LONE PINE CA	20.0/32.0	Be-7	0.32	0.24	0.17
NEEDLES CA	11.0/28.0	Be-7	0.22	0.12	0.064
RIDGECREST CA	10.1/25.4	Be-7	0.35	0.22	0.11
DENVER CO	10.0/28.1	Be-7	0.55	0.18	0.13
DURANGO CO	3.0/21.4	Be-7	0.32	0.32	0.044
GRAND JUNCTION CO	13.1/23.9	Be-7	0.55	0.24	0.19
PUEBLO CO	4.1/28.3	Be-7	0.34	0.31	0.046
BOISE ID	3.0/34.9	Be-7	0.14	0.14	0.013
IDAHO FALLS ID	3.1/27.9	Be-7	0.24	0.24	0.027
POCATELLO ID	3.0/25.9	Be-7	0.21	0.21	0.024
PRESTON ID	5.0/27.0	Be-7	0.33	0.29	0.056
TWIN FALLS ID	11.0/28.0	Be-7	0.37	0.27	0.12

(CONTINUED)

TABLE E-2. (CONTINUED)

SAMPLING LOCATION	NO. DAYS DETECTED /SAMPLED	RADIO- NUCLIDE	RADIOACTIVITY CONC. (pCi/m^3) MAX	MIN	AVG
DODGE CITY KS	8.0/28.0	Be-7	0.32	0.27	0.083
LAKE CHARLES LA	2.0/27.9	Be-7	0.18	0.18	0.013
MONROE LA	5.5/28.1	Be-7	0.24	0.17	0.041
MINNEAPOLIS MN	4.0/36.5	Be-7	0.37	0.21	0.032
CLAYTON MO	4.0/22.0	Be-7	0.23	0.12	0.031
ST JOSEPH MO	18.0/39.5	Be-7	0.29	0.10	0.093
BILLINGS MT	4.9/26.3	Be-7	0.34	0.16	0.043
BOZEMAN MT	7.2/27.4	Be-7	0.28	0.14	0.053
MISSOULA MT	11.2/28.3	Be-7	0.27	0.16	0.089
NORTH PLATTE NB	8.1/25.2	Be-7	0.22	0.15	0.063
BATTLE MOUNTAIN NV	3.0/21.0	Be-7	0.30	0.30	0.042
BLUE JAY NV	2.9/13.9	Be-7	0.25	0.25	0.052
CALIENTE NV	16.1/27.1	Be-7	0.51	0.26	0.21
CURRANT NV - ANGLE WORM RANCH	11.9/28.2	Be-7	0.45	0.21	0.14
CURRIE NV	11.3/20.1	Be-7	0.42	0.24	0.18
DUCKWATER NV	2.0/6.0	Be-7	0.42	0.42	0.14
ELKO NV	9.1/14.9	Be-7	0.53	0.19	0.20
EUREKA NV	15.2/27.0	Be-7	0.59	0.18	0.17
FALLON NV	2.0/20.9	Be-7	0.32	0.32	0.030
FRENCHMAN STATION NV	2.0/20.0	Be-7	0.47	0.47	0.046
LOVELOCK NV	8.8/21.5	Be-7	0.39	0.13	0.11

(CONTINUED)

TABLE E-2. (CONTINUED)

SAMPLING LOCATION	NO. DAYS DETECTED /SAMPLED	RADIO-NUCLIDE	RADIOACTIVITY CONC. (pCi/m^3) MAX	MIN	AVG
LUND NV	15.6/27.6	Be-7	0.53	0.31	0.22
MESQUITE NV	22.0/35.0	Be-7	0.32	0.10	0.14
PIOCHE NV	14.2/26.9	Be-7	0.66	0.38	0.25
RENO NV	8.1/27.9	Be-7	0.33	0.27	0.086
ROUND MOUNTAIN NV	9.9/27.2	Be-7	0.42	0.25	0.12
WELLS NV	11.3/28.0	Be-7	0.62	0.23	0.14
WINNEMUCCA NV	2.9/26.3	Be-7	0.18	0.18	0.020
ALBUQUERQUE NM	14.1/51.6	Be-7	0.36	0.23	0.083
CARLSBAD NM	5.6/24.9	Be-7	0.22	0.17	0.044
MUSKOGEE OK	5.0/18.0	Be-7	0.26	0.20	0.062
NORMAN OK	2.0/20.0	Be-7	0.30	0.30	0.030
MEDFORD OR	7.9/33.6	Be-7	0.26	0.17	0.048
BURNS OR	5.0/28.0	Be-7	0.33	0.19	0.043
ABILENE TX	9.3/21.3	Be-7	0.32	0.18	0.10
AMARILLO TX	3.0/28.0	Be-7	0.24	0.24	0.026
AUSTIN TX	11.0/33.8	Be-7	0.27	0.12	0.058
BRYCE CANYON UT	6.0/25.9	Be-7	0.54	0.52	0.12
CAPITOL REEF NAT'L MONUMENT UT	14.3/27.2	Be-7	0.52	0.28	0.17
DUGWAY UT	11.6/24.6	Be-7	0.52	0.18	0.14
ENTERPRISE UT	12.0/28.0	Be-7	0.51	0.20	0.15
GARRISON UT	7.5/28.2	Be-7	0.37	0.32	0.089

(CONTINUED)

TABLE E-2. (CONTINUED)

SAMPLING LOCATION	NO. DAYS DETECTED /SAMPLED	RADIO-NUCLIDE	RADIOACTIVITY CONC. (pCi/m^3) MAX	MIN	AVG
LOGAN UT	9.0/28.1	Be-7	0.24	0.20	0.071
MONTICELLO UT	9.8/26.7	Be-7	0.56	0.24	0.15
PROVO UT	14.1/55.9	Be-7	0.61	0.22	0.079
VERNAL UT	10.0/24.9	Be-7	0.45	0.12	0.11
WENDOVER UT	5.0/28.0	Be-7	0.36	0.22	0.049
SEATTLE WA	2.0/22.0	Be-7	0.19	0.19	0.017
SPOKANE WA	5.0/56.0	Be-7	0.21	0.19	0.018
CASPER WY	8.0/21.0	Be-7	0.40	0.23	0.12
ROCK SPRINGS WY	8.0/26.0	Be-7	0.41	0.19	0.079
WORLAND WY	3.0/28.0	Be-7	0.34	0.34	0.036

THE FOLLOWING STATIONS HAD NEGLIGIBLE GAMMA-SPECTRA:

LITTLE ROCK AK
MOUNTAIN HOME ID
IOWA CITY IA
SIOUX CITY IA
NEW ORLEANS LA
JOPLIN MO
GEYSER RANCH NV
WARM SPRINGS NV
ABERDEEN SD
RAPID CITY SD
FORT WORTH TX
PAROWAN UT

TABLE E-3. 1982 SUMMARY OF ANALYTICAL RESULTS FOR THE NOBLE GAS AND TRITIUM SURVEILLANCE NETWORK

SAMPLING LOCATION	NO. DAYS DETECTED	RADIONUCLIDE	RADIOACTIVITY CONC. (pCi/m^3)* MAX	MIN	AVG	PERCENT CONC. GUIDE+
SHOSHONE	268.4	Kr-85	33	20	25	0.02
CA	254.5	Xe-133	<30	<6	3.6	<0.01
	335.7	H-3 IN ATM. M.*	<0.5	<0.4	0.082	-
	335.7	H-3 AS HTO IN AIR	<8	<2	0.49	<0.01
ADAVEN (CANFIELD)	2.0	Kr-85	23	23	23	0.02
NV**	2.0	Xe-133	<50	<50	20	0.02
ALAMO	344.8	Kr-85	31	20	24	0.02
NV	317.8	Xe-133	<30	<7	4.9	<0.01
	349.0	H-3 IN ATM. M.*	0.51	<0.4	0.055	-
	349.0	H-3 AS HTO IN AIR	<9	<2	0.40	<0.01
AUSTIN	219.9	Kr-85	32	16	24	0.02
NV	212.9	Xe-133	<40	<7	4.8	<0.01
	236.0	H-3 IN ATM. M.*	<0.5	<0.5	0.10	-
	236.0	H-3 AS HTO IN AIR	<6	<2	0.68	<0.01
BEATTY	348.5	Kr-85	31	17	25	0.02
NV	320.5	Xe-133	<100	<7	8.0	<0.01
	362.6	H-3 IN ATM. M.*	0.57	<0.3	0.11	-
	362.6	H-3 AS HTO IN AIR	<6	<1	0.63	<0.01
DIABLO (REVEILLE)	2.6	Kr-85	22	22	22	0.02
NV**	2.6	Xe-133	<30	<30	16	0.02
ELY	279.7	Kr-85	32	17	24	0.02
NV	253.6	Xe-133	<30	<5	3.5	<0.01
	306.1	H-3 IN ATM. M.*	0.57	<0.4	0.11	-
	306.1	H-3 AS HTO IN AIR	6.2	<2	0.74	<0.01
GOLDFIELD	333.3	Kr-85	34	17	25	0.02
NV	319.3	Xe-133	<30	<8	6.0	<0.01
	293.8	H-3 IN ATM. M.*	0.54	<0.4	0.084	-
	293.8	H-3 AS HTO IN AIR	<6	<2	0.55	<0.01
HIKO	2.6	Kr-85	26	26	26	0.03
NV**	2.6	Xe-133	<6	<6	1.9	<0.01

(CONTINUED)

TABLE E-3. (CONTINUED)

SAMPLING LOCATION	NO. DAYS DETECTED	RADIONUCLIDE	RADIOACTIVITY CONC. (pCi/m^3)* MAX	MIN	AVG	PERCENT CONC. GUIDE+
INDIAN SPRINGS	307.8	Kr-85	32	17	24	0.02
NV	307.8	Xe-133	<40	<5	3.9	<0.01
	355.7	H-3 IN ATM. M.*	0.75	<0.4	0.084	-
	355.7	H-3 AS HTO IN AIR	<6	<0.6	0.31	<0.01
LAS VEGAS	317.5	Kr-85	32	18	24	0.02
NV	310.5	Xe-133	<20	<4	3.0	<0.01
	364.8	H-3 IN ATM. M.*	<0.5	<0.4	0.061	-
	357.8	H-3 AS HTO IN AIR	<8	<0.8	0.35	<0.01
LATHROP WELLS	361.5	Kr-85	29	19	24	0.02
NV	340.6	Xe-133	<200	<7	8.0	<0.01
	338.5	H-3 IN ATM. M.*	<0.5	<0.4	0.13	-
	338.5	H-3 AS HTO IN AIR	<7	<0.9	0.69	<0.01
OVERTON	307.3	Kr-85	30	18	24	0.02
NV	281.2	Xe-133	<60	<6	5.5	<0.01
	361.5	H-3 IN ATM. M.*	<0.5	<0.4	0.039	-
	354.4	H-3 AS HTO IN AIR	<8	<2	0.15	<0.01
PAHRUMP	337.5	Kr-85	30	20	24	0.02
NV	344.7	Xe-133	<40	<6	3.9	<0.01
	363.7	H-3 IN ATM. M.*	<0.5	<0.4	0.057	-
	363.7	H-3 AS HTO IN AIR	<8	<0.9	0.39	<0.01
RACHEL	347.7	Kr-85	31	19	26	0.03
NV	326.6	Xe-133	<40	<5	4.2	<0.01
	361.9	H-3 IN ATM. M.*	<0.5	<0.3	0.083	-
	361.9	H-3 AS HTO IN AIR	<7	<0.6	0.48	<0.01
TONOPAH	355.3	Kr-85	31	16	24	0.02
NV	348.3	Xe-133	<60	<7	6.0	<0.01
	355.6	H-3 IN ATM. M.*	0.54	<0.4	0.087	-
	355.6	H-3 AS HTO IN AIR	<5	<2	0.45	<0.01
TWIN SPRINGS RN	2.6	Kr-85	27	27	27	0.03
NV**	2.6	Xe-133	<200	<200	55	0.06
CEDAR CITY	279.5	Kr-85	32	20	25	0.02
UT	251.5	Xe-133	<50	<5	6.8	<0.01
	336.0	H-3 IN ATM. M.*	0.52	<0.4	0.073	-
	336.0	H-3 AS HTO IN AIR	<7	<2	0.35	<0.01

(CONTINUED)

TABLE E-3. (CONTINUED)

SAMPLING LOCATION	NO. DAYS DETECTED	RADIONUCLIDE	RADIOACTIVITY CONC. (pCi/m^3)* MAX	MIN	AVG	PERCENT CONC. GUIDE+
ST GEORGE UT	294.6	Kr-85	30	19	24	0.02
	287.7	Xe-133	<30	<7	4.6	<0.01
	336.6	H-3 IN ATM. M.*	0.49	<0.4	0.049	-
	336.6	H-3 AS HTO IN AIR	<7	<0.9	0.33	<0.01
SALT LAKE CITY UT	224.1	Kr-85	32	19	25	0.02
	208.1	Xe-133	<40	<4	5.1	<0.01
	224.1	H-3 IN ATM. M.*	0.53	<0.5	0.089	-
	224.1	H-3 AS HTO IN AIR	<8	<3	0.67	<0.01

* CONCENTRATIONS OF TRITIUM IN ATMOSPHERIC MOISTURE (ATM. M.) ARE EXPRESSED AS pCi PER ML OF WATER COLLECTED.

\+ CONCENTRATION GUIDES USED ARE FOR EXPOSURE TO A SUITABLE SAMPLE OF THE POPULATION IN AN UNCONTROLLED AREA.

**SPECIAL SAMPLING PROGRAM, SEE TEXT.

TABLE E-4. 1982 SUMMARY OF GROSS BETA ANALYSES FOR FIVE ASN STATIONS

SAMPLING LOCATION	NO. DAYS SAMPLED	RADIOACTIVITY CONC. (pCi/m^3) MAX	MIN	AVG
SHOSHONE CA	327.4	0.052	0.0033	0.0095
LAS VEGAS NV	362.5	0.090	<0.004	0.012
DELTA UT	354.6	0.070	0.0022	0.011
MILFORD UT	329.7	0.055	<0.002	0.012
ST GEORGE UT	363.0	0.048	0.0028	0.012

TABLE E-5. 1982 SUMMARY OF PLUTONIUM CONCENTRATIONS AT SELECTED AIR SURVEILLANCE NETWORK STATIONS

SAMPLING LOCATION	NO. DAYS SAMPLED	RADIO-NUCLIDE	RADIOACTIVITY CONC. (aCi/m^3) MAX	MIN	AVG	PERCENT CONC. GUIDE
(WINSLOW and PHOENIX)	59.3	Pu-238	<10	<4	3.0	0.01
AZ	59.3	Pu-239	190	<7	69	0.3
(BARSTOW and BISHOP)	78.5	Pu-238	<8	<2	0.61	<0.01
CA	78.5	Pu-239	13	<8	9.7	0.05
(DURANGO and PUEBLO)	42.7	Pu-238	<200	<5	35	0.2
CO	42.7	Pu-239	730	<20	260	1
(BOISE and MOUNTAIN HOME)	56.0	Pu-238	<20	<5	3.1	0.01
ID	56.0	Pu-239	<20	<5	12	0.06
(IOWA CITY and SIOUX CITY)	40.6	Pu-238	<20	<4	0.20	<0.01
IA	40.6	Pu-239	27	<7	14	0.07
(MONROE and NEW ORLEANS)	49.0	Pu-238	<20	<3	1.5	<0.01
LA	49.0	Pu-239	<30	<6	4.1	0.02
(JOPLIN and ST. JOSEPH)	66.5	Pu-238	<4	<2	-0.17	<0.01
MO	66.5	Pu-239	22	<5	12	0.06
(BOZEMAN and MISSOULA)	55.8	Pu-238	<20	<6	-0.075	<0.01
MT	55.8	Pu-239	<20	<7	6.8	0.03
LAS VEGAS,	361.2	Pu-238	<40	<7	5.5	0.02
NV	361.2	Pu-239	250	<20	60	0.3
LATHROP WELLS,	326.7	Pu-238	<30	<8	5.8	0.03
NV	326.7	Pu-239	160	<20	65	0.3
RACHEL,	346.7	Pu-238	<30	<7	3.6	0.02
NV	346.7	Pu-239	190	<20	46	0.2
(ALBUQUERQUE and CARLSBAD)	76.4	Pu-238	<10	<2	1.0	<0.01
NM	76.4	Pu-239	25	<5	11	0.05
(MUSKOGEE and NORMAN)	39.0	Pu-238	<5	<3	-0.30	<0.01
OK	39.0	Pu-239	<20	<5	5.9	0.03
(BURNS and MEDFORD)	61.6	Pu-238	<30	<2	0.13	<0.01
OR	61.6	Pu-239	<30	<6	4.9	0.02

(CONTINUED)

TABLE E-5. (CONTINUED)

SAMPLING LOCATION	NO. DAYS SAMPLED	RADIO-NUCLIDE	RADIOACTIVITY CONC. (aCi/m^3) MAX	MIN	AVG	PERCENT CONC. GUIDE
(ABERDEEN and RAPID CITY)	40.6	Pu-238	<30	<2	-1.8	<0.01
SD	40.6	Pu-239	<20	<3	0.42	<0.01
(AUSTIN and FT.WORTH)	37.8	Pu-238	<40	<4	11	0.05
TX	37.8	Pu-239	<20	<5	3.7	0.02
(PROVO and VERNAL)	80.8	Pu-238	<7	<3	-0.71	<0.01
UT	80.8	Pu-239	16	<2	7.2	0.04
(SEATTLE and SPOKANE)	78.0	Pu-238	<7	<3	-0.019	<0.01
WA	78.0	Pu-239	<8	<3	1.3	<0.01
(CASPER and WORLAND)	49.0	Pu-238	<20	<3	2.2	<0.01
WY	49.0	Pu-239	<20	<9	6.1	0.03

TABLE E-6. 1982 SUMMARY OF TRITIUM RESULTS FOR THE NTS MONTHLY LONG-TERM HYDROLOGICAL MONITORING PROGRAM

SAMPLING LOCATION	NO. SAMPLES	TRITIUM CONCENTRATION (pCi/L)			PERCENT CONC. GUIDE
		MAX	MIN	AVG	
WELL 8	8	<9	<7	-1.7	<0.01
WELL A	9	<9	<7	-2.9	<0.01
WELL C	9	280	22	79	<0.01
WELL 5C	9	<9	<7	-1.5	<0.01
WELL ARMY 1	9	14	<8	-0.84	<0.01
WELL 2	9	13	<7	0.40	<0.01
TEST WELL B	7	160	110	130	0.01
WELL 3	9	<9	<7	3.5	<0.01
WELL 4	9	<9	<7	-1.5	<0.01
WELL J-13	9	<9	<7	-3.0	<0.01
WELL U19C	9	<9	<7	-1.4	<0.01
WELL UE7NS	2	1500	1400	1400	0.1

TABLE E-7. TRITIUM RESULTS FOR THE NTS SEMI-ANNUAL LONG-TERM HYDROLOGICAL MONITORING PROGRAM

SAMPLING LOCATION	COLLECTION DATE 1982	TRITIUM CONC. ± 2 SIGMA (pCi/L)	PCT OF CONC. GUIDE
ASH MEADOWS NV CRYSTAL POOL	01/14	-3.2 ± 5.0*	<0.01
	07/07	-2.4 ± 5.6*	<0.01
WELL 18S-51E-7DV	01/14	-2.8 ± 5.5*	<0.01
	07/07	0.34 ± 5.5*	<0.01
WELL 17S-50E-14CAC	01/14	-3.2 ± 4.9*	<0.01
	07/07	-0.56 ± 5.5*	<0.01
FAIRBANKS SPRINGS	01/14	-3.5 ± 4.8*	<0.01
	07/07	-5.0 ± 6.2*	<0.01
BEATTY NV NECO WELL	01/14	10 ± 4	<0.01
	07/08	1.9 ± 5.7*	<0.01
COFFERS WELL 11S/48/1DD	01/13	-3.3 ± 4.6*	<0.01
	07/06	170 ± 6	0.02
CITY SUPPLY 12S-47E-7DB	01/13	4.9 ± 4.6*	<0.01
	07/08	2.7 ± 5.4*	<0.01
BOULDER CITY NV LAKE MEAD INTAKE	07/30	160 ± 7 (SEE NOTE 1)	0.02
INDIAN SPRINGS NV USAF WELL 2	01/12	1.1 ± 4.9*	<0.01

(CONTINUED)

TABLE E-7. (CONTINUED)

SAMPLING LOCATION	COLLECTION DATE 1982	TRITIUM CONC. ± 2 SIGMA (pCi/L)	PCT OF CONC. GUIDE
INDIAN SPRINGS NV (Cont) USAF WELL 2	07/06	-1.1 ± 5.2*	<0.01
SEWER CO INC WELL 1	01/12	-2.4 ± 4.6*	<0.01
	07/06	-1.3 ± 5.3*	<0.01
LATHROP WELLS NV CITY 15S-50E-18CDC	01/14	-3.0 ± 4.6*	<0.01
	07/08	5.6 ± 5.2*	<0.01
NTS NV WELL UE18R	01/20	NO SAMPLE COLLECTED	
	07/14	NO SAMPLE COLLECTED	
WELL UE15D	01/20	NO SAMPLE COLLECTED	
	07/15	NO SAMPLE COLLECTED	
TEST WELL D	01/21	6.5 ± 5.1*	<0.01
	07/15	3.3 ± 5.3*	<0.01
WELL UE1C	01/21	0.32 ± 5.0*	<0.01
	07/15	1.3 ± 5.4*	<0.01
WELL C-1	01/20	14 ± 4	<0.01
	07/14	6.6 ± 5.3*	<0.01
WELL UE5C	01/19	10 ± 5	<0.01
	07/14	180 ± 7	0.02

(CONTINUED)

TABLE E-7. (CONTINUED)

SAMPLING LOCATION	COLLECTION DATE 1982	TRITIUM CONC. ± 2 SIGMA (pCi/L)	PCT OF CONC. GUIDE
NTS NV (Cont) WELL 5B	01/19	-2.3 ± 6.3*	
	07/14	180 ± 7	0.02
TEST WELL F	01/13	NO SAMPLE COLLECTED	
	07/15	NO SAMPLE COLLECTED	
WELL U16D	07/14	-8.9 ± 5.3* (SEE NOTE 2)	
OASIS VALLEY NV GOSS SPRINGS	01/13	-1.6 ± 5.3*	
	07/08	190 ± 7	0.02
SARCOBATUS FLAT NV RD D WNDMLL 594637AL	01/13	NO SAMPLE COLLECTED	

* CONCENTRATION IS LESS THAN THE MINIMUM DETECTABLE CONCENTRATION (MDC).

	ANALYSIS	RESULT	2 SIGMA	UNITS
NOTE 1	Ra-226	0.52	0.13	pCi/L
	Sr-89	0.99	2.1*	pCi/L
	Pu-238	0.024	0.028*	pCi/L
	Sr-90	0.25	0.60*	pCi/L
	Pu-239	0.12	0.04	pCi/L
NOTE 2	Ra-226	1.3	0.2	pCi/L
	Pu-238	0.021	0.032*	pCi/L
	Sr-90	LOST IN CHEMISTRY		
	Pu-239	0.013	0.025*	pCi/L

TABLE E-8. TRITIUM RESULTS FOR THE NTS ANNUAL LONG-TERM HYDROLOGICAL MONITORING PROGRAM

SAMPLING LOCATION	COLLECTION DATE 1982	TRITIUM CONC. ± 2 SIGMA (pCi/L)	PCT OF CONC. GUIDE
SHOSHONE CA SHOSHONE SPRING	08/24	130 ± 220*	0.01
ADAVEN NV ADAVEN SPRING	08/25	350 ± 190	0.03
ALAMO NV CITY WELL 4	08/31	79 ± 220*	<0.01
CLARK STATION NV TTR WELL 6	08/25	50 ± 220*	<0.01
HIKO NV CRYSTAL SPRINGS	08/31	50 ± 220*	<0.01
LAS VEGAS NV WATER DISTRICT WELL 28	08/23	130 ± 220*	0.01
NYALA NV SHARP'S RANCH	08/25	-84 ± 220*	<0.01
PAHRUMP NV CALVADA WELL 3	08/24	-20 ± 220*	<0.01
TEMPIUTE NV UNION CARBIDE WELL	08/31	-20 ± 220*	<0.01
TONOPAH NV CITY WELL	08/26	15 ± 220*	<0.01
WARM SPRINGS NV TWIN SPRINGS RCH	08/25	-180 ± 220*	<0.01

* CONCENTRATION IS LESS THAN THE MINIMUM DETECTABLE CONCENTRATION (MDC).

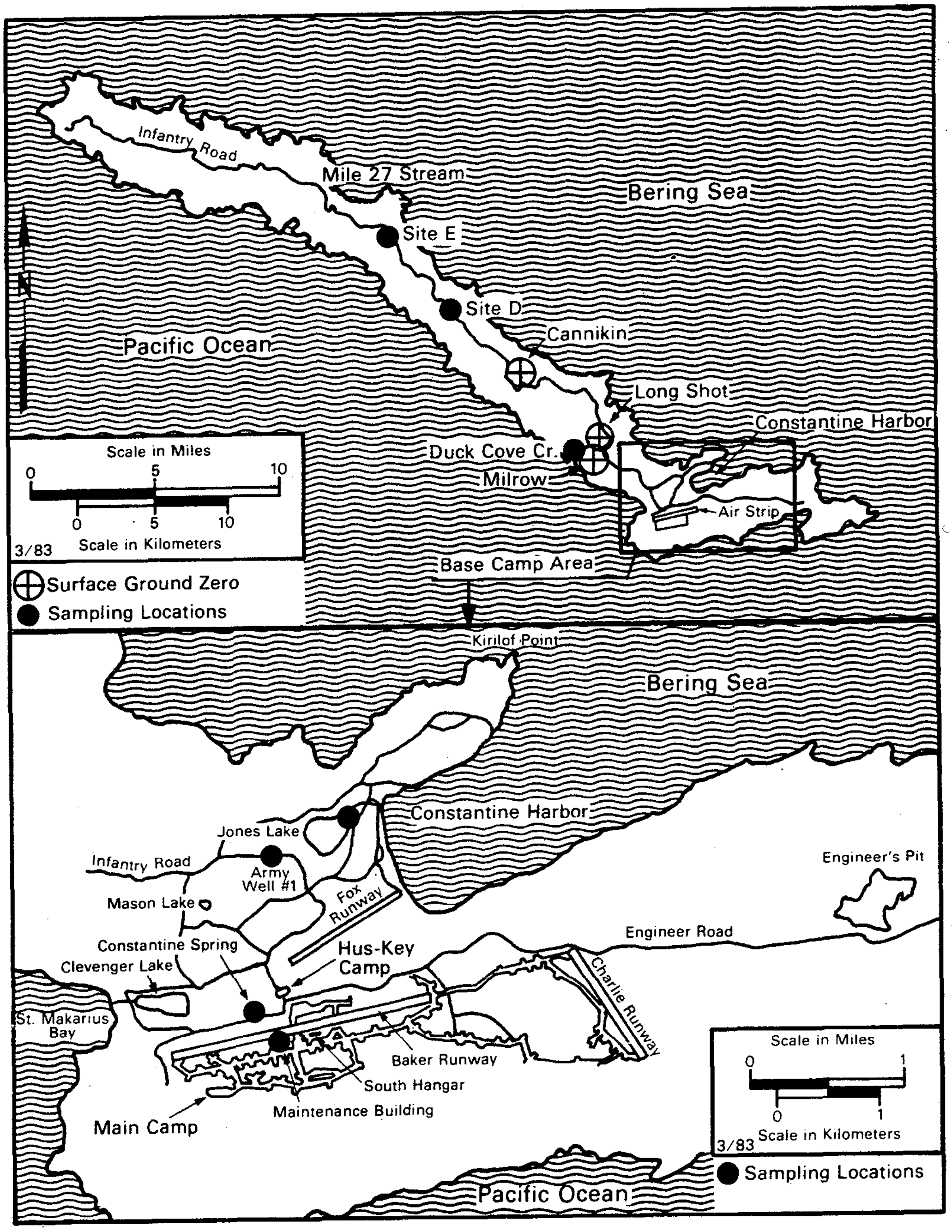

Figure E-1. Amchitka Island and background sampling locations for the LTHMP.

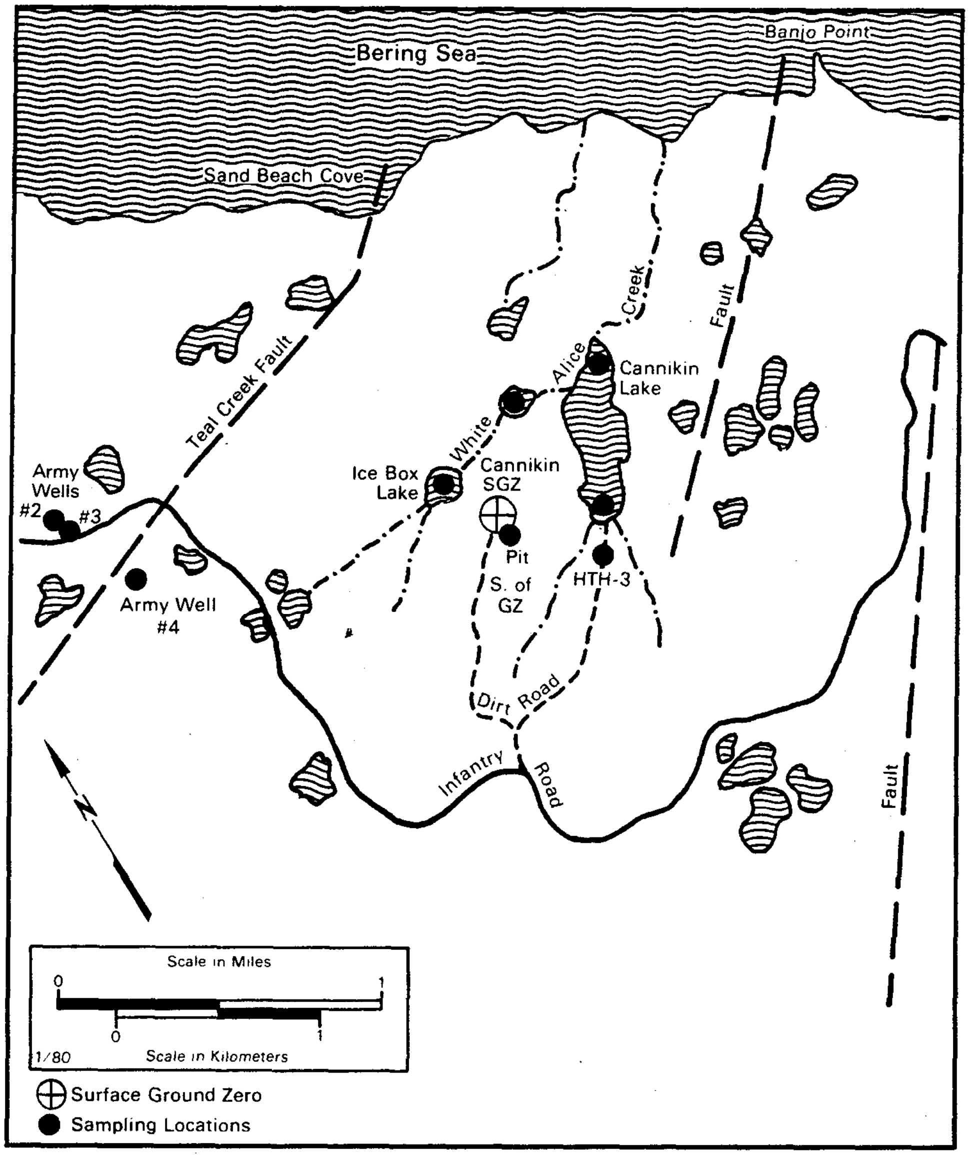

Figure E-2. LTHMP sampling locations for Project Cannikin.

TABLE E-9. TRITIUM RESULTS FOR THE OFF-NTS LONG-TERM HYDROLOGICAL MONITORING PROGRAM (Annual Samples)

SAMPLING LOCATION	COLLECTION DATE 1982	TRITIUM CONC. ± 2 SIGMA (pCi/L)	PCT OF CONC. GUIDE
PROJECT CANNIKIN-- AMCHITKA, ALAS			
SOUTH END CANNIKIN LAKE	09/14	51 ± 5	<0.01
NORTH END CANNIKIN LAKE	09/14	54 ± 6	<0.01
WELL HTH-3	09/14	62 ± 6	<0.01
ICE BOX LAKE	09/14	47 ± 5	<0.01
WHITE ALICE CREEK	09/14	62 ± 6	<0.01
WELL AEC-1		NO SAMPLE COLLECTED	
PIT S OF CANNIKIN GZ	09/14	48 ± 6	<0.01
PROJECT MILROW - AMCHITKA, ALAS			
HEART LAKE	09/15	61 ± 6	<0.01
WELL W-2	09/15	50 ± 6	<0.01
WELL W-3	09/15	40 ± 6	<0.01
WELL W-4	09/15	NO SAMPLE COLLECTED	
WELL W-5	09/15	59 ± 6	<0.01
WELL W-6	09/15	58 ± 6	<0.01
WELL W-7	09/15	46 ± 6	<0.01
WELL W-8	09/15	73 ± 6	<0.01
WELL W-10	09/15	67 ± 5	<0.01
WELL W-11	09/15	82 ± 6	<0.01

(CONTINUED)

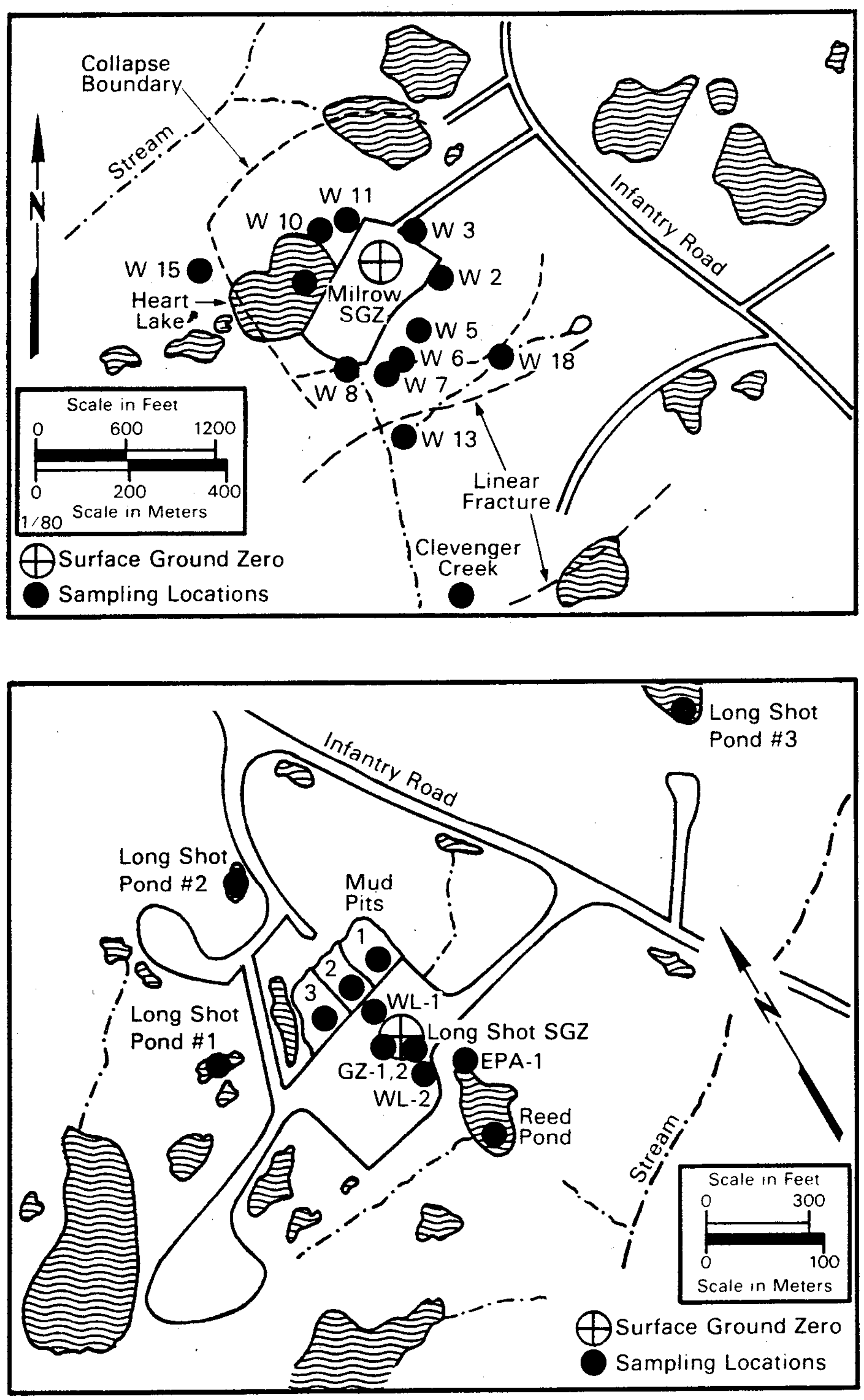

Figure E-3. LTHMP sampling locations for Projects Milrow and Long Shot.

TABLE E-9. CONTINUED

SAMPLING LOCATION	COLLECTION DATE 1982	TRITIUM CONC. ± 2 SIGMA (pCi/L)	PCT OF CONC. GUIDE
<u>PROJECT MILROW - AMCHITKA AK (Cont)</u>			
WELL W-12	09/15	NO SAMPLE COLLECTED	
WELL W-13	09/15	71 ± 6	<0.01
WELL W-15	09/15	49 ± 5	<0.01
WELL W-18	09/15	58 ± 5	<0.01
WELL W-19	09/16	NO SAMPLE COLLECTED	
CLEVENGER CREEK	09/16	73 ± 6	<0.01
<u>PROJECT LONG SHOT - AMCHITKA AK</u>			
WELL WL-2	09/16	420 ± 9	0.04
EPA WELL-1	09/16	97 ± 6	0.01
REED POND	09/16	70 ± 6	<0.01
WELL GZ 1	09/16	3800 ± 240	0.4
WELL GZ 2	09/16	320 ± 9	0.03
WELL WL-1	09/16	64 ± 6	<0.01
MUD PIT 1	09/17	690 ± 200	0.07
MUD PIT 2	09/16	850 ± 210	0.08
MUD PIT 3	09/16	1000 ± 210	0.1
LONG SHOT POND NO 1	09/17	48 ± 6 (SEE NOTE 2)	<0.01
LONG SHOT POND NO 2	09/17	58 ± 6 (SEE NOTE 3)	<0.01

(CONTINUED)

TABLE E-9. CONTINUED

SAMPLING LOCATION	COLLECTION DATE 1982	TRITIUM CONC. ± 2 SIGMA (pCi/L)	PCT OF CONC. GUIDE
PROJECT LONG SHOT - AMCHITKA AK (Cont)			
LONG SHOT POND NO 3	09/17	69 ± 6 (SEE NOTE 4)	<0.01
BACKGROUND SAMPLES - AMCHITKA AK			
CONSTANTINE SPRING	09/14	94 ± 7	0.01
JONES LAKE	09/14	67 ± 7	<0.01
DUCK COVE CREEK	09/15	63 ± 6	<0.01
RAIN SAMPLE	09/16	65 ± 6	<0.01
	09/18	88 ± 6 (SEE NOTE 1)	<0.01
	09/19	78 ± 6	<0.01
ARMY WELL 1	09/14	72 ± 6	<0.01
ARMY WELL 2	09/15	32 ± 6	<0.01
ARMY WELL 3	09/15	79 ± 6	<0.01
	09/15	NA	<0.01
ARMY WELL NO 4	09/15	82 ± 6 (SEE NOTE 5)	<0.01
SITE E HYDRO EXPLOR HOL	09/15	200 ± 7 OIL & DIESEL FUEL IN WELL	0.02
SITE D HYDRO EXPLOR HOL	09/15	100 ± 6	<0.01

* CONCENTRATION IS LESS THAN THE MINIMUM DETECTABLE CONCENTRATION (MDC).

TABLE E-9. CONTINUED

	ANALYSIS	RESULT	2SIGMA	UNITS
NOTE 1	U-238	0.077	0.038	pCi/L
	U-234	0.10	0.05	pCi/L
	U-235	0.0037	0.019*	pCi/L
	Ra-226	0.16	0.11	pCi/L
	Sr-89	2.2	2.8*	pCi/L
	Sr-90	-0.49	0.62*	pCi/L
	Pu-238	-0.0098	0.032*	pCi/L
	Pu-239	-0.0025	0.0081*	pCi/L
NOTE 2	U-238	0.13	0.05	pCi/L
	U-234	0.18	0.07	pCi/L
	U-235	0.0050	0.026*	pCi/L
	Ra-226	0.096	0.079*	pCi/L
	Pu-238	-0.013	0.44*	pCi/L
	Pu-239	0.013	0.020*	pCi/L
	Sr-90	0.16	0.56*	pCi/L
	Sr-89	0.36	2.5*	pCi/L
NOTE 3	U-235	0.0040	0.023*	pCi/L
	U-238	0.064	0.036	pCi/L
	U-234	0.044	0.049*	pCi/L
	Pu-238	-0.0053	0.017*	pCi/L
	Ra-226	0.23	0.13	pCi/L
	Pu-239	-0.0026	0.0087*	pCi/L
	Sr-90	-0.25	0.51*	pCi/L
	Sr-89	2.1	2.4*	pCi/L
NOTE 4	U-234	0.0060	0.060*	pCi/L
	U-238	0.048	0.038*	pCi/L
	U-235	-0.0030	0.035*	pCi/L
	Pu-238	-0.016	0.054*	pCi/L
	Ra-226	0.15	0.10	pCi/L
	Pu-239	-0.0027	0.0090*	pCi/L
	Sr-90	0.15	0.54*	pCi/L
	Sr-89	0.64	2.4*	pCi/L

(CONTINUED)

TABLE E-9. CONTINUED

	ANALYSIS	RESULT	2SIGMA	UNITS
NOTE 5	U-235	0.049	0.064*	pCi/L
	U-238	0.21	0.09	pCi/L
	U-234	0.25	0.10	pCi/L
	Ra-226	0.32	0.25	pCi/L
	Pu-239	-0.0056	0.019*	pCi/L
	Sr-90	0.36	0.61*	pCi/L
	Sr-89	-1.1	2.8*	pCi/L
	Pu-238	-0.014	0.046*	pCi/L

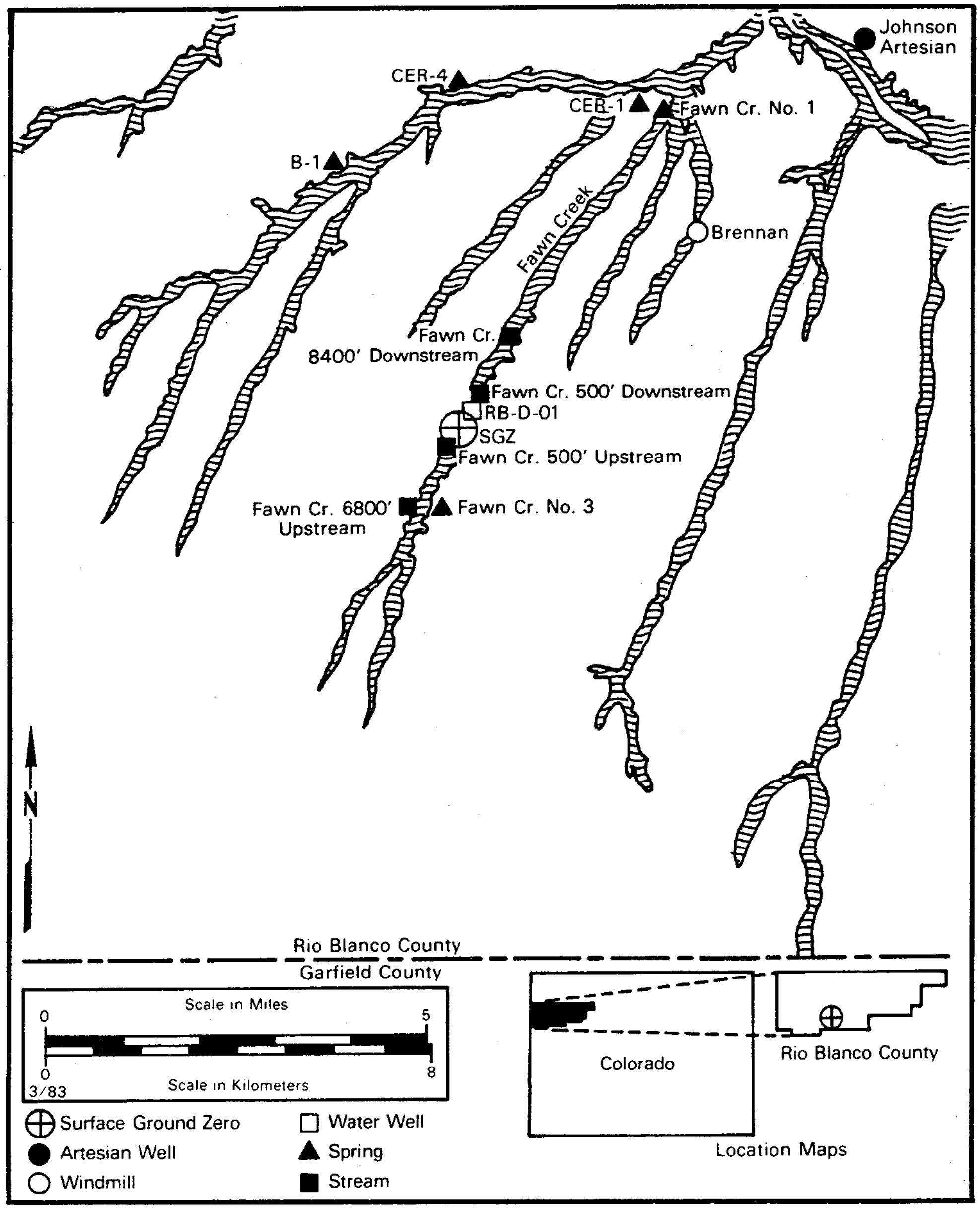

Figure E-4. LTHMP sampling locations for Project Rio Blanco.

TABLE E-9. CONTINUED

SAMPLING LOCATION	COLLECTION DATE 1982	TRITIUM CONC. ± 2 SIGMA (pCi/L)	PCT OF CONC. GUIDE
<u>PROJECT RIO BLANCO - RIO BLANCO CO</u>			
FAWN CREEK 6800FT UPSTR	05/18	69 ± 6	<0.01
FAWN CREEK 500FT UPSTRE	05/18	72 ± 6	<0.01
FAWN CREEK 500FT DWNSTR	05/18	74 ± 6	<0.01
FAWN CREEK 8400FT DWNST	05/18	84 ± 6	<0.01
FAWN CREEK 1	05/18	57 ± 6	<0.01
FAWN CREEK 3	05/18	50 ± 6	<0.01
CER 1 BLACK SULPHUR	05/19	73 ± 6	<0.01
CER 4 BLACK SULPHUR	05/19	120 ± 6	0.01
B-1 EQUITY CAMP	05/19	130 ± 6	0.01
BRENNAN WINDMILL	05/18	NO SAMPLE COLLECTED	
JOHNSON ARTESIAN WELL	05/19	-1.5 ± 6.4*	<0.01
WELL RB-D-01	05/19	0.42 ± 5.5*	<0.01

* CONCENTRATION IS LESS THAN THE MINIMUM DETECTABLE CONCENTRATION (MDC).

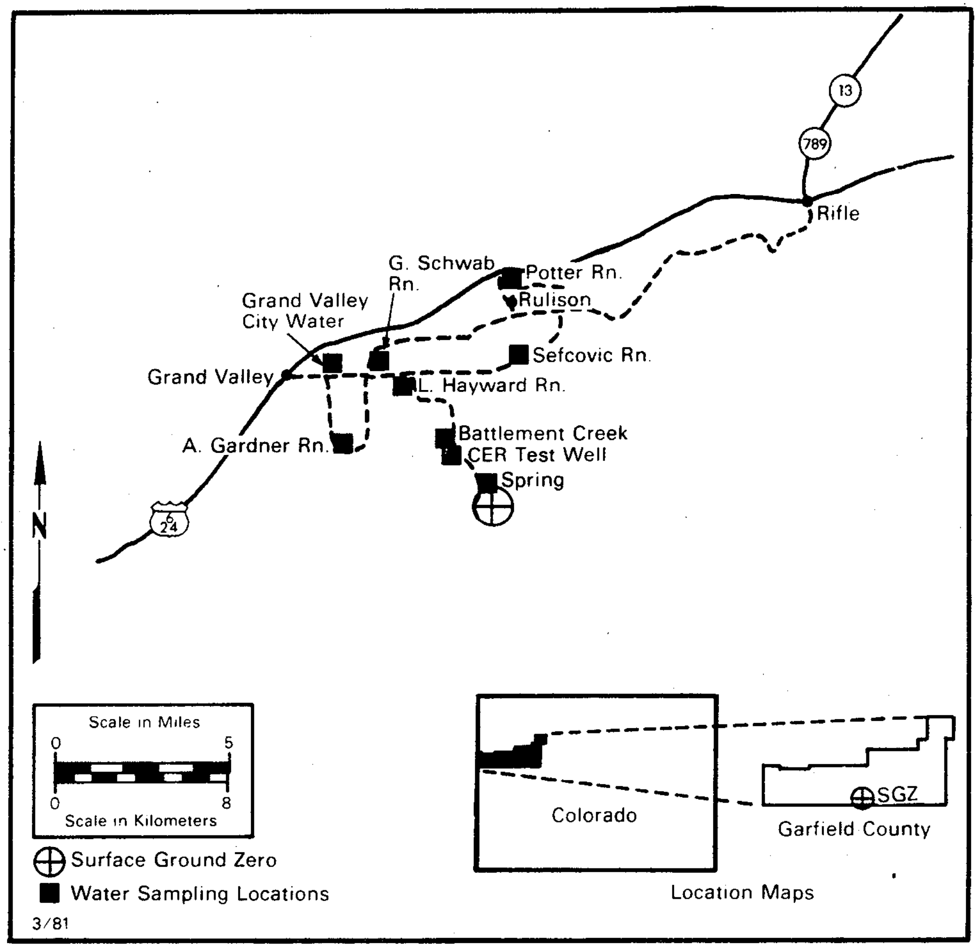

Figure E-5. LTHMP sampling locations for Project Rulison.

TABLE E-9. CONTINUED

SAMPLING LOCATION	COLLECTION DATE 1982	TRITIUM CONC. ± 2 SIGMA (pCi/L)	PCT OF CONC. GUIDE
PROJECT RULISON - GRAND VALLEY CO			
ALBERT GARDNER RANCH	05/21	250 ± 8	0.03
GRAND VALLEY CITY SPRIN	05/23	74 ± 6	<0.01
SPRING 300 YRDS NW OF G	05/22	190 ± 7	0.02
BATTLEMENT CREEK	05/22	190 ± 7	0.02
CER TEST WELL	05/22	280 ± 8	0.03
LEE HAYWARD RANCH	05/21	370 ± 8	0.04
ROBERT SEARCY RANCH(G S)	05/21	320 ± 8	0.03
FELIX SEFCOVIC RANCH	05/23	320 ± 8	0.03
POTTER RANCH	05/23	270 ± 8	0.03

* CONCENTRATION IS LESS THAN THE MINIMUM DETECTABLE CONCENTRATION (MDC).

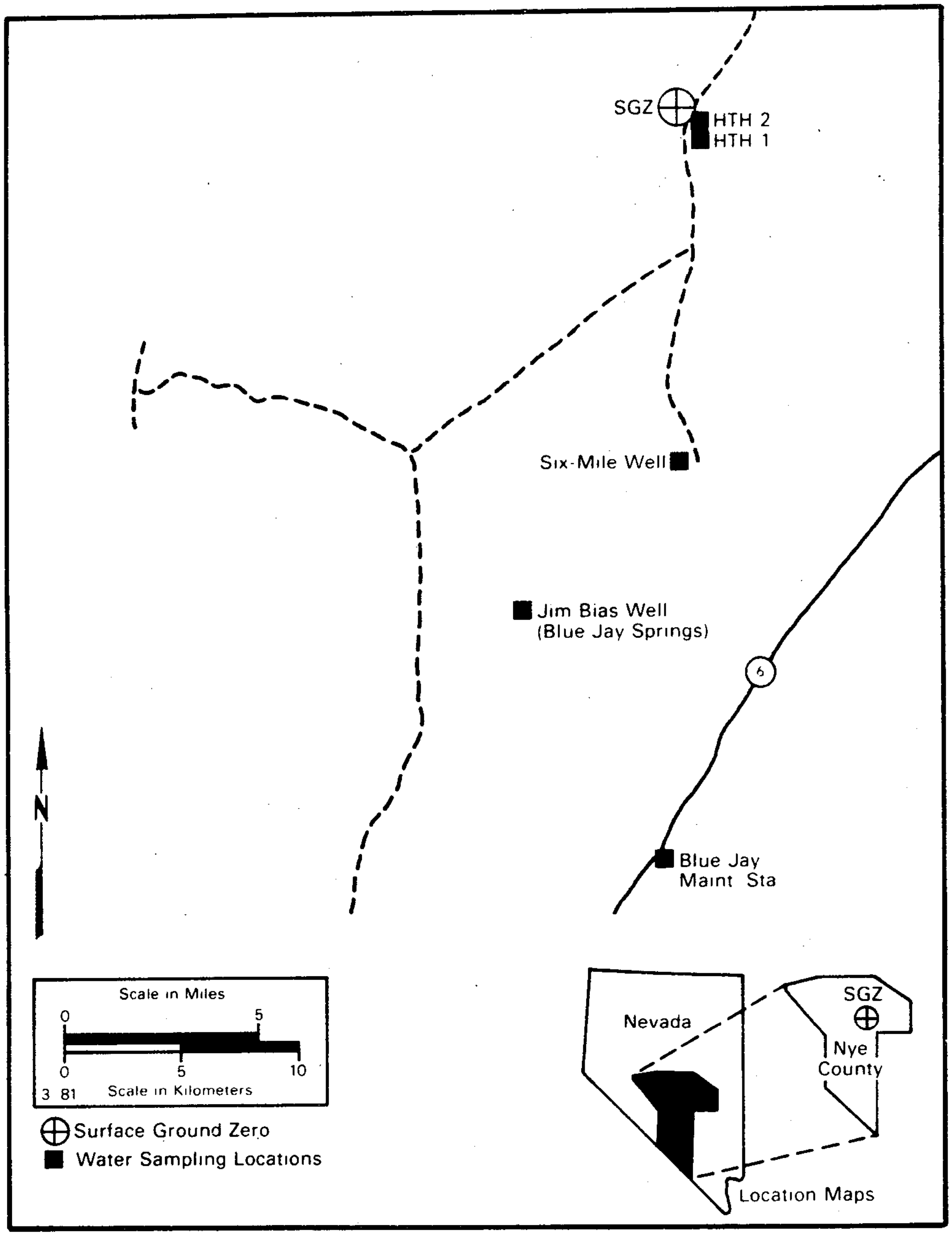

Figure E-6. LTHMP sampling locations for Project Faultless.

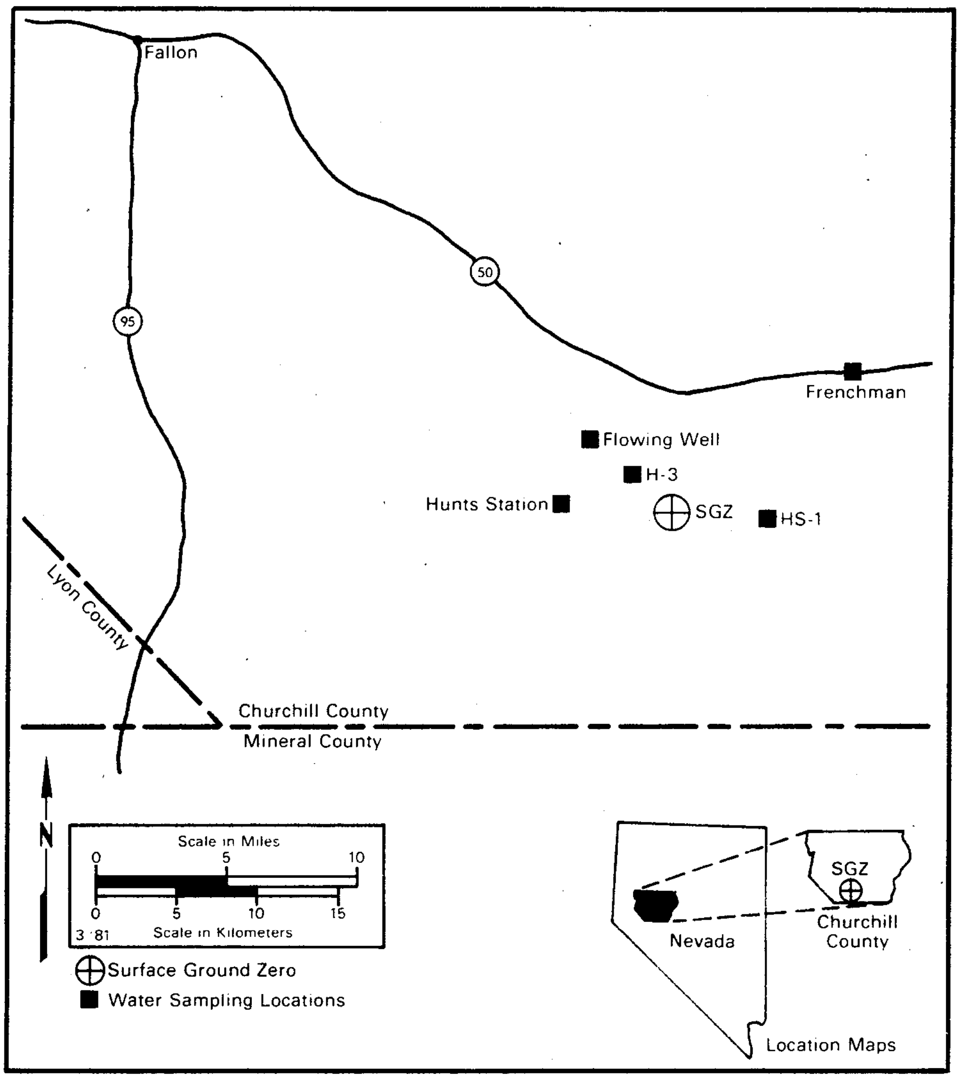

Figure E-7. LTHMP sampling locations for Project Shoal.

TABLE E-9. CONTINUED

SAMPLING LOCATION	COLLECTION DATE 1982	TRITIUM CONC. ± 2 SIGMA (pCi/L)	PCT OF CONC. GUIDE
PROJECT FAULTLESS - BLUE JAY NV			
MAINTENANCE STATION	07/22	5.8 ± 5.2*	<0.01
SIX MILE WELL	07/21	3.7 ± 5.2*	<0.01
WELL HTH-1	07/21	240 ± 7	0.02
	10/14	-5.2 ± 5.6*	
WELL HTH-2	07/21	SAMPLE LOST	
	10/14	2.2 ± 5.3*	<0.01
BIAS WELL	07/22	4.7 ± 5.4*	<0.01
PROJECT SHOAL - FRENCHMAN STATION NV			
FRENCHMAN STATION	02/24	2.0 ± 6.3*	<0.01
WELL HS-1	02/24	0 ± 5.6*	<0.01
WELL H-3	02/25	NO SAMPLE COLLECTED	
FLOWING WELL	02/24	5.9 ± 5.5*	<0.01
HUNTS STATION	02/24	2.9 ± 5.4*	<0.01

* CONCENTRATION IS LESS THAN THE MINIMUM DETECTABLE CONCENTRATION (MDC).

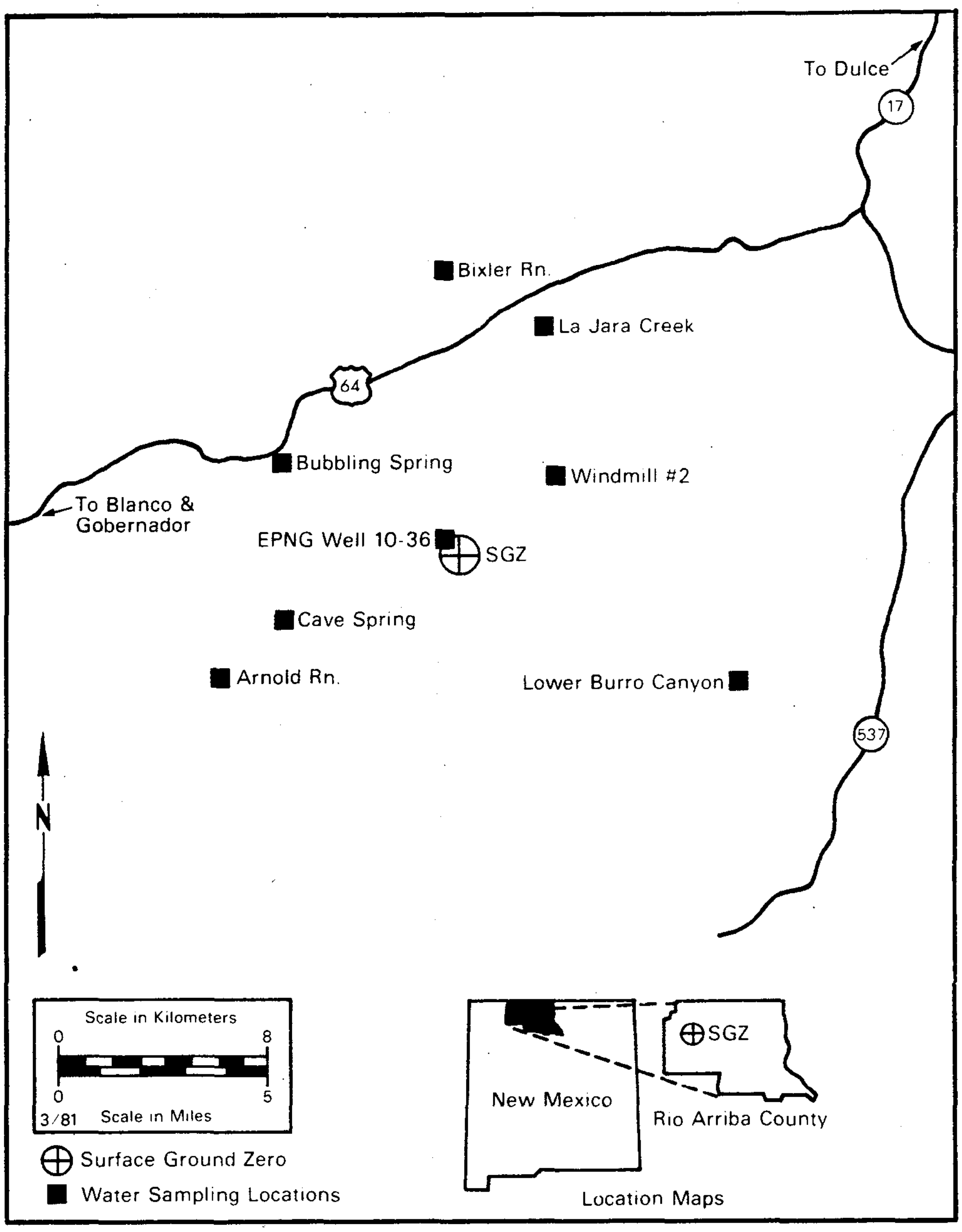

Figure E-8. LTHMP sampling locations for Project Gasbuggy.

TABLE E-9. CONTINUED

SAMPLING LOCATION	COLLECTION DATE 1982	TRITIUM CONC. ± 2 SIGMA (pCi/L)	PCT OF CONC. GUIDE
<u>PROJECT GASBUGGY - GOBERNADOR NM</u>			
ARNOLD RANCH	05/03	-3.2 ± 6.1*	
WELL 30.3.32.343 NORTH	05/02	NO SAMPLE COLLECTED	
WELL 28.3.33.233 SOUTH	05/03	NO SAMPLE COLLECTED	
LOWER BURRO CANYON	05/06	-10 ± 6*	
BIXLER RANCH	05/02	13 ± 5	<0.01
CAVE SPRINGS	05/06	57 ± 6	<0.01
WINDMILL 2	05/02	NO SAMPLE COLLECTED	<0.01
BUBBLING SPRINGS	05/02	87 ± 6	<0.01
EPNG WELL 10-36	05/06	20 ± 5	<0.01
LA JARA CREEK	05/02	81 ± 6	<0.01

* CONCENTRATION IS LESS THAN THE MINIMUM DETECTABLE CONCENTRATION (MDC).

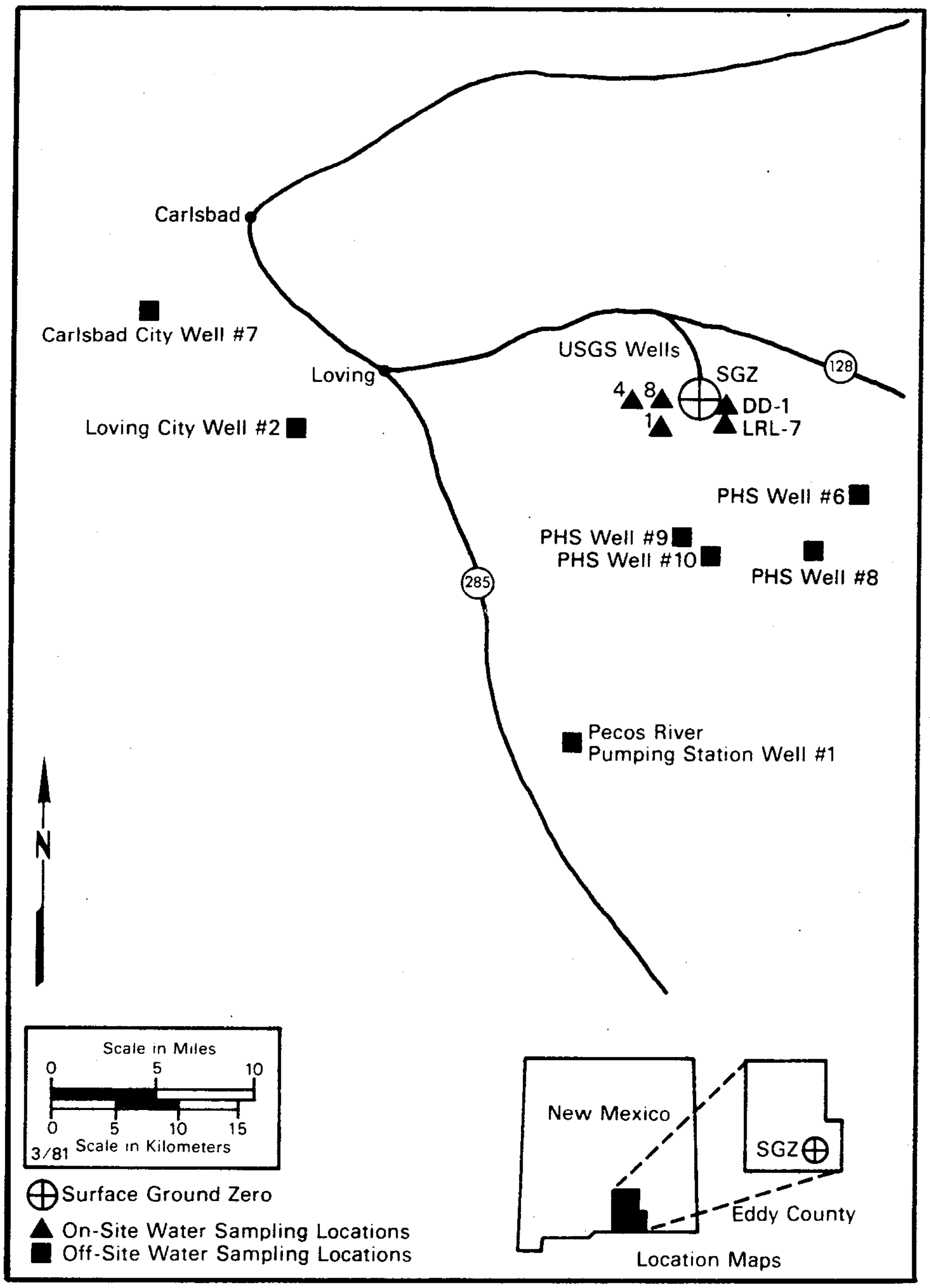

Figure E-9. LTHMP sampling stations for Project Gnome.

TABLE E-9. CONTINUED

SAMPLING LOCATION	COLLECTION DATE 1982	TRITIUM CONC. ± 2 SIGMA (pCi/L)	PCT OF CONC. GUIDE
PROJECT GNOME - CARSBAD NM			
CARLSBAD CITY WELL 7	04/26	-3.1 ± 5.9*	<0.01
PROJECT GNOME - LOVING NM			
LOVING CITY WATER WELL	04/23	6.2 ± 5.7*	<0.01
PROJECT GNOME - MALAGA NM			
USGS WELL 1	04/29	-4.5 ± 6.2* (SEE NOTE 1)	<0.01
USGS WELL 4	04/25	360000 ± 1600 (SEE NOTE 2)	40
USGS WELL 8	04/25	290000 ± 1500 (SEE NOTE 3)	30
PHS WELL 6	04/24	69 ± 6	<0.01
PHS WELL 8	04/24	5.5 ± 5.3*	<0.01
PHS WELL 9	04/28	-4.6 ± 5.3* (SEE NOTE 4)	<0.01
PHS WELL 10	04/28	-1.8 ± 5.4*	<0.01
PECOS PUMPING STATION W	04/23	-1.8 ± 5.4*	<0.01
WELL LRL-7	04/27	22000 ± 440 (SEE NOTE 5)	2
WELL DD-1	04/27	1.5E±08 ± 45000 (SEE NOTE 6)	10,000

* CONCENTRATION IS LESS THAN THE MINIMUM DETECTABLE CONCENTRATION (MDC).

TABLE E-9. CONTINUED

	ANALYSIS	RESULT	2SIGMA	UNITS
NOTE 1	Ra-226	5.5	0.4	pCi/L
NOTE 2	Ra-226	3.5	0.3	pCi/L
	Sr-89	-35000	110000*	pCi/L
	Sr-90	8500	2600	pCi/L
	Pu-238	-0.16	0.52*	pCi/L
	Pu-239	-0.079	0.26*	pCi/L
NOTE 3	Cs-137	21	10	pCi/L
	Ra-226	1.2	0.2	pCi/L
	Sr-89	-6100	20000*	pCi/L
	Sr-90	6900	2100	pCi/L
	Pu-238	0	0.2*	pCi/L
	Pu-239	0	0.2*	pCi/L
NOTE 4	Ra-226	0.18	0.09	pCi/L
NOTE 5	Cs-137	250	21	pCi/L
	Sr-89	-50	730*	pCi/L
	Sr-90	10	16*	pCi/L
	Pu-238	0	0.1*	pCi/L
	Pu-239	0.045	0.15*	pCi/L
NOTE 6	Cs-137	970000	11000	pCi/L
	Sr and Pu Sample lost			

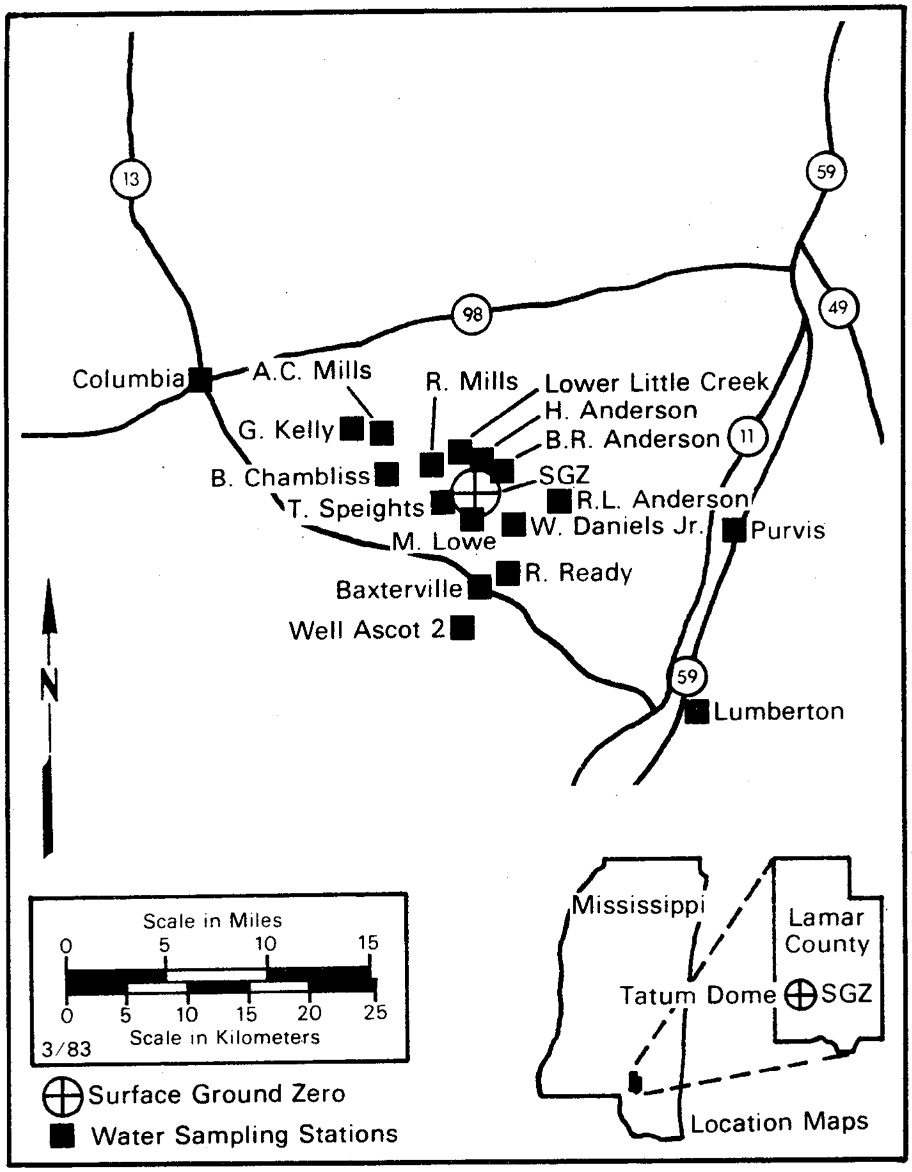

Figure E-10. LTHMP sampling locations for Project Dribble - towns and residences.

TABLE E-9. CONTINUED

SAMPLING LOCATION	COLLECTION DATE 1982	TRITIUM CONC. ± 2 SIGMA (PCI/L)	PCT OF CONC. GUIDE
<u>PROJECT DRIBBLE - BAXTERVILLE MS</u>			
PIT EAST OF GZ	03/18	39 ± 5	<0.01
PIT SOUTH OF GZ	03/18	27 ± 6	<0.01
BAXTERVILLE CITY WELL	03/17	53 ± 5	<0.01
LOWER LITTLE CREEK	03/16	52 ± 5	<0.01
WELL HT-2C	03/22	8.8 ± 4.7	<0.01
WELL HT-4	03/21	95 ± 6	<0.01
WELL HT-5	03/21	2.2 ± 5.4*	<0.01
WELL E-7	03/21	6.6 ± 4.9*	<0.01
HALF MOON CREEK	03/19	52 ± 6	<0.01
T SPEIGHTS	03/17	64 ± 6	<0.01
R L ANDERSON	03/18	44 ± 6	<0.01
M LOWE	03/16	40 ± 5	<0.01
R READY	03/18	73 ± 6	<0.01
W DANIELS JR	03/16	44 ± 5	<0.01
HALF MOON CREEK OVRFLW	03/16	110 ± 6	0.01
WELL ASCOT 2	03/23	32 ± 6	<0.01
WELL HMH-1	03/18	10000 ± 320	1
WELL HMH-2	03/16	2100 ± 220	0.2
WELL HMH-3	03/16	110 ± 7	0.01

(CONTINUED)

TABLE E-9. CONTINUED

SAMPLING LOCATION	COLLECTION DATE 1982	TRITIUM CONC. ± 2 SIGMA (pCi/L)	PCT OF CONC. GUIDE
<u>PROJECT DRIBBLE - BAXTERVILLE MS</u>			
COLUMBIA MS CITY WELL 64B	03/16	6.8 ± 5.0*	<0.01
LUMBERTON MS CITY WELL 2	03/16	5.4 ± 4.9*	<0.01
PURVIS MS CITY WELL 2	03/16	1.7 ± 5.2*	<0.01
BAXTERVILLE CITY WELL	03/17	53 ± 5	<0.01
LOWER LITTLE CREEK	03/16	52 ± 5	<0.01
WELL ASCOT 2	03/23	32 ± 6	<0.01
T SPEIGHTS	03/17	64 ± 6	<0.01
R L ANDERSON	03/18	44 ± 6	<0.01
M LOWE	03/16	40 ± 5	<0.01
R READY	03/18	73 ± 6	<0.01
W DANIELS JR	03/16	44 ± 5	<0.01
B CHAMBLISS	03/16	4.7 ± 4.9*	<0.01
B R ANDERSON	03/18	49 ± 5	<0.01
R MILLS	03/18	52 ± 6	<0.01
A C MILLS	03/18	2.0 ± 6.2*	<0.01
G KELLY	03/18	2.9 ± 5.0*	<0.01
H ANDERSON	03/18	39 ± 5	<0.01
HALF MOON CREEK OVRFLW	03/16	110 ± 6	0.01

(CONTINUED)

TABLE E-9. CONTINUED

SAMPLING LOCATION	COLLECTION DATE 1982	TRITIUM CONC. ± 2 SIGMA (pCi/L)	PCT OF CONC. GUIDE
<u>PROJECT DRIBBLE - BAXTERVILLE MS</u>			
WELL HMH-1	03/18	10000 ± 320	1
WELL HMH-2	03/16	2100 ± 220	0.2
WELL HMH-3	03/16	110 ± 7	0.01
WELL HMH-4	03/17	33 ± 5	<0.01
WELL HMH-5	03/17	1600 ± 210	0.2
WELL HMH-6	03/17	1700 ± 220	0.2
WELL HMH-7	03/16	210 ± 8	0.02
WELL HMH-8	03/16	29 ± 6	<0.01
WELL HMH-9	03/16	63 ± 6	<0.01
WELL HMH-10	03/16	29 ± 5	<0.01
WELL HMH-11	03/16	100 ± 6	0.01
WELL HM-S	03/18	24000 ± 450	2.4
WELL HM-1	03/16	2.3 ± 4.9*	<0.01
WELL HM-L	03/17	2000 ± 220	0.2
WELL HM-2A	03/16	0.12 ± 5.0*	<0.01
WELL HM-2B	03/16	4.0 ± 5.7*	<0.01
WELL HM-3	03/16	2.0 ± 5.0*	<0.01
WELL HT-2C	03/22	8.8 ± 4.7	<0.01
WELL HT-4	03/21	95 ± 6	<0.01
WELL HT-5	03/21	2.2 ± 5.4*	<0.01
WELL E-7	03/21	6.6 ± 4.9*	<0.01

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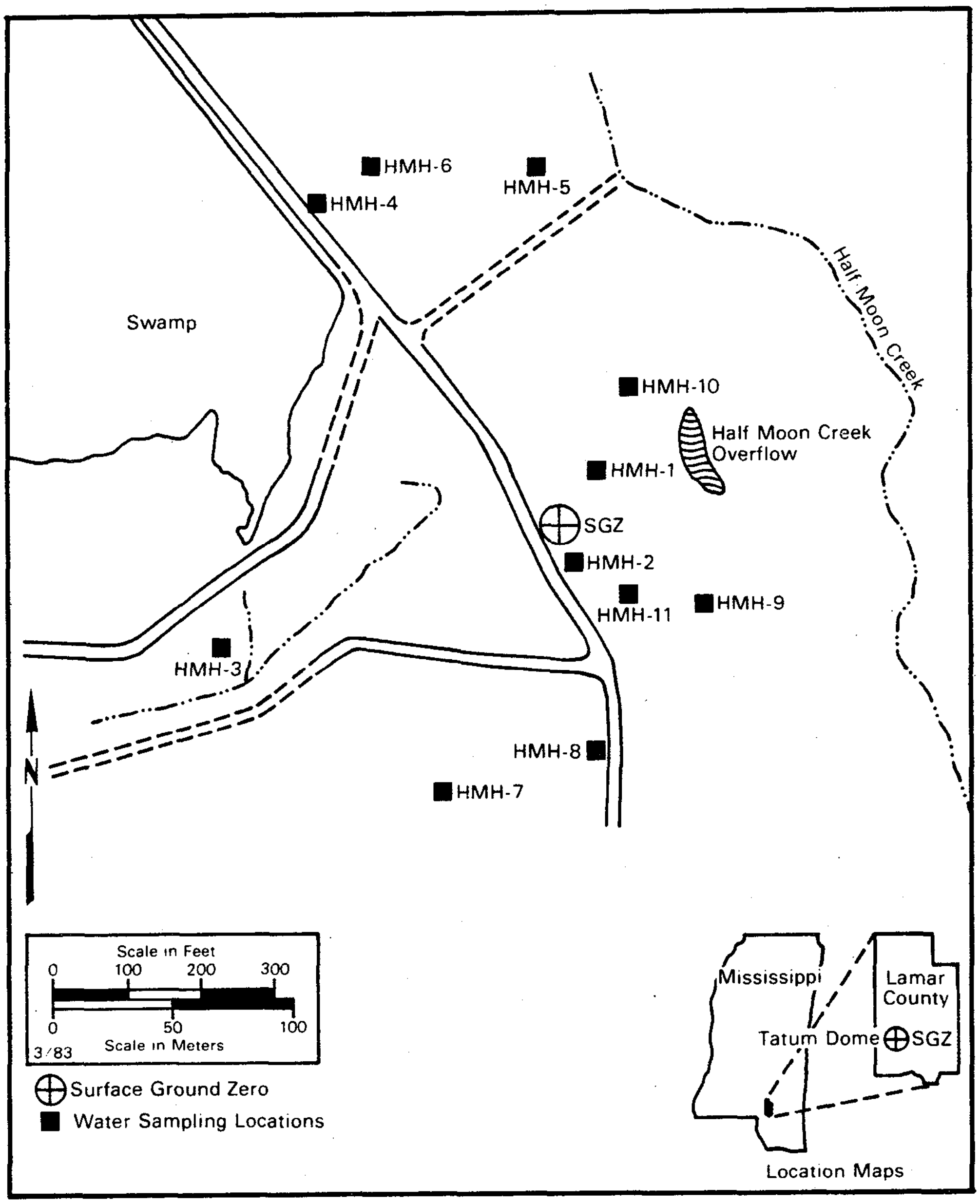

Figure E-11. LTHMP sampling locations for Project Dribble - near GZ.

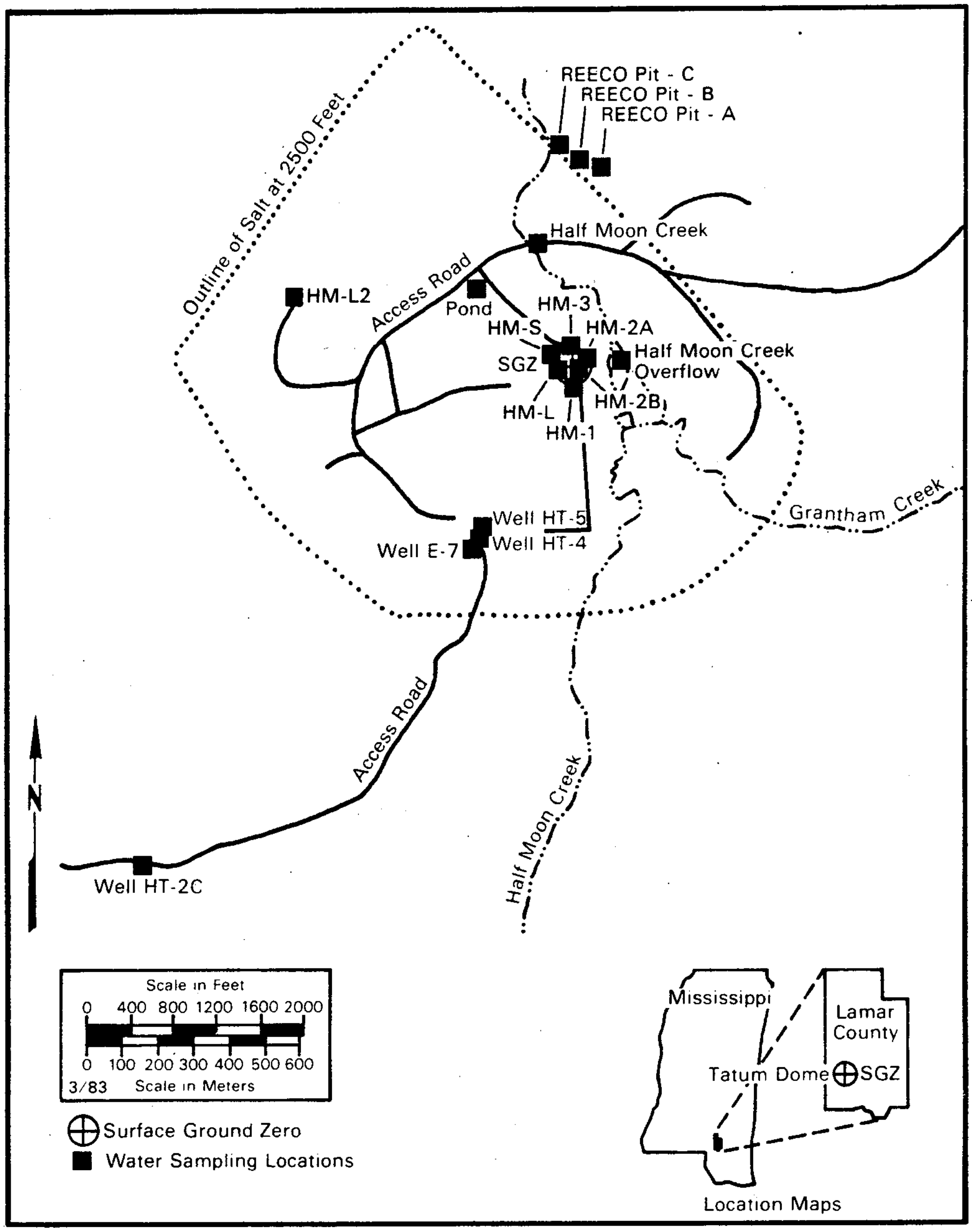

Figure E-12. LTHMP sampling locations for Project Dribble - near salt dome.

TABLE E-9. CONTINUED

SAMPLING LOCATION	COLLECTION DATE 1982	TRITIUM CONC. ± 2 SIGMA (pCi/L)	PCT OF CONC. GUIDE
PROJECT DRIBBLE - BAXTERVILLE MS			
WELL HM-L2	03/17	4.4 ± 5.0* (SEE NOTE 1)	<0.01
HALF MOON CREEK	03/19	52 ± 6	<0.01
REECO PIT DRAINAGE-A	03/18	96 ± 6	<0.01
REECO PIT DRAINAGE-B	03/18	1200 ± 210	0.1
REECO PIT DRAINAGE-C	03/18	1400 ± 210	0.1
PIT EAST OF GZ	03/18	39 ± 5	<0.01
PIT SOUTH OF GZ	03/18	27 ± 6	<0.01
POND WEST OF GZ	03/19	33 ± 5	<0.01

* CONCENTRATION IS LESS THAN THE MINIMUM DETECTABLE CONCENTRATION (MDC).

	ANALYSIS	RESULT	2SIGMA	UNITS
NOTE 1	90SR	1.5	2.4*	pCi/L

TABLE E-10. 1982 SUMMARY OF ANALYTICAL RESULTS FOR THE MILK SURVEILLANCE NETWORK

SAMPLING LOCATION	SAMPLE TYPE	NO. OF SAMPLES	RADIO-NUCLIDE	RADIOACTIVITY CONC. (pCi/L) MAX	MIN	AVG
HINKLEY CA	12	4	H-3	560	<300	210
BILL NELSON DAIRY		4	Sr-89	<30	<8	-0.97
		4	Sr-90	<3	<0.9	0.61
RIDGECREST CA	10	1	H-3	<300	<300	100
CEDARSAGE FARM		1	Sr-89	<20	<20	-7.4
		1	Sr-90	<3	<3	1.4
RIDGECREST CA	13	2	H-3	470	<500	280
JANE SZYMANSKI RANCH		2	Sr-89	<30	<20	7.4
		2	Sr-90	<3	<2	0.47
ALAMO NV	13	1	H-3	<400	<400	52
BUCK HORN RANCH		1	Sr-89	<5	<5	4.0
		1	Sr-90	<0.6	<0.6	-0.13
AUSTIN NV	13	4	H-3	<500	<300	180
YOUNG'S RANCH		4	Sr-89	<40	<20	2.7
		4	Sr-90	<4	<2	1.7
CURRANT NV	13	4	H-3	<500	<300	16
BLUE EAGLE RANCH		3	Sr-89	<20	<6	-0.77
		3	Sr-90	3.1	<0.8	1.4
CURRANT NV	13	4	H-3	<500	<300	110
MANZONIE RANCH		3	Sr-89	<50	<8	-0.46
		3	Sr-90	<6	<2	1.3
HIKO NV	13	2	H-3	<500	<300	110
DARREL HANSEN RANCH		2	Sr-89	<30	<20	-5.9
		2	Sr-90	<3	<2	1.2

(CONTINUED)

TABLE E-10. (CONTINUED)

SAMPLING LOCATION	SAMPLE TYPE	NO. OF SAMPLES	RADIO-NUCLIDE	RADIOACTIVITY CONC. (pCi/L) MAX	MIN	AVG
LAS VEGAS NV	12	4	H-3	<500	<300	160
LDS DAIRY FARMS		4	Sr-89	<50	<5	6.9
		4	Sr-90	12	<0.7	3.6
LATHROP WELLS NV	13	3	H-3	<500	<300	92
R J EASTMAN RANCH		3	Sr-89	<20	<9	-0.003
		3	Sr-90	<2	<2	0.53
LIDA NV	13	4	H-3	<500	<300	74
LIDA LIVESTOCK COMPANY		4	Sr-89	<30	<6	1.2
		4	Sr-90	4.4	1.2	2.3
LOGANDALE NV	12	5	H-3	<500	<300	79
KNUDSEN CORP		4	Sr-89	<20	<6	6.3
		4	Sr-90	<2	<0.8	-0.041
LUND NV	12	4	H-3	<500	<300	54
MCKENZIE DAIRY		4	Sr-89	<50	<7	-1.1
		4	Sr-90	12	<0.9	3.4
MCGILL NV	13	2	H-3	<500	<500	190
LARSEN RANCH		2	Sr-89	<20	<20	-1.2
		2	Sr-90	<2	<2	0.66
MESQUITE NV	12	4	H-3	<500	<300	16
SF AND K DAIRY		4	Sr-89	<20	<8	2.2
		4	Sr-90	<2	<1	0.27
MOAPA NV	12	4	H-3	600	<300	230
DECADE CORP		4	Sr-89	<20	<6	5.7
		4	Sr-90	<3	<0.8	0.10
NYALA NV	13	4	H-3	<500	<300	120
SHARP'S RANCH		4	Sr-89	<30	<8	5.0
		4	Sr-90	<3	<0.9	-0.078

(CONTINUED)

TABLE E-10. (CONTINUED)

SAMPLING LOCATION	SAMPLE TYPE	NO. OF SAMPLES	RADIO-NUCLIDE	RADIOACTIVITY CONC. (pCi/L) MAX	MIN	AVG
CALIENTE NV JUNE COX RANCH	13	4	H-3	<500	<300	30
		4	Sr-89	<50	<5	-0.71
		4	Sr-90	<8	<0.8	1.1
ROUND MT NV BERG'S RANCH	13	3	H-3	<500	<300	55
		3	Sr-89	<20	<9	1.5
		3	Sr-90	3.1	<2	2.5
SHOSHONE NV HARBECKE RANCH	13	3	H-3	<500	<300	200
		3	Sr-89	<300	<20	-22
		3	Sr-90	5.5	<2	2.4
WARM SPRINGS NV TWIN SPRINGS RCH	13	2	H-3	<500	<300	-52
		2	Sr-89	<20	<20	8.0
		2	Sr-90	<3	<2	0.91
CEDAR CITY UT WESTERN GEN DAIRIES	12	4	H-3	560	<300	200
		4	Sr-89	<90	<7	15
		4	Sr-90	<9	<2	-0.45
ST GEORGE UT DROUBAY DAIRY	12	4	H-3	<500	<300	180
		4	Sr-89	<30	<7	0.30
		4	Sr-90	<4	<1	1.2

TABLE E-11. 1982 ANALYTICAL RESULTS FOR STANDBY MILK SURVEILLANCE NETWORK

SAMPLING LOCATION	COLLECTION DATE 1982	CONCENTRATION ± 2 SIGMA (pCi/L) H-3	SR-89	SR-90
KINGMAN AZ CANYON FARMS	08/31	NA	-13 ± 15*	2.3 ± 0.8
PIMA AZ SMITH HUNT DAIRY	08/31	NA	- 5.7 ± 10*	0.91 ± 0.82*
TAYLOR AZ SUNRISE DAIRY	08/31	410 ± 300*	0.91 ± 11*	0.83 ± 0.84*
TEMPE AZ UNITED DAIRYMEN OF AZ	08/31	NA	-3.2 ± 18*	0.89 ± 1.7*
TUCSON AZ SHAMROCK DAIRY (PIMA CO	08/31	250 ± 300*	-6.7 ± 11*	1.1 ± 0.9*
YUMA AZ GOLDEN WEST DAIRY	08/31	NA	-5.0 ± 11*	1.1 ± 0.9*
FAYETTEVILLE AR UNIVERSITY OF AR	07/26	NA	4.0 ± 8.8*	2.2 ± 0.6
LITTLE ROCK AR BORDENS	07/26	210 ± 320*	11 ± 13*	3.9 ± 0.8
RUSSELLVILLE AR ARKANSAS TECH UNIV	07/27	180 ± 320*	3.3 ± 10*	2.4 ± 0.7
BAKERSFIELD CA CARNATION DAIRY	08/30	370 ± 300*	-0.36 ± 8.4*	0.67 ± 0.68*
FERNBRIDGE CA HUMBOLDT CREAMERY	08/30	NA	-1.8 ± 14*	2.1 ± 0.7
FRESNO CA STATE UNIV CREAMERY	08/31	NA	-23 ± 17*	2.8 ± 1.0
HOLTVILLE CA SCHAFFNER AND SON DAIRY	09/01	NA	-0.79 ± 2.5*	0.65 ± 2.4*
LEMON GROVE CA MILLER DAIRY	08/30	410 ± 300*	-8.4 ± 10*	1.3 ± 0.5

(CONTINUED)

TABLE E-11. (CONTINUED)

SAMPLING LOCATION	COLLECTION DATE 1982	CONCENTRATION ± 2 SIGMA (pCi/L) H-3	SR-89	SR-90
MANTECA CA LEGEND DAIRY FARMS	08/31	NA	-2.5 ± 33*	0.79 ± 3.2*
MODESTO CA FOSTER FARMS DAIRY	11/14	NA	1.3 ± 2.3*	0.14 ± 0.23*
OXNARD CA CHASE BROS DAIRY	09/07	NA	-16 ± 12*	2.1 ± 0.7
REDDING CA MCCOLL'S DAIRY PROD	08/31	NA	13 ± 26*	0.069 ± 2.5*
SAN LUIS OBISPO CA CAL STATE POLY	09/01	NA	-7.8 ± 14*	1.5 ± 1.3*
SMITH RIVER CA COUNTRY MAID DAIRY	08/31	NA	-3.3 ± 15*	2.6 ± 0.7
SOLEDAD CA CTF DAIRY	09/01	NA	-8.1 ± 16*	0.84 ± 1.2*
WILLITS CA RIDGEWOOD RANCH DAIRY	09/01	NA	-5.5 ± 15*	1.6 ± 1.5*
WILLOWS CA FOREMOST FOODS COMPANY	08/30	340 ± 300*	9.7 ± 18*	0.045 ± 1.6*
COLORADO SPGS CO SINTON DAIRY CO	08/16	NA	-41 ± 33*	3.3 ± 1.0
DELTA CO ARDEN MEADOW GOLD DAIRY	08/19	NA	-9.6 ± 15*	1.7 ± 0.6
GRAND JCT CO COLORADO WEST DAIRIES	08/16	200 ± 320*	-9.3 ± 19*	1.7 ± 1.4*
PUEBLO CO HYDE PARK DAIRY CO	08/17	320 ± 310*	-7.4 ± 15*	1.4 ± 1.1*
BOISE ID MEADOW GOLD DAIRIES	07/26	590 ± 280	3.5 ± 9.8*	0.68 ± 0.92*

(CONTINUED)

TABLE E-11. (CONTINUED)

SAMPLING LOCATION	COLLECTION DATE 1982	CONCENTRATION ± 2 SIGMA (pCi/L) H-3	SR-89	SR-90
TWIN FALLS ID YOUNGS DAIRY	09/03	NA	7.2 ± 25*	1.1 ± 2.5*
CALDWELL ID DCA RECEIVING STA	09/15	NA	-8.6 ± 20*	2.3 ± 2.1*
IDAHO FALLS ID WESTERN GENERAL DAIRY	07/26	660 ± 280	6.0 ± 8.1*	1.1 ± 0.5
LEWISTON ID GOLDEN GRAIN DAIRY PROD	07/26	NA	8.0 ± 6.0*	0.89 ± 0.34
POCATELLO ID ROWLAND'S DAIRY	07/26	NA	4.4 ± 6.0*	1.0 ± 0.4
DAVENPORT IA SWISS VALLEY FARMS CO	09/14	-53 ± 310*	-0.091 ± 13*	2.8 ± 0.8
KIMBALLTON IA AMPI RECEIVING STA	09/14	NA	0.038 ± 12*	2.5 ± 0.6
LAKE MILLS IA LAKE MILLS COOP CRMY	09/13	NA NO SR ANALYSES-SOUR MILK	NA	NA
LEMARS IA WELLS DAIRY	09/13	NA	-2.4 ± 10*	1.7 ± 0.5
CONCORDIA KS FAIRMONT FOOD CO	09/13	41 ± 310*	-2.2 ± 12*	NA
GARDEN CITY KS MYERS MILK PROD	09/13	41 ± 310*	-5.0 ± 12*	2.5 ± 0.6
ELLIS KS MID-AMERICA DAIRY	09/13	NA	-4.2 ± 18*	2.5 ± 1.8*
TOPEKA KS THE DAIRY CO.	09/14	NA	-3.3 ± 11*	2.3 ± 0.6
BATON ROUGE LA LA STATE UNIV	07/26	98 ± 320*	-1.2 ± 7.2*	1.2 ± 0.4

(CONTINUED)

TABLE E-11. (CONTINUED)

SAMPLING LOCATION	COLLECTION DATE 1982	CONCENTRATION ± 2 SIGMA (pCi/L) H-3	SR-89	SR-90
HAMMOND LA SOUTHEASTERN LA COLLEGE	07/26	NA	11 ± 8*	0.95 ± 0.39
LAFAYETTE LA UNIV SOUTHWESTERN LA	07/26	NA	5.3 ± 6.3*	0.88 ± 0.41
LAKE CHARLES LA BORDEN'S	08/05	NA	3.0 ± 6.7*	1.7 ± 0.5
MONROE LA BORDEN'S	07/30	150 ± 320*	7.3 ± 7.8*	1.4 ± 0.4
NEW ORLEANS LA BORDEN'S	07/25	380 ± 320*	-0.41 ± 12*	3.0 ± 0.7
RUSTON LA TECH UNIV DAIRY	07/26	NA	7.0 ± 7.4*	0.87 ± 0.38
SHREVEPORT LA MIDWEST FARMS	08/17	NA	-7.4 ± 19*	2.8 ± 0.9
DALTON MN DALTON CO-OP CREAMERY	08/17	NA	-8.5 ± 19*	2.3 ± 0.8
FLENSBURG MN FLENSBURG CO-OP CMRY	08/16	270 ± 200* (SEE NOTE 1)	-20 ± 26*	2.7 ± 0.8
FOSSTON MN LAND O' LAKES INC	08/24	500 ± 270	-7.5 ± 38*	4.3 ± 3.2*
NICOLLET MN WALTER SCHULTZ FARM	08/17	NA	-8.4 ± 20*	1.5 ± 1.5*
ROCHESTER MN ASSC MILK PRODUCERS	08/16	140 ± 310*	-14 ± 22*	3.0 ± 1.0
AURORA MO MID-AMERICA DAIRY INC	09/13	140 ± 310*	-7.8 ± 17*	4.6 ± 0.9
CHILLICOTHE MO MID-AMERICA DAIRYMEN	09/13	16 ± 310*	-3.3 ± 14*	2.0 ± 0.7

(CONTINUED)

TABLE E-11. (CONTINUED)

SAMPLING LOCATION	COLLECTION DATE 1982	CONCENTRATION ± 2 SIGMA (pCi/L) H-3	SR-89	SR-90
JACKSON MO MID-AMERICA DAIRYMEN IN	09/13	NA	-9.2 ± 13*	2.7 ± 0.7
ST CHARLES MO ST CHARLES DAIRY	09/16	NA	-12 ± 13*	2.9 ± 0.7
BOZEMAN MT DARIGOLD FARMS	11/10	NA	-12 ± 23*	4.6 ± 3.8*
GREAT FALLS MT MEADOW GOLD DAIRY	07/01	NA	-39 ± 42*	3.2 ± 0.9
KALISPELL MT EQUITY SUPPLY CO	11/14	NA	-2.0 ± 7.4*	2.1 ± 0.7
HASTINGS NB ABBOTTS DAIRY	09/14	NA	-8.1 ± 12*	2.8 ± 0.7
NORTH PLATTE NB MID AMERICA DAIRYMEN	09/14	-41 ± 310*	-29 ± 22*	6.5 ± 1.3
FALLON NV CREAMLAND DAIRY	09/03	38 ± 290*	-5.1 ± 16*	1.8 ± 1.6*
LAS VEGAS NV ANDERSON DAIRY	09/02	NA	4.1 ± 8.0*	0.40 ± 0.62*
RENO NV MODEL DAIRY	09/02	NA	8.7 ± 11*	0.26 ± 0.87*
YERINGTON NV VALLEY DAIRY	09/02	NA	-5.3 ± 14*	1.1 ± 1.4*
LAS CRUCES NM LONG'S DAIRY	10/06	NA	-18 ± 23*	2.8 ± 2.3*
BISMARCK ND BRIDGEMENS CREAMERY	08/16	150 ± 310*	-6.7 ± 19*	3.6 ± 0.8
DEVILS LAKE ND LAKE VIEW DAIRY	08/16	NA	-17 ± 37*	3.4 ± 1.2

(CONTINUED)

TABLE E-11. (CONTINUED)

SAMPLING LOCATION	COLLECTION DATE 1982	CONCENTRATION ± 2 SIGMA (pCi/L) H-3	SR-89	SR-90
FARGO ND CASSCLAY CREAMERY	08/18	NA	-13 ± 25*	4.0 ± 1.1
GRAND FORKS ND MINNESOTA DAIRY	08/17	340 ± 310*	-2.3 ± 18*	2.8 ± 0.7
JAMESTOWN ND COUNTRY BOY DAIRY	08/24	NA	-12 ± 22*	4.2 ± 1.0
WILLISTON ND PETERSONS CREAMERY	09/27	NA	-15 ± 32*	4.3 ± 3.1*
ATOKA OK MUNGLE DAIRY	11/15	NA	5.6 ± 10*	4.8 ± 1.0
CLAREMORE OK SWAN BROS DAIRY	08/16	NA	-6.8 ± 17*	2.5 ± 0.7
ENID OK AMPI GOLDSPOT DIVISION	07/26	49 ± 320*	5.1 ± 9.6*	2.0 ± 0.6
MCALESTER OK OKLA ST PENITENTIARY	07/26	670 ± 290	-3.1 ± 7.7*	1.8 ± 0.5
STILLWATER OK OSU DAIRY	08/18	NA	23 ± 36*	3.0 ± 1.0
CORVALLIS OR SUNNY BROOK DAIRY	07/26	410 ± 310*	2.4 ± 6.1*	0.62 ± 0.58*
EUGENE OR ECHO SPRINGS DAIRY	07/26	NA	3.1 ± 5.7*	0.81 ± 0.34
GRANTS PASS OR VALLEY OF ROGUE DAIR	07/26	NA	4.8 ± 4.5*	0.37 ± 0.44*
KLAMATH FALLS OR NEDO BEL CREAMERY	07/26	NA	6.6 ± 6.2*	0.97 ± 0.36
MEDFORD OR DAIRYGOLD FARMS	07/27	580 ± 280	5.1 ± 6.0*	0.46 ± 0.60*

(CONTINUED)

TABLE E-11. (CONTINUED)

SAMPLING LOCATION	COLLECTION DATE 1982	CONCENTRATION ± 2 SIGMA (pCi/L) H-3	SR-89	SR-90
MILTON-FREEWATER OR PARENTS DAIRY	07/26	NA	4.0 ± 5.5*	0.94 ± 0.32
MYRTLE POINT OR SAFEWAY STORES INC	07/26	NA	10 ± 8*	0.65 ± 0.69*
PORTLAND OR DARIGOLD FARMS	07/27	NA	4.3 ± 7.7*	1.7 ± 0.5
REDMOND OR EBERHARD'S CREAMERY INC	07/26	NA	7.0 ± 6.6*	0.39 ± 0.64*
TILLAMOOK OR TILLAMOOK CO CRMY	07/26	NA	11 ± 11*	2.6 ± 0.6
MITCHELL SD CULHANES DAIRY	08/16	NA	-18 ± 25*	3.9 ± 1.1
RAPID CITY SD BROWN SWISS DAIRY	11/11	NA	-11 ± 14*	4.3 ± 1.4
SIOUX FALLS SD TERRACE PARK DAIRY	08/16	350 ± 310*	-22 ± 26*	3.6 ± 1.1
VOLGA SD LAND O'LAKES INC	11/14	NA	-2.9 ± 11*	2.5 ± 1.0
BEAVER UT CACHE VALLEY DAIRY	08/19	NA	-0.25 ± 13*	1.2 ± 1.0*
PROVO UT BYU DAIRY PRODUCTS LAB	08/16	150 ± 310*	-9.6 ± 18*	2.6 ± 0.7
CEDAR CITY UT WESTERN GEN DAIRIES	08/16	NA	-8.7 ± 15*	1.5 ± 0.6
RICHFIELD UT IDEAL DAIRY	08/17	NA	-15 ± 46*	2.6 ± 2.5*
SMITHFIELD UT CACHE VALLEY DAIRY	08/19	NA	-7.6 ± 18*	2.5 ± 0.7

(CONTINUED)

TABLE E-11. (CONTINUED)

SAMPLING LOCATION	COLLECTION DATE 1982	CONCENTRATION ± 2 SIGMA (pCi/L) H-3	SR-89	SR-90
MOSES LAKE WA SAFEWAY STORES INC	09/10	NA	-25 ± 22*	3.9 ± 1.3
SPOKANE WA CONSOLIDATED DAIRY	07/27	510 ± 280	12 ± 16*	1.6 ± 1.6*
CHEYENNE WY DAIRY GOLD FOODS	08/17	NA	-10 ± 21*	2.9 ± 0.9
LARAMIE WY UNIV OF WYO (DAIRY)	11/12	NA	-0.34 ± 7.4*	1.9 ± 0.7
POWELL WY CREAM OF THE VALLEY DAI	08/15	-64 ± 320*	-12 ± 19*	3.3 ± 0.8
RIVERTON WY ALBERTSON'S PLANT	08/19	NA	-19 ± 18*	3.2 ± 0.7

* CONCENTRATION IS LESS THAN THE MINIMUM DETECTABLE CONCENTRATION (MDC).

	ANALYSIS	RESULT	2SIGMA	UNITS
NOTE 1	137CS	16	8	pCi/L

TABLE E-12. 1982 SUMMARY OF RADIATION DOSES FOR THE DOSIMETRY NETWORK

STATION LOCATION	MEASUREMENT PERIOD ISSUE	COLLECT	DOSE EQUIVALENT RATE (MREM/D) MAX.	MIN.	AVG.	ANNUAL ADJUSTED DOSE EQUIVALENT (MREM/A)
ADAVEN, NV	01/20/82	01/12/83	0.36	0.28	0.33	121
ALAMO, NV	01/08/82	01/13/83	0.24	0.23	0.24	87
AMERICAN BORATE, NV	01/05/82	01/10/83	0.26	0.26	0.26	94
AUSTIN, NV	01/12/82	01/11/83	0.35	0.31	0.33	121
BAKER, CA	01/11/82	01/10/83	0.23	0.22	0.22	82
BARSTOW, CA	01/11/82	01/10/83	0.30	0.29	0.30	108
BEATTY, NV	01/05/82	01/12/83	0.31	0.29	0.30	109
BISHOP, CA	01/12/82	01/12/83	0.27	0.26	0.27	97
BLUE EAGLE RANCH, NV	01/06/82	01/11/83	0.18	0.17	0.18	64
BLUE JAY, NV	01/12/82	01/12/83	0.33	0.31	0.32	115
CACTUS SPRINGS, NV	01/04/82	01/10/83	0.16	0.15	0.15	56
CALIENTE, NV	01/06/82	01/12/83	0.31	0.29	0.30	109
CARP, NV	01/07/82	01/13/83	0.30	0.27	0.28	103
CASEY'S RANCH, NV	01/12/82	01/12/83	0.20	0.20	0.20	73
CEDAR CITY, UT	01/05/82	01/11/83	0.20	0.19	0.19	69
CLARK STATION, NV	01/11/82	01/11/83	0.32	0.31	0.31	115
COMPLEX I, NV	01/20/82	01/12/83	0.28	0.24	0.27	98
CORN CREEK STATION, NV	01/04/82	01/10/83	0.14	0.14	0.14	51
COYOTE SUMMIT, NV	01/11/82	01/11/83	0.34	0.32	0.33	118
CURRANT, NV	01/06/82	01/11/83	0.28	0.27	0.27	99
DEATH VALLEY JCT., CA	01/14/82	01/13/83	0.21	0.19	0.20	74

(CONTINUED)

TABLE E-12. CONTINUED

STATION LOCATION	MEASUREMENT PERIOD ISSUE	MEASUREMENT PERIOD COLLECT	DOSE EQUIVALENT RATE (MREM/D) MAX.	MIN.	AVG.	ANNUAL ADJUSTED DOSE EQUIVALENT (MREM/A)
DIABLO MAINT. STA., NV	01/11/82	01/11/83	0.34	0.34	0.34	124
DUCKWATER, NV	01/06/82	01/11/83	0.28	0.26	0.27	98
ELGIN, NV	01/07/82	01/13/83	0.34	0.32	0.33	120
ELY, NV	01/07/82	01/13/83	0.22	0.20	0.21	78
ENTERPRISE, UT	01/05/82	01/12/83	0.27	0.26	0.26	96
EUREKA, NV	01/11/82	01/11/83	0.30	0.28	0.29	107
FURNACE CREEK, CA	01/14/82	01/13/83	0.19	0.17	0.18	66
GARRISON, UT	01/07/82	01/11/83	0.18	0.17	0.18	66
GEYSER MAINT. STA., NV	01/07/82	01/10/83	0.28	0.27	0.27	100
GOLDFIELD, NV	01/13/81	01/10/83	0.24	0.23	0.24	88
GROOM LAKE, NV	01/11/82	01/10/83	0.19	0.19	0.19	69
HANCOCK SUMMIT, NV[1]	01/11/82	01/10/83	0.39	0.37	0.38	139
HIKO, NV	01/08/82	01/13/83	0.21	0.19	0.20	71
HOT CREEK RANCH, NV	01/11/82	01/12/83	0.25	0.25	0.25	90
INDEPENDENCE, CA	01/12/82	01/12/83	0.26	0.25	0.25	92
INDIAN SPRINGS, NV	01/04/83	01/10/83	0.14	0.14	0.14	50
KIRKEBY RANCH, NV	01/07/82	01/10/83	0.21	0.20	0.20	72
KOYNES, NV	01/13/82	01/11/83	0.26	0.24	0.25	90
LAS VEGAS (AIRPORT),NV	01/04/82	12/29/82	0.14	0.13	0.14	49
LAS VEGAS (PLACAK), NV	01/04/82	12/19/82	0.14	0.13	0.14	50
LAS VEGAS (UNLV), NV	01/04/82	12/29/82	0.12	0.11	0.12	47

(CONTINUED)

TABLE E-12. CONTINUED

STATION LOCATION	MEASUREMENT PERIOD ISSUE	MEASUREMENT PERIOD COLLECT	DOSE EQUIVALENT RATE (MREM/D) MAX.	MIN.	AVG.	ANNUAL ADJUSTED DOSE EQUIVALENT (MREM/A)
LAS VEGAS (USDI), NV	01/04/82	12/29/82	0.17	0.16	0.16	59
LATHROP WELLS, NV	01/05/82	01/10/83	0.27	0.24	0.26	94
LAVADAS MARKET, NV	01/05/82	01/12/83	0.24	0.22	0.23	85
LIDA, NV	01/13/82	01/10/83	0.26	0.25	0.26	94
LONE PINE, CA	01/12/82	01/12/83	0.26	0.24	0.25	90
LUND, NV	01/08/82	01/13/83	0.23	0.22	0.22	81
MAMMOTH MTN., CA[2]	01/13/82	10/05/82	0.34	0.23	0.26	96
MANHATTAN, NV	01/12/82	01/11/83	0.34	0.31	0.33	118
MESQUITE, NV	01/04/82	01/10/83	0.17	0.17	0.17	62
NEVADA FARMS, NV	01/11/82	01/11/83	0.31	0.30	0.31	112
NYALA, NV	01/12/82	01/12/83	0.23	0.20	0.21	77
OLANCHA, CA	01/12/82	01/12/83	0.26	0.25	0.26	93
OVERTON, NV	01/12/82	01/10/83	0.16	0.15	0.16	57
PAHRUMP, NV	01/04/82	01/13/83	0.14	0.14	0.14	51
PINE CREEK RANCH, NV	01/20/82	01/12/83	0.32	0.28	0.31	112
PIOCHE, NV	01/06/82	01/12/83	0.23	0.22	0.22	80
QUEEN CITY SUMMIT, NV	01/11/83	01/10/83	0.35	0.34	0.35	127
RACHEL, NV	01/11/82	01/11/83	0.30	0.29	0.29	107
REED RANCH, NV	01/11/82	01/11/83	0.31	0.30	0.30	110
RIDGECREST, CA	01/12/82	01/11/83	0.25	0.24	0.24	88
ROUND MOUNTAIN, NV	01/12/82	01/11/83	0.30	0.29	0.30	108

(CONTINUED)

TABLE E-12. CONTINUED

STATION LOCATION	MEASUREMENT PERIOD ISSUE	MEASUREMENT PERIOD COLLECT	DOSE EQUIVALENT RATE (MREM/D) MAX.	MIN.	AVG.	ANNUAL ADJUSTED DOSE EQUIVALENT (MREM/A)
ROX, NV	01/04/82	01/10/83	0.20	0.18	0.19	67
SALT LAKE CITY, UT	01/05/82	01/17/83	0.24	0.20	0.22	79
SCOTTY'S JUNCTION, NV	01/13/82	01/10/83	0.28	0.27	0.28	101
SHERRI'S BAR, NV	01/08/82	01/14/83	0.20	0.19	0.20	71
SHOSHONE, CA	01/14/82	01/13/83	0.21	0.19	0.20	73
SPRINGDALE, NV	01/06/82	01/11/83	0.30	0.29	0.29	106
SPRING MEADOWS, NV	01/05/82	01/10/83	0.17	0.16	0.16	59
ST. GEORGE, UT	01/04/82	01/11/83	0.16	0.15	0.15	55
STONE CABIN RANCH, NV	01/12/82	01/12/83	0.30	0.28	0.30	108
SUNNYSIDE, NV	01/08/82	01/13/83	0.18	0.16	0.17	63
TEMPIUTE, NV	01/13/82	01/11/83	0.30	0.30	0.30	110
TICKABOO VALLEY, NV	10/12/82	01/10/83	0.27	0.27	0.27	97
TONOPAH, NV	01/12/82	01/11/83	0.31	0.30	0.31	112
TONOPAH TEST RANGE, NV	01/12/82	01/11/83	0.27	0.26	0.27	97
TWIN SPRINGS RANCH, NV	01/12/82	01/11/83	0.30	0.27	0.28	103
U.S. ECOLOGY, NV	01/05/82	01/11/83	0.31	0.29	0.30	108
VALLEY CREST, CA	01/14/82	01/13/83	0.16	0.15	0.15	55
WARM SPRINGS, NV	01/11/82	01/12/83	0.31	0.29	0.30	110
YOUNG'S RANCH, NV	01/12/82	01/11/83	0.25	0.24	0.24	89

[1] STATION VANDALIZED SECOND QUARTER 1982.

[2] STATION VALDALIZED FOURTH QUARTER 1982.

TABLE E-13. 1982 SUMMARY OF RADIATION DOSES FOR OFFSITE RESIDENTS

RESIDENT NO.	BACKGROUND STATION LOCATION	MEASUREMENT ISSUE	PERIOD COLLECT	DOSE EQUIVALENT RATE (MREM/D) MAX.	MIN.	AVG.	NET EXPOSURE (MREM)
2	CALIENTE, NV	01/12/82	01/12/83	0.26	0.24	0.25	0.0
3	BLUE JAY, NV	01/12/82	01/12/83	0.25	0.23	0.24	0.0
6	INDIAN SPRINGS, NV	01/08/82	01/10/83	0.15	0.14	0.14	0.0
7	GOLDFIELD, NV	01/13/82	01/10/83	0.21	0.20	0.20	0.0
8	TWIN SPRINGS RANCH, NV	01/12/82	01/11/83	0.28	0.27	0.28	0.0
9	BLUE EAGLE RANCH, NV	01/06/82	01/11/83	0.18	0.16	0.16	0.0
10	COMPLEX I, NV	01/20/82	01/12/83	0.28	0.23	0.26	0.0
11	COMPLEX I, NV	01/20/82	01/12/83	0.28	0.24	0.26	0.0
12	CORN CREEK, NV	01/04/82	12/29/82	0.13	0.12	0.13	0.0
13	KOYNES RANCH, NV	01/13/82	01/11/83	0.23	0.18	0.19	0.0
14	HANCOCK SUMMIT, NV	01/11/82	01/11/83	0.26	0.21	0.24	0.0
15	HANCOCK SUMMIT, NV	01/11/82	01/10/83	0.24	0.22	0.23	0.0
17	NYALA, NV	01/12/82	01/12/83	0.20	0.18	0.19	0.0
18	NYALA, NV	01/12/82	01/12/83	0.21	0.18	0.20	0.0
19	GOLDFIELD, NV	01/13/82	01/10/83	0.21	0.19	0.21	0.0
21	BEATTY, NV	01/05/82	01/11/83	0.27	0.22	0.24	0.0
22	ALAMO, NV	01/08/82	01/13/83	0.18	0.17	0.18	0.0
24	CORN CREEK, NV	01/04/82	12/29/82	0.12	0.10	0.11	0.0
25	CORN CREEK, NV	01/04/82	12/29/82	0.22	0.14	0.18	12
27	PAHRUMP, NV	01/07/82	01/13/83	0.17	0.16	0.16	2.0
28	HOT CREEK RANCH, NV	01/12/82	01/12/83	0.27	0.23	0.24	0.0

(CONTINUED)

TABLE E-13. CONTINUED

RESIDENT NO.	BACKGROUND STATION LOCATION	MEASUREMENT ISSUE	PERIOD COLLECT	DOSE EQUIVALENT RATE (MREM/D) MAX.	MIN.	AVG.	NET EXPOSURE (MREM)
29	STONE CABIN RANCH, NV	01/12/82	01/12/83	0.29	0.26	0.27	0.0
30	RACHEL, NV	01/13/82	01/11/83	0.25	0.24	0.25	0.0
33	LATHROP WELLS, NV	07/14/82	10/05/82	0.24	0.22	0.23	0.0
34	FURNACE CREEK, CA	04/07/82	01/13/82	0.17	0.16	0.16	0.0
35	DEATH VALLEY JCT., CA	01/14/82	01/14/83	0.19	0.19	0.19	0.0
36	PAHRUMP, NV	01/04/82	01/13/83	0.13	0.12	0.13	0.0
37	INDIAN SPRINGS, NV	01/04/82	01/10/83	0.14	0.14	0.14	0.0
38	BEATTY, NV	01/04/82	01/13/83	0.31	0.25	0.28	0.0
40	GOLDFIELD, NV	01/13/82	10/06/82	0.22	0.21	0.22	0.0
41	AUSTIN, NV	01/12/82	01/11/83	0.29	0.26	0.28	0.0
42	TONOPAH, NV	01/13/82	01/11/83	0.26	0.22	0.24	0.0
43	ALAMO, NV	01/08/82	01/13/83	0.25	0.18	0.20	0.0
44	CEDAR CITY, UT	01/05/82	01/11/83	0.23	0.19	0.21	7.2
45	ST. GEORGE, UT	01/04/82	01/11/83	0.18	0.16	0.17	0.0
47	ELY, NV	01/07/82	01/13/83	0.18	0.18	0.18	0.0
48	RACHEL, NV	01/13/82	01/11/83	0.24	0.21	0.22	0.0
49	LAS VEGAS, UNLV	01/13/82	12/29/82	0.41	0.26	0.32	74
50	HOT CREEK RANCH, NV	01/12/82	01/12/83	0.27	0.21	0.24	0.0
51	TONOPAH, NV	01/12/82	01/10/83	0.23	0.22	0.22	0.0
52	SALT LAKE CITY, UT	01/05/82	01/11/83	0.28	0.24	0.25	7.4
53	SHOSHONE, CA	04/26/82	01/17/83	0.23	0.19	0.21	0.0

(CONTINUED)

TABLE E-13. CONTINUED

RESIDENT NO.	BACKGROUND STATION LOCATION	MEASUREMENT ISSUE	PERIOD COLLECT	DOSE EQUIVALENT RATE (MREM/D) MAX.	MIN.	AVG.	NET EXPOSURE (MREM)
54	RACHEL, NV	04/23/82	01/11/83	0.30	0.27	0.28	0.0
55	RACHEL, NV	04/23/82	01/11/83	0.28	0.27	0.28	0.0
56	CORN CREEK STATION, NV	06/30/82	12/29/82	0.17	0.15	0.16	3.4
57	OVERTON, NV	04/05/82	10/04/82	0.21	0.21	0.21	4.7

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA 600/4-83-032	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE OFFSITE ENVIRONMENTAL MONITORING REPORT Radiation Monitoring Around U.S. Nuclear Test Areas, Calendar Year 1982		5. REPORT DATE 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) S.C. Black, R.F. Grossman, A.A. Mullen , G.D. Potter, D.D. Smith and J. L. Hopper		8. PERFORMING ORGANIZATION REPORT NO.
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15. SUPPLEMENTARY NOTES

Prepared for the U. S. Department of Energy under Interagency Agreement No. DE-AI08-76DP00539

16. ABSTRACT

This report covers the routine radiation monitoring activities conducted by the Environmental Monitoring Systems Laboratory-Las Vegas in areas which may be affected by nuclear testing programs of the Department of Energy. This monitoring is conducted to document compliance with standards, to identify trends in environmental radiation, and to provide such information to the public. It summarizes these activities for calendar year 1982.

No radioactivity attributable to NTS activities was detectable offsite by the monitoring networks. Using recorded wind data and Pasquill stability categories, atmospheric dispersion calculations based on reported radionuclide releases yield an estimated dose of 10^{-5} man-rem to the population within 80 km of the Nevada Test Site during 1982. World-wide fallout of Kr-85, Sr-90, Cs-137, and Pu-239 detected by the monitoring networks would cause maximum exposure to an individual of less than 0.3 mrem per year. Plutonium and krypton in air were similar to 1981 levels while cesium and strontium in other samples were near the detection limits. An occasional net exposure to offsite residents has been detected by the TLD network. On investigation , the cause of such net exposures has been due to personal habits or occupational activities, not to NTS activities.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group

18. DISTRIBUTION STATEMENT RELEASE TO THE PUBLIC	19. SECURITY CLASS *(This Report)* UNCLASSIFIED	21. NO. OF PAGES
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