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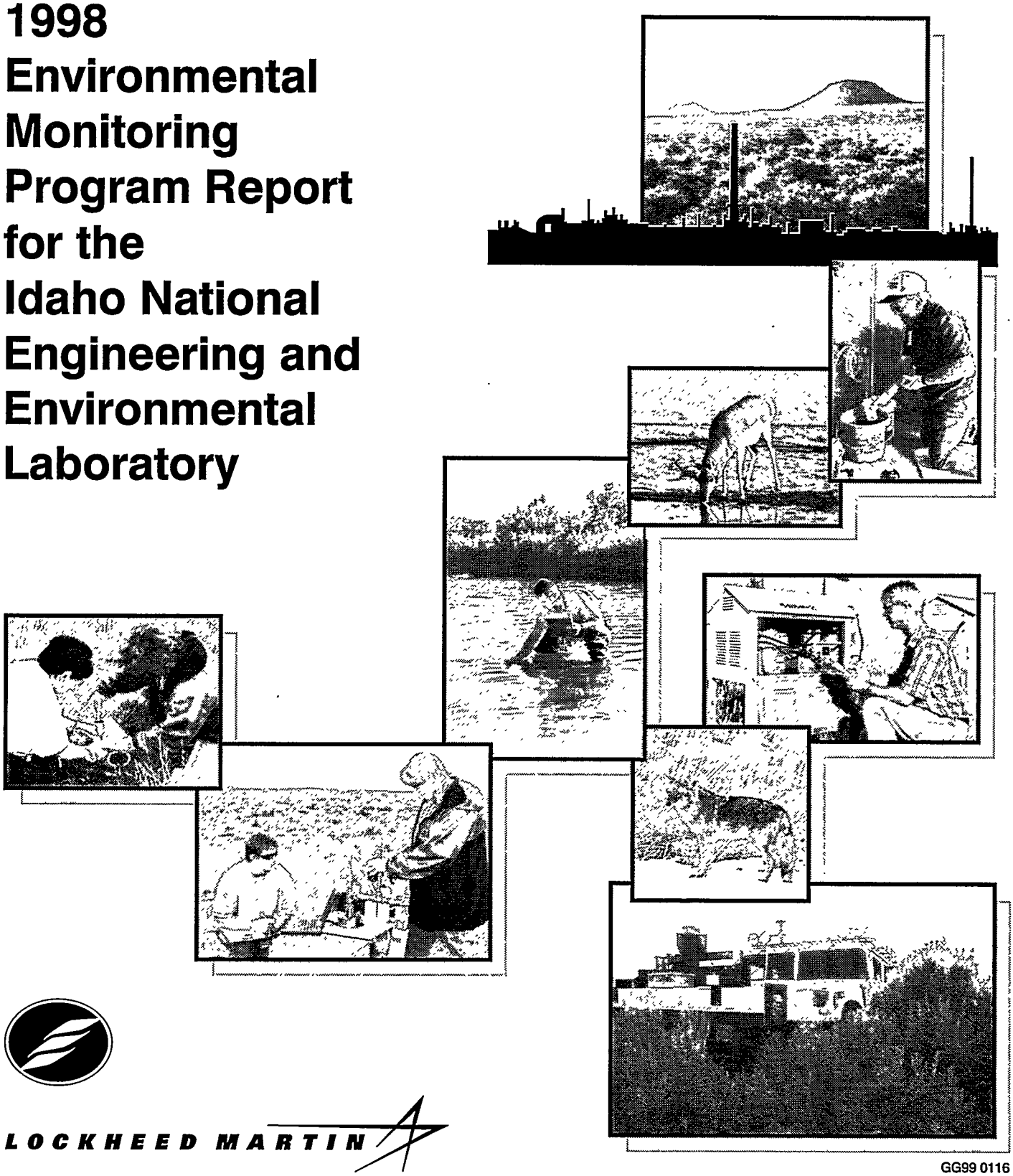
1998 Environmental Monitoring Program Report for the Idaho National Engineering and Environmental Laboratory



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1998 Environmental Monitoring Program Report for the Idaho National Engineering and Environmental Laboratory

Published September 1999

Idaho National Engineering and Environmental Laboratory
Environmental Monitoring Group
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Assistant Secretary for Environmental Management
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ABSTRACT

This report describes the calendar year 1998 compliance monitoring and environmental surveillance activities of the Lockheed Martin Idaho Technologies Company Environmental Monitoring Program performed at the Idaho National Engineering and Environmental Laboratory. This report includes results of sampling performed by the Drinking Water, Effluent, Storm Water, Groundwater Monitoring, and Environmental Surveillance Programs. This report compares the 1998 results to program-specific regulatory guidelines and past data to evaluate trends. The primary purposes of the monitoring and surveillance activities are to evaluate environmental conditions, to provide and interpret data, to verify compliance with applicable regulations or standards, and to ensure protection of public health and the environment.

Surveillance of environmental media did not identify any previously unknown environmental problems or trends, which would indicate a loss of control or unplanned releases from facility operations. The INEEL complied with permits and applicable regulations, with the exception of nitrogen samples in a disposal pond effluent stream and iron and total coliform bacteria in groundwater downgradient from one disposal pond. Data collected by the Environmental Monitoring Program demonstrate that the public health and environment were protected.

SUMMARY

The Environmental Monitoring Program monitors environmental media and facility effluents to assess the effects of the Idaho National Engineering and Environmental Laboratory (INEEL) operations on the environment; to protect public health; and to demonstrate compliance with federal, state, and local regulations. Monitoring data are compared to regulatory criteria to show compliance with regulations and permits and to voluntary protection criteria, to assess potential environmental impacts, and to ensure protection of public health. Monitoring data from the current year are compared to past monitoring data to identify trends or changes that may indicate loss of control, unplanned releases, or ineffectiveness of pollution prevention programs.

Environmental compliance programs monitor drinking water, storm water runoff, liquid effluents, and groundwater to show compliance with federal, state, and City of Idaho Falls regulations and permits. There were a few instances where permit criteria were exceeded. Corrective action has been taken or is planned to address those situations.

In the past, coliform bacteria were detected in drinking water systems at INEEL facilities as a result of old, deteriorating pipes, stagnant water from buildings and storage tanks where water was seldom used, and biofilm. Water treatment systems for bacteria were installed at all affected INEEL facilities, and as a result, no coliform bacteria was detected in INEEL drinking water systems during 1998. There are three locations at the INEEL where groundwater contains contaminants at or near the drinking water standards. Treatment systems have been installed where necessary, and water supplied through drinking water distribution systems meets the drinking water standards.

Liquid effluents from two INEEL Idaho Falls facilities were monitored for compliance with City of Idaho Falls wastewater acceptance permits. All discharges to the sewer system met the discharge limits in the city permits.

Liquid effluent was monitored at the Central Facilities Area, Idaho Nuclear Technology and Engineering Center, and Test Area North, and groundwater was monitored at Idaho Nuclear Technology and Engineering Center and Test Area North for compliance with State of Idaho Wastewater Land Application Permits. Liquid effluents at five additional facilities were monitored for characterization and surveillance purposes. All effluent samples at the Central Facilities Area Sewage Treatment Plant and Test Area North were in compliance with permit requirements.

Two facilities at the Idaho Nuclear Technology and Engineering Center are monitored under Wastewater Land Application Permits: the Sewage Treatment Plant and the Percolation Ponds. Groundwater sample results complied with all permit limits. Concentrations of total suspended solids at the Sewage Treatment Plant complied with the permit. Total nitrogen concentrations exceeded the limit of 20 mg/L in five monthly samples. As a result, an engineering study was conducted to determine the cause of the elevated nitrogen concentrations and to recommend actions to bring nitrogen concentrations into compliance. Maintenance and operational corrective actions are underway and are being evaluated to determine their effectiveness in reducing nitrogen concentrations. If these

corrective actions do not reduce the nitrogen to acceptable concentrations, additional operational and plant modifications will be implemented to correct the situation.

At Test Area North, wastewater effluent and groundwater are monitored for compliance with the Sewage Treatment Plant Wastewater Land Application Permit. Effluent flow volumes and concentrations were within limits established by the permit, but some contaminant concentrations in the groundwater exceeded applicable limits. Groundwater concentrations of iron, sodium, and total coliform exceeded secondary maximum contaminant level and maximum allowable concentration standards. These observations are consistent with the results of the past few years and are not believed to be related to any recent operational changes. The relationship between the elevated contaminant concentrations and discharges to the Disposal Pond is not well defined since historic groundwater contamination and ongoing groundwater remediation efforts continue to significantly impact the groundwater at Test Area North.

During 1998, samples were collected at eight of the 16 storm water monitoring locations. One sample was collected from a discharge to the Big Lost River System in compliance with the NPDES General Permit for Storm Water Associated with Industrial Activities. Additional storm water data were collected for surveillance purposes and were compared to Derived Concentration Guides and Environmental Protection Agency benchmark concentrations as voluntary protection criteria. Of the contaminants that exceeded Environmental Protection Agency benchmarks in 1998, iron, zinc, and total suspended solids were the most frequently detected. Zinc may be contributed by galvanized metals in drainage culverts. Filtered samples analyzed for iron were nondetectable, which indicates that the elevated concentrations are due to suspended solids in the runoff. Elevated concentrations of total suspended solids at the Idaho Nuclear Technology and Engineering Center and the Radioactive Waste Management Complex may be attributed to soil disturbance activities. Lower than historical concentrations of total suspended solids at the Subsurface Disposal Area indicate that erosion control may be improving.

In accordance with injection well permit requirements, snow melt was sampled at the Special Power Excursion Reactor Test III injection well as it flowed down the well. All parameters met drinking water standards, with the exception of iron and di(2-ethylhexyl)phthalate. Iron is a secondary drinking water standard and does not have a permit limit. Di(2-ethylhexyl)phthalate is a primary drinking water standard. It is also a common contaminant found in plastics.

Environmental surveillance programs monitor ambient air, direct radiation, soils, biota, and surface water. Surveillance of environmental media during 1998 did not identify any trends in data that indicated a loss of control or unplanned releases from facility operations.

Ambient air quality was monitored for radionuclides, particulate matter, nitrogen oxides, and sulfur dioxide. Gross alpha and gross beta radiation are routinely detected in air monitors from natural background radionuclides. Cesium-137 was the only man-made gamma-emitting radionuclide detected that could be attributed to facility operations. Cesium-137 was found in two samples collected from the Radioactive Waste Management Complex, in one sample from

Test Area North, and from the quarterly composite sample collected from the Naval Reactors Facility. Strontium-90, americium-241 and plutonium-239/240 were the only alpha- and beta-emitting radionuclides detected at the Radioactive Waste Management Complex. Strontium-90 was detected at the Test Reactor Area. All detected radionuclides are consistent with historical data.

The New Waste Calcining Facility at the Idaho Nuclear Technology and Engineering Center operated from January until April 10, 1998. Atmospheric concentrations of nitrogen oxides were consistent with those of previous years. Nitrogen oxides and sulfur dioxide concentrations were well below Environmental Protection Agency established ambient air quality standards throughout the year.

Surface water runoff was sampled at the Radioactive Waste Management Complex. Cesium-137, americium-241, plutonium-239/240, and strontium-90 were detected. Cesium-137 is commonly detected in environmental samples collected at the Radioactive Waste Management Complex and is usually at or near background concentrations. The americium-241, plutonium-239/240, and strontium-90 were detected at concentrations consistent with those typically seen in waters collected from areas with high volumes of suspended particulates.

Surface water runoff was also sampled at the Waste Experimental Reduction Facility seepage basins. Cesium-137 was detected at concentrations comparable to historical concentrations and other monitoring results from water samples collected at the INEEL. Americium-241 was also detected but was within the range attributed to fallout.

Soil samples were collected from the Waste Experimental Reduction Facility and the Stored Waste Examination Pilot Plant. Cesium-137 was detected at both locations. At the Waste Experimental Reduction Facility, the concentration was lower than previous concentrations. At the Stored Waste Examination Pilot Plant, the concentration was comparable to historical concentrations and within the range attributed to fallout. Americium-241, plutonium-239/240, and strontium-90 were also detected at the Stored Waste Examination Pilot Plant at concentrations consistent with those previously seen in and around the Radioactive Waste Management Complex.

Soil samples were collected at the Auxiliary Reactor Area. Americium-241, plutonium-239/240, and strontium-90 were detected. The americium-241 and plutonium-239/240 detections were within the background range for the INEEL and surrounding areas and is a result of past fallout. The strontium-90 detections were above background but are consistent with historical concentrations at the Auxiliary Reactor Area.

Direct radiation exposure was generally consistent with historical data.

Environmental Monitoring results demonstrate that the public health and environment were protected.

CONTENTS

FIGURES

TABLES

ACRONYMS

Am	americium
ANL-W	Argonne National Laboratory-West
ARA	Auxiliary Reactor Area
BLRS	Big Lost River System
BOD	biological oxygen demand
cc	cubic centimeters
CFA	Central Facilities Area
cfm	cubic ft per minute
CFR	Code of Federal Regulations
CN	cyanide
COD	chemical oxygen demand
CPP	Chemical Processing Plant
Cs	cesium
CTF	Contained Test Facility
DCG	Derived Concentration Guide
DOE	U.S. Department of Energy
DOE-ID	U.S. Department of Energy Idaho Operations Office
EBR-I	Experimental Breeder Reactor-I
ECG	environmental concentration guide
EFS	Experimental Field Station
EPA	Environmental Protection Agency
ESRF	Environmental Science and Research Foundation
ESRP	Eastern Snake River Plain
g	gram
GPRS	global positioning radiometric scanner
IDAPA	Idaho Administrative Procedures Act
IFF	Idaho Falls Facilities
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
IRC	INEEL Research Center
IWA	Industrial Wastewater Acceptance
L	liter
LMITCO	Lockheed Martin Idaho Technologies Company
m	meter
MAC	maximum allowable concentration
MCL	maximum contaminant level
mL	millileter
mR	milliroetgen
mrem	millirem
MWSF	Mixed Waste Storage Facility

NNN	nitrate and nitrite as nitrogen
NPDES	National Pollutant Discharge Elimination System
NRF	Naval Reactors Facility
OMRE	Organic Moderated Reactor Experiment
PBF	Power Burst Facility
pCi	picocurie
PM_{10}	particulate matter ≤ 10 μm
ppb	parts per billion
Pu	plutonium
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RWMC	Radioactive Waste Management Complex
SAR	sodium absorption ratio
SDA	Subsurface Disposal Area
SL-1	Stationary Low-Power Reactor No. 1
SMC	Specific Manufacturing Capability
SMCL	secondary maximum contaminant level
SP	suspended particulate
SPERT	Special Power Excursion Reactor Test
Sr	strontium
SRPA	Snake River Plain Aquifer
STF	Security Training Facility
STP	sewage treatment plant
SWEPP	Stored Waste Experimental Pilot Plant
SWPPP-IA	INEEL Storm Water Pollution Prevention Plan for Industrial Activities
TAN	Test Area North
TCE	trichloroethylene
TDS	total dissolved solids
TKN	total Kjeldahl nitrogen
TLD	thermoluminescent dosimeter
TOG	total oil and grease
TRA	Test Reactor Area
TSA	Transuranic Storage Area
TSF	Technical Support Facility
TSS	total suspended solids
USGS	United States Geological Survey
VANB	Van Buren Boulevard
VOC	volatile organic compound
WCB	Willow Creek Building
WERF	Waste Experimental Reduction Facility
WET	whole effluent toxicity

WLAP	Wastewater Land Application Permit
WRRTF	Water Reactor Research Test Facility

1998 Environmental Monitoring Program Report for the Idaho National Engineering and Environmental Laboratory

1. INTRODUCTION

This report summarizes the monitoring results and activities of the Lockheed Martin Idaho Technologies Company (LMITCO) Environmental Monitoring Program at the Idaho National Engineering and Environmental Laboratory (INEEL) for calendar year 1998. The purposes of the Environmental Monitoring Program are to monitor effluents and environmental media to meet applicable permits, rules, and regulations, to assess the impact of INEEL operations on the environment, and to protect public health.

The INEEL is owned by the U.S. Department of Energy (DOE), and various management and operating contractors have been at the INEEL over the years; LMITCO is the current management and operating contractor. The Atomic Energy Commission established the INEEL as the National Reactor Testing Station in 1949 to conduct research and further the development of peaceful uses of atomic energy. The name changed in 1974 to the Idaho National Engineering Laboratory to include a broader scope of engineering support activities for DOE. In response to the increased role the laboratory currently plays in the environmental cleanup of the DOE complex and technology development, the name was changed to the Idaho National Engineering and Environmental Laboratory in 1997.

Early monitoring activities focused on pathways along which radioactive contaminants from INEEL operations could be released and where exposure to the general public in southeast Idaho could occur.[1] Radionuclides were the major contaminants of concern because the INEEL was heavily involved in testing at nuclear facilities. The United States Geological Survey (USGS) has been involved in environmental surveillance at the INEEL from the beginning by monitoring groundwater quality in the Snake River Plain Aquifer. During those early years, facility operators conducted limited sampling of liquid effluents to develop waste inventory information.

Currently, environmental monitoring is conducted by LMITCO, the USGS, the Environmental Science and Research Foundation (ESRF), and the INEEL Oversight Program. The primary emphasis of LMITCO environmental monitoring is on-Site compliance. The USGS and ESRF conduct both on-Site and off-Site monitoring, while the INEEL Oversight Program provides an independent verification program both on- and off-Site.

1.1 Scope

The LMITCO Environmental Monitoring Program is responsible for routine compliance monitoring and environmental surveillance at the INEEL. The primary purposes of the monitoring and surveillance activities are to:

- Evaluate environmental conditions
- Provide and interpret data
- Verify compliance with applicable regulations or standards
- Ensure protection of human health and the environment.

The LMITCO Environmental Monitoring Program samples the following media (see Figure 1-1):

- Drinking water
- Liquid effluents
- Groundwater
- Ambient air
- Surface water
- Soils and biota
- Direct radiation.

The LMITCO Environmental Monitoring Program evaluates the sampling results and sends them to the applicable agencies and summarizes them in this annual INEEL Environmental Monitoring Program report.

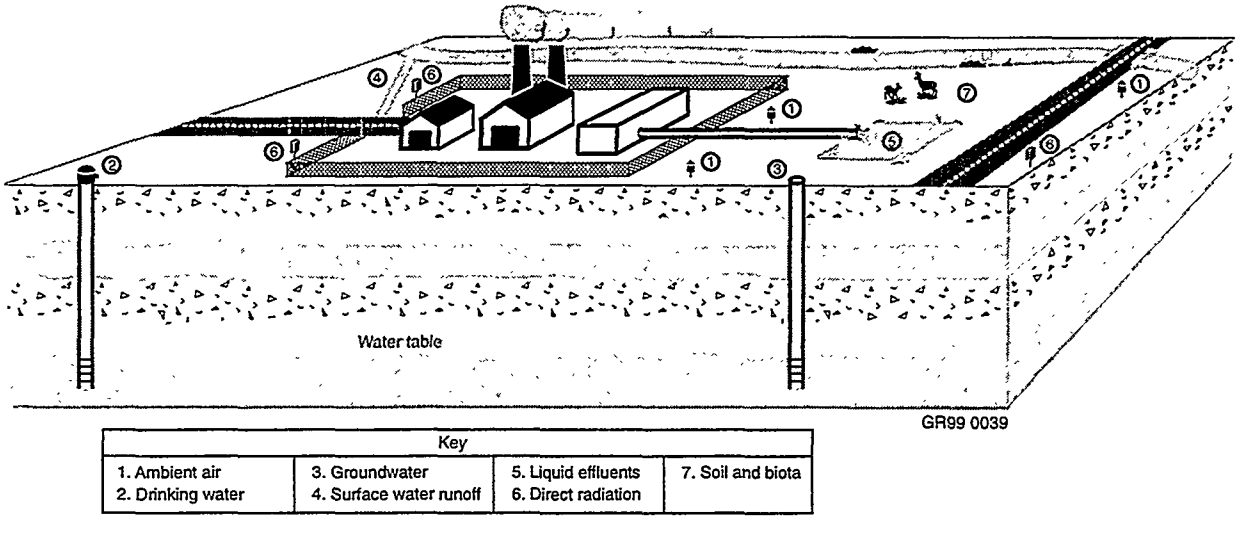


Figure 1-1. Environmental Monitoring media sampled (GR99 0039).

1.2 Program Objectives

The objective of the Environmental Monitoring Program is to provide, interpret, and report data to ensure compliance with the following:

- Safe Drinking Water Act[2]
- Clean Water Act[3]
- Clean Air Act[4]
- State of Idaho Wastewater Land Application Permits[5]
- State of Idaho Injection Well Permits[6]
- City of Idaho Falls Industrial Waste Acceptance Forms[7]
- National Pollutant Discharge Elimination System Storm Water Permit[8,9]
- DOE Order 5400.1 "General Environmental Protection Program"[10]
- DOE Order 5400.5 "Radiation Protection of the Public and the Environment"[11]
- DOE Order 5820.2A "Radioactive Waste Management."[12]

These rules, regulations, permits, and orders provide the objectives of environmental monitoring. The LMITCO Environmental Monitoring Program internal technical procedures, management control procedures, and program plans provide the details on how to meet the objectives.

1.2.1 Environmental Monitoring Objectives

Environmental monitoring is conducted to satisfy the following program objectives:

- Verify and support compliance with applicable federal, state, and local environmental laws, regulations, permits, and orders
- Establish baselines and characterize trends in the physical, chemical, and biological condition of effluent and environmental media
- Identify potential environmental problems and evaluate the need for remedial actions or mitigative measures
- Detect, characterize, and report unplanned releases
- Evaluate the effectiveness of effluent treatment and control and pollution abatement programs
- Determine compliance with commitments made in environmental impact statements, environmental assessments, safety analysis reports, or other official DOE documents.

1.2.2 Approach to Meeting Objectives

DOE orders also provide some guidance on implementation. The general approaches to meeting the objectives are as follows:

- Review proposed and implemented rules and regulations to determine requirements
- Monitor drinking water for the protection of the workers, general public, and the environment
- Develop a baseline for effluents and environmental media from historical monitoring data
- Compare monitoring data from effluents and environmental media to historical data to monitor trends and changes that may indicate loss of process control, unplanned releases, or loss of effectiveness of pollution abatement programs
- Obtain required permits for effluents
- Monitor according to effluent permit requirements in terms of parameters, frequency, and methods
- Develop voluntary release criteria or alert levels, where permit criteria are not provided, to define levels of compounds that can be released to the environment or be present in environmental media without creating environmental problems or incurring future remediation liability
- Compare current monitoring data to release criteria in permits and to other criteria that have been adopted by the program
- Identify concerns to facility operations and support operations managers to resolve issues.

2. QUALITY ASSURANCE/QUALITY CONTROL

To ensure the LMITCO Environmental Monitoring Program is effective, quality assurance (QA) and quality control (QC) programs are implemented. The Quality Assurance Program for the Environmental Monitoring Program:

- Ensures that the sampling methods produce representative samples of the media being monitored
- Confirms that laboratory analyses are reliable
- Verifies that the quality of reported results is suitable to support decisions based on the environmental monitoring data.

Quality control samples are used to measure and document the uncertainty in analytical data.

2.1 Quality Assurance Program

A QA Program ensures quality data are generated. Therefore, a written QA Program is prepared for each Environmental Monitoring program. Quality Assurance Program elements are listed below:

- Program plans
- Technical procedures for sampling and conducting field work and analytical procedures
- Corrective action plans
- Chain of custody
- Instrument calibration records
- Data verification/validation
- Internal/external inspection reports
- Personnel qualification/training records
- Records/logbooks
- Analytical reports/data packages
- Statements of work
- Purchasing.

To further ensure quality data are generated, written program plans and technical procedures document responsibilities and requirements for collecting, analyzing, and processing samples. They also document program design criteria and decision criteria.

2.2 Quality Control Program

The QC Program consists of submitting samples to the laboratory to measure the amount of uncertainty in analytical data. Results of QC samples are reviewed as part of the self-assessment program to determine if the monitoring data are meeting program goals. Types of QC samples, frequency, and tolerance levels are documented in program-specific plans. Types of QC samples are as follows:

- Blanks/trip blanks
- Field duplicates/replicates
- Splits
- Known standards.

3. SITE OVERVIEW

The INEEL is located in southeastern Idaho, roughly equidistant from Salt Lake City, Utah (368 km, 228 mi); Butte, Montana (380 km, 236 mi); and Boise, Idaho (366 km, 228 mi). Fourteen Idaho counties are located in part or entirely within 80 km (50 mi) of the INEEL (Figure 3-1). The INEEL includes portions of five counties (Bingham, Bonneville, Butte, Clark, and Jefferson).

There are nine primary facility areas and three smaller secondary facilities at the INEEL (Figure 3-1). The nine primary facility areas are:

- Argonne National Laboratory-West
- Auxiliary Reactor Area
- Central Facilities Area
- Idaho Nuclear Technology and Engineering Center
- Naval Reactors Facility
- Power Burst Facility
- Radioactive Waste Management Complex
- Test Area North
- Test Reactor Area.

The three secondary facilities are:

- Experimental Breeder Reactor-I
- Experimental Field Station
- Security Training Facility.

There are also administrative, scientific support, and nonnuclear research laboratories in Idaho Falls, Idaho.

The LMITCO Environmental Monitoring Program conducts surveillances or monitoring at the following locations:

- Nine primary facility areas and three secondary facilities (listed above)
- Outside facility boundaries
- Off-Site locations
- Idaho Falls facilities.

Appendix A includes specific facility maps and monitoring locations.

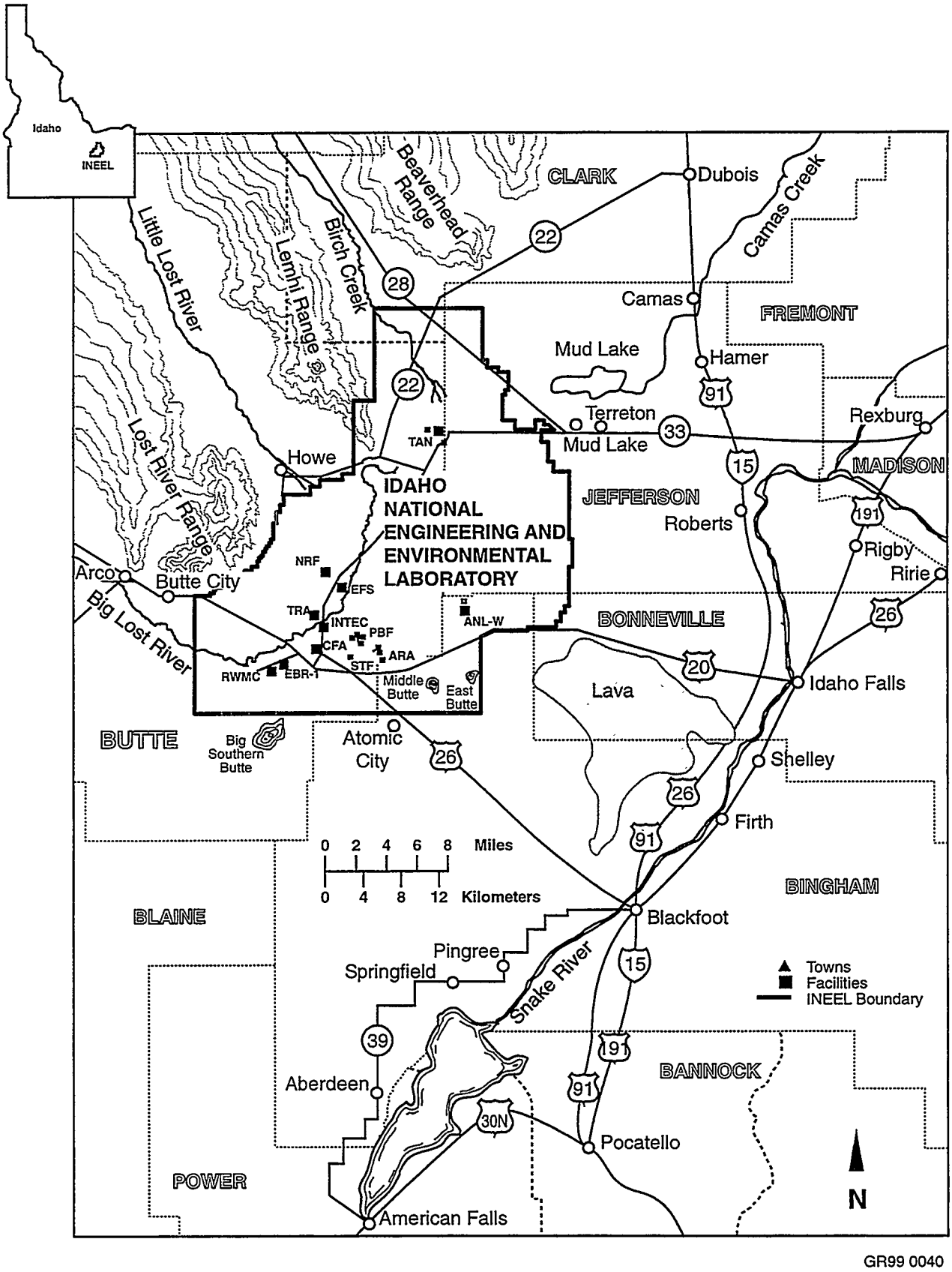


Figure 3-1. Map of Idaho National Engineering and Environmental Laboratory vicinity showing primary and secondary facilities, counties, and cities (GR 99 0040).

3.1 Demographics

The largest population centers near the INEEL are to the southeast and east along the Snake River and Interstate 15. Table 3-1 lists the largest communities closest to the INEEL boundaries, population, and distance from the INEEL.

Table 3-1. Communities near the Idaho National Engineering and Environmental Laboratory.

Community	Population[a]	Distance from INEEL
Idaho Falls	48,122	35 km (22 mi) east of nearest INEEL boundary
Blackfoot	10,453	37 km (23 mi) southeast of nearest INEEL boundary
Pocatello	53,074	70 km (37 mi) south-southeast of nearest INEEL boundary
Arco	1,091	11 km (7 mi) west of nearest INEEL boundary
Atomic City	26	0.8 km (0.5 mi) south of nearest INEEL boundary
Howe	7	6 km (4 mi) west of nearest INEEL boundary
Terreton	1,263	4 km (2.5 mi) east of nearest INEEL boundary
Mud Lake	188	5 km (3 mi) east of nearest INEEL boundary
Butte City	63	5 km (3 mi) west of nearest INEEL boundary

a. 1998 figures from Idaho Department of Commerce.

3.2 Regional Physical Setting

3.2.1 Physiography

The INEEL is located in the north-central part of the Eastern Snake River Plain (ESRP). The ESRP is the eastern segment of the Snake River Plain and extends from the Hagerman-Twin Falls area northeast toward the Yellowstone Plateau. The ESRP is bounded on the northwest and southeast by the north-to northwest-trending, fault-block mountains of the Basin and Range physiographic province. The southern extremities of the Lost River, Lemhi, and the Beaverhead Ranges extend to the western and northwestern borders of the INEEL. At the base of the mountain ranges, the average elevation is about 1,524 m (5,000 ft) above mean sea level. Individual mountains immediately adjacent to the plain rise to elevations of 3,300 m (10,830 ft) above mean sea level.

The surface of the ESRP is rolling-to-broken and is underlaid by basalt with a thin, discontinuous covering of surficial sediment. Hundreds of extinct volcanic craters and cones are scattered across the surface of the plain. Craters of the Moon National Monument, Big Southern Butte, Twin Buttes, and many small volcanic cones are aligned generally along a broad volcanic ridge trending northeastward from Craters of the Moon toward the Mud Lake basin. Between this volcanic ridge and the northern edge of the plain lies a lower area from which no exterior drainage exists. The INEEL occupies a substantial part of this lower closed topographic basin.

The INEEL is approximately 63 km (39 mi) long in a north-south direction and 58 km (36 mi) wide at its widest point. The INEEL is approximately 2,307 km^2 (890 mi^2). The topography of the INEEL, like that of the entire Snake River Plain, is rolling-to-broken. The lowest area on the INEEL is the Big Lost River Sinks at an elevation of 1,455 m (4,774 ft) above mean sea level. The highest

elevations are the East Butte, 2,003 m (6,572 ft) above mean sea level, and Middle Butte, 1,948 m (6,391 ft) above mean sea level.

3.2.2 Climatology

Physiography affects the climate of the INEEL. The mountains lying west and north of the INEEL deflect moisture-laden air masses upward, which creates an arid to semi-arid climate on the downwind side of the mountains where the INEEL is located. The INEEL climate is characteristically warm and dry in the summer and cold in the winter. The relatively dry air and infrequent low clouds permit intense solar heating of the surface during the day and rapid cooling at night. Meteorological data have been collected at over 45 locations on and near the INEEL since 1949. Thirty meteorological stations are currently operating. The following climatological data are from the National Oceanic and Atmospheric Administration.[13]

The average annual precipitation at the Central Facilities Area (CFA) and Test Area North (TAN) is 22.12 cm (8.71 in.) and 19.94 cm (7.85 in.), respectively. Thunderstorms cause a pronounced precipitation peak in May and June at both CFA and TAN, with an average of 3.1 cm (1.2 in.) at CFA and 3.3 cm (1.3 in.) at TAN for each of these months. The annual average snowfall recorded at CFA is 70.1 cm (27.6 in.), and the water content of melted snow contributes between one-quarter and one-third of the annual precipitation. In 1998, snowfall measured 94 cm (37 in.) and contributed 7.9 cm (3.12 in.) to the total precipitation (27.7 cm [10.92 in.]) at CFA.

Average daily air temperatures during 1998 at the INEEL (CFA) ranged from a low of -14.5°C (-25.8°F) on December 21 to a high of 25.8°C (78.5°F) on July 27. The long-term (1950–1988) average daily air temperature at CFA ranges from -12°C (10°F) during early January to 21°C (70°F) during the latter half of July. The average annual temperature at the INEEL gradually increases over 7 months beginning with the first week in January and continuing through the third week in July. The temperature then decreases over the course of 5 months until the minimum average temperature is again reached in January. A winter thaw has occurred in a number of years in late January. This thaw often has been followed by more cold weather until the spring thaw.

Wind speed and direction have been continuously monitored at many stations on and surrounding the INEEL since 1950. Eastern Idaho lies in a region of prevailing westerly winds. The orientation of the bordering mountain ranges and the general northeast trend of the ESRP strongly influence wind direction at the INEEL. Channeling of these winds within the ESRP usually produces a west-southwest or southwest wind at most locations on the INEEL. The highest and lowest average wind speeds at CFA occur in April (15.0 km/hr [9.3 mph]) and December (8.2 km/hr [5.1 mph]), respectively.

Local topographic features at TAN result in a greater diversity of wind directions than elsewhere on the INEEL. At the mouth of Birch Creek, the northwest-to-southeast orientation of the Birch Creek valley occasionally channels strong north-northwest winds into the TAN area. At TAN, average wind speeds are highest in April (15.3 km/hr [9.5 mph]) and lowest in December (7.4 km/hr [4.6 mph]). The highest hourly wind speeds occur at several wind directions. Like the rest of the INEEL, TAN usually experiences the highest hourly wind speeds during west-southwest or southwesterly winds. However, strong winds also blow from the northwest and north-northwest.

3.3 Geology

The INEEL is located on the ESRP, which is a broad northeast trending structural depression filled with silicic and basaltic volcanic rocks and interlayered sedimentary materials. Basalt vents of the ESRP form linear arrays of fissure flows, small shields, cones, pit craters, and open cracks. These features

define volcanic rift zones where eruptive activity has been concentrated.[14] Individual basalt flows typically range from 3–75 m (10–250 ft) in thickness.[15,16] Sedimentary interbeds represent quiescent periods between volcanic episodes when the surface was covered by accumulations of windblown, alluvial, and lake bed sediments. The cumulative thickness of basalt lava flows and interflow sediments beneath the INEEL may vary from as little as 120 m (400 ft) to 760 m (2,500 ft) or more.[17]

3.4 Hydrology

3.4.1 Surface Water Hydrology

Three surface drainages terminate within the INEEL. The Big Lost River, Little Lost River, and Birch Creek drain mountain watersheds located to the north and west of the INEEL (Figure 3-1). For more than 100 years, flows from the Little Lost River and Birch Creek have been diverted for irrigation. Birch Creek terminates at a playa near the north end of the INEEL, and the Little Lost River terminates at a playa just north of the central northwestern boundary of the INEEL.

The Big Lost River, the major surface water feature on the INEEL, drains more than 3,600 km^2 (1,400 mi^2) of mountainous area, including parts of the Lost River and the Pioneer Ranges west of the INEEL. The river flows onto the INEEL near the southwestern corner, bends to the northeast, and flows northeastward to the Big Lost River playas.[18] During the 1998 water year (October 1997 through September 1998), flow was recorded continuously in the Big Lost River at the diversion dam near the Radioactive Waste Management Complex (RWMC). A total of 126,457,394 m^3 (102,520 acre-ft) of water reached the diversion dam in the river. During peak river flows, 40,951,868 m^3 (33,200 acre-ft) of water were diverted to the INEEL spreading areas. A total of 85,505,527 m^3 (69,320 acre-ft) of water flowed downstream of the diversion dam in the Big Lost River channel. Because of infiltration losses in the channel, flow decreased downstream with 70,864,001 m^3 (57,450 acre-ft) reaching the Lincoln Boulevard bridge and 61,415,467 m^3 (49,790 acre-ft) reaching the Big Lost River sinks. This was the largest volume of annual discharge in the river since 1986.[19]

Local precipitation and surface runoff occasionally affect the INEEL. INEEL facilities, such as the RWMC, experienced flooding caused by local basin runoff in 1962, 1969, and 1982.[1] These events were caused by rapid snow melt combined with heavy rains and were often compounded by frozen soil conditions.

3.4.2 Groundwater Hydrology

The Snake River Plain Aquifer (SRPA) is a vast groundwater reservoir that may contain more than 1,200 km^3 (1 billion acre-ft) of water. The SRPA is composed of basaltic lava flows and interbedded sedimentary deposits. Water is contained in and moves through intercrystalline and intergranular pores, fractures, cavities, interstitial voids, interflow zones, and lava tubes. Openings in the rock units and their degree of interconnection complicate the movement of groundwater in the aquifer. The groundwater in the SRPA flows chiefly to the south-southwest at rates that range from 1.5 to 6 m/day (5 to 20 ft/day).[20]

Groundwater inflow to the SRPA at the INEEL consists mainly of underflow from the northeastern part of the plain and from drainages on the west and north.[20] Most of the groundwater is recharged in the uplands to the northeast, moves southwestward through the SRPA, and is discharged from springs along the Snake River near Hagerman. Lesser amounts of water are derived from local precipitation on the plain. Part of the precipitation evaporates, but part infiltrates into the ground surface and percolates downward to the SRPA. At the INEEL, significant recharge is derived from the intermittent flows of the Big Lost River.

4. COMPLIANCE MONITORING PROGRAMS

Compliance Monitoring Programs sample drinking water, liquid effluents, storm water runoff, and groundwater to show compliance with federal, state, and City of Idaho Falls regulations and permits. Section 4.1 describes the Drinking Water Monitoring Program, Section 4.2 describes the Liquid Effluent Monitoring Program, Section 4.3 describes the Storm Water Monitoring Program, and Section 4.4 describes the Groundwater Monitoring Program.

4.1 Drinking Water Program

In response to a U.S. Department of Energy Idaho Operations Office (DOE-ID) request in 1988, a centralized drinking water program was established for most INEEL facilities. As part of the contract consolidation effort, the Idaho Nuclear Technology and Engineering Center (INTEC) facility was incorporated into the LMITCO Drinking Water Program in January 1995.

The Drinking Water Program was established to monitor production and drinking water wells, which are multiple-use wells for industrial use, fire safety, and drinking water. Routine monitoring is conducted INEEL-wide; this report covers monitoring conducted at LMITCO-operated facilities. According to the Idaho Regulations for Public Drinking Water Systems (Idaho Administrative Procedures Act [IDAPA] 16.01.08),[21] LMITCO drinking water systems are classified as either nontransient or transient, noncommunity water systems. The transient, noncommunity water systems are at the Experimental Breeder Reactor (EBR)-I, the Gun Range, and the Main Gate. The rest of the water systems at the INEEL are classified as nontransient, noncommunity water systems, which have more stringent requirements than transient, noncommunity water systems.

Because groundwater supplies the drinking water at the INEEL, information on groundwater quality was used to help develop the Drinking Water Program. The United States Geological Survey (USGS) and LMITCO monitor and characterize groundwater quality at the INEEL. Three drinking water systems are impacted by known groundwater contaminant plumes: tritium at Central Facilities Area (CFA), carbon tetrachloride at Radioactive Waste Management Complex (RWMC), trichloroethylene at Test Area North/Technical Support Facility (TAN/TSF).

4.1.1 Program Design Basis

The Drinking Water Program monitors drinking water to ensure it is safe for consumption by demonstrating that it meets federal and state regulations (that is, maximum contaminant levels [MCLs] are not exceeded). The Safe Drinking Water Act[2] establishes the overall requirements for the Drinking Water Program.

As required by the State of Idaho, the Drinking Water Program uses only Environmental Protection Agency (EPA)-approved analytical methods to analyze drinking water in compliance with IDAPA 16.01.08[21] and 40 Code of Federal Regulations (CFR) 141–143.[22]

Currently, the Drinking Water Program monitors 10 water systems, which include 17 wells and 10 distribution systems. Drinking water parameters are regulated by the State of Idaho under authority of the Safe Drinking Water Act. Parameters with primary MCLs are required to be monitored at least once every compliance period, which is three years. Parameters with secondary maximum contaminant level (SMCLs) are monitored every three years based on a recommendation by the EPA. The three-year compliance periods for the Drinking Water Program are 1996–1998, 1999–2001, and so on. Many parameters require more frequent sampling during an initial period to establish a baseline, and subsequent monitoring frequency is determined from the baseline.

The Drinking Water Program monitors more frequently than the minimum regulatory requirements at CFA, TSF, and RWMC because of known contaminant plumes. Even though regulations only require quarterly monitoring at most facilities for bacteriological analyses, the Drinking Water Program samples more frequently because of historical problems with bacteriological contaminants. These detections were usually caused by deteriorating water lines and stagnant water, and resampling of these areas normally indicated compliance with the MCL. Table 4-1 lists the 1998 Drinking Water Program monitoring locations and schedule.

Table 4-1. 1998 drinking water monitoring locations and schedule.

Facility	Sample Point	Parameters	Sample Frequency
CFA	Selected buildings	Bacteriological	2 monthly[a] 4 monthly[b]
		Total trihalomethanes	1 quarterly[b]
	1603	Nitrate	1 annually[a]
	1603, point-of-entry to distribution system after treatment and #1 Well	Organics (40 CFR 141.12, .24, .40, and .61)[c]	1, as required (quarterly or annually)[b]
	1603	Metals, inorganics, and secondary drinking water standards	1, as required every 3 years
	Wells #1 and #2 and 1603	Gross alpha, beta, and tritium	1 sample each, quarterly[b]
CTF	Selected buildings	Bacteriological	1 quarterly[a] 3 monthly[b]
	614, point-of-entry to distribution system after treatment	Nitrate	1 annually[a]
		Gross alpha, beta, and tritium	1 quarterly[b]
	614 and Wells #1 and #2	Organics (40 CFR 141.12, .24, .40, and .61)[c]	1, as required (quarterly or annually)[a]
	614	Metals, inorganics, and secondary drinking water standards	1, as required every 3 years
EBR-I	Selected buildings	Bacteriological	1 quarterly[a] 1, May, June, July, August, and September[b]
	601, point-of-entry to distribution system after treatment	Nitrate	1 annually[a]
		Gross alpha, beta, and tritium	1 quarterly[b]
	601 and Well	Organics (40 CFR 141.12, .24, .40, and .61)[c]	1, as required (quarterly or annually)[a]
	601	Metal, inorganics, and secondary drinking water standards	1, as required every 3 years
Gun Range	Selected buildings	Bacteriological	1 quarterly[a] 1 monthly[b]
		Total trihalomethanes	1 quarterly[b]
	608, point-of-entry to distribution system after treatment	Nitrate	1 annually[a]
		Gross alpha, beta, and tritium	1 quarterly[b]

Table 4-1. (continued).

Facility	Sample Point	Parameters	Sample Frequency
Gun Range (continued)	608 and Well	Organics (40 CFR 141.12., .24, .40, and .61)[c]	1, as required (quarterly or annually)[a]
	608	Metals, inorganics, and secondary drinking water standards	1, as required every 3 years
INTEC	Selected buildings	Bacteriological	2 monthly[a] 2 monthly[b]
		Total trihalomethanes	1 quarterly[b]
	614, point-of-entry to distribution system after treatment	Nitrate	1 annually[a]
	614 and Wells #1 and #5	Organics (40 CFR 141.12, .24, .40, and .61)[c]	1, as required (quarterly or annually)[a]
		Gross alpha, beta, tritium, and Sr-90	1 sample each, quarterly[b]
	614	Metals, inorganics, and secondary drinking water standards	1, as required every 3 years
Main Gate	Selected buildings	Bacteriological	1 quarterly[a] 3 monthly[b]
	603, point-of-entry to distribution system after treatment	Nitrate	1 annually[a]
		Gross alpha, beta, and tritium	1 quarterly[b]
	603 and Well	Organics (40 CFR 141.12, .24, .40 and .61)[c]	1, as required (quarterly or annually)[b]
	603	Metals, inorganics, and secondary drinking water standards	1, as required every 3 years
PBF	Selected buildings	Bacteriological	1 quarterly[a] 3 monthly[b]
	638, point-of-entry to distribution system after treatment	Nitrate	1 annually[a]
	638 and Wells #1 and #2	Organics (40 CFR 141.12, .24, .40, and .61)[c]	1, as required (quarterly or annually)[b]
	638	Metals, inorganics, and secondary drinking water standards	1, as required every 3 years
RWMC	Selected buildings	Bacteriological	1 quarterly[a] 3 monthly[b]
	604, point-of-entry to distribution system after treatment	Nitrate	1 annually[a]
	604, point-of-entry to distribution system after treatment	Metals, inorganics, and secondary drinking water standards	1, as required every 3 years

Table 4-1. (continued).

Facility	Sample Point	Parameters	Sample Frequency
RWMC (continued)	603 well, 604, point-of-entry to distribution system after treatment	Gross alpha, beta, and tritium	1 quarterly[b]
		Organics as listed in Table 5 (40 CFR 141.12, .24, .40, and .61)[c]	1, as required (quarterly and annually)[a]
TRA	Selected buildings	Bacteriological	1 quarterly[a] 4 monthly[b]
		Total trihalomethanes	1 quarterly[b]
	608, point-of-entry to distribution system after treatment	Nitrate	1 annually[a]
		Gross alpha, beta, and tritium	1 quarterly[b]
	608 and Wells #1, #3, and #4	Organics (40 CFR 141.12, .24, .40, and .61)[c]	1, as required (quarterly or annually)[a]
	608	Metals, inorganics, and secondary drinking water standards	1, as required every 3 years
TSF	Selected buildings	Bacteriological	1 quarterly[a] 3 monthly[b]
		Total trihalomethanes	1 quarterly[b]
	610, point-of-entry to distribution system after treatment	Nitrate	1 annually[c]
		Gross alpha, beta, and tritium	1 quarterly[b]
	610 #1 and #2 Wells	Organics as listed in Table 5 (40 CFR 141.12, .24, .40, and .61)[c]	1, as required (quarterly or annually)[a]
	610	Metals, inorganics, and secondary drinking water standards	1, as required every 3 years

a. Compliance samples.

b. Surveillance samples.

c. Waivers for reduced monitoring of some organic parameters (e.g., dioxin) were obtained from the State of Idaho.

4.1.2 Data Summary and Assessment by Facility

During 1998, a total of 840 routine samples were collected and analyzed for CFA, EBR-I, Gun Range, INTEC, Main Gate, Power Burst Facility (PBF), RWMC, TAN (Contained Test Facility [CTF] and TSF), and Test Reactor Area (TRA). In addition to the routine sampling, the Drinking Water Program received 28 nonroutine requests for sampling. Based on 1998 sampling results, no MCLs were exceeded at the compliance point for LMITCO-operated water systems at the INEEL. Those analytical results that approached an MCL in 1998 are presented in Table 4-2 and are discussed in the following subsections. EBR-I, Gun Range, INTEC, Main Gate, PBF, TAN/CTF, and TRA were well below drinking water limits for all regulatory parameters and are therefore not discussed.

Table 4-2. Parameters monitored that approached, but did not exceed, maximum contaminant levels in 1998.

Parameter[a]	Location	Results (4-Quarter Average)	MCL
Trichloroethylene	TSF #1 Well	4.60 μg/L[b]	5 μg/L
Tritium	CFA Dist.	11,730 picocurie (pCi)/L	20,000 pCi/L
	CFA #1 Well	12,867 pCi/L[c]	20,000 pCi/L
	CFA #2 Well	10,835 pCi/L	20,000 pCi/L
Carbon tetrachloride	RWMC Well	4.75 μg/L	5 μg/L
	RWMC Dist.	2.80 μg/L	5 μg/L
Trichloroethylene	RWMC Well	2.20 μg/L	5 μg/L
	RWMC Dist.	1.45 μg/L	5 μg/L

a. These parameters did not exceed their respective MCLs, but are known contaminants that the Drinking Water Program is tracking. See specific sections for details.

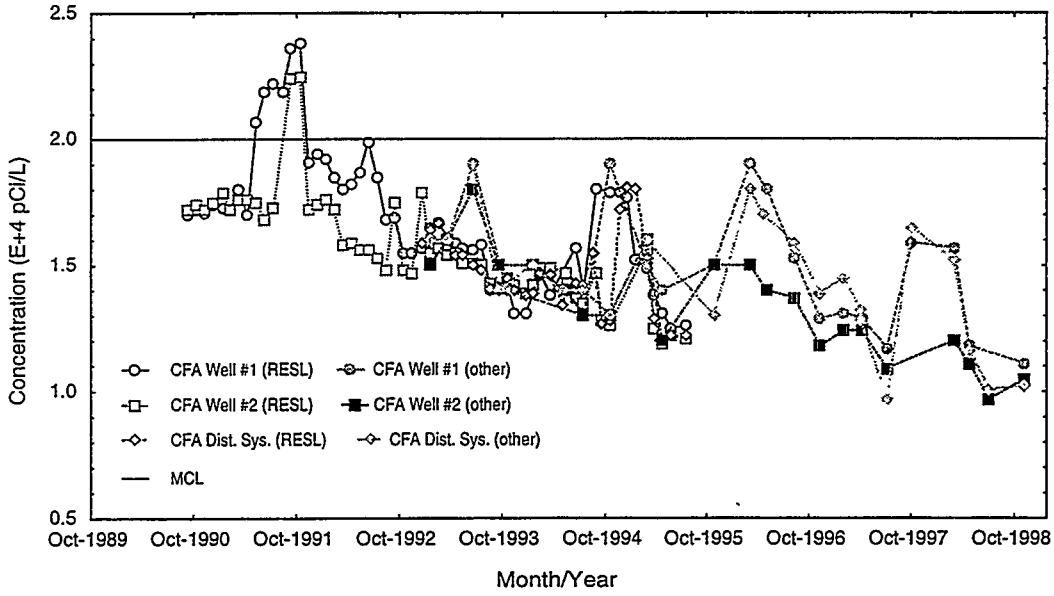
b. This is a one-time sampling event at the wellhead. The compliance point is after the sparger system (air stripping process); the compliance result is 1.42 μg/L for the three-quarter average. No sampling was conducted during the fourth quarter since the system had been taken out of service to replace piping.

c. Due to construction activities, the well was out of service during the third quarter; therefore, this value was averaged over three quarters.

4.1.2.1 Central Facilities Area. The CFA water system serves over 1,000 people daily. Since the early 1950s, wastewater containing tritium has been disposed to the Snake River Plain Aquifer at TRA and INTEC (Figure 3-1) through injection wells and infiltration ponds. These wastewaters migrated south-southwest and are the suspected source of tritium contamination in the CFA water supply wells.

In 1998, water samples were collected quarterly from CFA #1 well (located at CFA-651), CFA #2 well (located at CFA-642), and CFA-1603 (point of entry to the distribution system) for compliance purposes. Since December 1991, the mean tritium concentration has been below the MCL at all three locations. Figure 4-1 illustrates the variation of tritium concentrations since 1990. The Radiological and Environmental Sciences Laboratory collected groundwater samples for surveillance and hydrologic studies of tritium. Environmental Monitoring collected samples for compliance purposes. Both are included in Figure 4-1 to show trends in tritium concentrations over time. In general, tritium concentrations in groundwater have been decreasing due to changes in disposal rates, disposal techniques, recharge conditions, and radioactive decay.

4.1.2.2 Radioactive Waste Management Complex. Various solid and liquid radioactive and chemical wastes, including transuranic wastes, have been disposed at the RWMC. The RWMC contains pits, trenches, and vaults where radioactive and organic wastes were disposed belowgrade, as well as placed abovegrade and covered on a large pad. During an INEEL-wide characterization program conducted by USGS, carbon tetrachloride and other volatile organic compounds (VOCs) were detected in groundwater samples taken at the RWMC.[23] Review of waste disposal records indicated an estimated 334,600 L (88,400 gal) of organic chemical wastes were disposed at the RWMC prior to 1970, including carbon tetrachloride, trichloroethylene, tetrachloroethylene, toluene, benzene, 1,1,1-trichloroethane, and



NOTE: Radiological and Environmental Sciences Laboratory.
Other—Other analytical laboratories.

Figure 4-1. Tritium concentrations in Central Facilities Area drinking water.

lubricating oil. High vapor-phase concentrations (up to 2,700 parts per million vapor phase) of VOCs were measured in the unsaturated zone above the water table. Groundwater models predict that VOC concentrations will continue to increase in the groundwater at the RWMC.

The RWMC production well is located in WMF-603 and supplies all of the drinking water for over 150 people at the RWMC. The well was put into service in 1974. Water samples were collected at the wellhead and from the point of entry to the distribution system, which is the point of compliance, located at WMF-604.

Since monitoring began at RWMC in 1988, there has been an upward trend in concentrations of carbon tetrachloride (Figure 4-2). In October 1995, the concentrations of carbon tetrachloride increased to 5.48 μg/L at the well. This was the first time the concentrations in the well exceeded the MCL of 5.0 μg/L. However, the MCL for carbon tetrachloride is based on a four-quarter average. The concentrations at the well are used for comparison purposes only because no MCL was exceeded at the distribution system (WMF-604), which is the compliance point. The distribution system is the point from which water is first consumed at RWMC. Table 4-3 presents the carbon tetrachloride concentrations at the RWMC drinking water well and distribution system for 1998. The mean concentration at the well for 1998 was 4.75 μg/L, and the maximum concentration was 5.50 μg/L. The mean concentration at the distribution system was 2.80 μg/L, and the maximum concentration was 3.00 μg/L Co-sampling with USGS and increased Drinking Water Program sampling are being implemented to monitor carbon tetrachloride concentrations.

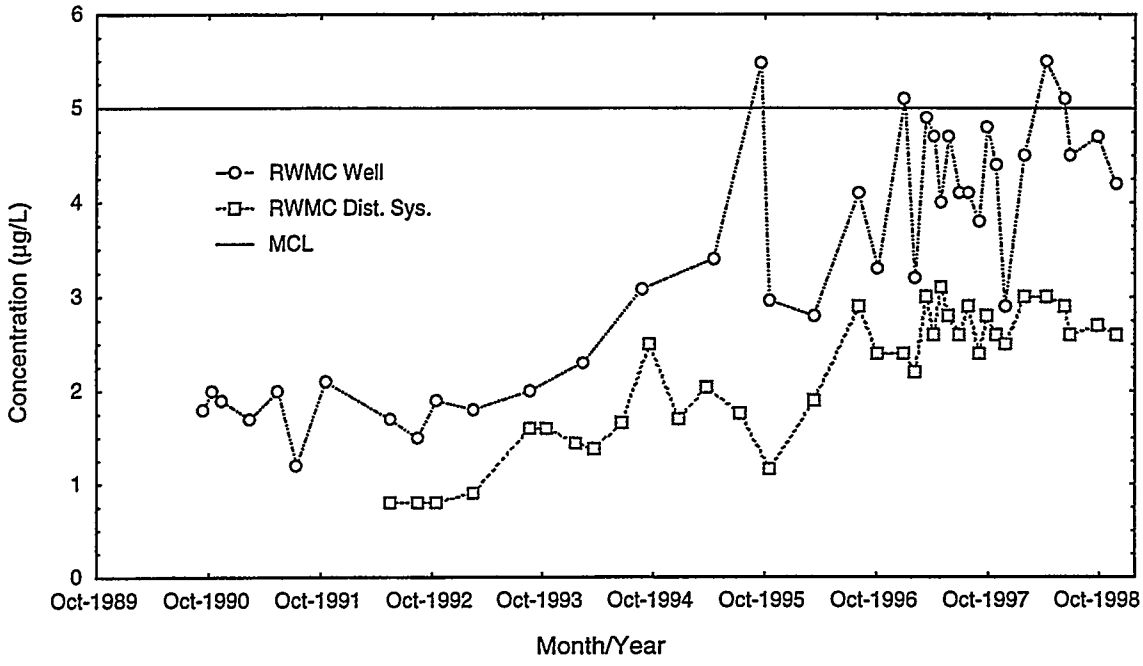


Figure 4-2. Carbon tetrachloride concentrations in Radioactive Waste Management Complex drinking water.

Table 4-3. Carbon tetrachloride concentrations at Radioactive Waste Management Complex drinking water well and distribution system (1998).

Well/Dist.	Number of Samples	Carbon Tetrachloride Concentration (µg/L)			
		Minimum	Maximum	Mean	MCL
RWMC WMF-603 Well	6	4.20	5.50	4.75	5.0
RWMC WMF-604 Dist.	6	2.60	3.00	2.80	5.0

4.1.2.3 Test Area North/Technical Support Facility. The inactive TSF injection well (TSF-05) is believed to be the principal source of trichloroethylene (TCE) contamination at the TSF facility. In 1987, TCE was detected at both TSF #1 and #2 wells, which supply drinking water to approximately 100 employees at TSF daily. Bottled water was provided until 1988 when a sparger system (air stripping process) was installed in the water storage tank to volatilize the TCE below the MCL.

During the third quarter of 1997, TSF #1 was taken off line and TSF #2 was put on line as the main supply well because the TCE concentration of TSF #2 was below the MCL of 5.0 µg/L. Therefore, by using TSF #2 well, no treatment (sparger air stripping system) is required. TSF #1 is used as a backup to TSF #2. If TSF #1 must be used, the sparger system must be activated to treat the water. The mean concentration of TCE at the distribution system for 1998 was 1.42 µg/L.

Table 4-4 presents the TCE concentrations at the TAN/TSF wells and distribution system. Figure 4-3 illustrates the concentrations of TCE in both TSF wells and the distribution system from 1989 through 1998. The exceeded MCL in the August 1994 distribution sample is attributed to preventive maintenance activities interrupting operation of the distribution system. The difference in concentrations between the two wells is attributed to different usage rates, proximity to the contamination source, seasonal change, and groundwater mobility.

Table 4-4. Trichloroethylene concentrations at Test Area North/Technical Support Facility wells and distribution system (1998).

Well/Dist.	Number of Samples	Trichloroethylene (μg/L) Minimum	Maximum	Mean	MCL
TSF #1 (612)	1	4.60	4.60	4.60	5.0
TSF #2 (613)	2	1.80	3.40	2.60	5.0
TSF Dist. (610)	5	1.10	1.90	1.42	5.0

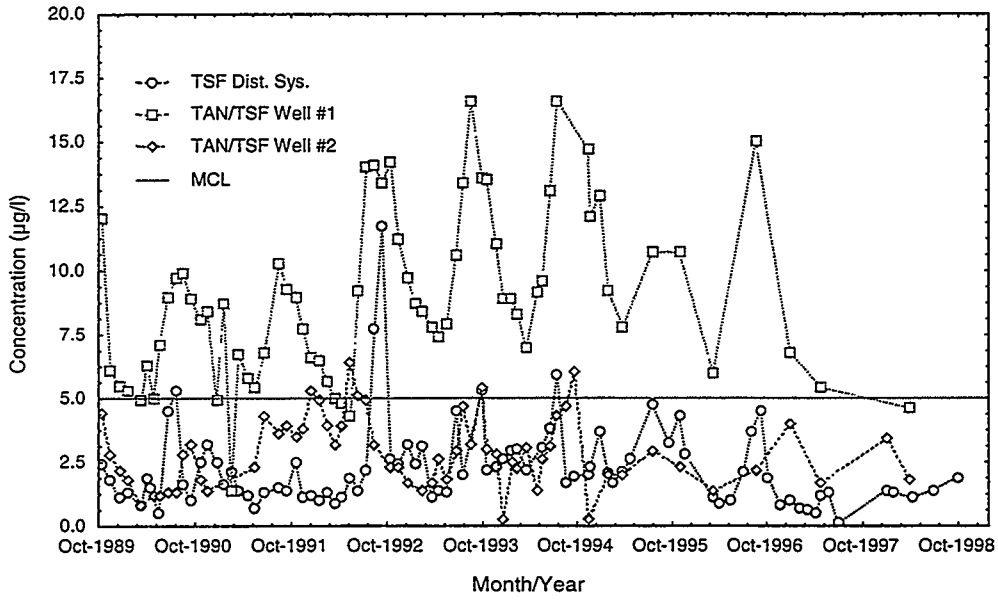


Figure 4-3. Trichloroethylene concentrations in Technical Support Facility drinking water.

4.1.3 Quality Assurance/Quality Control

Only approved drinking water methods as listed in 40 CFR 141–143 were used for drinking water analyses. All laboratories that performed analyses were certified by or had reciprocity with the State of Idaho for drinking water analyses.

Ten percent of the samples submitted each calendar year are QA/QC samples (splits, duplicates, trip blanks, field blanks, and blind spikes). In 1998, the results from the splits, duplicates, and field

blanks were within the acceptable ranges. Methylene chloride was detected a few times in trip blanks. Methylene chloride is a common laboratory contaminant and is often present in trip blanks and laboratory method blanks. One nitrate sample was suspect because of poor recovery of the matrix spike, which caused matrix interferance. No action is required because no nitrates were detected, which is consistent with previous data. With the exception of the one nitrate sample, all results were within the QC standard range. All QA/QC blind samples were validated and found not to have affected the quality of the data.

4.2 Liquid Effluent Monitoring Program

The Liquid Effluent Monitoring Program provides environmental monitoring for nonradioactive and radioactive parameters in liquid waste effluents generated within selected facilities at the INEEL. This program ensures that liquid effluent samples provide representative data to demonstrate compliance with regulatory requirements.

4.2.1 Program Design Basis

The Liquid Effluent Monitoring Program was instituted at the INEEL in 1986, and radiological monitoring of selected effluent streams was added to the program in 1992. Effluent monitoring for compliance with various permits was added as permits were obtained.

INEEL Idaho Falls facilities are required to comply with the applicable regulations found in Chapter 1, Section 8, of the Municipal Code of the City of Idaho Falls.[24] The City of Idaho Falls is authorized by the Clean Water Act to set pretreatment standards for nondomestic discharges to the publicly-owned treatment works.[25] Industrial Wastewater Acceptance (IWA) Forms[7] are obtained for facilities that dispose process liquid effluent through the City of Idaho Falls sewer system. The forms contain requirements that apply to all LMITCO and DOE-ID-operated facilities that discharge to the City sewer system. Permits include general requirements applicable to all facilities and specific monitoring requirements for the INEEL Research Center (IRC) and the Willow Creek Building (WCB) due to the nature of activities at these two facilities.

The State of Idaho regulates the discharge of liquid effluent under IDAPA 16.01.02, "Water Quality Standards and Wastewater Treatment Requirements."[26] Much of the wastewater discharged at the INEEL is to the ground surface through infiltration ponds or sprinkler irrigation systems. Discharge of wastewater to the land surface must be permitted under IDAPA 16.01.17, "Wastewater Land Application Permits"[5] (WLAPs). LMITCO operates seven facilities that require WLAPs at the INEEL. Four of the seven facilities have been issued WLAPs:

- CFA Sewage Treatment Plant (STP)
- INTEC Percolation Ponds
- INTEC STP
- TAN/TSF STP.

WLAP applications have been submitted to the Idaho Division of Environmental Quality for the remaining three of the seven facilities:

- Water Reactor Research Test Facility (WRRTF) process and sewage ponds
- TRA Cold Waste Pond

- TRA Chemical Waste Pond.

The WLAPs generally require compliance with the Idaho groundwater quality standards[26] in specified downgradient groundwater monitoring wells, annual discharge volume and application rates, and effluent quality limits.

The *1998 Annual Wastewater Land Application Site Performance Reports for the Idaho National Engineering Laboratory*[27] for permitted wastewater land application facilities were submitted to the Idaho Divisions of Environmental Quality on February 25, 1999. As required by State of Idaho WLAPs, the reports describe site conditions for the four permitted facilities. These reports contain:

- Permit-required monitoring data
- Status of special compliance conditions
- Discussions of environmental impacts by the facilities.

Parameters monitored in 1997 were reviewed in 1998 to accommodate new permits, regulations, orders, and codes and to reflect the changing processes at the INEEL. Sampling frequency and type are determined by considering the purpose for obtaining the data. Sampling locations are chosen where the samples most closely represent the released effluent, when practical. Effluent discharges that fall under a WLAP are monitored as the WLAP requires.

The sampling design was based on an approach developed to evaluate effluent sampling locations, frequencies, and parameters based on risk.[28] Risk is defined as the statistical probability of exceeding a release limit (both regulatory limits and environmental risk-based limits). The sampling design differentiates between streams requiring characterization monitoring and those requiring surveillance monitoring. The objectives of characterization monitoring are to provide data from which risk can be quantified and to establish baseline conditions for measuring change. Streams requiring characterization monitoring did not have sufficient historical data to quantify risk. Sites requiring surveillance monitoring were determined from historical data to have a potential risk of exceeding a limit or potential impact to the environment.

Table 4-5 lists effluent streams that were sampled during 1998 and the parameters and frequency of monitoring for each stream. The specific day during the period was randomly selected. Monitoring for WLAP-required parameters was conducted according to the frequencies specified in WLAPs for applicable streams.

Twenty-four hour composite samplers were used at all accessible locations. Grab sampling was conducted at certain areas because of inaccessibility to the effluent stream or the nature of the discharge. The Industrial Wastewater Acceptance agreements with the City of Idaho Falls and the WLAPs require use of analytical methods for the analysis of pollutants listed in 40 CFR 136, Subchapter N, "Effluent Guidelines and Standards."[29]

Table 4-5. 1998 effluent monitoring locations, parameters, and frequencies.

Location	Discharge Description	Type of Monitoring	Parameters[a]	Frequency
CFA-LS1, STP Lift Station	Untreated wastewater from all sanitary sewer drains throughout CFA	WLAP	WLAP parameters[b]	Monthly
CFA-STF, STP effluent pump pit	Treated wastewater from the CFA STP lagoons prior to land application	WLAP and characterization	WLAP parameters	Monthly (when pivot operating)
			Cl, F, SO_4, total dissolved solids (TDS), ICP metals[c] + Hg and radiological parameters[d]	Quarterly (when pivot operating)
CFA-696,[e] Transportation Complex oil and water separator	Water associated with the floor drains and vehicle maintenance areas in the new transportation complex	Characterization	Total oil and grease and VOCs[f]	Quarterly
CPP-769, influent to STP	Untreated wastewater from sanitary sewer drain throughout INTEC	WLAP	WLAP parameters	Monthly
CPP-773, STP effluent to Rapid Infiltration Trenches	Treated wastewater from the INTEC lagoons prior to the infiltration trenches	WLAP and characterization	WLAP parameters ICP metals + Hg Radiological parameters	Monthly Quarterly
TRA-708,[e] Acid Caustic Pumphouse	Water treatment process at the TRA demineralizer facility	Surveillance	ICP metals + Hg, Cl, F, SO_4, TDS, and NNN	Quarterly
			Radiological parameters	Annually
TRA-764, effluent to Cold Waste Pond	Nonradioactive, nonsanitary drains throughout TRA	Surveillance	ICP metals + Hg, Cl, F, SO_4, TDS, and radiological parameters	Quarterly
TAN-655, effluent to TSF pond	Combination of process water from TAN-607 and treated sewage	WLAP and surveillance	WLAP parameters Radiological parameters	Monthly Quarterly
WRRTF-1,[e] Sewage Lagoon sump	Treated effluent from the sanitary system at WRRTF	Surveillance	ICP metals + Hg, Cl, F, SO_4, TSS, TDS, BOD, NNN, TKN, and P	Annually

Table 4-5. (continued).

Location	Discharge Description	Type of Monitoring	Parameters[a]	Frequency
WRRTF-2,[e] process pond sump pit	Nonsanitary, nonradioactive sources at WRRTF	Surveillance	ICP metals + Hg, Cl, F, SO_4, TSS, TDS, and NNN	Semiannually
IFF-603B, IRC east access port	Sewage and laboratory discharges from IRC and the Research Office Building	IWA Form	RCRA metals[g] + Cu, Ni, Zn, CN, and phenol	Semiannually
IFF-616, WCB effluent	Sanitary sewage and wastewater from WCB	IWA Form	RCRA metals + Cu, Ni, Zn, CN, and phenol	Semiannually

a. All locations are sampled for field parameters including pH, specific conductance, and temperature.

b. Wastewater Land Application Permit parameters are specified in the individual permits.

c. ICP metals include antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc.

d. Radiological parameters include gross alpha, gross beta, and gamma spectrometry.

e. These samples were collected as grab samples. Other samples are 24-hour composites.

f. EPA Method 624 Target List.

g. RCRA metals include arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver.

4.2.2 Data Summary and Assessment by Facility

During 1998, a total of 12 effluent discharge points were routinely monitored for nonradiological parameters and five for radiological parameters at the following five areas:

- CFA
- INTEC
- Idaho Falls
- TAN
- TRA.

Approximately 1,400 effluent samples were collected.

To assess the data for trends or changes that might indicate loss of process control or unplanned release, control limits are calculated based on past monitoring data (see Appendix B for discussion of control limits). The INTEC Sewage Treatment Plant was the only stream for which parameters repeatedly exceeded Level 2 control limits (Section 4.2.2.1). All other Level 2 exceeded parameters were infrequent occurrences and did not indicate a trend or identify a regulatory issue, and therefore, are not discussed.

Measurement results were compared to regulatory limits. Regulatory limits include Resource Conservation and Recovery Act (RCRA) toxicity characteristic hazardous waste limits and limits set in applicable permits. Any detections above regulatory limits were addressed with facility representatives and regulatory agencies, and if required, actions were taken based upon these reviews. All results were below RCRA characteristic hazardous waste limits and City of Idaho Falls limits. With the exception of several total nitrogen samples at the INTEC STP, which exceeded WLAP limits, all results were within regulatory limits.

Additionally, concentrations in discharges to land application facilities were compared to calculated risk-based release levels. Release levels were developed for disposal of wastewater to land application facilities (percolation ponds or sprinkler irrigation sites).[30,31] Release levels were developed to ensure that long-term use of the ponds for wastewater disposal would not result in accumulation of contaminants that potentially become an unacceptable risk to human health or result in degradation of groundwater quality in excess of WLAP limits. Gross alpha and gross beta concentrations were compared to the Derived Concentration Guide (DCG) for the most restrictive alpha- and beta-emitting radionuclides (americium [Am]-241 and strontium [Sr]-90, respectively).

Historical and 1998 summary statistical data for effluent streams are in Environmental Monitoring Program files. The following sections discuss only the effluent streams and parameters that exceeded the applicable limits in 1998. Concentrations for parameters measured in 1998 were all below corresponding release levels, except where noted in the following sections.

4.2.2.1 Idaho Nuclear Technology and Engineering Center Sewage Treatment Plant.

The INTEC STP treats and disposes of sanitary and other related wastes at the INTEC. It consists of:

- Two aerated lagoons
- Two quiescent, facultative stabilization lagoons
- Four rapid infiltration trenches
- Six weir boxes (control stations) that move the sewage through the lagoons and trenches.

Automatic, flow-proportional composite samplers are located at control stations CPP-769 and CPP-773 (Figure A-8). The WLAP for the STP sets the following limits for effluent prior to the infiltration trenches (CPP-773):

- Total suspended solids (TSS) of 100 mg/L averaged monthly
- Total nitrogen (nitrate + nitrate + total Kjeldahl nitrogen [TKN]) of 20 mg/L averaged monthly
- Flow to rapid infiltration trenches of 30 million gallons annually.

For 1998, the STP effluent did not exceed the 100 mg/L TSS or the flow limit set forth in the permit. However, the total nitrogen limit of 20 mg/L was exceeded in the February, March, August, November, and December samples. The annual average concentration was 18.1 mg/L. Figure 4-4 shows influent and effluent total nitrogen concentrations from October 1995 through December 1998. Effluent total nitrogen concentrations appear to fluctuate with seasonal temperatures as shown by the decreasing nitrogen concentrations in the summer and increasing concentrations in winter. Microbial activity in the lagoons decreases during periods of cold temperatures and results in decreased nitrification/denitrification

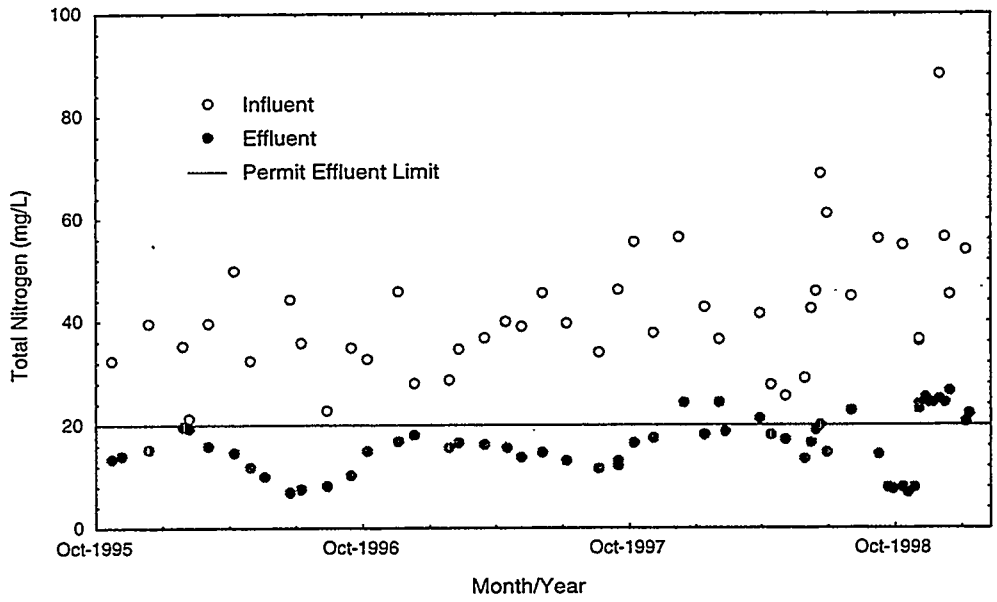


Figure 4-4. Total nitrogen concentrations at the Idaho Nuclear Technology and Engineering Center Sewage Treatment Plant from 1995 through 1998.

processes. The probable explanation for the high nitrogen in August is that the algae out-competed the nitrifying bacteria for the small amount of carbon going into the ponds.

The Idaho Division of Environmental Quality was notified of the exceeded concentrations when data were received, and sampling frequency was increased. LMITCO proceeded with an engineering study[32] to determine the cause of the elevated nitrogen concentrations and recommend actions to bring nitrogen concentrations into compliance. Maintenance and operational corrective actions are underway and are being evaluated to determine their effectiveness in reducing nitrogen concentrations. If these corrective actions do not reduce the nitrogen to acceptable concentrations, additional operational and plant modifications will be implemented to correct the situation.

Monthly TSS and TKN concentrations exceeded the Level 2 statistical control limits several times during 1998 (Table 4-6). Although effluent TSS concentrations did not approach the 100-mg/L permit limit, these excursions indicate a deviation from normal operating conditions since the permit was issued. The increasing trend in influent TKN corresponds to the increase in effluent TKN; however, a corresponding trend in effluent TSS is not apparent. As part of the ongoing nitrogen study, an in-depth inventory of sources contributing to INTEC sewage will be conducted. The inventory will be evaluated to determine what could be causing these increasing concentrations.

4.2.2.1.1 Effluent to the Cold Waste Pond (TRA-764)—Effluent to the Cold Waste Pond (TRA-764) is from nonradioactive, cold waste drains within TRA. The cold drains are located throughout TRA, including laboratories and craft shops. Maintenance cleaning waste, floor, and yard drains are examples of intermittent TRA discharges that might alter water quality parameters during normal operations. The largest volume of wastewater received by the Cold Waste Pond is secondary cooling water from the Advanced Test Reactor when it is in operation. Chemicals used in cooling tower water are primarily commercial corrosion inhibitors and sulfuric acid to control pH. The cold waste effluents collect at the cold well sump and sampling station, and are pumped out to the Cold Waste Pond,

Table 4-6. Total suspended solids and total Kjeldahl nitrogen data exceeding Level 2 control limit for Idaho Nuclear Technology and Engineering Center Sewage Treatment Plant influent and effluent.

Parameter	Stream	Sample Date	Concentration (mg/L)	Level 2 Limit (mg/L)
TKN	Influent	06/23/98	68.8	59.1
	Influent	07/01/98	61.1	59.1
	Influent	12/02/98	88.2	59.1
	Effluent	11/12/98	24.3	23.9
	Effluent	12/16/98	25.8	23.9
TSS	Influent	06/23/98	170	142
	Influent	07/01/98	190	142
	Influent	10/14/98	190	142
	Influent	12/16/98	230	142
	Effluent	05/05/98	31	23
	Effluent	06/23/98	38	23
	Effluent	09/10/98	27	23

which is located outside the TRA fence. A radiation monitor and alarm on the cooling tower system prevents accidental discharges of radiologically contaminated cooling water.

Data collected in 1998 met all applicable limits except for total dissolved solids (TDS). The average TDS concentration in 1998 (575 mg/L) and the historical average (563 mg/L) exceeded the risk-based release level of 560 mg/L. TDS concentrations of samples collected during reactor operation differ significantly from those collected during reactor outages (Figure 4-5). This difference is due to the discharge of approximately 80–120 gallons per minute of secondary cooling water containing four to five times the normal raw water hardness, as well as corrosion inhibitor, and acrylic polymer additions. This discharge occurs when the reactor is operating and during the first day of the outage and results in TDS concentrations two to three times the concentration discharged during outages. The average concentrations slightly exceed the concentrations predicted to result in degradation of groundwater quality in excess of drinking water standards. This issue will be addressed during the WLAP permitting process.

4.2.2.1.2 Effluent to the Chemical Waste Pond (TRA-708)—The TRA effluent to the Chemical Waste Pond is generated by water treatment processes at the TRA demineralizer facility. The ion-exchange process uses electrically-charged resin beads to attract and adsorb oppositely charged ions from the water until the resin exchange sites are filled with ions from the water. When the exchange capacity of the resin is saturated, the resin bed is regenerated by rinsing the resin with an appropriate chemical solution. Cation-exchange regeneration, which uses sulfuric acid as a regenerant, is performed approximately every other day. Anion-exchange regeneration, which uses a sodium-hydroxide regenerant, is performed approximately every third day. The waste streams are neutralized before being discharged to the Chemical Waste Pond. The neutralization took place in the brine pit (TRA-731A) until September 1995, when an aboveground tank (TRA-708C) was put into operation for neutralization. During 1998, the neutralized waste stream was sampled from the sampling point in TRA-708C. In 1998, the field pH measurement ranged from 8.60 to 9.71.

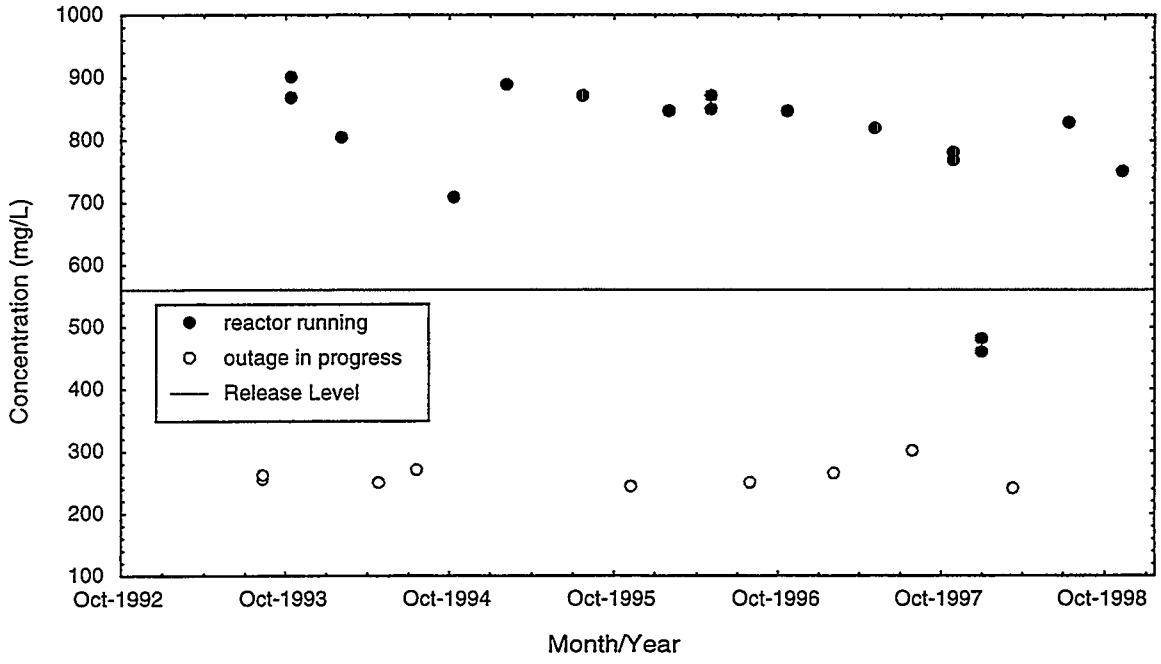


Figure 4-5. Test Reactor Area-764 total dissolved solids concentrations.

Ion-exchange regeneration waste streams typically contained mineral salts removed from the water, excess regenerant chemicals, and rinse waters from the regeneration process. Specific waste stream constituents anticipated in regeneration wastewater include calcium, sodium and magnesium salts, iron, copper, zinc, aluminum, manganese, potassium, chlorides, sulfates, mercury, and sodium-hydroxide. With the exception of sulfate, TDS, and sodium, all were below risk-based levels.

Water quality data from 1987 to 1998 were consistent with the large quantities of dissolved salts in demineralizer effluents. The high historical mean conductivity (20,444 μS) and TDS (20,504 mg/L) resulted from the elevated concentrations of dissolved salts and free ions introduced during the regeneration process. The high historical mean concentrations for sodium (3,638 mg/L) and sulfate (16,837 mg/L) resulted from the sodium-hydroxide and sulfuric acid used in the regeneration process. Average concentrations in 1998 exceeded risk-based release levels for sulfate (by 18 times), TDS (by 12 times), and sodium (by 17 times). The high concentrations of these constituents have the potential to degrade groundwater and represent an environmental concern. A reverse osmosis system is scheduled to replace the existing demineralizer system in 1999. This will eliminate discharge of these contaminants to the Chemical Waste Pond.

4.2.3 Special Studies

The CFA STP was built in 1994 to treat wastewater in pretreatment lagoons followed by land application via a pivot irrigation system. The WLAP for the CFA STP requires annual soil sampling inside the irrigation area. These results are reported in the Annual WLAP Site Performance Reports.[27] In addition to permit-required soil sampling, additional soil and soil pore-water sampling was initiated in 1997 as part of a special study. The primary objectives of this study are to evaluate the effects additional nitrogen and salt loading have on the overall soil profile in a native sagebrush steppe environment (one of three plant communities in the irrigation area) and to determine the implications on the long-term ecological health of the area. This study will measure soil chemistry for the same constituents as those required for the WLAP (except phosphorous) inside the irrigation area, and compare them to similar

measurements made immediately outside the irrigation area in the same plant community. Lysimeters were also installed to extract soil pore-water at the same locations and depth intervals as the soil samples.

Sampling locations were chosen based on their proximity to the Environmental Science and Research Foundation's neutron probe access tubes. During the summer of 1997, a cluster of three lysimeters were placed (30-cm [12-in.], 60-cm [24-in.], and 90-cm [35-in.] depths) adjacent to five neutron probes within the irrigation area and five neutron probes in an adjacent control area. Soil pore-water sampling began at these locations in the spring of 1998. Soils were sampled at the same depths and areas in the spring at the same time as the soil pore-water sampling, and again in the fall at the same time as the soil sampling for the WLAP permit compliance.

Compared to the adjacent control area outside the irrigation area, results of soil sampling indicate soluble salts increased inside the irrigation area. Specifically, the less soluble calcium and magnesium appear to have been deposited throughout the profile, while more soluble sodium was leached through the soil profile. Sodium concentration has, however, increased in the top 30.5-cm (12-in.) interval of the soil profile. It is possible that a reversal in the soil pore-water movement from downward to upward (due to drying of surface soil when irrigation was stopped in September) caused sodium to be deposited on the surface, while leaving the magnesium and calcium at depth (Figures 4-6, 4-7, and 4-8).

Conductivity is elevated throughout the two soil intervals (relative to the control area), while the sodium absorption ratio (SAR) is elevated only in the 0–30.5-cm (0–12-in.) interval within the irrigation area (Figures 4-9 and 4-10). A low SAR (2–10) indicates little danger to soil structure from sodium; an SAR between 7 and 18 is a medium hazard, and an SAR between 11 and 26 is a high hazard. Although there is some soluble salt buildup near the surface, it is well below concentrations considered detrimental to plant growth and soil permeability.

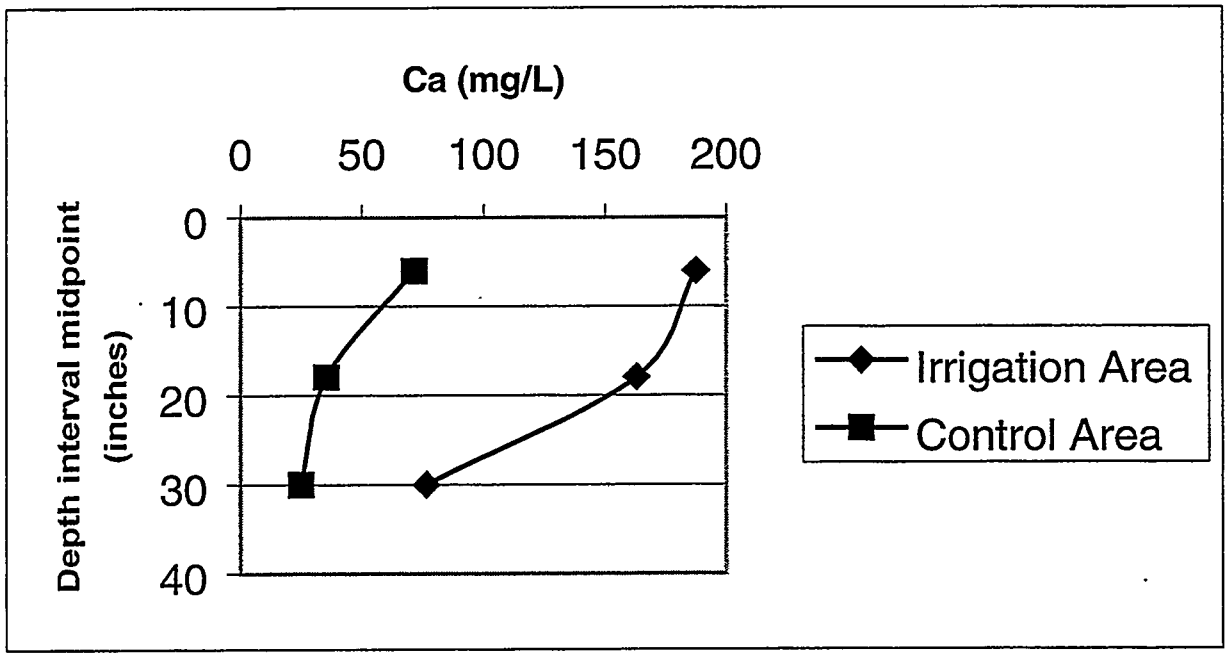


Figure 4-6. Average calcium vs. soil depth, November 1998.

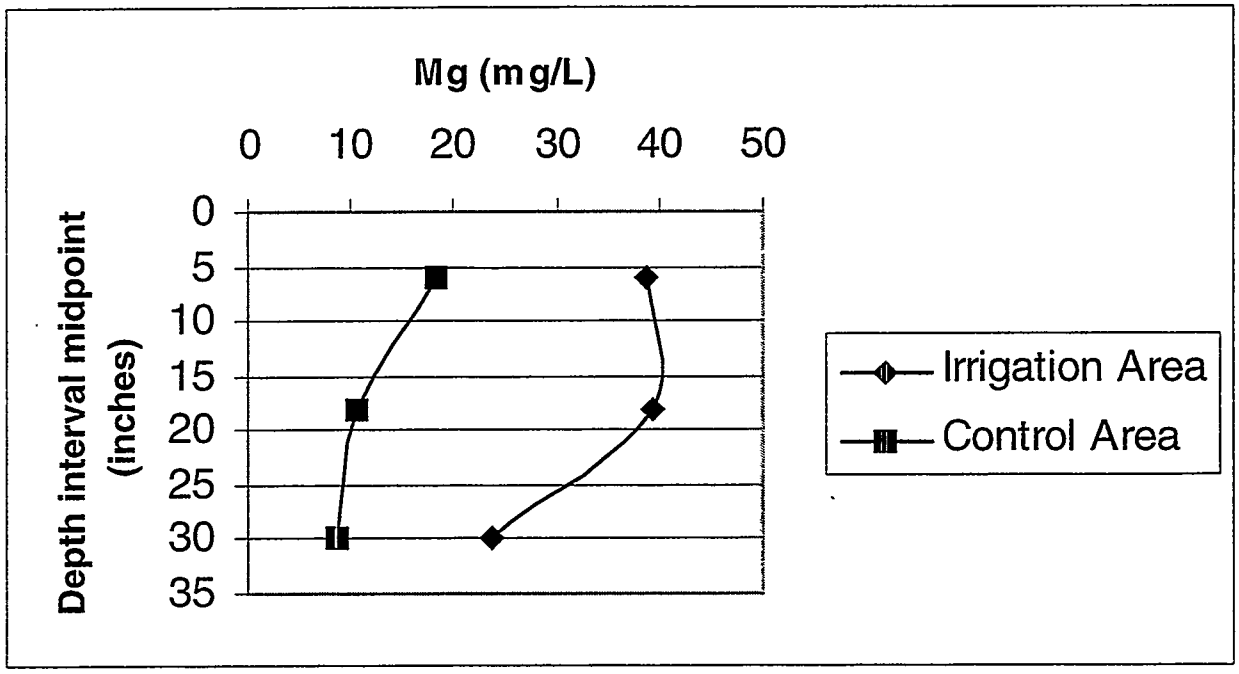


Figure 4-7. Average magnesium vs. soil depth, November 1998.

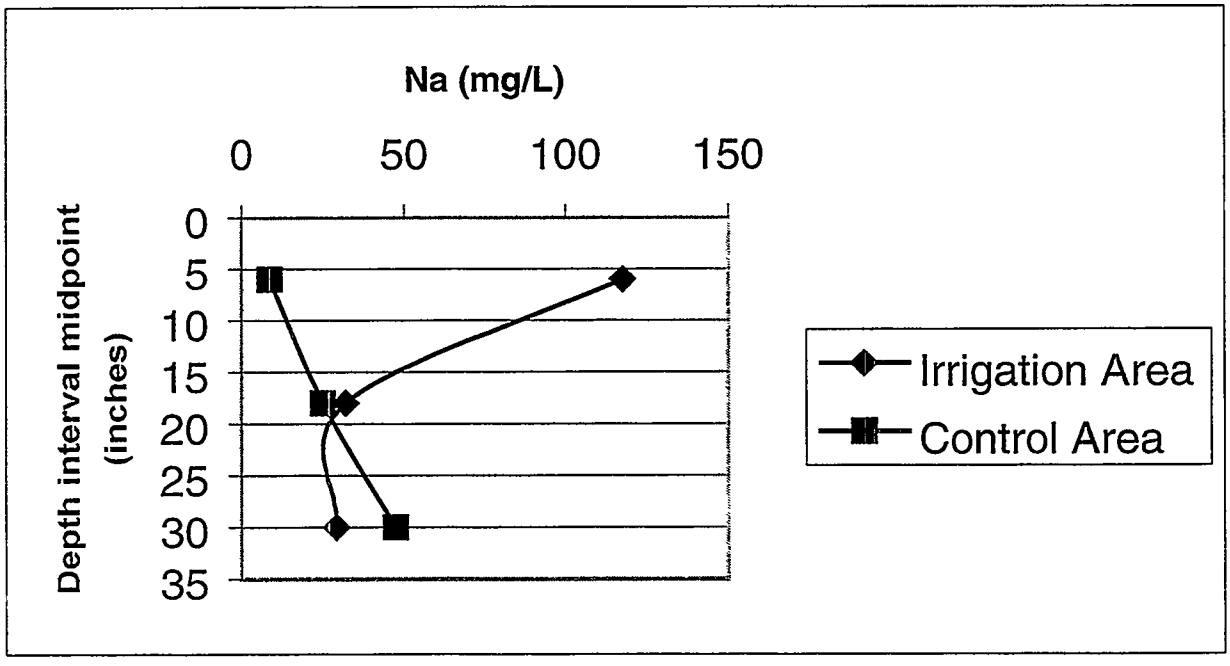


Figure 4-8. Average sodium vs. soil depth, November 1998.

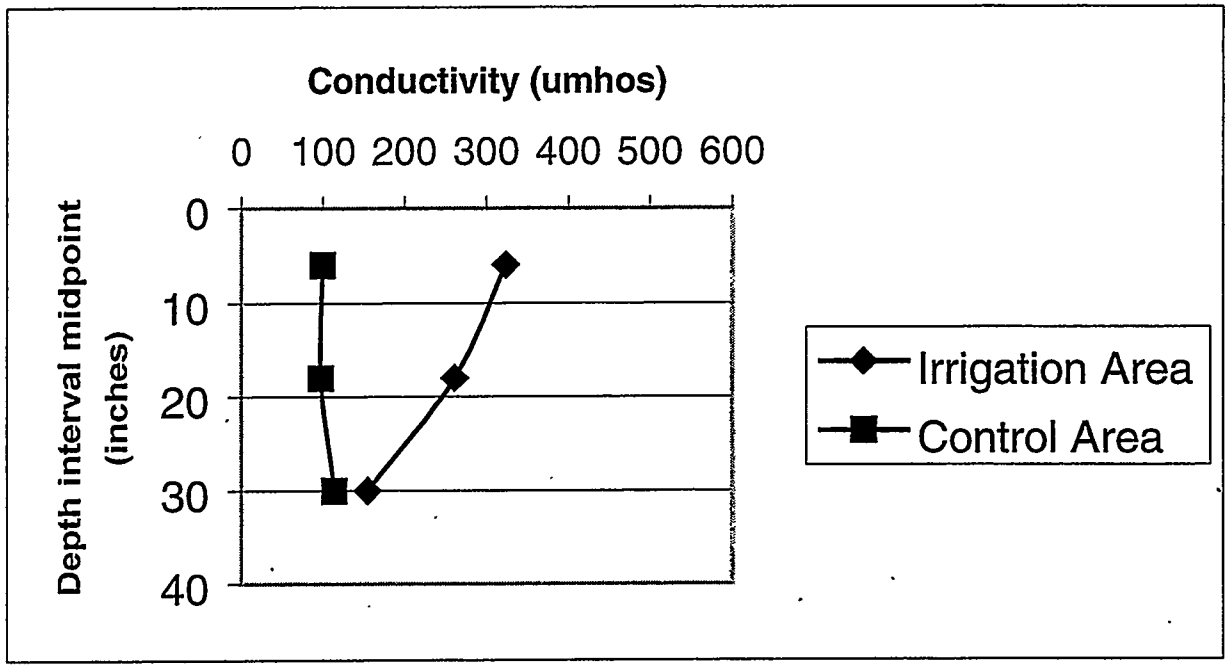


Figure 4-9. Average electrical conductivity vs. soil depth, November 1998.

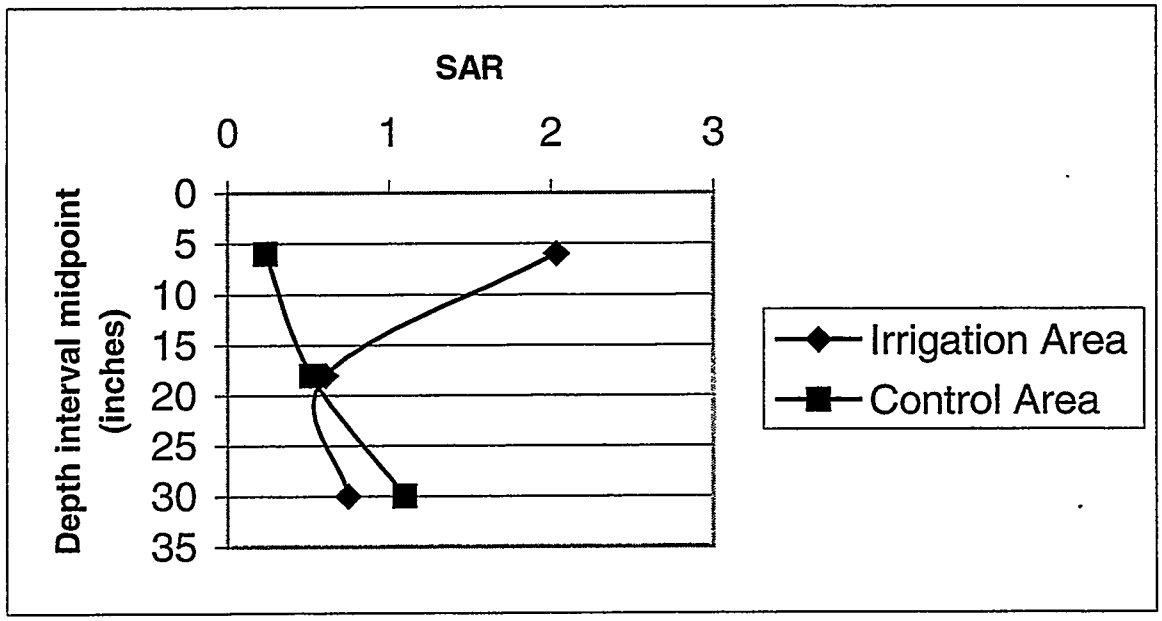


Figure 4-10. Average sodium absorption ratio vs. soil depth, November 1998.

Ammonia, nitrogen, and TKN concentrations within the soil profile have not increased significantly due to irrigation, but rather have decreased slightly. It is likely that most of the ammonia is volatilized upon application, and plants quickly utilize the remaining ammonia. In addition, it is possible that increased nutrients available to the plants as a result of wastewater application are actually stimulating plant growth, resulting in rapid utilization of plant-available nitrogen and ammonia.

Organic matter did not change significantly within the irrigation area. Significant changes in the percentage of organic matter are not expected for several years until plant matter from several growing seasons is incorporated into the soil profile.

Soil pore water samples were taken in April 1998 concurrently with the soil samples. Due to the low soil moisture content of the desert soils and the relatively high pore-water tension typical of soils with moderate to high clay content, it was difficult to extract sufficient water to meet laboratory minimum volumes for analyses. Some changes will be made to the methodology for 1999 to apply a vacuum to the lysimeters over a longer period and perhaps increase the amount of water recovered from the soil. The limited data obtained from the lysimeters are thus far consistent with the data obtained from soil sampling (for example, elevated salt concentrations in the irrigation area), however data are insufficient to make definitive conclusions.

Additional data will be collected in the spring and fall of the following years. As more data are obtained, statistical analyses will be performed to better determine effects of nitrogen and salt loading on the overall soil profile. Information obtained will be used to determine the implications this may have on the long-term ecological health of the area.

4.2.4 Quality Assurance/Quality Control

Duplicate samples are collected approximately once per year per sampling location. The goal is to achieve less than or equal to 35% relative percent difference between any pair of duplicate samples. Ninety-seven percent of duplicates analyzed for metals achieved this goal, 92% of duplicates analyzed for inorganics achieved this goal, and 83% of duplicates analyzed for radionuclides achieved this goal. In many instances, the effluent samples collected are either nondetected for various analytes or contain analyte concentrations less than five times greater than the method detection limit. When an analyte concentration is less than five times greater than the method detection limit, quantification of the analyte becomes less certain.

A set of equipment blanks (rinsates) was collected prior to collecting samples at Idaho Falls Facility (IFF)-616 and IFF-603 in October. These samples were collected by pumping deionized water through the compositors, and they were analyzed for metals. There were no detectable metals in the equipment blanks.

Three trip blanks (prepared with high-performance liquid chromatography water) were sent in 1998 with the three VOC samples collected at CFA-696. On two occasions, these trip blanks contained low concentrations of chloroform. No chloroform was detected in the laboratory blanks or in the samples. No source for the chloroform in the trip blanks could be identified. The high-performance liquid chromatography water used for preparing trip blanks has since been replaced.

The primary contract laboratories used by the Liquid Effluent Monitoring Program include Recra Lab Net Philadelphia, Lockheed Martin Energy Systems Analytical Services Organization and Paragon Analytics. These laboratories participate in the DOE Mixed Analyte Performance Evaluation Program and in the DOE Integrated Performance Evaluation Program, which integrates QC data obtained by the EPA Water Pollution Laboratory Performance Evaluation Program. These programs send blind QC

spikes to participating laboratories in order to evaluate their performance. For effluent radiological analyses, interlaboratory comparison samples (blind spikes) are sent to participating laboratories (including Paragon Analytics) by the EPA Las Vegas Performance Evaluation Program, the DOE Mixed Analyte Performance Evaluation Program, and the DOE Environmental Measurements Laboratory Quality Assessment Program. The laboratories demonstrated acceptable accuracy and precision for these analyses.

Usually, blind standards (QA/QC field blinds) are submitted approximately quarterly. In 1998, difficulties with laboratory procurement and laboratory service backlogs limited the program to two sets of blind standards. One set of blind standards was submitted in June, and one set was submitted in October. The standard labeling and sample numbering scheme was used so that the analytical laboratory cannot determine that the samples are QC samples.

The second quarter (June) field blind spikes sent to the analytical laboratory (Recra Lab Net Philadelphia) consisted of phenolics, cyanide, TKN, nitrate + nitrite, TSS, chloride, fluoride, sulfate, biological oxygen demand (BOD), and chemical oxygen demand (COD). The majority of results were within the performance acceptance limits recommended by the supplier of the standards. The laboratory failed to detect fluoride and sulfate, and the result for BOD was below the low end of the performance acceptance criteria.

Fourth quarter (October) blind spikes sent to the laboratories (Lockheed Martin Energy Systems Analytical Service Organization and Paragon Analytical, Inc.) consisted of trace metals and inorganics. Both laboratories achieved acceptable results for trace metals. Lockheed Martin Energy Systems Analytical Service Organization analyzed blind spike samples for nitrate + nitrite, BOD, COD, TKN, cyanide, and phenolics. TKN and BOD were slightly below the acceptable ranges, and the cyanide result was above the high end of the acceptable range. Paragon Analytical analyzed for TDS, TSS, chloride, fluoride, sulfate, and nitrate + nitrite. Chloride, fluoride, sulfate, and nitrate + nitrite analytical results were within acceptable ranges. The TDS result was below the low end of the acceptable range, and Paragon failed to detect TSS in the field blinds.

Low bias in results of analyses performed on blind QC samples may indicate that the results of effluent samples collected in the same period may also be biased low. Data remains usable as long as this possibility is taken into account. For the Liquid Effluent Monitoring Program, the majority of the analytical results are several times lower than any specified limits. In other words, analytical results could be, in most instances, several times higher than they are and still be less than the discharge limits.

Analytical data obtained from the QC field blinds were validated, but no specific problems could be identified. The raw data submitted by the laboratories showed no irregularities.

4.3 Storm Water Monitoring Program

The EPA National Pollutant Discharge Elimination System (NPDES) rules for the point source discharges of storm water to waters of the U.S. require permits for discharges from industrial activities and construction sites.[8,9] For regulatory purposes, waters of the U.S. at the INEEL include:

- Big Lost River
- Little Lost River
- Birch Creek

- Spreading areas
- Playas
- Tributaries.

Together the above comprise the Big Lost River System (BLRS) (Figure 4-11).

On September 9, 1992, the EPA issued the National Pollutant Discharge Elimination System General Permit for Storm Water Discharges Associated with Industrial Activity[8] with an effective date of October 1, 1992. The DOE-ID submitted a Notice of Intent to the EPA to obtain coverage of the INEEL under the NPDES General Permit. To meet the requirements of the permit, DOE-ID prepared the *INEEL Storm Water Pollution Prevention Plan for Industrial Activities*[33] (SWPPP-IA). The SWPPP-IA applies to all the facilities and includes:

- Pollution prevention teams
- Descriptions of potential sources of pollution
- Measures and controls
- Evaluation requirements
- Monitoring requirements.

Practices to minimize storm water pollution are evaluated annually, and the SWPPP-IA is revised accordingly. A Storm Water Monitoring Program in compliance with permit conditions was implemented in 1993. The program was modified as data were evaluated and needs were identified. In 1997, monitoring of storm water that enters deep injection wells was transferred from the USGS to LMITCO.

On October 1, 1998, the INEEL obtained coverage under the NPDES Multi-Sector General Permit[34] and implemented the analytical monitoring requirements of the new permit. However, in November 1998, the EPA issued a memorandum stating that Multi-Sector General Permit analytical monitoring is not required until January 1999.

4.3.1 Program Design Basis

The Storm Water Monitoring Program meets the NPDES General Permit requirements by conducting required monitoring. In addition, the program monitors storm water runoff to deep injection wells to comply with State of Idaho Injection Well Permits.[6] NPDES General Permit-required data are submitted to the EPA in a Discharge Monitoring Report.[35] Additionally, NPDES data are summarized in the annual updates to the SWPPP-IA. Data for storm water discharged down deep injection wells are reported to the Idaho Department of Water Resources.

During 1998, a total of 16 sites (Table 4-7) at eight INEEL areas (Appendix A) were designated as storm water monitoring locations based upon drainage patterns and proximity to potential sources of pollutants. Four locations met the conditions for semiannual monitoring required by the NPDES General

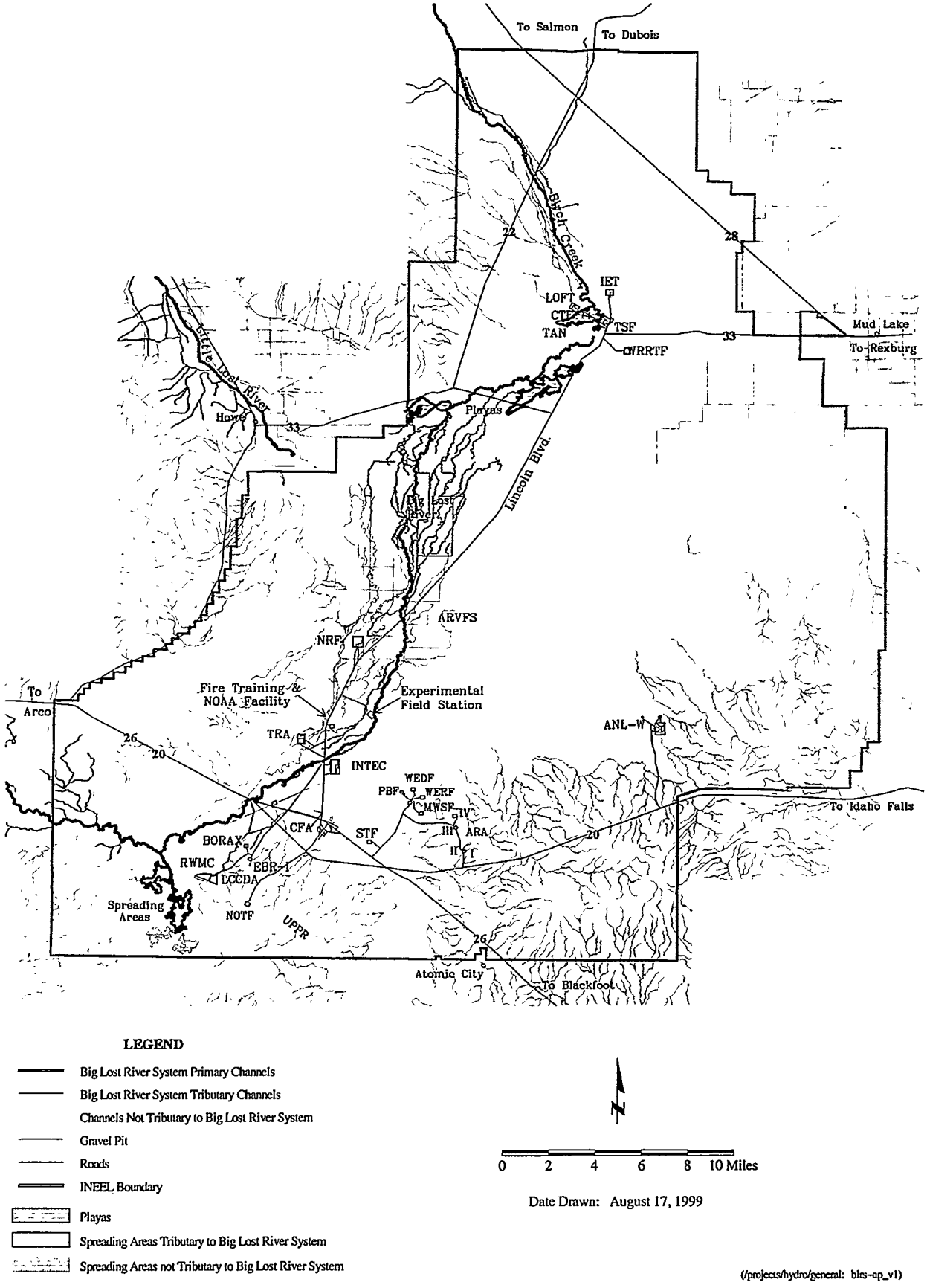


Figure 4-11. Big Lost River System.

Table 4-7. 1998 storm water monitoring locations and frequencies.

Site ID	Site Description	Parameters[a]	Number of Sampling Events in 1998
CFA-MP-2[b]	CFA Landfill #3 near entrance	RCRA metals[c] + total and dissolved Mg, inorganics[d] + TOC, TDS, TKN, CN, whole effluent toxicity, and radiological parameters[e]	0
CFA-MP-3	CFA Disposal Well near junction of Lincoln and Wyoming	Drinking water metals,[f] inorganics + TDS, CN, coliform, and radiological parameters	0
CPP-MP-1[b]	East Perimeter Road at culvert to retention basin	Inorganics + BOD, TKN, total P, and radiological parameters	3
CPP-MP-2[b]	South side of coal pile at discharge to ditch	Cu, Ni, Zn, TSS, COD, and TOG, and radiological parameters	1
PBF-MP-2	SPERT Disposal 1	Drinking water metals, inorganics + CN, TDS, coliform, and radiological parameters	0
PBF-MP-3	SPERT Disposal 2	Drinking water metals, inorganics + CN, TDS, coliform, and radiological parameters	1
PBF-MP-4	SPERT Disposal 3	Drinking water metals, inorganics + CN, TDS, coliform, and radiological parameters	1
RWMC-MP-2[b]	Outflow from the SDA at the sump by Culvert C-12	RCRA metals + total and dissolved Mg, inorganics + TDS, TKN, CN, radiological parameters, and whole effluent toxicity	5
SMC-MP-1	West side of Specific Manufacturing Capability (SMC) on Taylor Creek Road	Inorganics + BOD and radiological parameters	1
TRA-MP-1	Culvert C-11 north of TRA-602	Inorganics and radiological parameters	0
TRA-MP-2	Culvert C-10 north of TRA-601	Inorganics and radiological parameters	0
TSF-MP-1	TAN Drainage Disposal 1, corner of Lincoln and Nile	Drinking water metals, inorganics + CN, TDS, coliform, and radiological parameters	0
TSF-MP-2	TAN Drainage Disposal 2, discharge to basin TAN-782	Drinking water metals, inorganics + CN, TDS, coliform, and radiological parameters	0
TSF-MP-3	TAN Drainage Disposal 3, basin northwest of TSF	Drinking water metals, inorganics + CN, TDS, coliform, and radiological parameters	0

Table 4-7. (continued).

Site ID	Site Description	Parameters[a]	Number of Sampling Events in 1998
WRF-MP-1	Catch basin, east side of WERF	RCRA metals + total and dissolved Mg, inorganics + TDS, TOC, TKN, and radiological parameters	1
WRF-MP-2	Catch basin, south side of WERF	RCRA metals + total and dissolved Mg, inorganics + TDS, TOC, TKN, and radiological parameters	1

a. All locations are sampled for field parameters including pH, electrical conductivity, and temperature.

b. This location has specific NPDES General Permit monitoring requirements.

c. RCRA metals include arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver.

d. Inorganics include COD, TOG, TSS, and NNN.

e. Radiological parameters include gross alpha, gross beta, and gamma spectrometry.

f. Drinking water metals include antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, sodium, and thallium.

Permit when discharges occur to the Big Lost River System (CFA-MP-2, CPP-MP-1, CPP-MP-2, and RWMC-MP-2). Seven deep injection wells are monitored as required by the Injection Well Permits[6] when storm water discharges to those wells. Surveillance monitoring not specifically required by the permits was also conducted to evaluate the effectiveness of storm water pollution prevention practices.

The NPDES General Permit requires samples be collected from rain storms that left at least 0.25 cm (0.1 in.) of precipitation preceded by at least 72 hours without measurable precipitation to allow pollutants to build up and then be flushed from the drainage basin. The NPDES General Permit requires two samples per year for the four locations that are subject to the permit requirements. Because of unique meteorological conditions, not all sites may be sampled every year. Some samples may be collected from snow melt runoff or from storms that do not meet permit requirements in order obtain sufficient samples. The Storm Water Monitoring Program attempts to sample all locations twice a year. Either grab samples or composite samples are collected. Basin grab samples are collected instead of composite samples if the storm water was not discharged from the basin within 24 hours.

The storm duration, amount, and duration between the storm event sampled and the end of the previous storm are recorded for all precipitation events. In addition, if a storm results in a discharge to the BLRS, total discharge volume is also measured as required by the NPDES General Permit.

Storm water monitoring results are compared to a number of criteria to evaluate the quality of storm water discharges. The NPDES General Permit does not have numeric limitations for the required analytical parameters, except for the runoff from coal piles. The pH of runoff from the coal pile at INTEC must be within the range of 6 to 9. This is the only applicable regulatory limit; all other criteria were used for comparison purposes only. Nonradiological concentrations were compared to EPA benchmarks (see Appendix D) from the 1995 NPDES Storm Water Multi-Sector General Permit.[34] Radiological concentrations were compared to DCGs found in DOE Order 5400.5.[11] The benchmarks and DCGs are pollutant concentrations above which EPA and DOE determined represent a level of concern. The level of concern is a level at which a storm water discharge could potentially impair or

contribute to impairing water quality or affect human health by ingesting water or fish. The EPA has used EPA benchmarks to determine if a storm water discharge from any given facility merits further monitoring to ensure that the facility has been successful in implementing a storm water pollution prevention plan. Injection well permit data were compared to primary drinking water maximum contaminant levels from 40 CFR 141.[22]

Suspended solids are considered a pollutant when they significantly exceed natural concentrations and have a detrimental effect on water quality. Total suspended solids are a good indicator of pollutant removal efficiency and is used to evaluate storm water pollution prevention practices. Instances of elevated suspended solids may indicate that erosion control was not adequate at some facilities.

4.3.2 Data Summary and Assessment by Facility

During 1998, approximately 260 samples were collected from eight locations. Table 4-8 shows sampling dates and locations for the storm water events in 1998. No rainfall or snowmelt runoff was observed during 1998 at three monitoring points and five injection wells (Table 4-8); therefore, no samples were collected at those locations.

One storm water sample was collected of a discharge to the BLRS from the RWMC Subsurface Disposal Area (SDA) (RWMC-MP-2) in 1998 in compliance with the NPDES General Permit. All other samples were collected for surveillance monitoring purposes.

Historical and 1998 summary data are available in Environmental Monitoring Program files. Table 4-9 summarizes the analytical results that exceeded the comparison levels during 1998. No permit or regulatory limits were exceeded. Of the contaminants that exceeded the EPA benchmarks in 1998, iron, zinc, and TSS were the most frequently detected.

Although EPA benchmark concentrations were exceeded in several samples, the EPA stressed that exceeded concentrations do not imply that an actual violation of standards will exist in the receiving water body in question. This is particularly the case at INEEL, where in 1998, RWMC was the only location that discharged to a man-made channel that is a tributary of the Big Lost River, and runoff did not reach the Big Lost River.

The following sections discuss only the monitoring locations where results exceeded comparison levels in 1998.

4.3.2.1 Idaho Nuclear Technology and Engineering Center. The INTEC has two monitoring locations (Figure A-8); both of these locations are required by the NPDES General Permit. Three grab samples were collected from the culvert into the retention basin (ICPP-MP-1), and all parameters were reported below EPA benchmarks and DCGs, except for those listed in Table 4-9.

As of December 1998, 10 of 13 samples analyzed for either nitrate + nitrite or nitrate exceeded the benchmark at the retention basin. In comparison, six of 26 samples collected at other INEEL facilities exceeded the benchmark. No significant trends in concentration were identified, and the 1998 average concentration was within the range of historical average nitrate concentrations. Total phosphorous exceeded the benchmark for the first time in July 1998 out of 21 samples collected since 1993.

Table 4-8. 1998 storm water sampling events.

Location	Date	Event[a]	Precipitation[b] (cm)	Discharge to Big Lost River System	Flow Rate[c] (L/sec)
NPDES Permit Monitoring Points					
CPP-MP-1	03/17/98	SM	NA	No	0.34
CPP-MP-1	06/09/98	RR	0.05	No	6.00
CPP-MP-1	07/29/98	RR	1.52	No	15.01
CPP-MP-2	03/23/98	RR	0.45	No	0.03
RWMC-MP-2	01/29/98	SM	NA	No	NF
RWMC-MP-2	02/24/98[d]	SM/RR	0.11	Yes	25.2
RWMC-MP-2	03/24/98	SM/RR	0.45	No	NF
RWMC-MP-2	06/16/98	RR	0.42	No	NF
RWMC-MP-2	11/30/98	RR	0.18	No	NF
Injection Well Monitoring Points					
PBF-MP-3	03/13/98[e]	SM	NA	No	NF
PBF-MP-4	03/13/98[e]	SM	NA	No	NF
Surveillance Monitoring Points					
SMC-MP-1	02/18/98	SM	NA	No	NF
WRF-MP-1	02/03/98	SM	NA	No	NF
WRF-MP-2	02/03/98	SM	NA	No	1.13

a. SM = snow melt, RR = rain runoff.

b. NA = precipitation amounts are not applicable to snow melt events.

c. NF = no measurable flow at the time of sampling; sample was collected from ponded water.

d. Whole effluent toxicity sample taken on 2/24/98 was delayed in shipment; sample was retaken on 3/24/98.

e. Location was monitored on 3/13/98, 3/18/98, and 3/24/98.

Table 4-9. 1998 storm water/snow melt data exceeding comparison levels.

Monitoring Point	Parameter (Units)	Date	Result	Benchmark[a]
ICPP-MP-1	Nitrate + nitrite (mg-N/L)	06/09/98	1.6	0.68
	Nitrate + nitrite (mg-N/L)	07/29/98	1.9	0.68
	TSS (mg/L)	06/09/98	270.0	100.0
	TSS (mg/L)	07/29/98	150.0	100.0
	Total phosphorus (mg/L)	07/29/98	2.2	2.0
	Aluminum (mg/L)	07/29/98	42.4	7.500
	Copper (mg/L)	07/29/98	0.0704	0.064
	Iron (mg/L)	07/29/98	55.3	1.0
	Manganese (mg/L)	07/29/98	1.06	1.0
	Zinc (mg/L)	07/29/98	0.58	0.117
	Gross alpha (pCi/L)	07/29/98	52.00 ± 3.76	30.0[b]
ICPP-MP-2	TSS (mg/L)	03/23/98	688.71	100.0
	Iron (mg/L)	03/23/98	6.63	1.0
PBF-MP-3	Iron (mg/L)	03/13/98	1.64	0.3[d]
	Iron [F][c] (mg/L)	03/13/98	0.414	0.3[d]
	Di(2-ethylhexyl)phthalate (mg/L)	03/13/98	0.013	0.006[d]
PBF-MP-4	Iron (mg/L)	03/13/98	4.65	0.3[d]
	Iron [F] (mg/L)	03/13/98	1.54	0.3[d]
	Manganese (mg/L)	03/13/98	0.0904	0.05[d]
	Di(2-ethylhexyl)phthalate (mg/L)	03/13/98	0.0083	0.006[d]
RWMC-MP-2	pH	06/16/98	9.05	6.0–9.0
	Nitrate + nitrite (mg-N/L)	01/29/98	1.0	0.68
	TSS (mg/L)	11/30/98	140.0	100.0
	Iron (mg/L)	06/16/98	1.32	1.0
	Iron (mg/L)	11/30/98	6.8	1.0
	Zinc (mg/L)	01/29/98	2.82	0.117
	Zinc (mg/L)	02/24/98	0.638	0.117
	Zinc (mg/L)	06/16/98	0.33	0.117
	Zinc [F] (mg/L)	06/16/98	0.157	0.117
	Acute WET: Ceriodaphnia <24 hour	06/16/98	Failed	NA[e]

Table 4-9. (continued).

Monitoring Point	Parameter (Units)	Date	Result	Benchmark[a]
WRF-MP-1	Zinc (mg/L)	02/03/98	0.123	0.117
WRF-MP-2	Zinc (mg/L)	02/03/98	0.239	0.117

a. Benchmarks are EPA benchmarks from the 1995 NPDES Storm Water Multi-Sector General Permit[34] unless otherwise noted.

b. Benchmark is the low emitter DCG.

c. Result is from a filtered sample.

d. Injection well benchmarks are drinking water MCLs/SMCLs from 40 CFR 141.[22]

e. NA—not applicable.

High concentrations of TSS and zinc are common at the INEEL's more developed areas. Some correlation exists between TSS and zinc; however, in the 1998 sample, only a small portion of zinc (4%) and copper (5%) can be attributed to background concentrations from soil-forming minerals. Other possible sources of zinc and copper include culverts, fences, galvanized sheet metal, and roads. High TSS many be attributed to soil disturbance activities and eroded ditches. Maintenance of the drainage system has begun to control erosion and clean out culverts.

Aluminum, iron, and manganese were monitored at the retention basin for the first time in 1998, and unfiltered samples exceeded the benchmark with concentrations of 42.4 mg/L, 55.3 mg/L, and 1.06 mg/L respectively. The concentrations in the filtered samples were well below benchmarks or nondetectable, which indicates that the elevated concentrations are due to suspended solids in the runoff. These metals are typical rock- and soil-forming elements, and high concentrations would be expected in storm water containing suspended sediment.

Gross alpha and beta results (52 ± 3.76 and 103 ± 5.74 pCi/L, respectively) for storm water samples collected at the retention basin in July 1998 were slightly greater than the highest previously measured concentrations (50 ± 30 and 97 ± 13 pCi/L, respectively). Soil disturbance activities occurring at the time, such as maintenance of the storm water collection ditches, may have contributed to the elevated concentrations. Contaminated soils at INTEC most likely contributed a significant portion of the gross alpha and gross beta measured in the storm water.

Storm water from the coal pile (ICPP-MP-2) must have a pH between 6 and 9 to comply with a numeric effluent limitation. All pH readings have been within the limit. The concentration of TSS in the March 1998 sample exceeded the benchmark concentration of 100 mg/L. The average concentration of iron (measured for the first time in 1998) was 6.6 mg/L, which is above the benchmark concentration of 1.0 mg/L. All of the measured iron can be attributed to background levels from soil-forming minerals.

4.3.2.2 Power Burst Facility. There are five monitoring locations at PBF (Figure A-17). Three of the locations (PBF-MP-2, -3, and -4) are at injection well basins, and two NPDES storm water locations are at the Waste Experimental Reduction Facility (WERF) (WRF-MP-1 and -2).

One snow melt grab sample was collected from each WERF location for storm water surveillance purposes during 1998. The WERF results were below the applicable benchmarks, with the exception of zinc. No discharge to the Big Lost River System occurred, and water quality was not impacted.

A snow melt event was sampled at the PBF-MP-3 and -4 (Special Power Excursion Reactor Test [SPERT]-II and –III) injection well basins. Water flowed down the SPERT-II well (PBF-MP-3) during this event. Therefore, this sample is considered an injection well permit compliance sample. All parameters met drinking water standards, with the exception of iron and di(2-ethylhexyl)phthalate at both wells, and manganese at SPERT-III. Iron and manganese are secondary drinking water standards and do not have permit limits. Di(2-ethylhexyl)phthalate is a primary drinking water standard, and therefore the sample from SPERT-II exceeded the permit limits. Di(2-ethylhexyl)phthalate is a common laboratory contaminant found in plastics. Due to their persistence in the environment, phthalates are also found in groundwater, rivers, and storm water runoff and can occur from atmospheric deposition.[36]

4.3.2.3 Radioactive Waste Management Complex. The RWMC has one NPDES General Permit-required monitoring location (Figure A-12) at the SDA (RWMC-MP-2).

Samples were collected from the SDA during five snow melt and rainfall events in 1998. Storm water from the February event was discharged to the man-made channel that is part of the Big Lost River System. Therefore, this sample is considered a permit compliance sample. The discharge volume was 2,000 gallons. Water quality in the Big Lost River was not impacted because the discharge infiltrated in the man-made channel within a short distance of the discharge point.

Table 4-9 lists parameters that exceeded EPA benchmarks. Although one sample exceeded the nitrate + nitrite benchmark, the 1998 average was less than the historical average for SDA runoff. Fertilizers are not used in reseeding projects in the SDA; therefore, fertilizer runoff did not contribute to the elevated nitrate concentrations.

The TSS benchmark was exceeded in only one sample from the SDA in 1998. The 1998 average concentration (50 mg/L) was significantly lower than the historical average concentration of 1,318 mg/L, which indicates that erosion control may be improving. Soil stabilization efforts will continue to be monitored and assessed for improvement.

Average yearly concentrations of total and soluble magnesium (3.1 and 4.3 mg/L, respectively) were lower than the historical average (18.1 and 10.7 mg/L, respectively). RWMC personnel applied magnesium chloride salts to roads for dust suppression prior to 1994. Residual salts are the suspected source of the elevated magnesium concentrations.

Iron concentration in two samples from the SDA exceeded the benchmark in 1998. A filtered sample analyzed for iron was nondetectable, which indicates that the elevated concentrations are due to suspended solids in runoff. Zinc repeatedly exceeded the benchmark concentration at the SDA. Possible sources of zinc include culverts, fences, galvanized sheet metal, and roads.

In 1998, two samples from the SDA were analyzed for acute whole effluent toxicity (WET). The sample collected in March passed the 24-hour test at 100% effluent concentration for both invertebrate (Ceriodaphnia) and vertebrate (Fathead Minnow) species. The June sample passed for Fathead Minnow, but failed for Ceriodaphnia. According to the General Permit, if the WET test indicates toxicity, then an investigation is required to determine the source of the toxicity. After reviewing the chemical analyses of the sample, it was determined that zinc was most likely the cause of the toxicity. Zinc is commonly found to be toxic to Ceriodaphnia, with the lethal range being between 0.150–0.200 mg/L. The zinc concentration in the sample was 0.33 mg/L. Water quality was not impacted, however, because all of the water was contained in the basin and was not discharged to the Big Lost River System during the sampling event.

4.3.3 Quality Assurance/Quality Control

Due to the nature of storm water discharges and the inability to schedule sampling events, duplicate and blind standards were not submitted with storm water samples. The Storm Water Monitoring Program used the same laboratories and similar sampling techniques as the Liquid Effluent Monitoring Program for the majority of the analyses. Therefore, the results of QA/QC measures implemented for the Liquid Effluent Monitoring Program (see Section 4.2.4) were considered applicable to storm water data.

Low bias in the results of analyses performed on the effluent blind QC samples may indicate that the results of storm water samples collected in the same period may also be biased low. Data remains usable as long as this possibility is taken into account. For the Storm Water Monitoring Program, the majority of the analytical results are several times lower than EPA benchmarks. In other words, analytical results could be, in most instances, several times higher than they were and still be less than the EPA benchmarks. Analytical data obtained from the effluent QC field blinds were validated, but no specific problems could be identified, and the corresponding data were considered usable.

Trip blanks were sent with storm water samples collected for VOC analysis. On one occasion, methylene chloride was detected in the trip blank and method blank. Methylene chloride is a common laboratory contaminant and is often present in trip and method blanks. On another occasion, two sets of trip blanks contained detectable levels of bromodichloromethane, chloroform, 1,2-dichloroethylene, and methyl-t-butyl ether. No source for these volatiles in the trip blanks could be identified. The high-performance liquid chromatography water used for preparing trip blanks is a suspected source and has since been replaced.

Injection well samples for organic and radiological analyses were submitted to the same laboratories as the Drinking Water Program. Blind spikes were submitted quarterly by the Drinking Water Program and found to be acceptable. Therefore, it is assumed that the organic and radiological results obtained for the Storm Water Monitoring Program during the same time period are also acceptable.

4.4 Groundwater Monitoring Program

This section summarizes results from the 1998 groundwater compliance monitoring activities for Wastewater Land Application Permit (WLAP) facilities at the INEEL. Groundwater monitoring was conducted by the LMITCO Environmental Monitoring Program to ensure that the INEEL WLAP facilities were in compliance with State of Idaho permits.

4.4.1 Program Design Basis

The groundwater monitoring sampling locations, frequency, and analyses required by WLAPs were negotiated with the State of Idaho during permit approval. Based upon the hydrogeology of the area, wells were selected to determine the impact of discharging liquid effluent to ponds on the Snake River Plain Aquifer. For the INTEC Percolation Ponds, two wells, USGS-121 (sited upgradient from the facility) and USGS-048 (sited immediately upgradient from the percolation ponds), were chosen for surveillance monitoring. USGS-112 and USGS-113, both down gradient from the ponds, serve as compliance points. USGS-121 is also the upgradient aquifer well for the INTEC Sewage Treatment Plant (STP). In addition, a perched well (ICPP-MON-PW-24) is located immediately adjacent to the ponds and is completed approximately 70 ft below land surface. The point of compliance (USGS-052) is located downgradient from the STP. TANT-MON-A-001 was selected as the upgradient facility well for the TAN/TSF STP. Three aquifer wells located downgradient of the STP (TAN-10A, TAN-13A, and TANT-MON-A-002) serve as compliance points.

4.4.2 Data Summary and Assessment by Facility

The following sections provide observations and discussions of the significant trends at the INTEC Percolation Ponds, the INTEC STP, and the TAN/TSF STP.

4.4.2.1 Idaho Nuclear Technology and Engineering Center Percolation Pond Compliance Monitoring. In order to measure potential Percolation Pond impacts to groundwater, the permit requires that groundwater samples be collected from four monitoring wells (see Figure A-8):

- One background aquifer well (USGS-121) upgradient of INTEC
- One aquifer well (USGS-048) immediately upgradient of the Percolation Ponds
- Two aquifer wells (USGS-112 and 113) downgradient of the Percolation Ponds, which serve as points of compliance.

Sampling must be conducted semiannually and must include a number of specified parameters for analysis. Maximum allowable concentrations (MACs) and secondary maximum contaminant levels (SMCLs), as specified in the groundwater quality standards of the "Water Quality Standards and Wastewater Treatment Requirements,"[26] are compliance limits for USGS-112 and –113. Variances from these standards have been made for TDS and chloride, which have specified permit limits set at 800 mg/L and 350 mg/L, respectively.

During the 1998 reporting period, groundwater sampling was conducted in April and October. 1998 analytical results are very similar to previous years; no permit levles were exceeded at either compliance well during the reporting period, and chloride and TDS concentrations were elevated in USGS-112 and -113 compared to USGS-048. Sodium concentrations were above the MAC; however this MAC is a suggested optimum rather than a regulatory limit. These elevated levels are the result of the continued operation of the water softening and treatment processes at INTEC, which discharge chloride, TDS, and sodium to the Percolation Ponds.

Figures 4-12 and 4-13 show that groundwater chloride and TDS concentrations have exhibited slightly increasing trends in USGS-112 over the past four years. No statistically significant trends can be identified for USGS-113. This differs from that of the Percolation Pond effluent, where chloride and TDS concentrations have exhibited a decreasing trend since 1995. Groundwater concentrations for these two contaminants are expected to follow the trends exhibited by the effluent, with the exception of lower concentrations due to mixing in the aquifer, and a time lag and dampening effect due to the thick vadose zone through which the contaminants must pass prior to reaching the aquifer. However, the groundwater concentrations do not follow the effluent trends as expected (though chloride and TDS results of the three most recent groundwater sampling events indicate that concentrations may be starting to level off or even decline), indicating that other factors may be influencing the groundwater regime at INTEC. Some of these factors may include the Big Lost River, the complex vadose zone, and the cyclical nature of releases to the Percolation Ponds. Renewed flow in the Big Lost River has contributed to a rise in the groundwater table at INTEC of 0.6–0.9 m (2 to 3 ft) and possible changes to the capture zone for each monitoring well. Similarly, the heterogeneous vadose zone, composed of fractured basalt intermixed with sedimentary interbeds, stores and accumulates contaminants in perched water zones and surrounding sediments, affecting transport times and paths from the ponds to the aquifer. In addition, Percolation Pond discharge volumes and contaminant levels may vary dramatically throughout the year depending on treated water demands by the facility. In December 1997, 214.6 million liters (56.7 million gallons) of wastewater with a measured TDS concentration of 657 mg/L was discharged to the ponds; whereas, in October 1998, only 152.5 million liters (40.3 million gallons) was discharged, with a concentration of

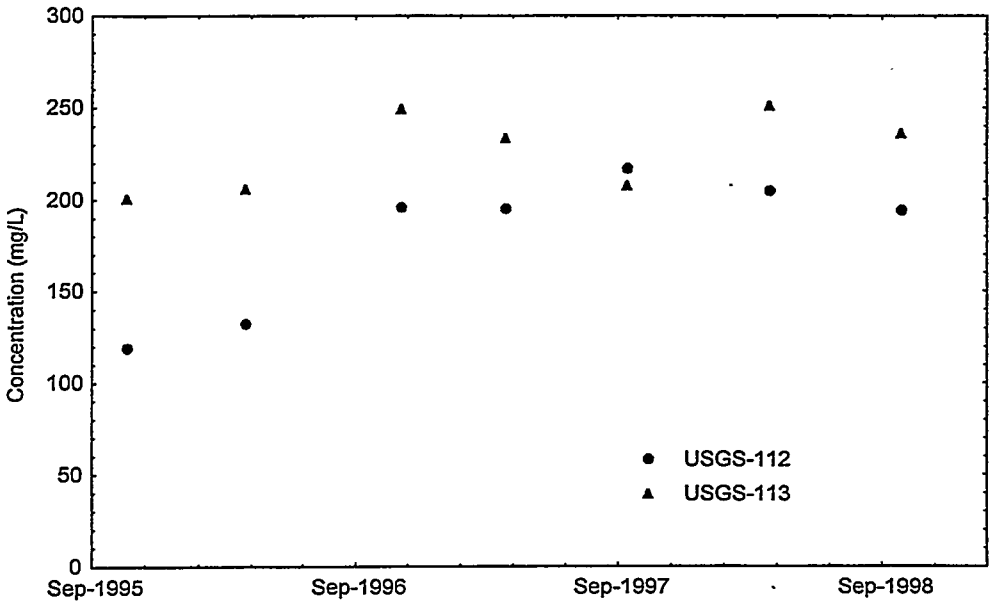


Figure 4-12. Chloride concentrations from Idaho Nuclear Technology and Engineering Center Percolation Pond wells.

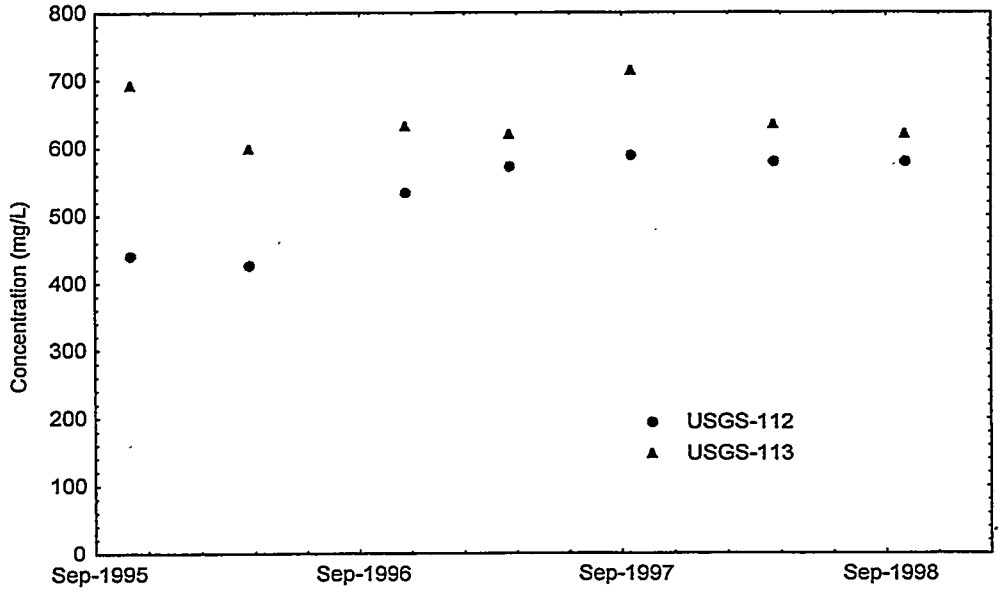


Figure 4-13. Total dissolved solids concentrations from Idaho Nuclear Technology and Engineering Center Percolation Pond wells.

385 mg/L. Some or all of these factors may be responsible for the diverging trends observed for the effluent and groundwater contaminant levels.

Iron concentrations fluctuated at several monitoring wells in 1998. USGS-112 increased the most (from an average of 0.07 mg/L in 1997 to an average of 0.23 mg/L in 1998), though noticeable changes were also observed in USGS-048 and -113. This is not believed to be the result of Percolation Pond operation. Increases were observed in wells both upgradient and downgradient of the Percolation Ponds over the past few years, and iron concentrations in the effluent are well below those of the groundwater. Chloride, TDS, and iron concentrations will continue to be monitored as a part of normal WLAP activities.

4.4.2.2 Idaho Nuclear Technology and Engineering Center Sewage Treatment Plant Compliance Monitoring. In order to measure potential STP impacts to groundwater, the permit requires that groundwater samples be collected from three monitoring wells (see Figure A-8):

- One background aquifer well (USGS-121) upgradient of INTEC
- One perched water well (ICPP-MON-PW-024) immediately adjacent to the STP
- One aquifer well (USGS-052) downgradient of the STP, which serves as the point of compliance.

Sampling must be conducted semiannually and must include a short list of specified parameters for analysis. MACs and SMCLs, as specified in the groundwater quality standards, are compliance limits for USGS-052.

During the 1998 reporting period, groundwater sampling was conducted in April and October. Groundwater samples collected from USGS-052 were in compliance with all permit limits during 1998. Very similar to 1997 and previous years, however, chloride, TDS, and nitrate concentrations in USGS-052 were slightly elevated compared to USGS-121.

ICPP-MON-PW-024, which has been completed in the perched water zone approximately 21 m (70 ft) below the surface of the infiltration trenches, is used as an indicator of treatment efficiency of the soil rather than serving as a point of compliance. Similar to previous years, total coliform concentrations in ICPP-MON-PW-024 were substantially lower than in the effluent (indicating significant removal by the soil), while TDS and chloride concentrations approximated those of the effluent (indicating minimal treatment for these parameters). Total nitrogen concentrations have changed recently. Before 1997, total nitrogen concentrations in the perched water closely followed those of the effluent, indicating minimal denitrification in the first 21 m (70 ft) of soil. To improve denitrification, trench rotation frequency was increased from biweekly to weekly in March 1997. As seen in Figure 4-14, total nitrogen concentrations in the perched water are now reduced compared to the effluent and are at concentrations between that of the effluent and that measured at USGS-052. It appears that this reduction began in December 1996, just before the trench rotation frequency was increased. This, coupled with a smaller number of perched water data points in 1997 and 1998, makes it difficult to quantify the relationship between trench rotation and denitrification. Weekly trench rotation will be continued, and contaminant trends will continue to be observed and tracked.

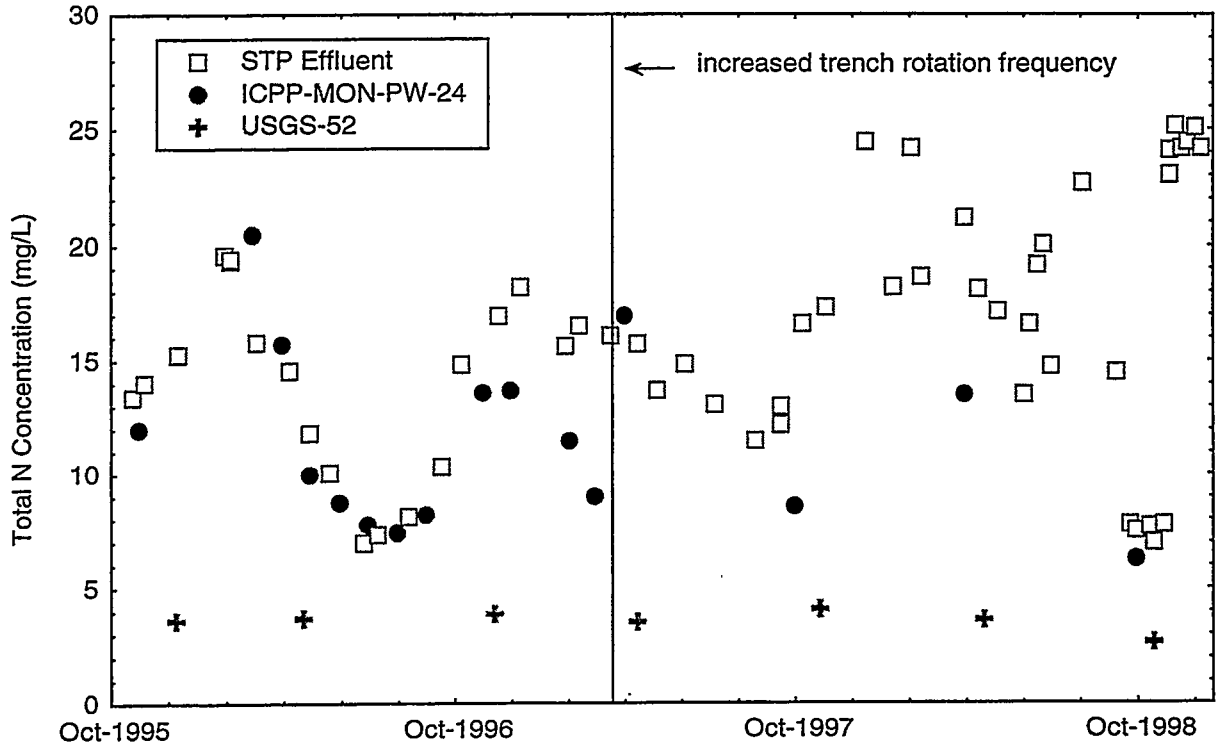


Figure 4-14. Total nitrogen concentrations in Sewage Treatment Plant effluent, ICPP-MON-PW-024, and USGS-052.

4.4.2.3 Test Area North/Technical Support Facility Sewage Treatment Plant Compliance Monitoring. In order to measure potential Disposal Pond impacts to groundwater, the permit requires that groundwater samples be collected from four monitoring wells (see Figure A-14):

- One background aquifer well (TANT-MON-A-001) upgradient of the Disposal Pond
- Three aquifer wells (TAN-10A, TAN-13A, and TANT-MON-A-002) downgradient of the Disposal Pond that serve as points of compliance.

Sampling must be conducted semiannually and must include several specified parameters for analysis. MACs and SMCLs, as specified in the groundwater quality standards, are compliance limits for TAN-10A, TAN-13A, and TANT-MON-A-002.

During the 1998 reporting period, groundwater sampling was conducted in April and October. Results of the groundwater sampling and analysis activities show that groundwater contaminant levels exceeded SMCL and MAC standards for iron, sodium, and total coliform. Iron and sodium levels exceeded the SMCL and MAC standards in TAN-10A during both sampling events, and iron exceeded the SMCL standard in TAN-13A during the October sampling event. These observations are consistent with results of the past few years and are within expectations; iron, and sodium have historically been detected at elevated levels at TAN (as was discussed in the WLAP application for the STP), suggesting that their presence in the groundwater is not the result of a recent change in facility operations. Also consistent with results from previous years, total coliform exceeded regulatory levels, though only during the April sampling event in TANT-MON-A-002. This coliform bacteria was speciated as *serratia*

liquifaciens, which is a bacteria found in natural water bodies and soils.[37] Little historical data are available for coliform bacteria at TAN; however, its detection in a well that has no history of impact by the Disposal Pond, the absence of fecal coliform in the samples, and the presence of a species of coliform that is commonly found in soils and water indicate that the coliform at TAN is probably not the result of Disposal Pond operation.

Of the three compliance monitoring wells, TAN-10A exhibits the highest contaminant levels when compared to the background monitoring well located upgradient of the facility. Groundwater samples collected from TAN-10A tend to have iron, sodium, chloride, and TDS levels that are similar to those found in the effluent to the Disposal Pond. It is difficult however, to establish a strong relationship between the water quality in TAN-10A and that of the Disposal Pond because of the presence of other factors. First, injectate from a former injection well (located close to TAN-10A and used for disposal of numerous waste streams, including those now discharged to the Disposal Pond) is still present in the groundwater and continues to have substantial impact on groundwater quality. Second, the consistent presence of zinc in groundwater samples collected from TAN-10A at concentrations significantly greater than that of the effluent to the Disposal Pond suggests the impact of other contaminant sources or influences. And third, groundwater remediation studies now underway near the former injection well have a significant influence on local hydraulic head gradients and contaminant concentrations near TAN-10A. Groundwater monitoring will continue in TAN-10A (as well as the other three wells) as a part of normal WLAP activities, though preliminary data suggest that groundwater remediation tests recently initiated at TAN may have significant impact on the contaminants and levels observed.

4.4.3 Quality Assurance/Quality Control

The groundwater sampling activities associated with WLAP compliance sampling follow established procedures and analytical methodologies. Field measurements such as pH, temperature, water concentration, turbidity, and specific conductivity are collected using portable water quality instruments calibrated in accordance with manufacturer's instructions. Water quality parameters for pH, temperature, and specific conductivity are monitored during well purging to ensure stable concentrations of the water source prior to sample collection. After the calculated purge volume is met and the final three collected water quality readings are within ±0.1 standard units for pH, ≤0.5°C for temperature, and ≤10 μS/cm for specific conductance, samples are collected in precleaned and certified containers. The stability of the water quality parameters ensures the samples collected represent the water quality of the groundwater source. To prevent cross-contamination, all sampling equipment contacting the samples are decontaminated between each groundwater well.

In addition to the regular groundwater samples, field QC samples were collected or prepared during the sampling activity. Because TAN and INTEC are regarded as separate sites, QC samples were prepared for each site. One duplicate was collected for every 20 samples collected or, at a minimum, 5% of the total number of samples collected. Duplicates were collected using the same sampling techniques and preservation requirements as a regular sample. Field blanks were collected at the same frequency as the duplicate samples. Deionized water was poured into the prepared bottles at the sampling site and were only analyzed for metals. Equipment blanks (rinsates) were collected from the sample port manifold after decontamination and before use. Trip blanks were prepared for and submitted with the volatile organic samples.

During 1998, 498 groundwater samples were scheduled for collection for program purposes. One hundred percent of the samples scheduled were collected and analyzed. Only nine sample results (less than 2% of the total) were rejected as unusable during data validation. All nine rejected samples were from the TAN wells from the October sampling event. None of the rejected samples affected compliance or trend evaluation at TAN.

5. ENVIRONMENTAL SURVEILLANCE PROGRAM

Lockheed Martin Idaho Technologies Company conducts environmental surveillance at INEEL facilities and selected off-Site locations. This surveillance is conducted in conjunction with the Environmental Science and Research Foundation (ESRF) for compliance with DOE Order 5400.5 ("Radiation Protection to the Public and the Environment").[11] The ESRF and LMITCO monitoring comprise the overall INEEL Environmental Surveillance Program.

Lockheed Martin Idaho Technologies Company also conducts environmental surveillance in and around waste management facilities for compliance with DOE 5820.2A.[12] The basis for the Waste Management Surveillance Program is somewhat different from the Site Surveillance Program in that it is more facility- or source-specific.

The Environmental Surveillance Program section of this report is presented by media, with separate subsections for waste management surveillance and site surveillance. These activities are listed in Table 5-1 and 5-2, respectively. A total of 3,548 samples were collected and analyzed for the Environmental Surveillance Program in 1998.

The Environmental Surveillance Program emphasizes measurement of airborne radionuclides because of the importance of the air transport pathway. Site surveillance data are used to monitor potential trends in radioactivity in the environment on the INEEL site in order to assess possible impact on-Site and off-Site.

Soils are also sampled to determine if long-term deposition of airborne materials released from the INEEL has resulted in a buildup of radionuclides in the environment. Food chain surveillance and off-Site air and soil measurements are conducted by the ESRF. The ESRF compiles an annual Idaho National Engineering and Environmental Laboratory Site environmental report, which provides additional information and dose calculations.

The analytical results reported in the following surveillance sections are those that are greater than two times the analytical uncertainty. Analytical uncertainties reported in text and tables are the 2-sigma uncertainty for the radiological analyses.

5.1 Air Surveillance

The Waste Management Surveillance Program collects particulate material on 10-cm (4-inch) membrane filters using two types of air monitors: particulate matter ≤ 10 μm (PM_{10}) and suspended particulate (SP) air monitors. While the PM_{10} monitors are designed to only admit particles less than 10 microns in diameter, the SP air monitors admit larger particles. The PM_{10} monitors the respirable size fraction of particulate materials, which is within the range of particle sizes that can be transported to off-Site locations by wind. The Waste Management Surveillance Program filters are collected and analyzed semimonthly for gross alpha and gross beta activity, and monthly composites of each location are analyzed quantitatively for gamma-emitting radionuclides. Filters from each sample location are also composited quarterly and are analyzed for specific alpha- and beta-emitting radionuclides. Appendix B presents the approach used for data analysis of these samples.

The Site Surveillance Program collects filters from a network of low-volume air monitors weekly. Each low-volume air monitor maintains an average airflow of about 57 L/min (12.5 gal/min) through a set of filters consisting of a five-cm (two-inch) 1.2 μm pore membrane filter followed by a charcoal

Table 5-1. Summary of waste management surveillance activities.

Facility	Media	Description	Frequency of Analyses	Type of Analyses
RWMC				
SDA	Air			
	• PM_{10}	8 air monitors operated at 0.11 m^3/min (includes 1 control and 1 replicate)	Semimonthly Semimonthly Monthly Quarterly	Gross alpha Gross beta Gamma spectrometry Radiochemistry[a]
	• Suspended particulate	1 air monitor operated at 0.14 m^3/min	Semimonthly Semimonthly Monthly Quarterly	Gross alpha Gross beta Gamma spectrometry Radiochemistry[a]
	Surface water	One 4-L sample from SDA and control location	Quarterly, depending on precipitation	Gross alpha Gross beta Gamma spectrometry Radiochemistry[a,b,c]
	Direct radiation			
	• Surface gamma activity	GPRS[d] detector system	Semiannually	External radiation levels
	• Ionizing radiation	4 TLD packets and 7 background communities	Semiannually	External radiation levels
	Soil	5 surface locations in each of 5 major areas (plus 1 control area)	Triennially	Gamma spectrometry Radiochemistry[a]
	Vegetation	3 composites in each of 5 major areas (plus 1 control area)[c]	Annually, species sampled varies each year as determined by availability	Gamma spectrometry Radiochemistry[a]
	Visual inspection	Tour SDA and TSA	Monthly	Results reported for any required corrective action
SWEPP	Air			
	• PM_{10}	7 air monitors operated at 0.11 m^3/min (includes 1 control)	Semimonthly Semimonthly Monthly Quarterly	Gross alpha Gross beta Gamma spectrometry Radiochemistry[a]
	• Suspended particulate	2 air monitors operated at 0.14 m^3/min	Semimonthly Semimonthly Monthly Quarterly	Gross alpha Gross beta Gamma spectrometry Radiochemistry[a]
	Surface water	One 4-L sample from TSA-1, TSA-2, TSA-3, TSA-4, and control locations	Quarterly, depending on precipitation	Gross alpha Gross beta Gamma spectrometry Radiochemistry[a]
	Soil	9 locations sampled (plus 2 control areas)	Triennially	Gamma spectrometry Radiochemistry[a]

Table 5-1. (continued).

Facility	Media	Description	Frequency of Analyses	Type of Analyses
WERF	Air			
	• PM_{10}	4 air monitors operated at 0.11 m^3/min (includes 1 control)	Semimonthly Semimonthly Monthly	Gross alpha Gross beta Gamma spectrometry
	• Suspended particulate	1 air monitor operated at 0.14 m^3/min	Semimonthly Semimonthly Monthly	Gross alpha Gross beta Gamma spectrometry
	• Ionizing radiation	11 TLD packets and 7 background communities	Semiannually	External radiation levels
	Soil			
	• Surface soils	15 surface locations	Triennially[c]	Gamma spectrometry
	• Seepage basins	3 locations	Annually	Gamma spectrometry
	Surface water	One 4-L sample from seepage basins	Quarterly, depending on precipitation	Gamma spectrometry
	Vegetation	15 locations (includes 3 controls)	Triennially	Gamma spectrometry
MWSF	Air			
	• PM_{10}	1 air monitor operated at 0.11 m^3/min	Semimonthly Semimonthly Monthly	Gross alpha Gross beta Gamma spectrometry
TAN	Air			
	• Suspended particulate	5 air monitors operated at 0.14 m^3/min	Semimonthly Semimonthly Monthly Quarterly	Gross alpha Gross beta Gamma spectrometry Radiochemistry
SL-1	No routine monitoring during 1998			
OMRE[f]	Direct radiation			
	• Surface gamma activity	GPRS detector system	Annually	External radiation levels

a. Analysis for Am-241, Pu-238, Pu-239/240, U-234, U-235, U-238, and Sr-90.

b. Samples for radiochemical analyses usually collected during second quarter only.

c. Exact number of samples may vary due to availability.

d. Global positioning radiometric scanner.

e. Sampling frequency may vary if air radioactivity levels increase.

f. Organic Moderated Reactor Experiment (OMRE) located adjacent to Security Training Facility (STF).

Table 5-2. Summary of site surveillance activities.

Sample Type	Analyses	Collection Frequency	Locations: Distant Communities	Locations: INEEL (on-Site)
Air—low volume (particulate)	Gross alpha	Weekly	Blackfoot, Craters of the Moon, Idaho Falls, Rexburg	ANL-W, ARA, CFA, EBR-I, TAN, TRA, RWMC, INTEC, EFS, Van Buren, PBF, NRF
	Gross beta	Weekly	Blackfoot, Craters of the Moon, Idaho Falls, Rexburg	ANL-W, ARA, CFA, EBR-I, TAN, TRA, RWMC, INTEC, EFS, Van Buren, PBF, NRF
	Gamma spectrometry	Quarterly	Blackfoot, Craters of the Moon, Idaho Falls, Rexburg	ANL-W, ARA, CFA, EBR-I, TAN, TRA, RWMC, INTEC, EFS, Van Buren, PBF, NRF
	Radiochemistry[a]	Quarterly	Blackfoot, Craters of the Moon, Idaho Falls, Rexburg	ANL-W, ARA, CFA, EBR-I, TAN, TRA, RWMC, INTEC, EFS, Van Buren, PBF, NRF
	Particulate	Quarterly	Blackfoot, Craters of the Moon, Idaho Falls, Rexburg	ANL-W, ARA, CFA, EBR-I, TAN, TRA, RWMC, INTEC, EFS, Van Buren, PBF, NRF
Air—low volume (cartridge)	I-131 (gamma screen)	Weekly	Blackfoot, Craters of the Moon, Idaho Falls, Rexburg	ANL-W, ARA, CFA, EBR-I, TAN, TRA, RWMC, INTEC, EFS, Van Buren, PBF, NRF
Air—NO_x	NO_x	Continuously	NA[b]	EFS, Van Buren
Air—SO_2	SO_2	Continuously	NA	Van Buren
Air—moisture	Tritium	4 to 13 weeks	NA	EFS, Van Buren
Soil	Gamma spectrometry	Annually	NA	Each major facility[c] once every 7 years
	Radiochemistry	Annually	NA	Each major facility once every 7 years
Direct radiation	TLD[d]	Semiannually	Aberdeen, Arco, Atomic City, Blackfoot, Craters of the Moon, Howe, Idaho Falls, Minidoka, Monteview, Mud Lake, Reno Ranch, Rexburg, Roberts	ANL-W, ARA, CFA, EBR- I, TAN, TRA, RWMC, INTEC, EFS, Van Buren, PBF, NRF
	Surface surveys	Annually	NA	Each perimeter of the major facilities every 3 years

a. Radiochemistry—Am-241, Pu-238, Pu-239/240, and Sr-90 is also included.

b. NA—not applicable.

c. Major facilities include ANL-W, ARA, CFA, INTEC, NRF, PBF, RWMC, TAN, and TRA.

d. TLD—thermoluminescent dosimetry.

cartridge. These filters are analyzed weekly for gross alpha and gross beta screening, then they are composited quarterly by location. The composite samples are analyzed using gamma spectrometry and specific radiochemical methods for alpha- and beta-emitting radionuclides. In addition to the particulate filter samples, charcoal cartridges are collected and analyzed weekly using gamma spectrometry.

There is no requirement to monitor the dust burden at the INEEL, but it is included in the program to provide comparison information to other monitoring programs and to DOE-ID. The SP dust burden is monitored with the same low-volume filters used to collect the radioactive particulate samples.

Nitrogen oxides are monitored at Van Buren Boulevard (VANB) and Experimental Field Station (EFS) using an EPA-equivalent method to implement the *Ambient Nitrogen Dioxide Monitoring Plan for the INEL*,[38] which fulfills one of the conditions specified in the "Permit to Construct, Idaho Chemical Processing Plant Nitrogen Oxide Sources."[39]

Sulfur dioxide measurements are recorded to confirm that the INEEL does not release significant amounts of sulfur dioxide with respect to national ambient air quality standards. Sulfur dioxide is monitored downwind from the Idaho Nuclear Technology and Engineering Center (INTEC) at the VANB location.

Samplers for tritium in water vapor in the atmosphere are located at the EFS and VANB locations (Figure A-1). Air is passed through a column of molecular sieve. The molecular sieve absorbs water vapor in the air; columns are changed when the molecular sieve absorbs sufficient moisture to obtain a sample. Tritium concentrations are then determined by liquid scintillation counting of the water extracted from the molecular sieve columns.

5.1.1 Data Summary and Assessment for Waste Management Surveillance

Gross alpha data provides rapid detection of significant changes in airborne alpha activity. The gross alpha data are also used as a criteria to screen samples for immediate radiochemical analyses for specific alpha emitters. Results of gross beta analysis of the air filters are evaluated to determine any significant increases in the radioactivity that may require more immediate or more in-depth analysis by gamma spectrometry or radiochemistry. Gross beta data are evaluated by comparing results with historical and background data to identify trends using a log concentration-versus-time plot. Each plot is compared against control concentrations, detection limits (Appendix C), and alert levels. Alert levels are 25% of the most restrictive Derived Concentration Guides (DCGs) for the public. Comparisons are made between stations and control monitors using statistical analysis methods (Appendix B). Also, concentrations are compared to applicable DCGs for the public (Appendix D).

Figures 5-1 and 5-2 summarize the 1997 and 1998 gross alpha and gross beta data by facility and monitor type and illustrate short-term changes in levels. Tables 5-3 and 5-4 provide corresponding summary statistics (for example, means, medians, maximum, and minimum values) for all 1997 and 1998 data.

Similar to the 1997 analyses of gross alpha concentrations, the gross alpha concentrations varied little among facilities during 1998 (Figure 5-1). Median SP monitor concentrations increased slightly from 1997 to 1998 for all facility groupings, while median PM_{10} monitor concentrations decreased for all groupings. The changes in median concentrations from 1997 to 1998 for gross alpha PM_{10} monitors located at the Subsurface Disposal Area (SDA), Stored Waste Experimental Pilot Plant (SWEPP), the SWEPP control location, and the Waste Experimental Reduction Facility (WERF); and the SP monitors

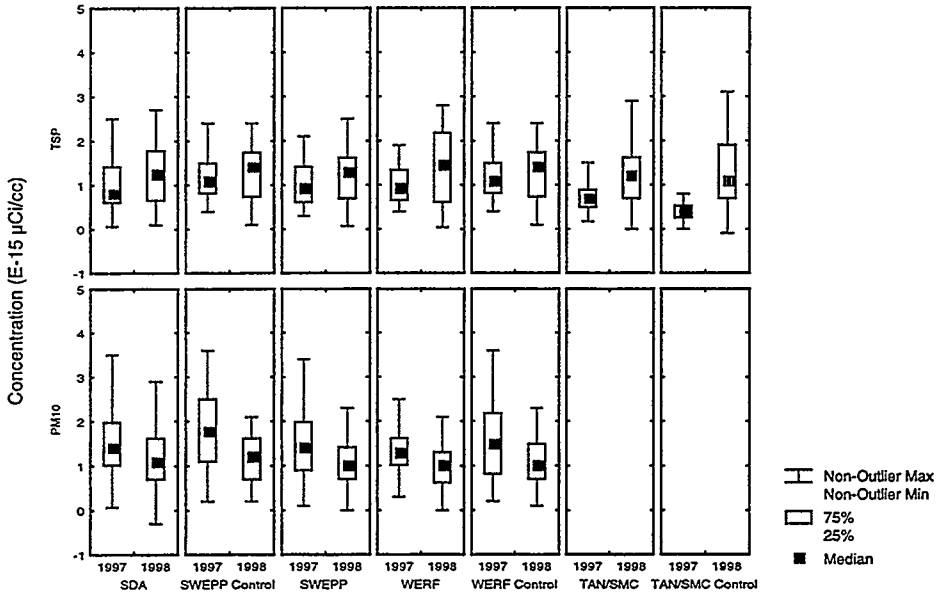


Figure 5-1. Gross alpha concentrations by year, facility, and monitor type.

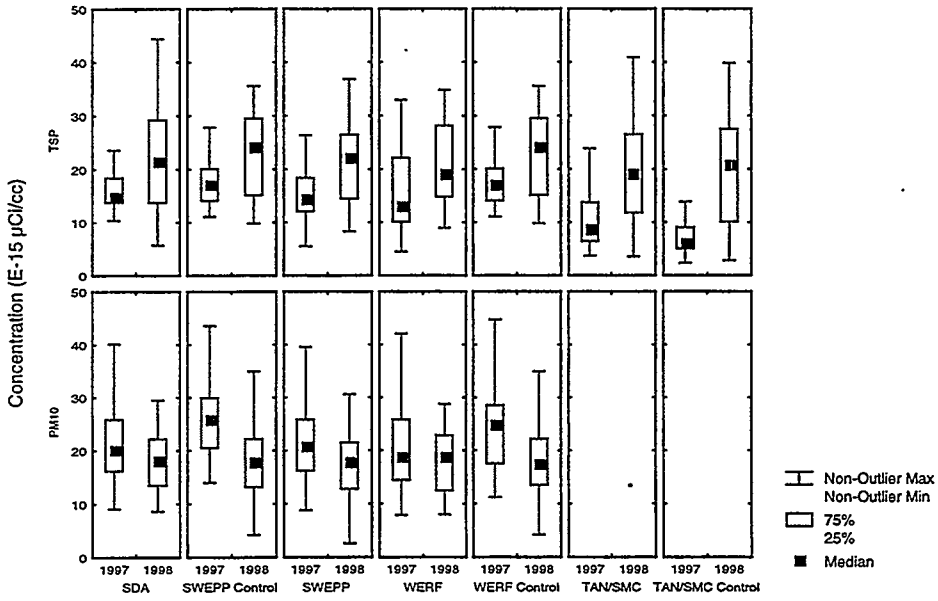


Figure 5-2. Gross beta concentrations by year, facility, and monitor type.

Table 5-3. Summary statistics for gross alpha concentrations (4-in. filters).

Monitor Type	Facility	Year	Number of Samples	Mean (E-15 μCi/cc)	Median (E-15 μCi/cc)	Minimum (E-15 μCi/cc)	Maximum (E-15 μCi/cc)
Suspended particulate	SDA	97	21	1.0	0.8	0.1	2.5
		98	24	1.1	1.3	0.1	2.7
	SWEPP	97	48	1.1	1.0	0.3	2.8
		98	41	1.3	1.3	0.1	3.0
	Control[a]	97	23	1.3	1.1	0.4	3.3
		98	24	1.4	1.4	0.1	3.6
	WERF	97	24	1.1	1.0	0.4	3.0
		98	18	1.4	1.5	0.04	2.8
	TAN/SMC	97	93	0.8	0.7	-0.2	2.6
		98	92	1.2	1.2	0.0	3.1
	Control[b]	97	24	0.4	0.4	0.0	1.4
		98	24	1.3	1.1	-0.1	3.1
PM_{10}	SDA	97	137	1.6	1.4	0.1	5.1
		98	140	1.2	1.1	-0.3	3.2
	SWEPP	97	134	1.6	1.4	0.1	5.5
		98	135	1.1	1.0	0.0	2.8
	Control[c]	97	23	1.8	1.8	0.2	3.6
		98	21	1.2	1.2	0.2	2.1
	WERF	97	69	1.4	1.3	-0.1	3.3
		98	66	1.0	1.0	-0.5	2.1
	Control[d]	97	20	1.4	1.4	0.6	3.4
		98	22	1.1	1.0	-0.7	2.3

a. SDA/SWEPP/WERF.

b. TAN/ Specific Manufacturing Capability (SMC).

c. SDA/SWEPP.

d. WERF.

Table 5-4. Summary statistics for gross beta concentrations (4-in. filters).

Monitor Type	Facility	Year	Number of Samples	Mean (E-15 μCi/cc)	Median (E-15 μCi/cc)	Minimum (E-15 μCi/cc)	Maximum (E-15 μCi/cc)
Suspended particulate	SDA	97	21	16.5	14.8	10.4	27.1
		98	24	21.3	21.4	5.7	44.4
	SWEPP	97	48	15.9	14.3	5.5	32.4
		98	41	21.4	22.1	8.3	36.8
	Control[a]	97	23	18.2	17.3	11.1	32.4
		98	24	23.2	24.3	9.8	35.5
	WERF	97	24	15.6	13.0	4.5	33.0
		98	18	20.7	19.0	9.0	34.8
	TAN/SMC	97	93	10.4	8.9	3.7	27.9
		98	92	20.0	19.2	3.6	40.9
	Control[b]	97	24	7.0	6.2	2.3	13.9
		98	24	20.0	20.9	2.8	39.8
PM_{10}	SDA	97	137	22.1	20.3	9.0	48.9
		98	140	18.1	18.2	8.6	38.9
	SWEPP	97	134	22.2	20.8	8.8	51.7
		98	135	17.9	17.9	2.6	45.6
	Control[c]	97	23	27.2	26.0	14.0	49.0
		98	21	18.2	17.7	4.2	35.0
	WERF	97	69	20.8	18.9	7.9	48.7
		98	66	17.9	18.8	8.0	28.8
	Control[d]	97	20	22.1	18.9	11.2	44.7
		98	22	18.2	17.1	6.5	36.3

a. SDA/SWEPP/WERF.

b. TAN/SMC.

c. SDA/SWEPP.

d. WERF.

located at the Test Area North/Specific Manufacturing Capability (TAN/SMC) and the TAN/SMC control location were found to be statistically significant at the 0.05 concentration. For the remaining facility/monitor type groupings, the changes in gross alpha median concentrations from 1997 and 1998 were not significant.

The median gross beta concentrations for SP monitors increased from 1997 to 1998 for all location groupings, while median gross beta concentrations from PM_{10} monitors decreased for all location groupings (Figure 5-2). For SP monitors, these increases were significant at the 0.05 concentration for all location groupings, except for the SDA and the WERF control grouping. The decreases in the median PM_{10} monitor concentrations were significant for the SDA, SWEPP, and SWEPP control groupings. Quarterly averages of Radioactive Waste Management Complex (RWMC) and WERF gross beta activity (Cs-137 equivalent) since 1988 are shown in Figures 5-3 and 5-4, respectively.

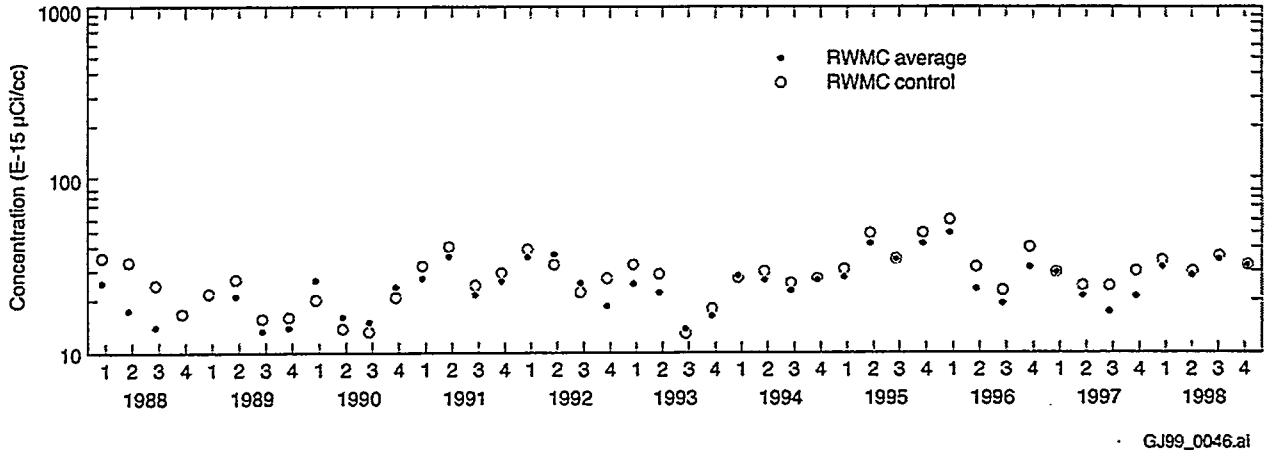


Figure 5-3. Quarterly average of gross beta air concentrations (Cs-137 equivalent) measured at Radioactive Waste Management Complex for the past 10 years (GJ99_0046.ai).

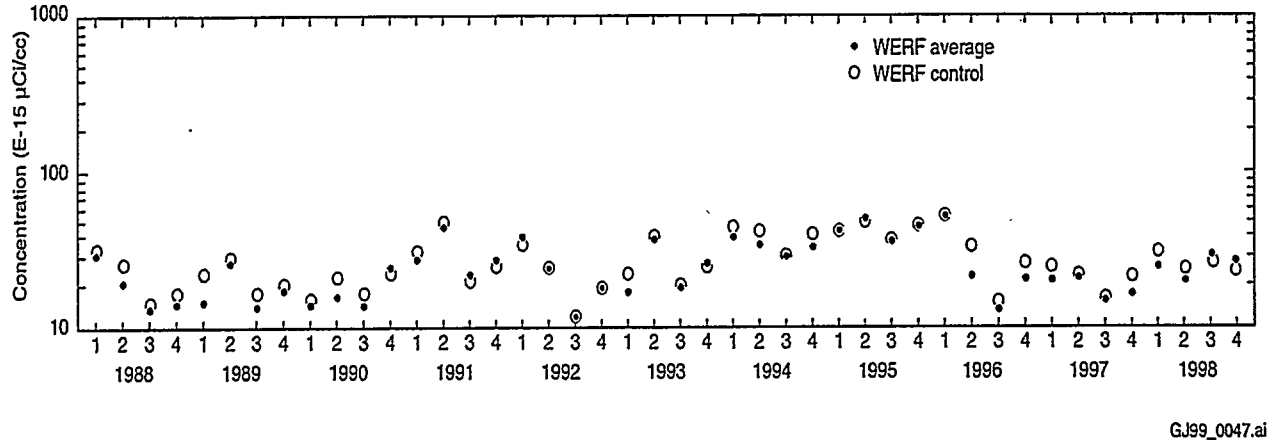


Figure 5-4. Quarterly average of gross beta air concentrations (Cs-137 equivalent) measured at Waste Experimental Reduction Facility for the past 10 years (GJ99_0047.ai).

Cesium (Cs)-137 was the only man-made, gamma-emitting radionuclide detected that could be attributable to waste management facility operations. Cs-137 was found in three samples: one collected in June at RWMC location 1.3 and the other two in the October composite at RWMC location 26.3 and TAN 101. The maximum concentration was detected in the composite air samples taken from RWMC location 26.3 and was 5.0 ± 1.6 E-16 microcuries per cubic centimeter (μCi/cc). This concentration represents 0.0001% of the DCG for Cs-137 in air for release to the public.

Strontium (Sr)-90, americium (Am)-241, and plutonium (Pu)-239/240 were the only alpha- and beta-emitting radionuclides detected during 1998. These detections are comparable to historical concentrations. Sr-90 was detected in the composite air samples from RWMC location 11.3 (see Figure A-12 for location). This concentration was 5.68 ± 1.59 E-17 μCi/cc and represents 0.001% of the DCG for airborne releases of Sr-90 to the public. Am-241 was detected in a third quarter composite air sample collected from RWMC location 2.0. This concentration was 4.16 ± 1.64 E-18 μCi/cc and

represents 0.02% of the DCG. Pu-239/240 was detected at RWMC location 22.3. This concentration was 2.34 ± 0.97 E-18 μCi/cc and represents 0.01% of the DCG.

5.1.2 Data Summary and Assessment for Site Surveillance

The maximum gross alpha concentration for each location is shown in Table 5-5. Gross alpha concentrations for 1998 were, in general, typical of those measured previously. The mean gross alpha concentrations are shown in Table 5-6.

The highest mean concentrations of gross beta were detected in the third and fourth quarters of 1998 (Table 5-7). The higher values generally occur during winter inversion conditions. The maximum quarterly gross beta concentration was measured at Test Reactor Area (TRA) in the third quarter and represents 0.4% of the DCG for Sr-90.

Table 5-5. Maximum gross alpha concentrations for 1998 per location.

Location	Date	Maximum Concentration[a] (E-15 μCi/cc)
ANL-W	11/04	3.2 ± 1.3
ARA	08/26	2.9 ± 1.3
CFA	05/06	2.8 ± 1.0
EBR-I	11/24	3.4 ± 1.6
EFS	04/29	4.4 ± 1.3
INTEC	11/24	1.7 ± 0.8
NRF	10/07	2.5 ± 1.0
PBF	12/16	2.1 ± 1.2
RWMC	08/26	2.1 ± 0.9
TAN	01/14	2.7 ± 1.1
TRA	05/06	4.4 ± 1.3
VANB	08/19	3.4 ± 1.2
Off-Site	12/09	6.9 ± 1.8

a. Uncertainties shown are the associated 2 sigma.

Table 5-6. Mean gross alpha concentrations for 1998 per location.

Location	1st Quarter Concentration (E-15 μCi/cc)	2nd Quarter Concentration (E-15 μCi/cc)	3rd Quarter Concentration (E-15 μCi/cc)	4th Quarter Concentration (E-15 μCi/cc)	Annual Concentration (E-15 μCi/cc)	Annual % of DCG
ANL-W	0.3	0.6	1.1	0.7	0.7	3.4
ARA	0.3	0.3	1.1	0.8	0.6	3.1
CFA	-0.09	0.6	1.0	0.7	0.6	2.8
EBR-I	-0.03	0.5	1.1	1.0	0.6	3.2
EFS	0.4	1.2	1.5	0.7	1.0	4.8
INTEC	0.3	0.5	0.9	0.5	0.6	2.8
NRF	0.3	0.4	0.6	0.5	0.5	2.3
PBF	0.2	-0.1	0.6	0.6	0.3	1.6
RWMC	0.2	0.6	1.0	1.0	0.7	3.5
TAN	0.3	1.1	1.3	0.9	0.9	4.5
TRA	0.2	0.9	1.0	0.6	0.7	3.4
VANB	0.1	0.8	1.5	0.8	0.8	4.0
Off-Site	0.5	0.8	1.1	1.0	0.8	4.4

Table 5-7. Mean gross beta concentrations for 1998 per location.

Location	1st Quarter Concentration (E-15 μCi/cc)	2nd Quarter Concentration (E-15 μCi/cc)	3rd Quarter Concentration (E-15 μCi/cc)	4th Quarter Concentration (E-15 μCi/cc)	Annual Mean Concentration (E-15 μCi/cc)	Annual % of DCG
ANL-W	14	17	29	24	21	0.2
ARA	25	18	30	24	24	0.3
CFA	16	15	27	28	22	0.2
INTEC	15	17	26	28	22	0.2
EBR-I	16	17	31	26	23	0.3
EFS	17	18	31	25	23	0.3
NRF	16	17	29	25	22	0.2
PBF	16	16	31	25	22	0.2
RWMC	14	15	25	18	18	0.2
TAN	17	15	24	23	20	0.2
TRA	16	17	33	26	23	0.3
VANB	14	16	29	23	21	0.2
Off-Site	15	15	25	23	20	0.2

Cs-137 was the only gamma-emitting radionuclide detected in the quarterly composite 2-in. low-volume filter samples submitted for analyses during 1998. The samples were collected from the Naval Reactors Facility (NRF) in the third quarter, and the Cs-137 concentration was 3.9 ± 0.7 E-16 μCi/cc. There were no positive detections of I-131 from the charcoal cartridges submitted for analyses in 1998.

Sr-90 and Am-241 were detected by radiochemical analysis (Table 5-8). The maximum Sr-90 concentration was collected in the third quarter from the TRA and was 1.6 ± 0.4 E-16 μCi/cc and represents 0.002% of the DCG. The only Am-241 detection was during the third quarter at the RWMC and was 8.04 ± 2.62 E-18. This detection is 0.04% of the DCG and is consistent with historical concentrations for resuspended soils around the northeastern corner of the RWMC SDA. These concentrations were at or near background.

The 1998 annual mean SP concentrations are shown in Table 5-9. Higher particulate concentrations were found at the distant and boundary locations than on the INEEL. The largest source of airborne particulates in the vicinity of the INEEL is considered to be resuspended dust from local agricultural operations.

Table 5-8. Site surveillance radiochemistry detections for air.

Location	Quarter	Analyses Type	Concentration[a] (E-15 μCi/cc)	% of DCG[b]
NRF	2nd	Sr-90	0.01 ± 0.03	0.0001
TRA	2nd	Sr-90	0.09 ± 0.03	0.001
INTEC	2nd	Sr-90	0.07 ± 0.02	0.0008
Rexburg	3rd	Sr-90	0.07 ± 0.03	0.0008
TAN	3rd	Sr-90	0.13 ± 0.03	0.0014
Location B (TAN)	3rd	Sr-90	0.12 ± 0.03	0.0013
NRF	3rd	Sr-90	0.07 ± 0.03	0.0008
EFS	3rd	Sr-90	0.11 ± 0.03	0.0012
TRA	3rd	Sr-90	0.16 ± 0.04	0.0018
INTEC	3rd	Sr-90	0.11 ± 0.03	0.0012
CFA	3rd	Sr-90	0.10 ± 0.03	0.0011
Blackfoot	3rd	Sr-90	0.13 ± 0.04	0.0014
Idaho Falls	3rd	Sr-90	0.11 ± 0.03	0.0012
ANL-W	3rd	Sr-90	0.10 ± 0.03	0.0011
RWMC	3rd	Am-241	0.008 ± 0.003	0.0402

a. Uncertainties shown are the associated 2 sigma.

b. The DCG values for Sr-90 (9,000 E-15 μCi/cc) and Am-241 (20 E-15 μCi/cc) are defined in DOE Order 5400.5.

Table 5-9. 1998 annual mean for suspended particulate concentrations.

Location	Annual Mean Concentration ($\mu g/m^3$)	Number of Samples
ANL-W	13 ± 0.40	51
ARA	5 ± 0.01	50
CFA	6 ± 0.02	48
EBR-I	9 ± 0.03	52
EFS	7 ± 0.02	52
INTEC	7 ± 0.01	52
NRF	7 ± 0.02	51
PBF	9 ± 0.01	51
RWMC	8 ± 0.03	49
TAN	8 ± 0.03	51
TRA	7 ± 0.02	51
VANB	8 ± 0.01	51
Blackfoot	16 ± 0.40	48
Craters of the Moon	7 ± 0.01	51
Idaho Falls	15 ± 0.60	51
Rexburg	17 ± 0.43	51

Tritium samples were collected at EFS and VANB (Figure A-1). Preliminary laboratory analyses indicated that some samples may have contained detectable concentrations of tritium slightly above background levels. A study of both sampling techniques and laboratory analyses is being conducted, and a separate report will be prepared.

Ambient nitrogen dioxide measurements were obtained on a continuous basis at the stations at the intersection of Van Buren Boulevard and U.S. Highway 20/26 and the EFS (Figure A-1). The New Waste Calcining Facility at INTEC, the largest single source of nitrogen dioxide on the INEEL, operated from the first of the year until April 10, and it did not operate during the remainder of 1998. The mean nitrogen dioxide concentrations for 1998 at VANB and EFS were 2.7 $\mu g/m^3$ (1.5 parts per billion [ppb]) and 7.3 $\mu g/m^3$ (3.9 ppb), respectively. These were significantly lower than the EPA national primary ambient air quality standard of 100 $\mu g/m^3$ (53 ppb). Figure 5-5 shows quarterly mean concentrations of nitrogen dioxide in 1998.

Ambient sulfur dioxide was continuously monitored at VANB during 1998 (Figure A-1). The mean sulfur dioxide concentration was 7.5 $\mu g/m^3$ (2.8 ppb) or 6.7% of the annual primary air quality standard. The maximum daily concentration of 25.6 $\mu g/m^3$ (9.6 ppb) was 7.0% of the primary standard for a 24-hour period. The maximum, recorded three-hour average of 33.3 $\mu g/m^3$ (12.5 ppb) was 2.6% of the secondary standard.

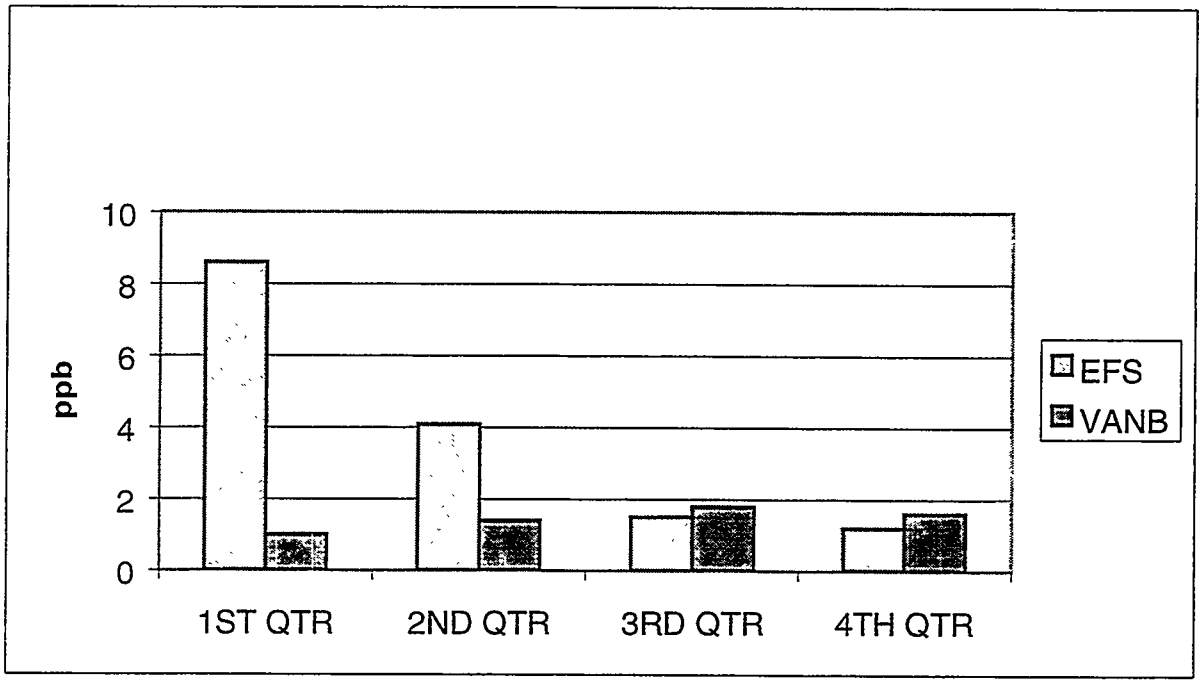


Figure 5-5. Quarterly mean concentration of nitrogen dioxide for 1998.

5.2 Surface Water Runoff

Surface water runoff is collected at waste management facilities (RWMC and WERF) to determine if radionuclide concentrations exceed alert levels or if concentrations have increased significantly compared to historical data.

Radionuclides could be transported outside the boundaries of the RWMC via surface water runoff. Surface water runoff occurs at the SDA only during periods of rapid snow melt or heavy precipitation. At these times, water may be pumped out of the SDA into a drainage canal. Water also runs off the asphalt pads around the Transuranic Storage Area (TSA) and into drainage culverts and the drainage canal, which direct the flow outside the RWMC. The canal also carries outside runoff that has been diverted around the RWMC. Ponding of the runoff in a few low areas may increase subsurface saturation, which would enhance subsurface migration.

Beginning in 1994, quarterly surface water runoff samples were collected at the WERF seepage basins to provide an indication of contamination releases from stored waste. Two control locations 2.0 km (1.24 mi) north of the RWMC are sampled. The control location for TSA and WERF samples is on the west side of the rest rooms at the Lost River Rest Area, and the control location for the SDA is 1.5 km (0.93 mi) west on U.S. Highway 20 from the Van Buren Boulevard intersection and 10 m (33 ft) north on the T-12 access road.

5.2.1 Data Summary and Assessment for Waste Management Surveillance

Surface water runoff samples were collected during the first, second, and third quarters of 1998 at the RWMC. No surface water runoff was available during the fourth quarter; therefore, no samples were

was collected during the third quarter and was 2.0 ± 1.0 E-9 μCi/mL. Cs-137 is commonly detected in environmental samples collected at the RWMC and is usually at or near background levels. This concentration represents 0.08% of the DCG for releases of Cs-137 to the public.

Alpha- and beta-emitting radionuclides were analyzed for second quarter samples. Am-241 and Pu-239/240 were detected in two different samples collected from the RWMC and control location. The Am-241 detections were found at the control location (T-12) and the SDA. These concentrations were 1.59 ± 0.26 E-10 and 6.62 ± 1.59 E-11 μCi/mL, respectively. The maximum concentration represents 0.53% of the DCG. Pu-239/240 was detected at these same locations at the RWMC and control location. These concentrations were 6.37 ± 1.34 E-11 and 3.50 ± 0.91 E-11 μCi/mL; the maximum concentration was detected at the control location. The maximum concentration represents 0.21% of the appropriate DCG. Sr-90 was only detected at the control location at a concentration of 4.05 ± 1.17 E-10 μCi/mL. These concentrations are consistent with those typically seen in waters collected from areas with higher volumes of suspended particulates.

Samples were also collected from the WERF seepage basins during the first, second, and third quarters in 1998. Cs-137 was detected in samples collected during the first and third quarters at WERF. The maximum concentration was 3.2 ± 1.8 E-9 μCi/mL collected at the west basin. This concentration represents 0.11% of the DCG. These concentrations are comparable to historical concentrations and other monitoring results from water samples collected at the INEEL.

5.3 Soil Surveillance

Soil is sampled at both waste management facilities and site surveillance locations. Samples are collected at each location, combined, and screened to form a single composite sample. These samples are analyzed by gamma spectrometry, and selected samples are submitted for radiochemistry.

5.3.1 Data Summary and Assessment for Waste Management Surveillance

During 1998, 12 soil samples were collected from waste management facilities (four seepage basin soil samples from WERF and eight soil samples from SWEPP). Cs-137 was the only man-made gamma radionuclide detected from either of the waste management facilities.

At the WERF control location, the maximum Cs-137 concentration was 4.6 ± 0.6 E-1 picocurie per gram (pCi/g), which represents 7.7% of the environmental concentration guide (ECG) (see Table D-4). All concentrations are lower than previous samples collected from WERF seepage basins. Am-241 was also detected at the west seepage basin at a concentration of 1.32 ± 0.6 E-2 pCi/g. This concentration is 0.03% of the ECG and is within the range that can be attributed to fallout.

At SWEPP, eight samples were analyzed by gamma spectrometry. The maximum Cs-137 concentration was 8.8 ± 0.8 E-1 pCi/g, which represents 14.7% of the ECG. This is comparable to historical concentrations and is also within the range attributed to fallout.

Six of the eight SWEPP samples were submitted for radiochemistry analyses. Am-241, Pu-239/240, and Sr-90 were detected in all six samples. Table 5-10 shows the maximum detections and percent of ECG. These concentrations are consistent with those previously seen in and around the RWMC.

Table 5-10. Soil surveillance results at waste management facilities.

Parameter	Maximum Detections	Percent of ECG
Am-241	1.24 ± 0.36 E-1	0.3%
Pu-239/240	3.36 ± 1.26 E-2	0.04%
Sr-90	3.27 ± 0.78 E-1	5.5%

5.3.2 Data Summary and Assessment for Site Surveillance

During 1998, eight soil samples were collected from Auxiliary Reactor Area (ARA)-I and analyzed by gamma spectroscopy, and four in situ gamma spectroscopy measurements were also collected from these same locations. Table 5-11 compares the analytical results with the in situ measurements for Cs-137. The maximum sample concentration was 9.31 ± 0.36 pCi/g (laboratory) (155% of ECG) and 7.07 ± 0.11 pCi/g (in situ measurement) (118% of ECG), which was measured at location ARA-45-2500.

Table 5-11. Comparison of cesium-137 results between in situ measurements and analytical results for Auxiliary Reactor Area.

	Measurements (pCi/g)	
Location	In Situ	Analytical
ARA-45-2500	7.07 ± 0.11	9.31 ± 0.36
ARA-180-1000	5.79 ± 0.09	7.24 ± 0.24
ARA-90-1000	2.24 ± 0.05	1.84 ± 0.12
ARA-157.5-1000	4.68 ± 0.09	4.90 ± 0.40

All eight ARA soil samples were submitted for radiochemistry analyses. Am-241, Pu-239/240, and Sr-90 were detected in all eight samples. The maximum Am-241 detection was 1.08 ± 0.54 E-2 pCi/g and represents 0.0003% of the ECG. The maximum Pu-239/240 detection was 2.58 ± 0.90 E-2 pCi/g and represents 0.002% of the ECG. The Am-241 and Pu-239/240 detections were all within the background range for the INEEL and surrounding areas and is attributable to past fallout. The maximum Sr-90 concentration was 1.24 ± 0.10 E-0 pCi/g and represents 21% of the ECG. The Sr-90 detections were above background for the INEEL but are consistent with historical concentrations at ARA. The Cs-137 and Sr-90 are elevated in this area due to the Stationary Low Power Reactor No. 1 (SL-1) accident that occurred in 1961.

Soil results from TRA were not received in time to be reported in the 1997 annual report. These results were received in 1998, and all the concentrations were within the range for the specific alpha- and beta-emitting radionuclides.

5.4 Biotic Surveillance

Biotic surveillance is conducted at waste management facilities (RWMC and WERF). Plant uptake of radionuclides at the RWMC has been documented by the Radiological and Environmental Sciences Laboratory.[40]

Crested wheatgrass is collected in odd-numbered years and is clipped at ground level within a 0.9 × 0.9-m (3 × 3-ft) frame. Russian thistle is collected in even-numbered years, and the entire plant is pulled up within a 0.9 × 0.9-m (3 × 3-ft) frame. Either rabbitbrush or sagebrush is collected in odd-numbered years by clipping 20% of the branches from the designated plants. Thus, the same plant can be sampled biennially.

5.4.1 Data Summary and Assessment for Waste Management Surveillance

Russian thistle samples were scheduled to be collected in 1998 from the RWMC. However, not enough Russian thistle was found at the RWMC to adequately sample. Therefore, no samples were collected. Vegetation sample collection from WERF began in 1984 and is normally performed every three years; therefore, no samples were scheduled for collection from WERF during 1998.

5.5 Direct Radiation

Thermoluminescent dosimeters (TLDs) measure cumulative exposures to ambient ionizing radiation for both waste management surveillance and site surveillance (see Appendix A for locations). The TLDs detect changes in ambient exposures attributed to handling, processing, transporting, or disposing radioactive waste. The TLDs are sensitive to beta energies greater than 200 KeV and to gamma energies greater than 10 KeV. The TLD packets contain five lithium fluoride chips and are placed about 0.9 m (3 ft) above the ground at specified locations. The five chips provide replicate measurements at each location. The TLD packets are replaced in May and November of each year. The sampling periods for 1998 were from November 1997 through May 1998 (spring) and from May through November 1998 (fall).

Background exposures result from direct radiation from:

- Natural terrestrial sources (rocks and soil)
- Cosmic radiation
- Fallout from testing nuclear weapons
- Local industrial processes.

The background exposures used in this report are exposure averages measured by TLDs in distant communities located outside the INEEL boundary.

In addition, the Environmental Surveillance Program uses a global positioning radiometric scanner (GPRS) system to conduct gamma-radiation surveys. The GPRS is mounted on a four-wheel drive vehicle; two plastic scintillation detectors identify contaminated areas, and both global positioning system and radiometric data are recorded. The vehicle is driven at approximately 8 kilometers per hour (5 mph) to collect survey data.

5.5.1 Data Summary and Assessment for Waste Management Surveillance

Figure 5-6 presents TLD cumulative 6-month exposure data from 1988 through 1998 from RWMC (SDA and TSA) and WERF. To provide an indication of the general trend in values over time, data in the graph were smoothed using negative exponential smoothing. The data are plotted on a logarithmic scale to give a clearer picture of the trends. The graph indicates a gradual declining trend in TLD exposures over time.

Table 5-12 summarizes statistics (that is, means, medians, maximum and minimum values) for 1997 and 1998 TLD exposures by season. In addition, Figure 5-7 provides box and whisker plots of the TLD exposures (including the distant communities) comparing 1997 and 1998 TLD data by facility. The 1997 TLD exposures are included to provide an indication of short-term changes in levels.

The median 1998 exposure value for the TSA and WERF facilities and the distant communities increased from the median grouping exposure values calculated for 1997. The 1998 SDA median exposure decreased from that calculated for 1997. However, the Kruskal-Wallis test for differences in medians indicated that none of the changes from 1997 to 1998 were statistically significant (at the 0.05 level).

Figure 5-8 shows the exposure levels measured at Stations 40 and 41 (located along the east and northeast borders of TSA). Although the exposure levels decreased slightly compared to the 1997 data, the decreased exposures for Station 41 remain elevated due to the increased waste stored in the Type II storage buildings. Station 41 exposure levels are expected to remain elevated as long as the waste remains in these buildings.

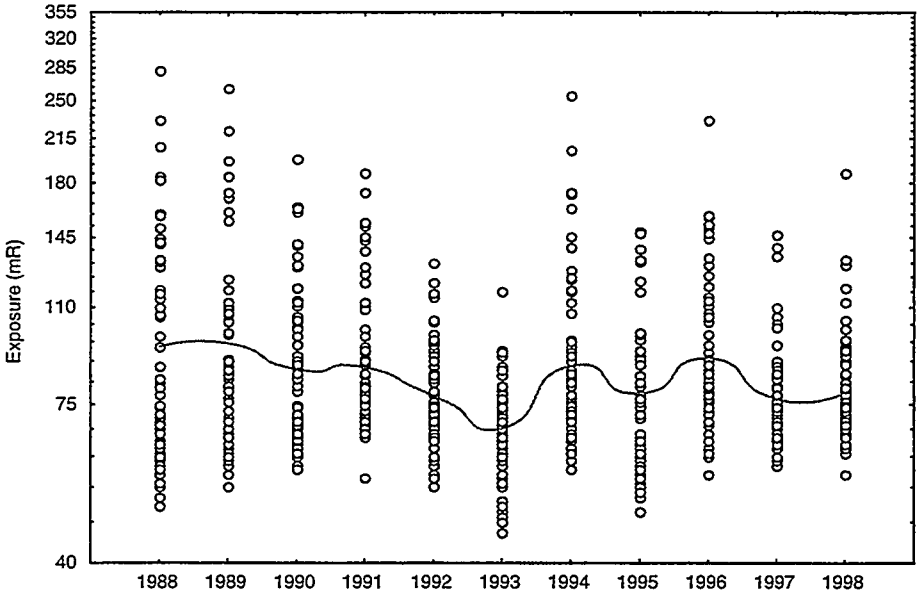


Figure 5-6. 1988–1998 Radioactive Waste Management Complex and Waste Experimental Reduction Facility thermoluminescent dosimeter exposures using negative exponential smoothing.

Table 5-12. Thermoluminescent dosimeter summary statistics by season.

Location	Season	Number of Samples	Mean (mR)	Median (mR)	Minimum (mR)	Maximum (mR)
		1997				
SDA	Spring	19	78	74	61	106
SDA	Fall	19	81	75	63	147
TSA	Spring	11	75	66	59	135
TSA	Fall	12	75	68	61	140
WERF	Spring	11	75	70	65	110
WERF	Fall	11	73	69	64	103
Distant communities	Spring	7	63	58	57	75
Distant communities	Fall	7	60	61	56	65
1997 overall	Spring	48	74	71	57	135
1997 overall	Fall	49	75	70	56	147
		1998				
SDA	Spring	19	79	75	63	112
SDA	Fall	19	83	73	64	188
TSA	Spring	12	75	72	57	130
TSA	Fall	12	77	73	63	101
WERF	Spring	11	74	69	62	119
WERF	Fall	11	80	75	66	133
Distant communities	Spring	7	65	59	54	87
Distant communities	Fall	7	63	64	54	70
1998 overall	Spring	49	75	72	54	130
1998 overall	Fall	49	74	72	54	133

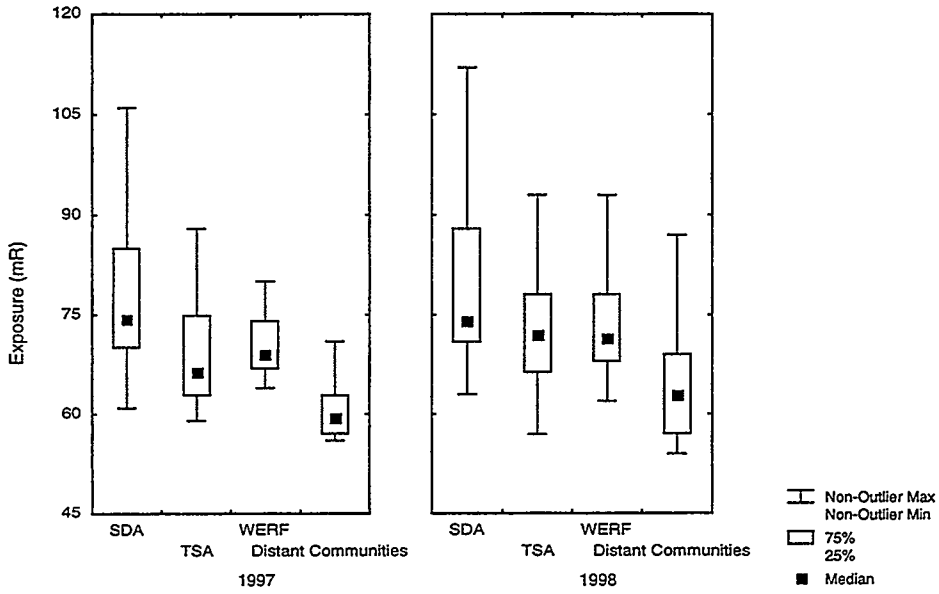
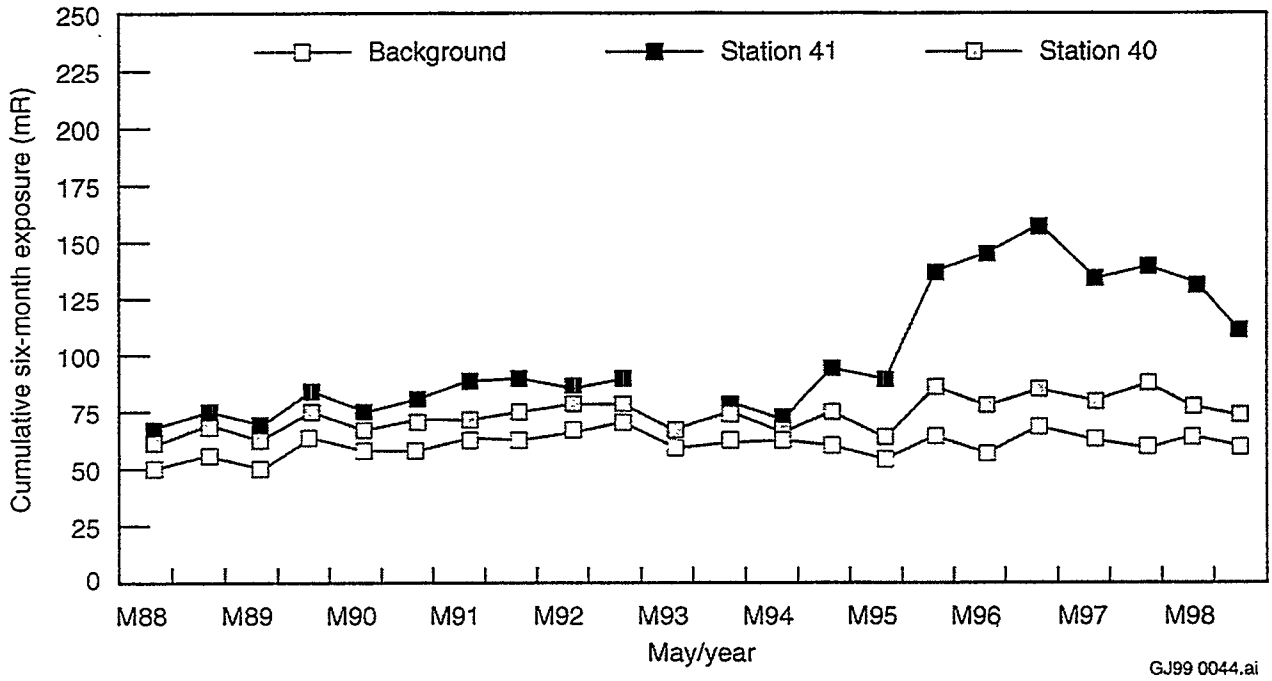


Figure 5-7. Comparison of 1997 and 1998 thermoluminescent dosimeter exposures by facility.



NOTE: TLD missing or destroyed in May 1993.

Figure 5-8. Six-month exposures measured by thermoluminescent dosimeters on the east and northeast borders of Transuranic Storage Area (GJ99_004.4.ai).

Station 8 is located 50 m (164 ft) northwest of WERF, which is near an area where waste is temporarily stored. Exposures measured at Station 8 have changed over the past few years due to periodic movement of waste and are shown in Figure 5-9.

Figure 5-10 shows the radiation readings from the 1998 RWMC spring survey, and Figure 5-11 shows the radiation readings from the 1998 RWMC fall survey. The maximum exposure rate measured in the spring, excluding the operating low-level waste pit, was 730 μR/hr at Pit #4. In addition to this area, several other elevated exposure areas were measured. Elevated readings were measured in an area south of Pad A and were attributed to temporarily stored radiological material. Also, there were numerous areas with elevated exposures just west of the old acid pit in Pit #13, which were also attributed to temporarily stored radiological material.

The RWMC fall survey (see Figure 5-11) shows that the levels returned to normal after the addition of soil cover and removal of the temporary radiological storage area. The maximum exposure rate, excluding the operating low-level waste pit, detected in the fall was 520 μR/hr, measured along Soil Vault Row #18. Pad A cannot be surveyed via the GPRS system because of driving restrictions. Instead, it was traversed with a hand-held HHD-440. No elevated exposure rates were noted during either the spring or fall survey.

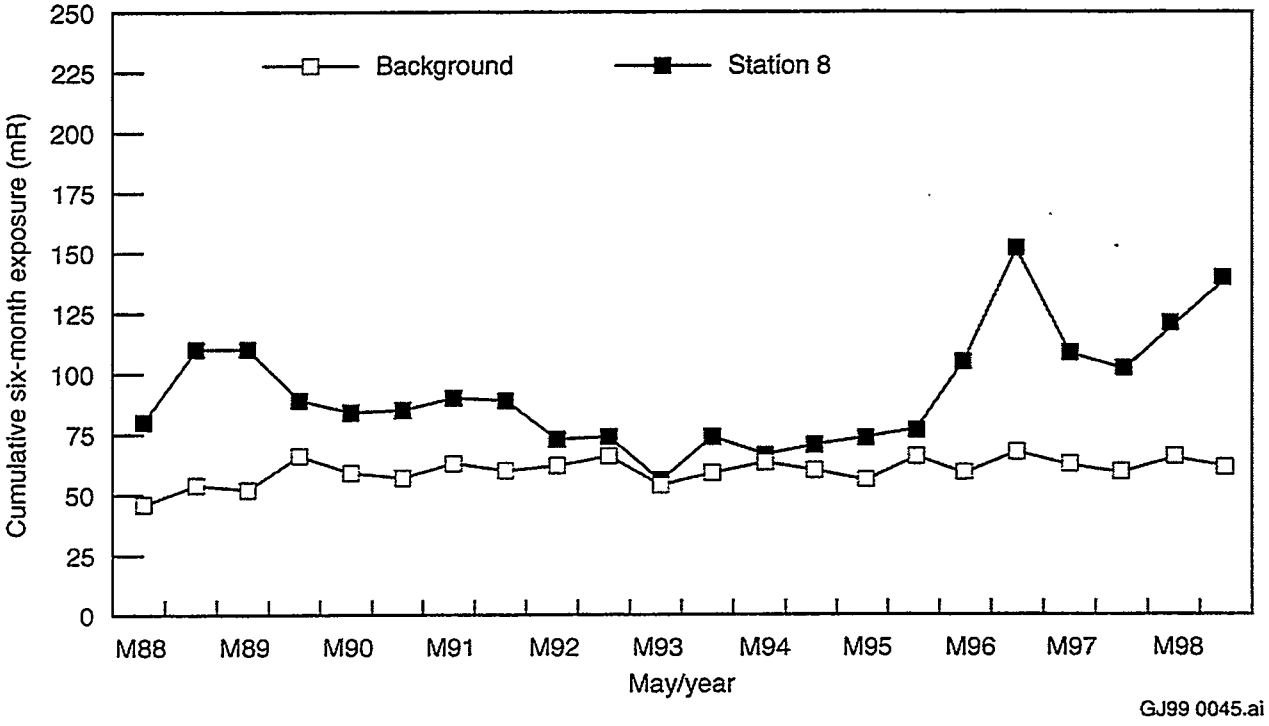


Figure 5-9. Six-month exposures measured by thermoluminescent dosimeters of the 50-m perimeter around Waste Experimental Reduction Facility (GJ99_0045.ai).

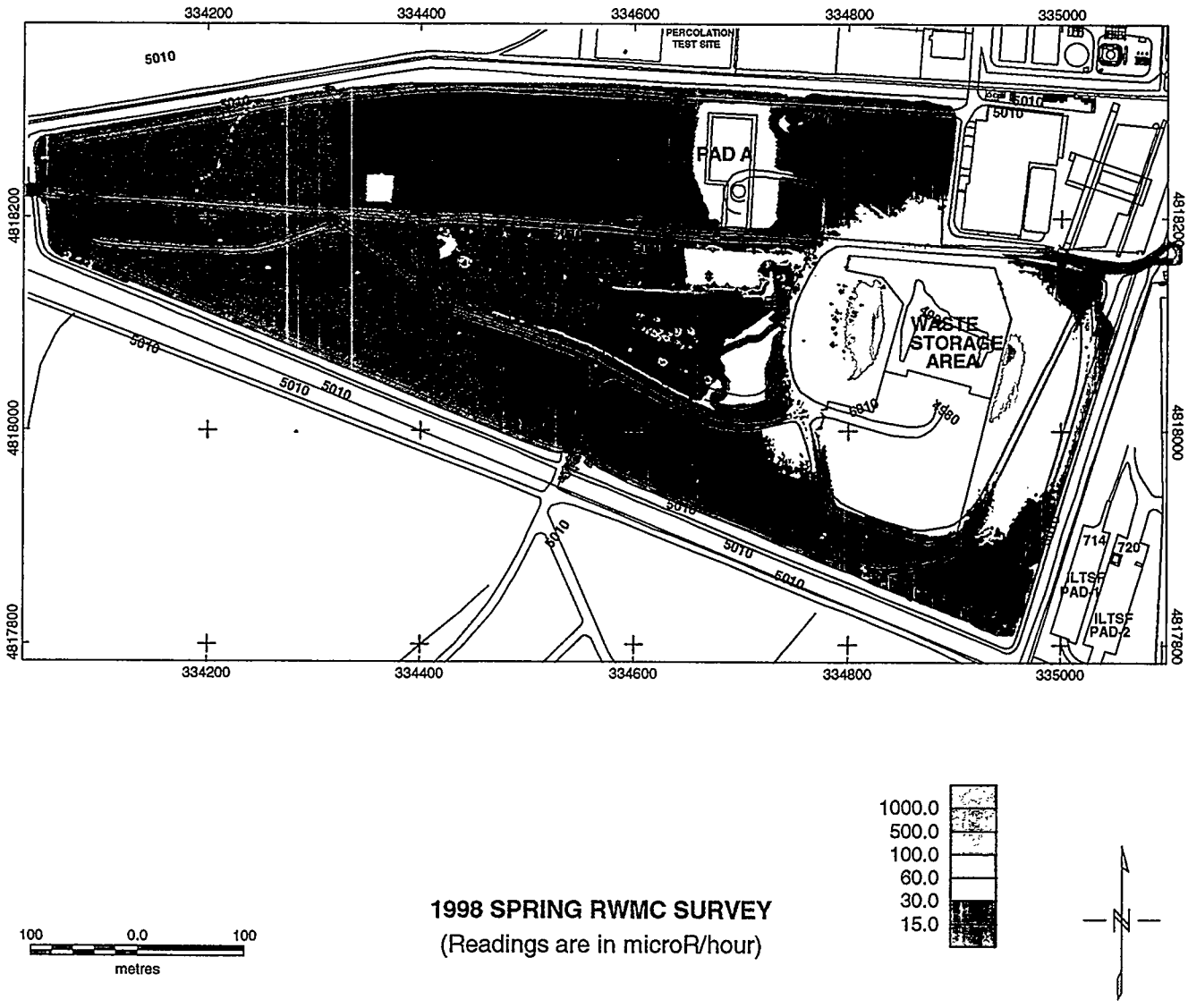


Figure 5-10. Spring 1998 Radioactive Waste Management Complex surface radiation survey.

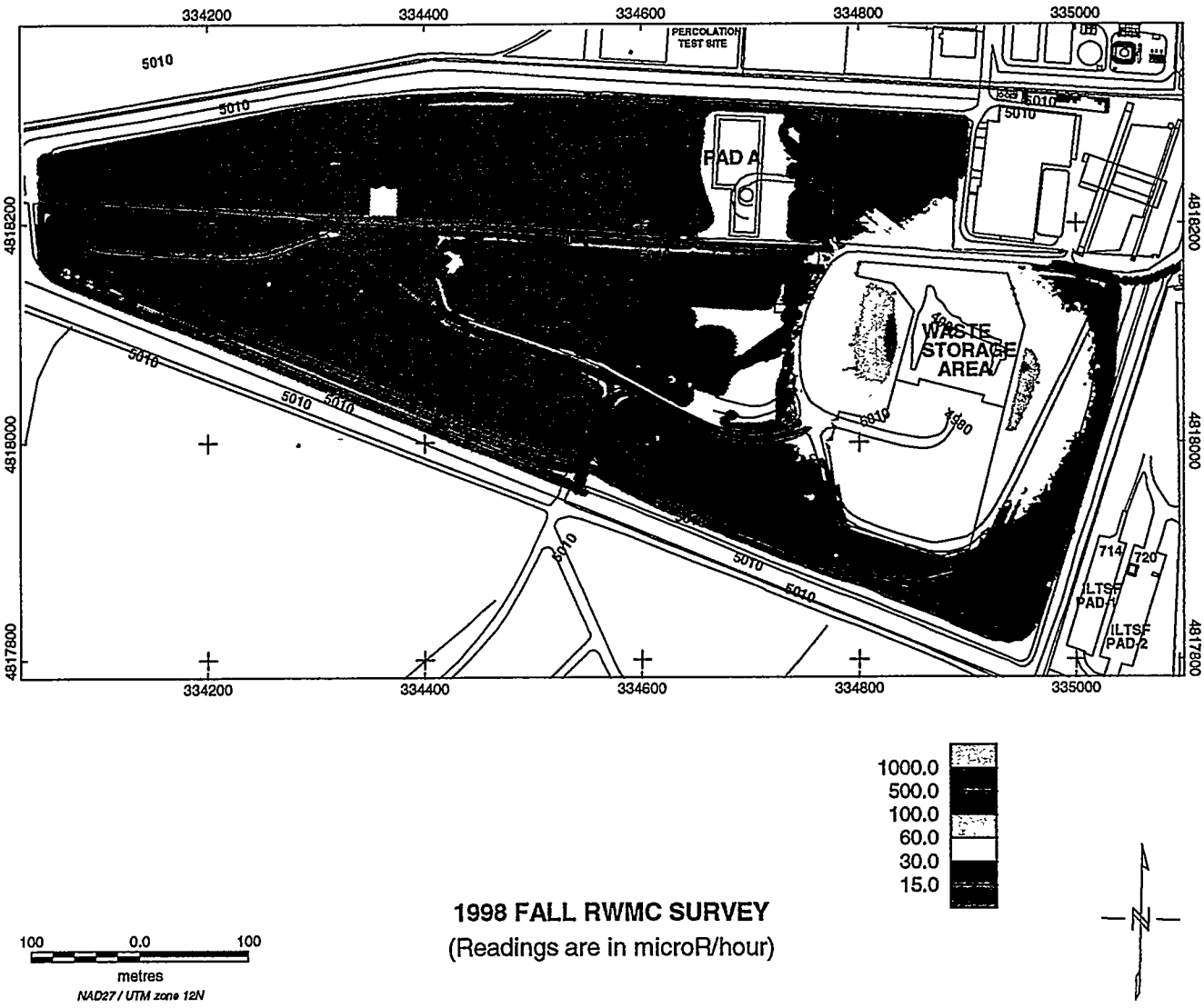


Figure 5-11. Fall 1998 Radioactive Waste Management Complex surface radiation survey.

5.5.2 Data Summary and Assessment for Site Surveillance

Table 5-13 shows the maximum TLD value data from the site surveillances and includes historical data. During 1998, the ARA 3 TLD measurement increased due to its close proximity to a temporary storage area.

The ICPP 9 TLD is located in a controlled access area, which used to be a contaminated soil area. The exposure measured at ICPP 9 in 1998 is comparable to past data. ICPP 20 is also in the vicinity of a radioactive material storage area, and 1998 exposure rates are consistent with historical exposures. INTEC Tree Farm 1 is also comparable to historical exposures.

TRA 2, 3, and 4 are adjacent to the former radioactive disposal pond, which has been drained and covered with clean soil. These locations are also close to a radioactive storage area, which is inside the facility fence line. TRA 3 had a maximum exposure (574 ± 58 mR). This location is the closest to the radioactive storage area, where the amount of material temporarily stored increased. The other exposures were comparable to historical exposures.

Table 5-13. Comparison of the highest site surveillance 1998 thermoluminescent dosimeter concentrations to past data.

	Exposure ± 2 standard deviations (mR)				
Location	1994	1995	1996	1997	1998
ARA 3	241 ± 13	207 ± 13	198 ± 8	167 ± 8	225 ± 8
ICPP 9	202 ± 8	83 ± 4[a]	283 ± 18	196 ± 8	200 ± 8
ICPP 20	217 ± 9	236 ± 9	251 ± 13	245 ± 10	233 ± 9
INTEC Tree Farm 1	191 ± 8	191 ± 7	214 ± 15	208 ± 12	214 ± 12
TRA 2	242 ± 14	261 ± 13	270 ± 10	257 ± 9	293 ± 12
TRA 3	—[a,b]	295 ± 11	345 ± 16	328 ± 14	574 ± 58
TRA 4	285 ± 12	252 ± 11	255 ± 10	246 ± 12	250 ± 6

a. Missing during fall change-out.

b. Missing during spring change-out.

5.6 Quality Assurance/Quality Control

The LMITCO Analytical Laboratories analyze all Environmental Surveillance Program samples as specified in the statements of work. These laboratories participate in a variety of intercomparison QA programs, which verify all the methods used to analyze environmental samples. The programs include the DOE Environmental Measurements Laboratory QA Program and the EPA Environmental Measurements Systems Laboratory QA Program. The results of QC sample analyses and laboratory performance in these programs are available in the INEEL Site Environmental Report. The laboratories met the performance objectives specified by the Environmental Measurements Laboratory and Environmental Measurements Systems Laboratory. The Environmental Surveillance Program submits duplicate, blank, and control samples with routine samples submitted for analyses. QA/QC samples were

also routinely submitted with program samples and demonstrated acceptable agreement ratio with spiked values for all radionuclides.

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Appendix A

Facility Maps with Monitoring Locations

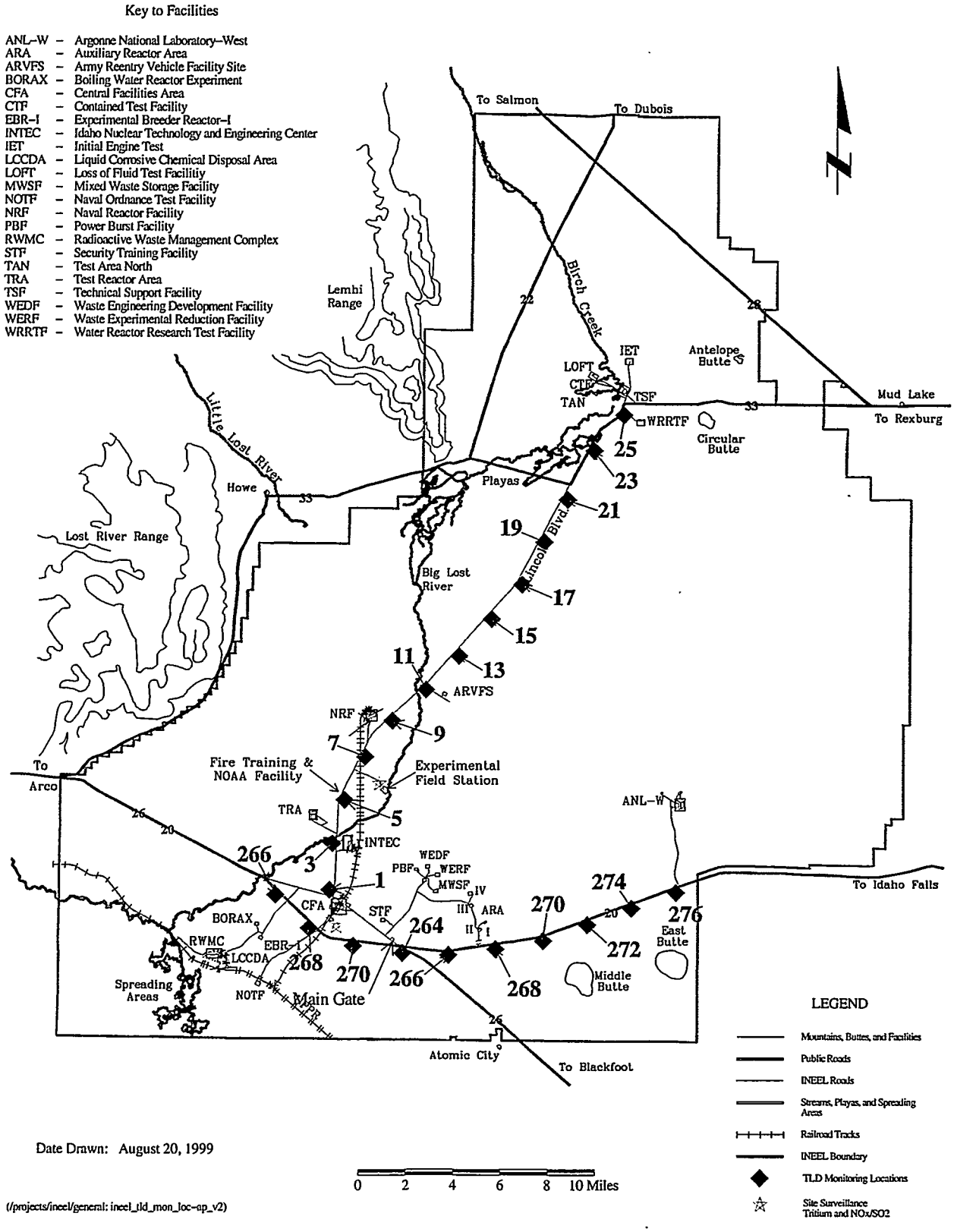

Figure A-1. Thermoluminescent dosimeter, tritium, and NO_x/SO_2 monitoring locations.

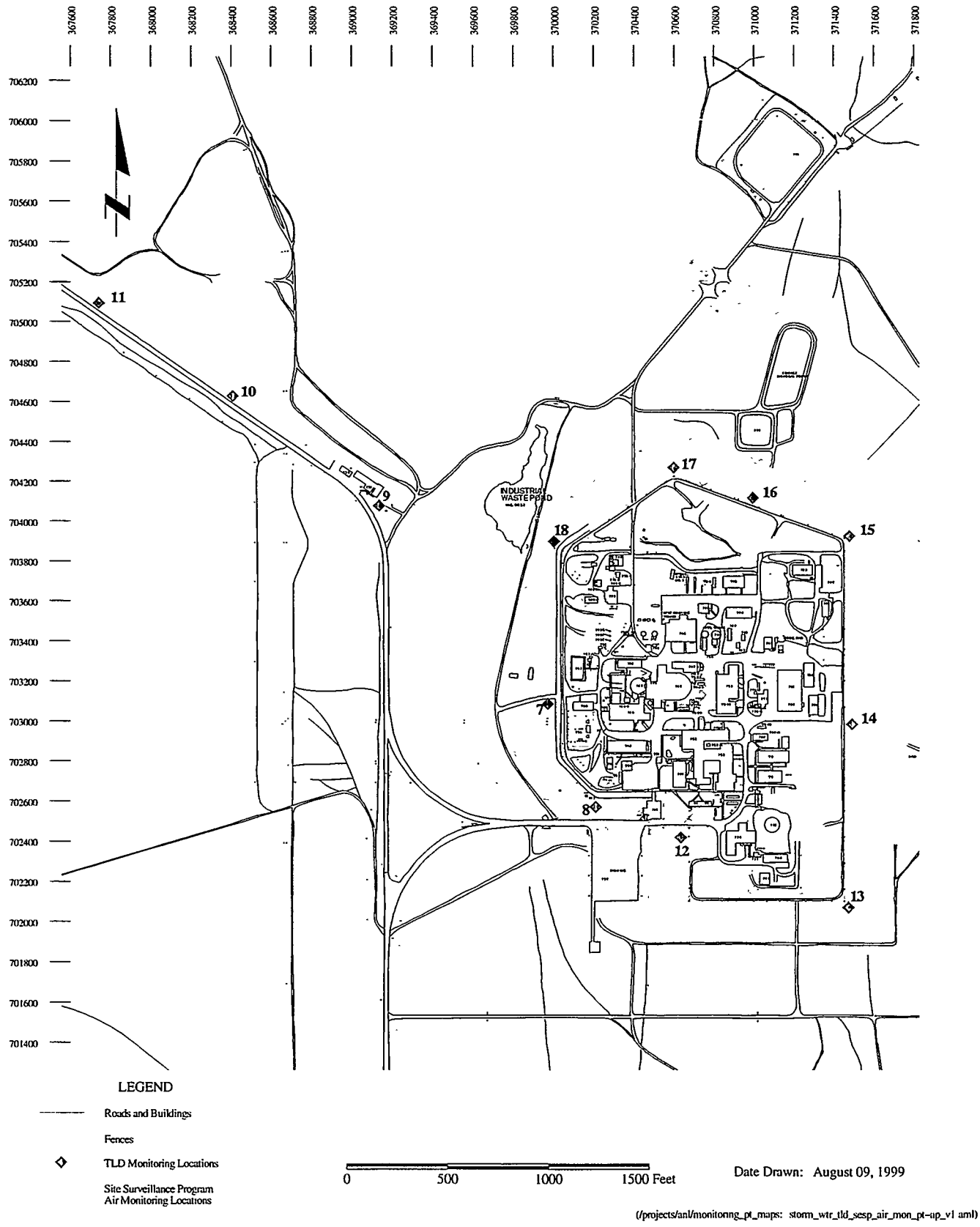

Figure A-2. Argonne National Laboratory–West monitoring locations.

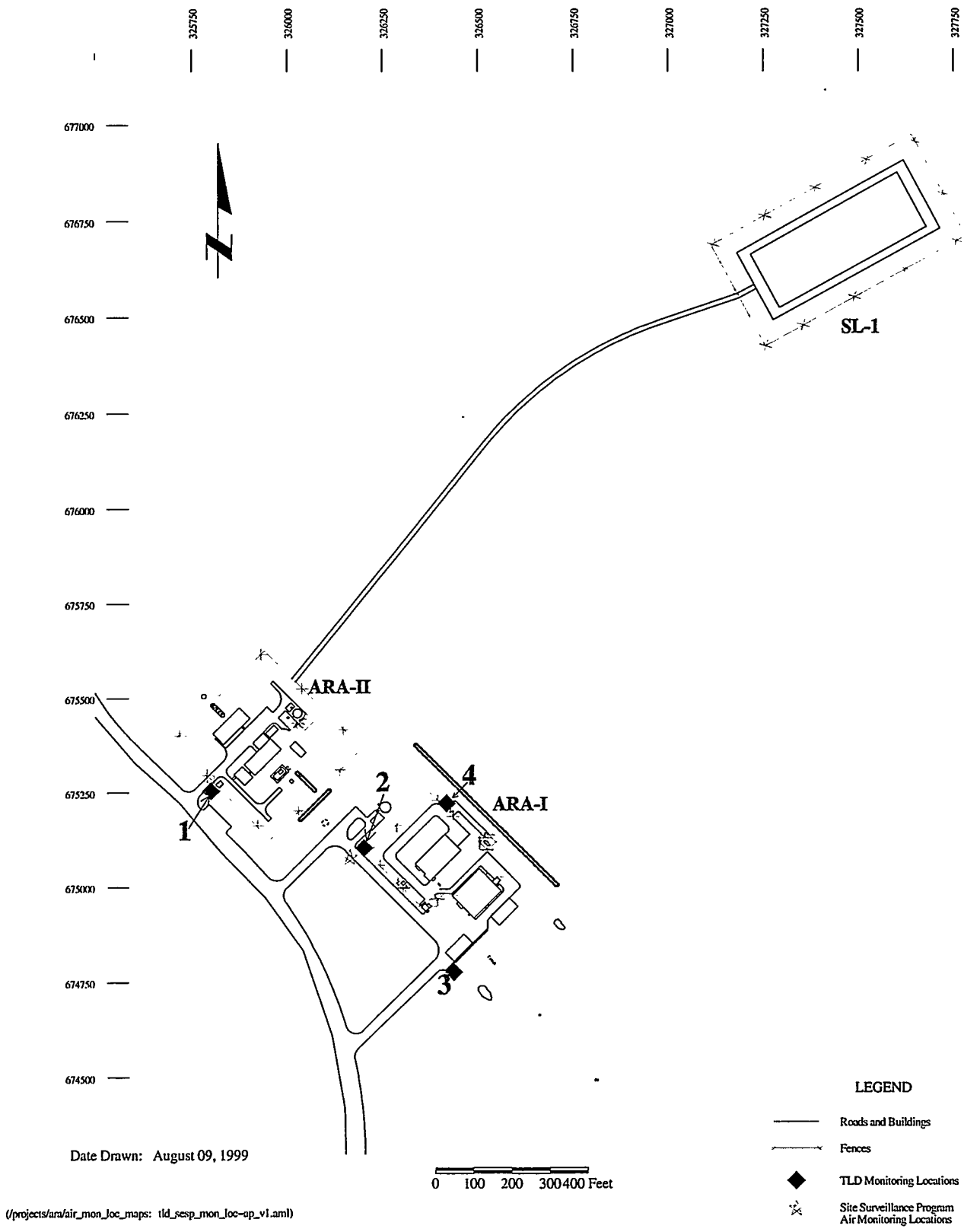

Figure A-3. Auxiliary Reactor Area monitoring locations.

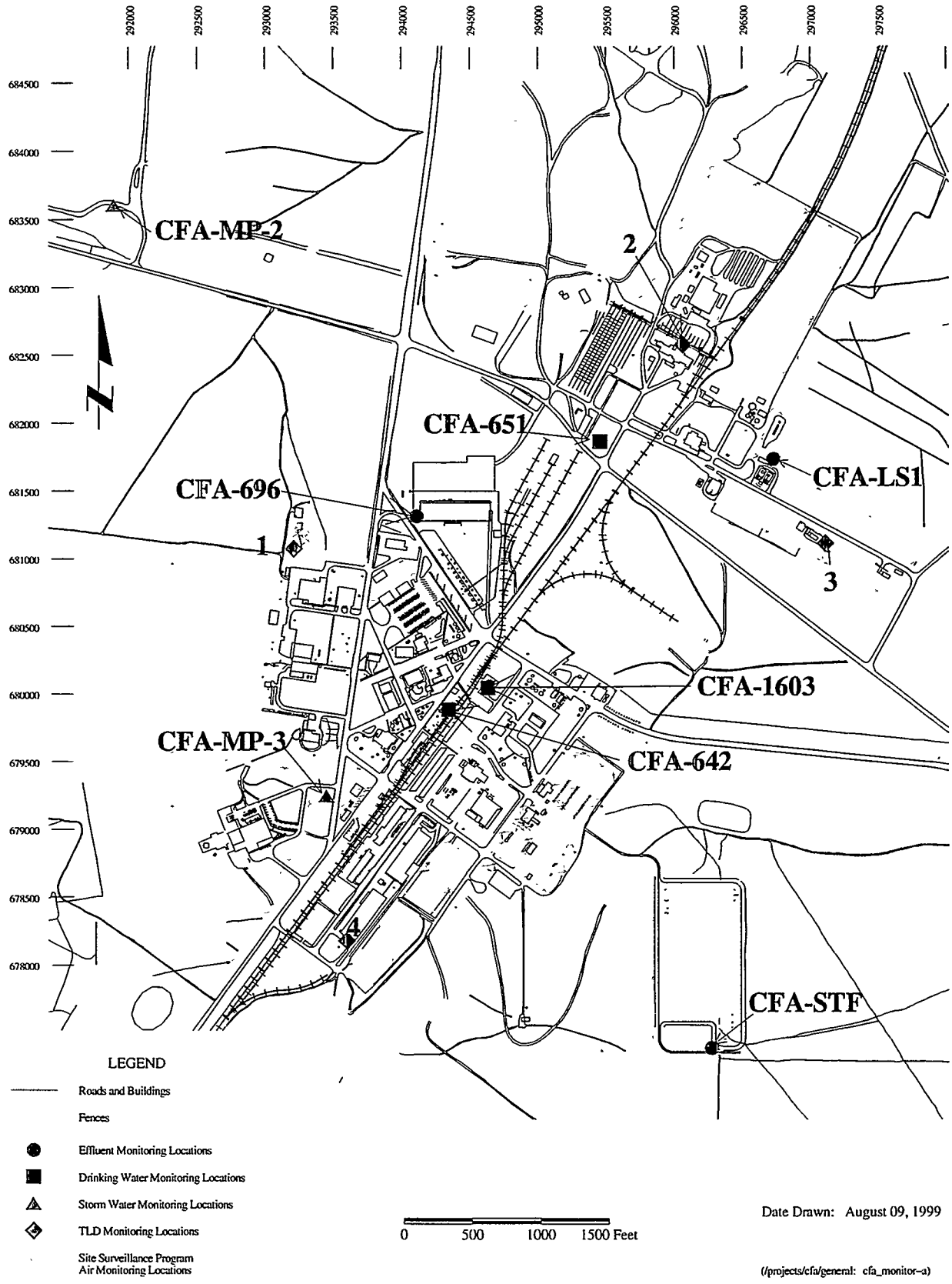

Figure A-4. Central Facilities Area monitoring locations.

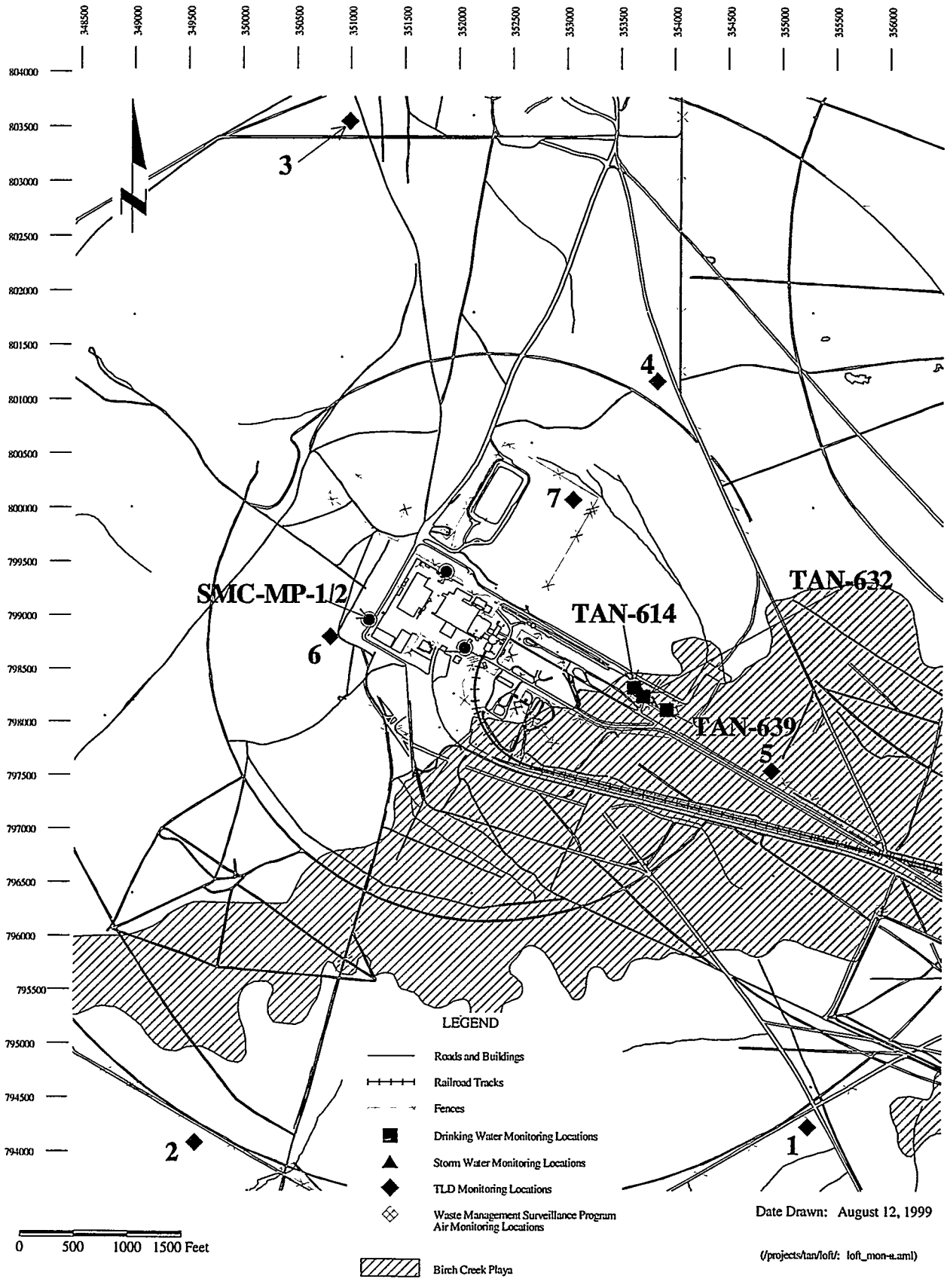

Figure A-5. Test Area North/Specific Manufacturing Capability monitoring locations.

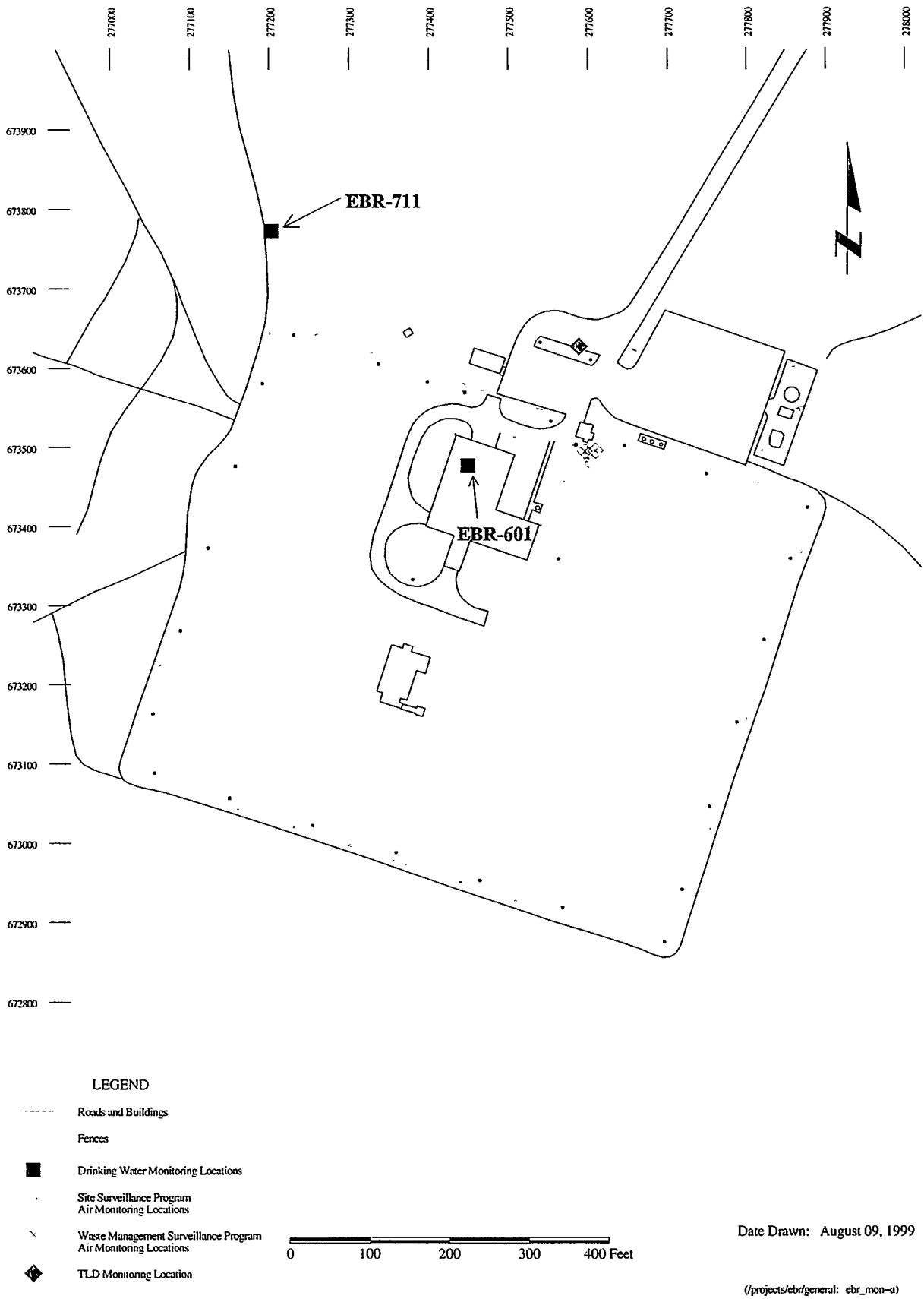

Figure A-6. Experimental Breeder Reactor–I monitoring locations.

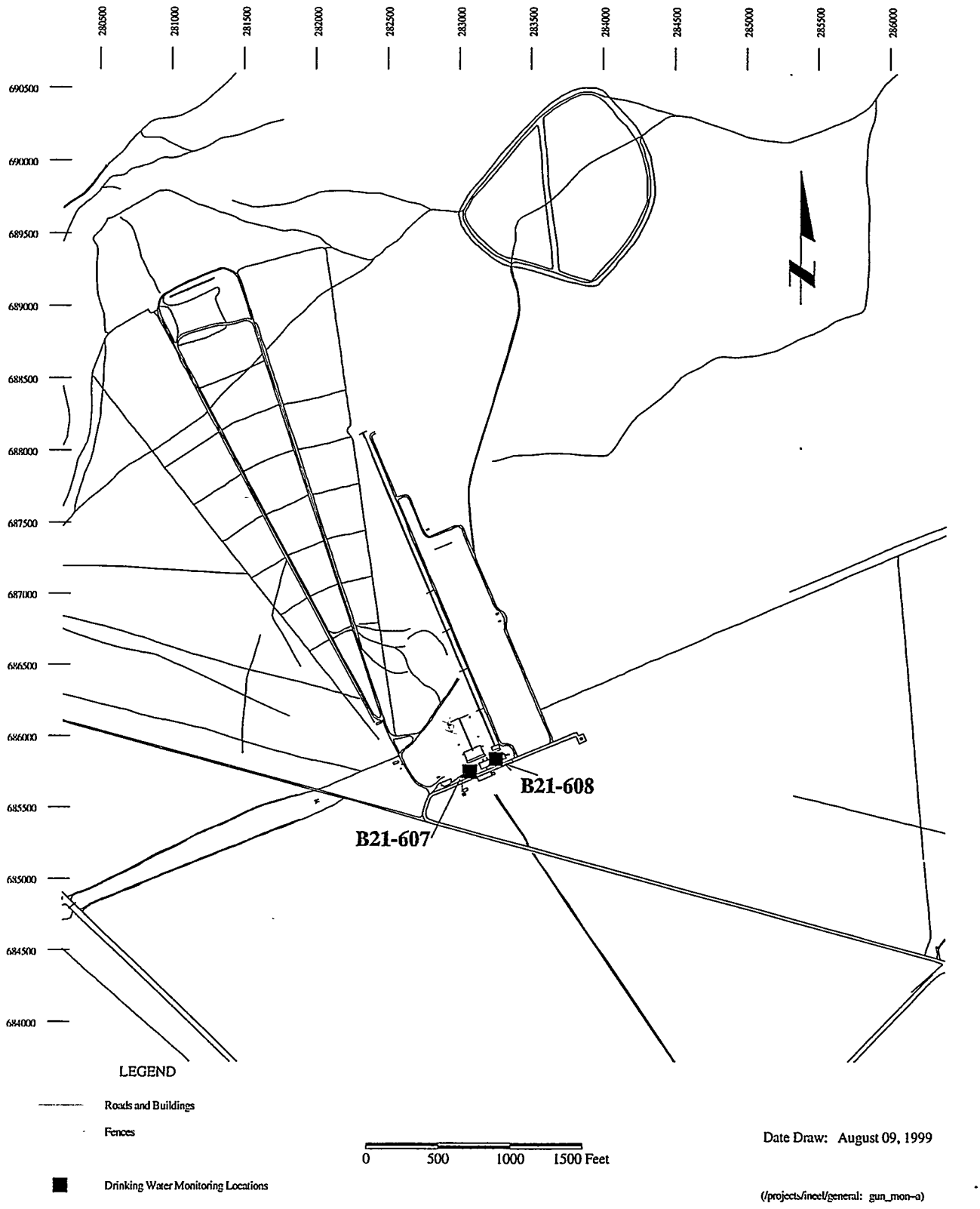

Figure A-7. Gun Range monitoring locations.

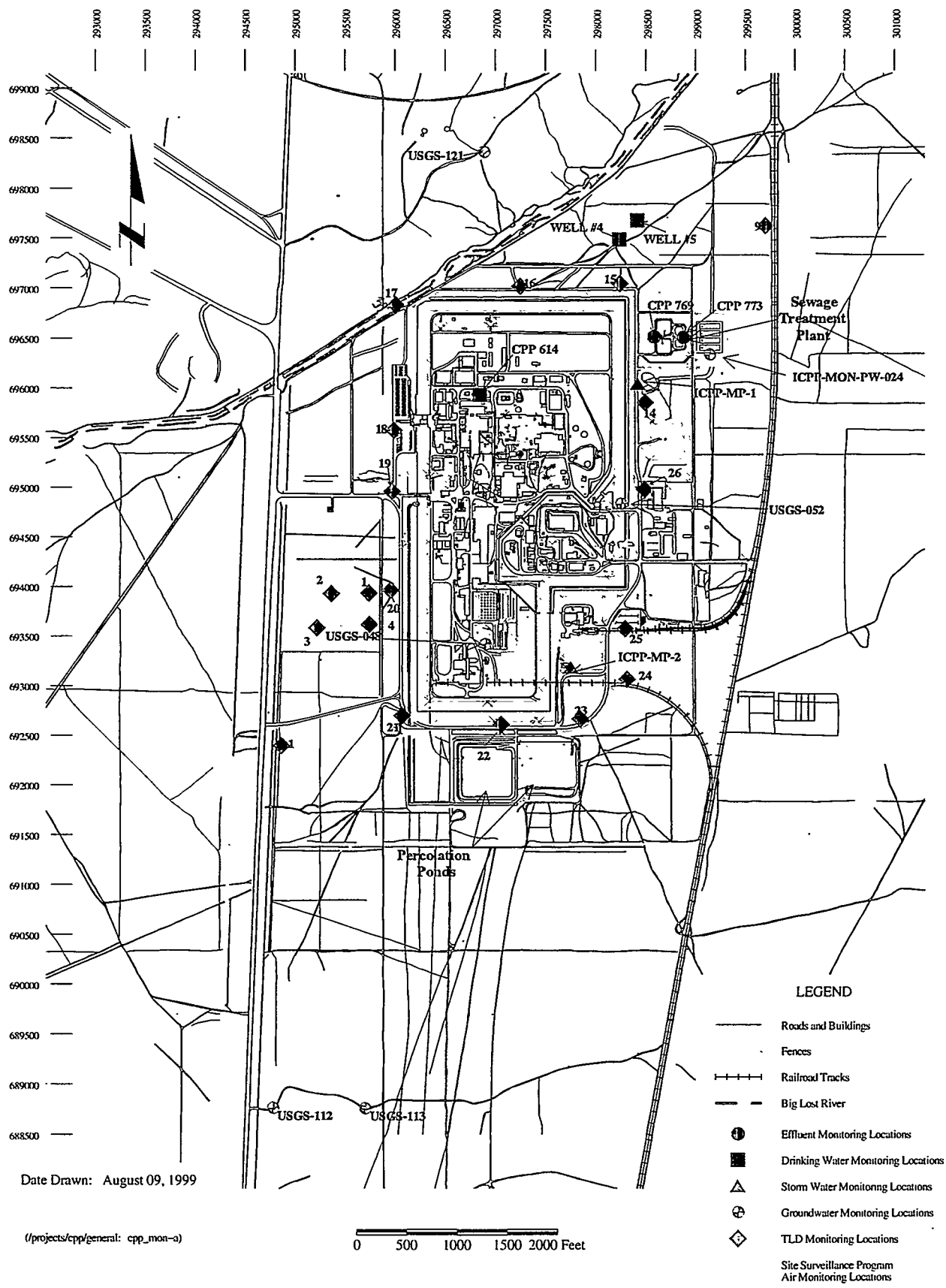

Figure A-8. Idaho Nuclear Technology and Engineering Center monitoring locations.

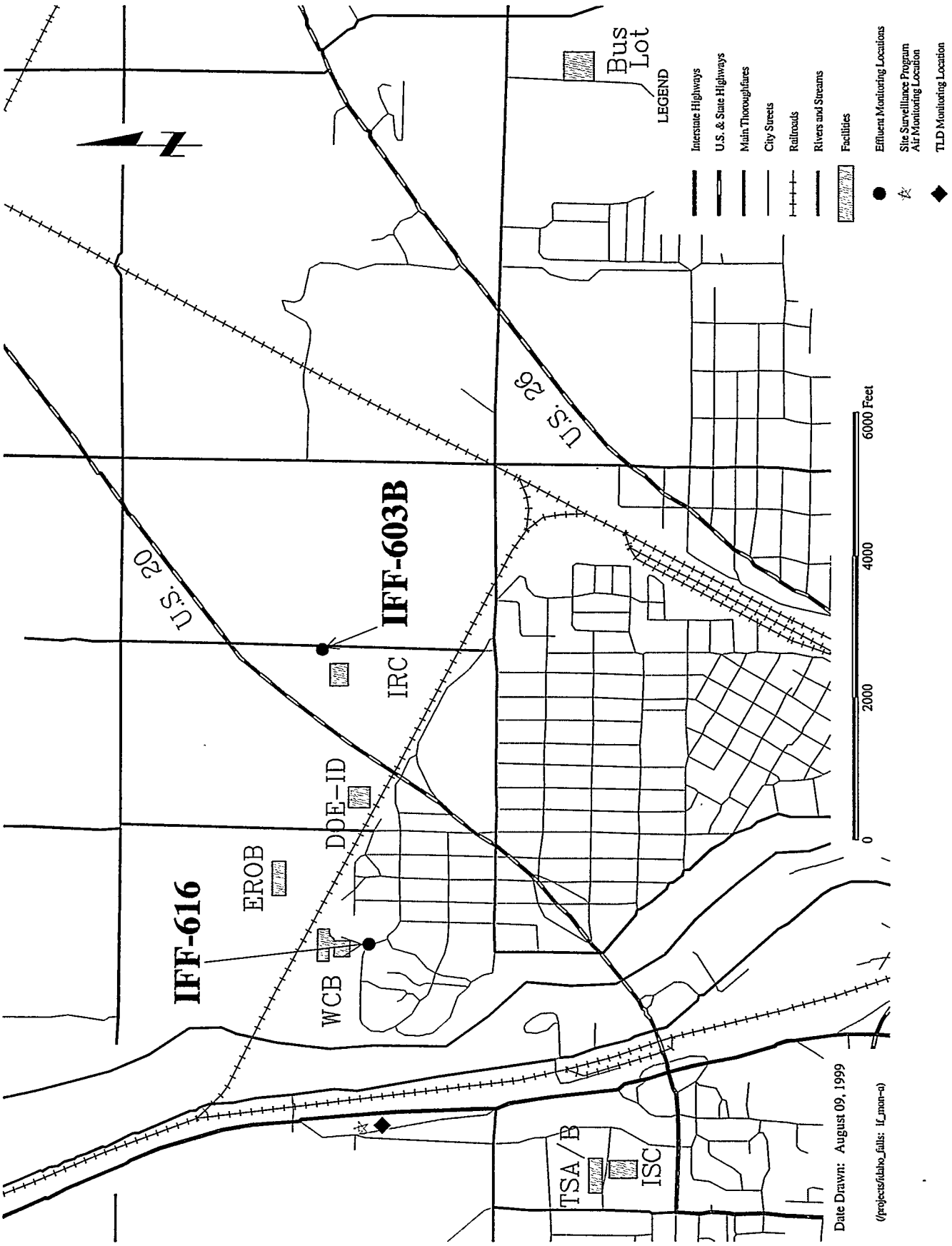

Figure A-9. Idaho Falls monitoring locations.

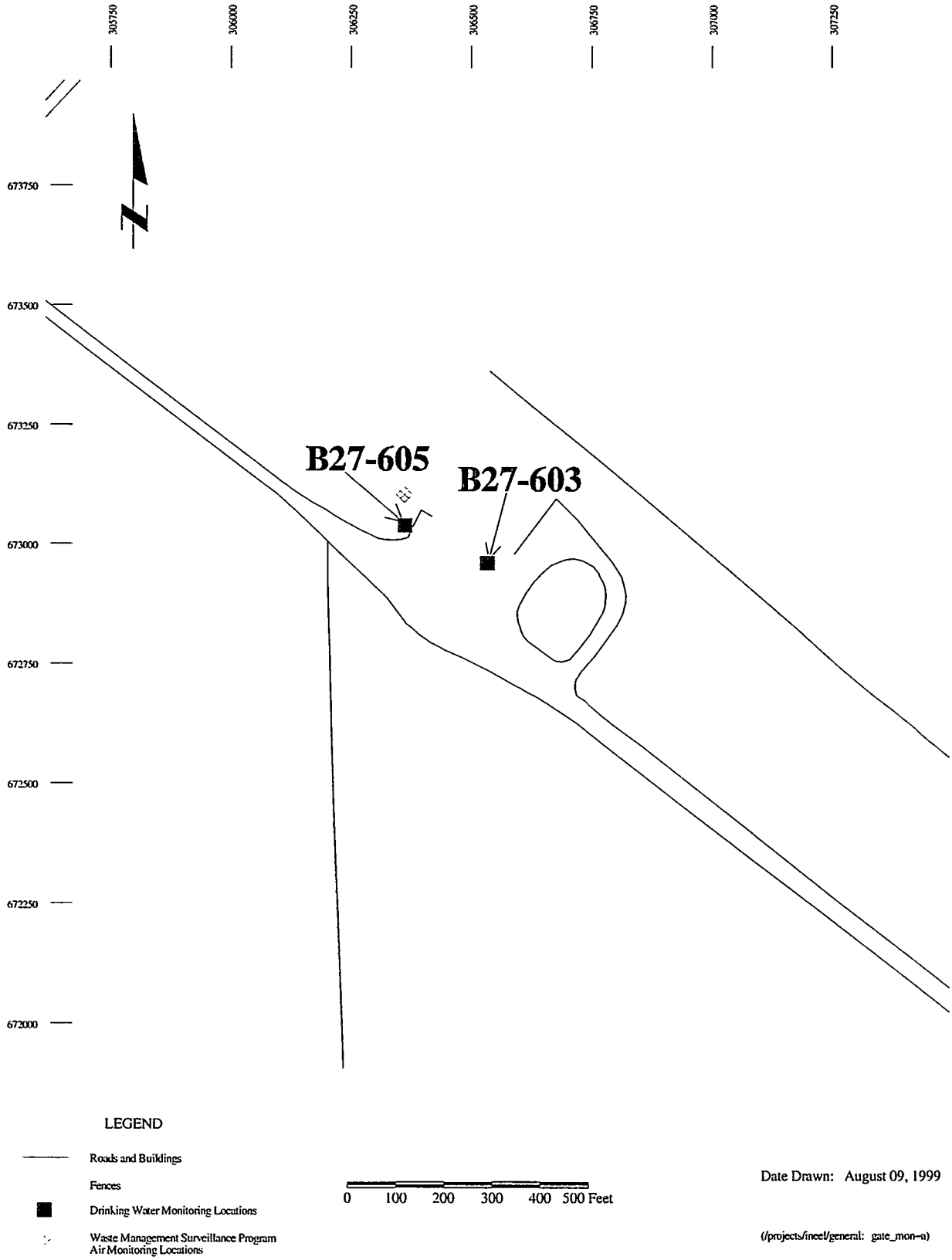

Figure A-10. Main Gate monitoring locations.

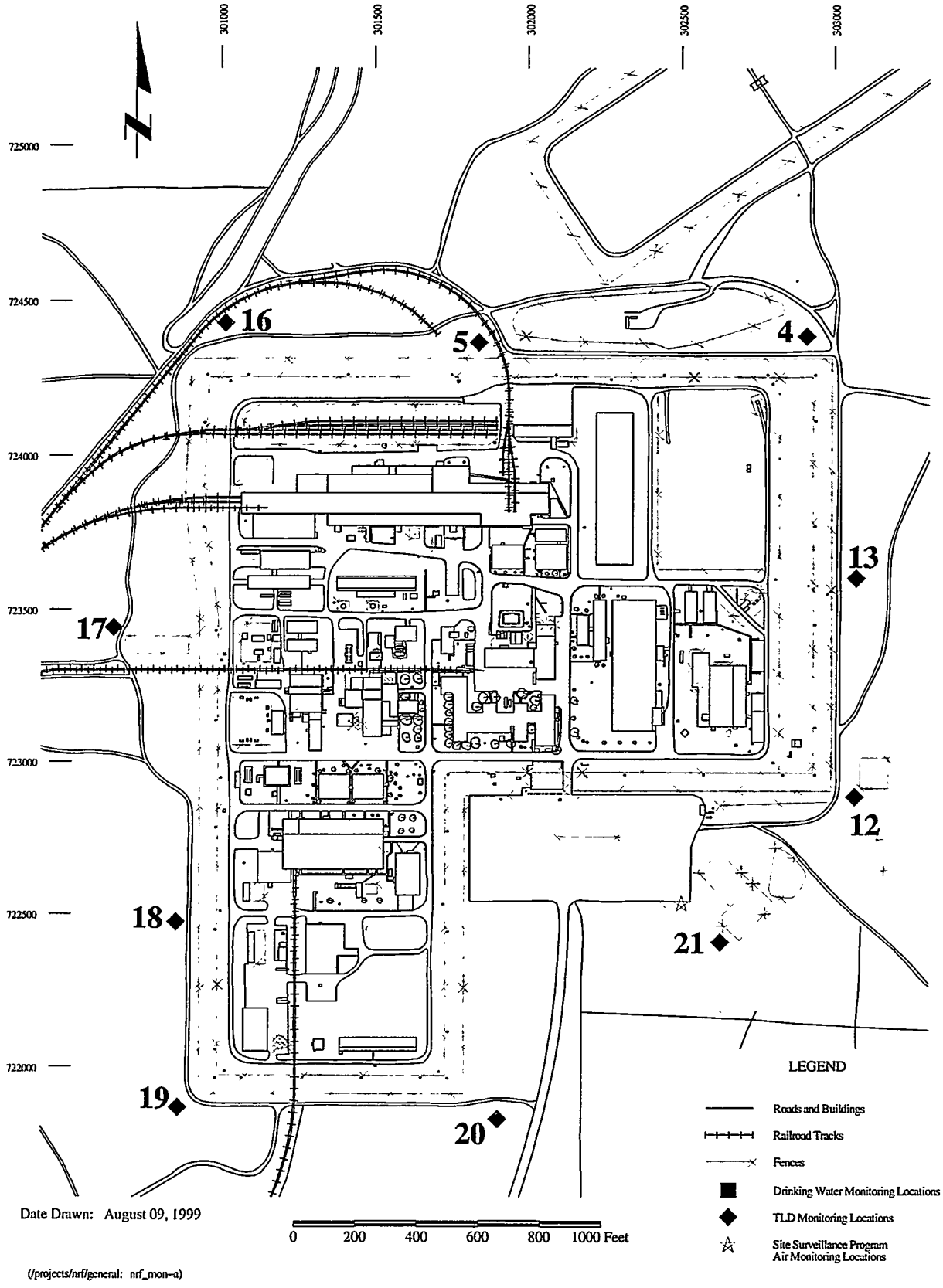

Figure A-11. Naval Reactors Facility monitoring locations.

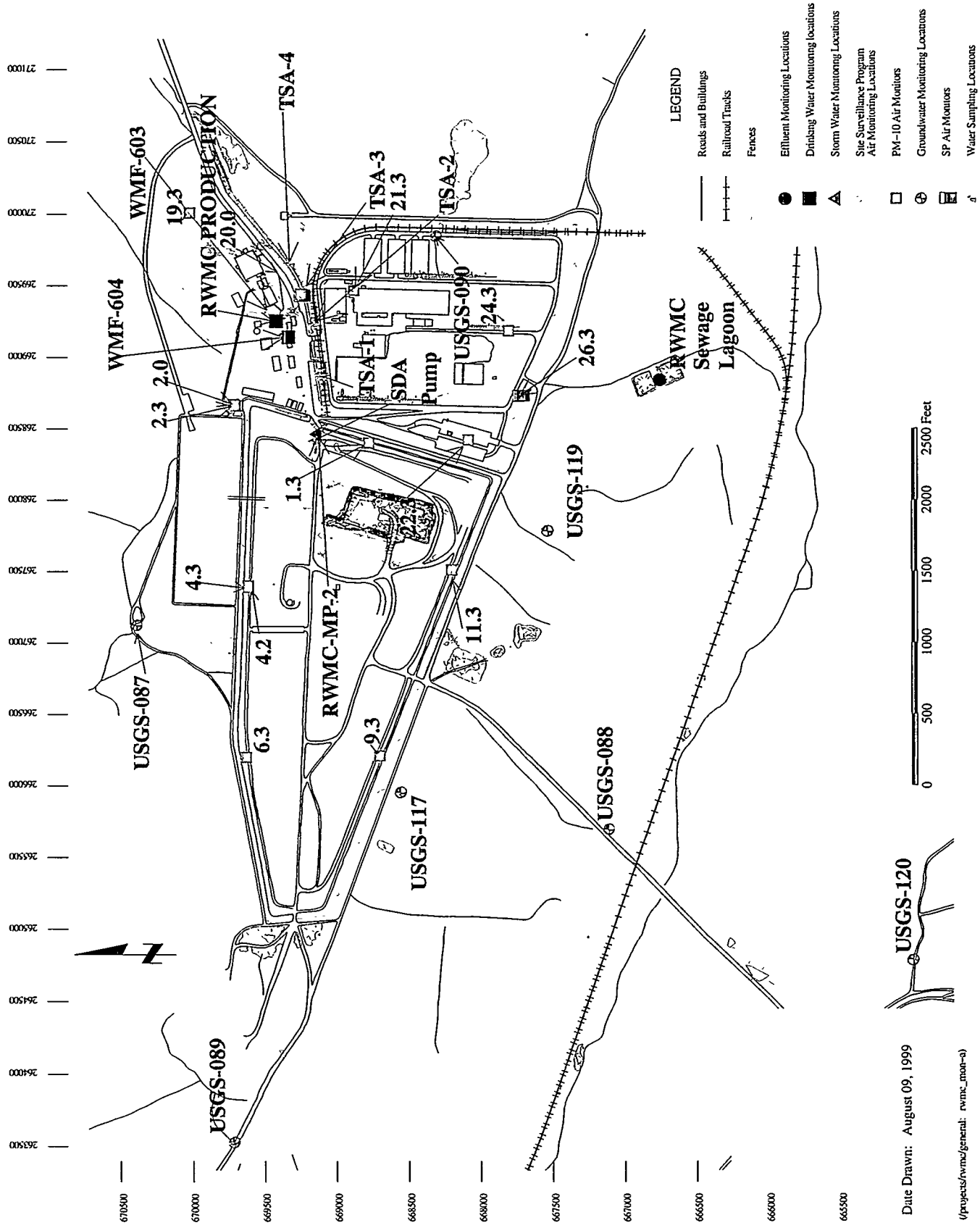

Figure A-12. Radioactive Waste Management Complex monitoring locations.

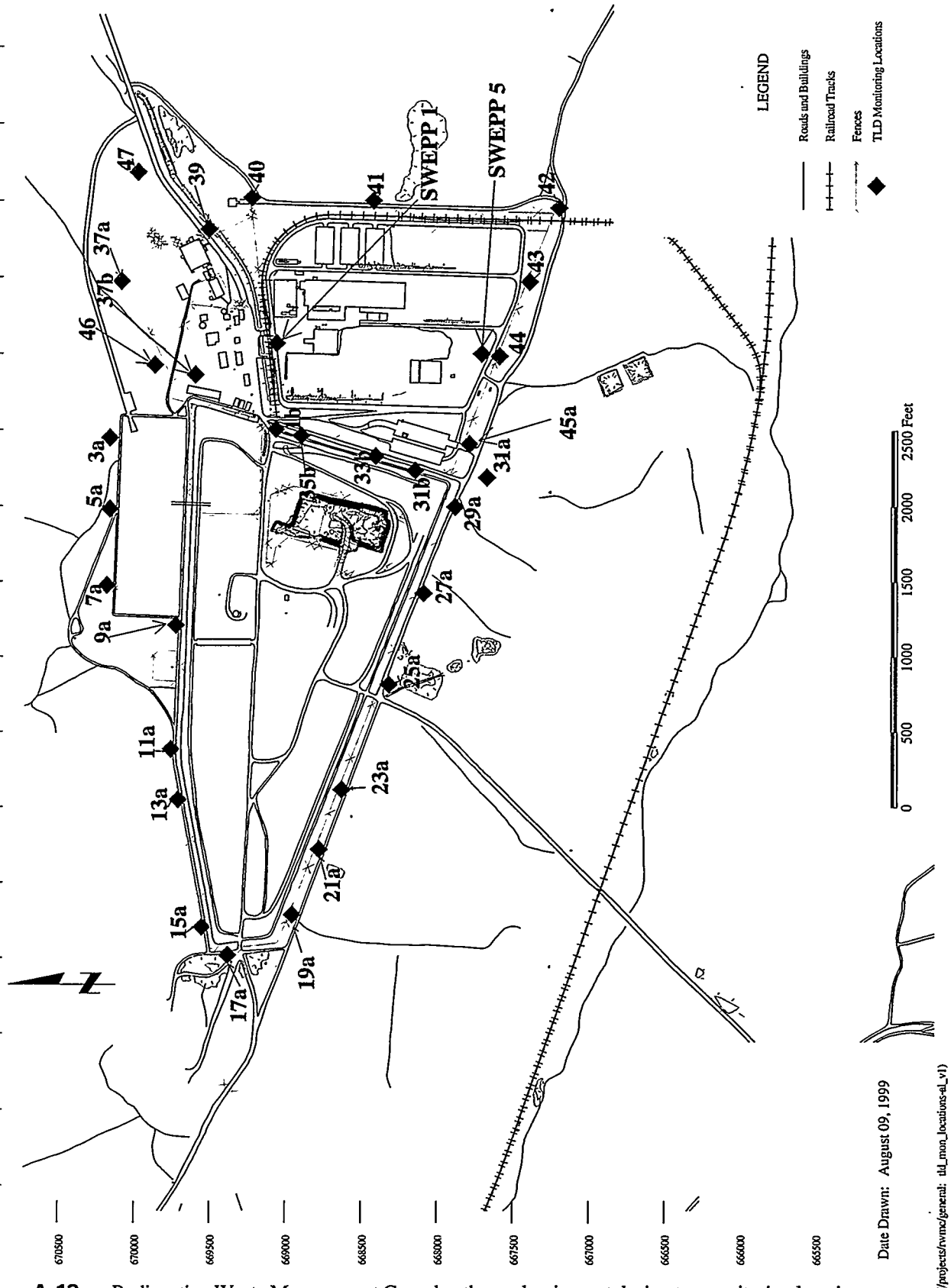

Figure A-13. Radioactive Waste Management Complex thermoluminesent dosimeter monitoring locations.

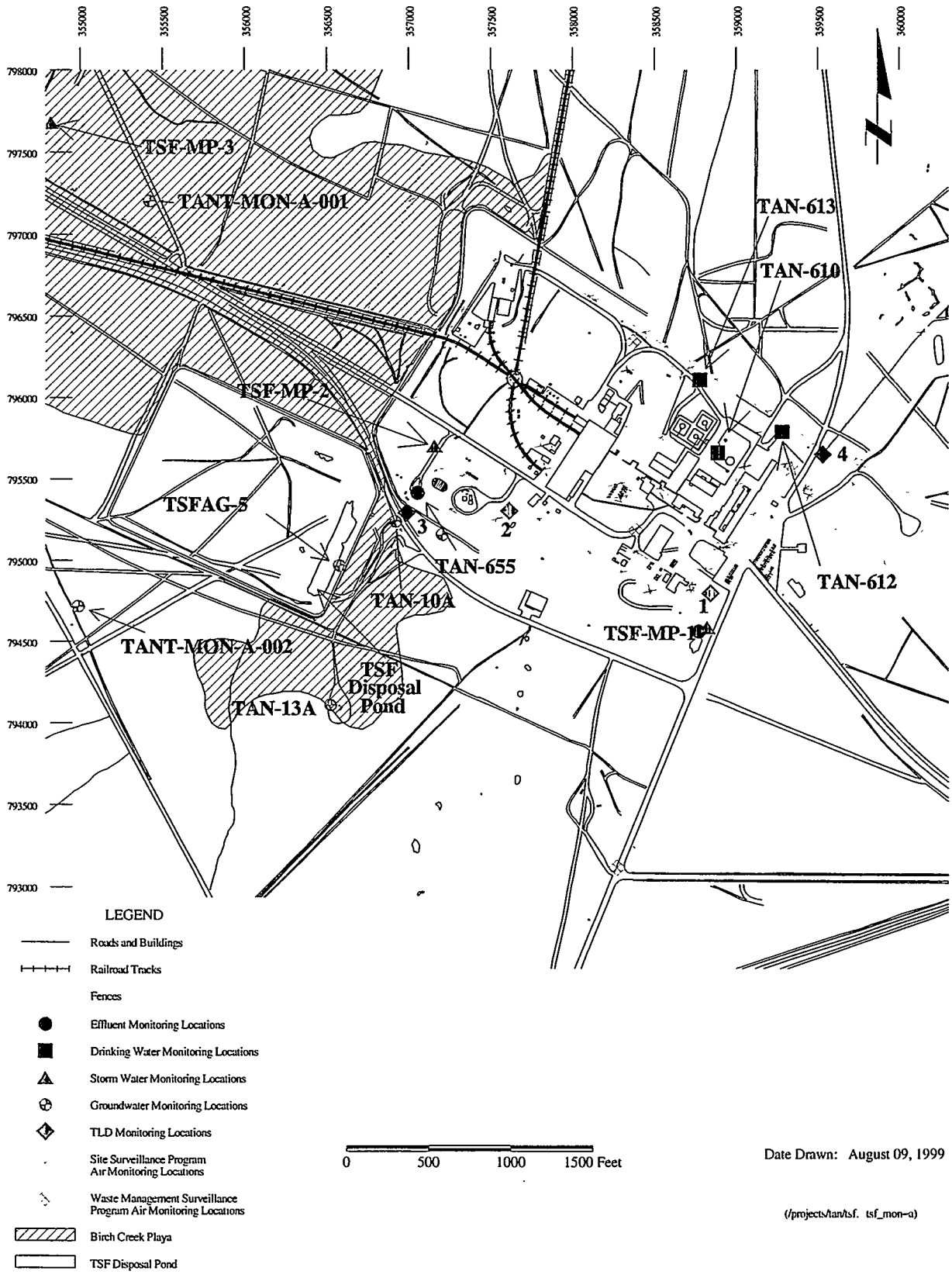

Figure A-14. Test Area North/Technical Support Facility monitoring locations.

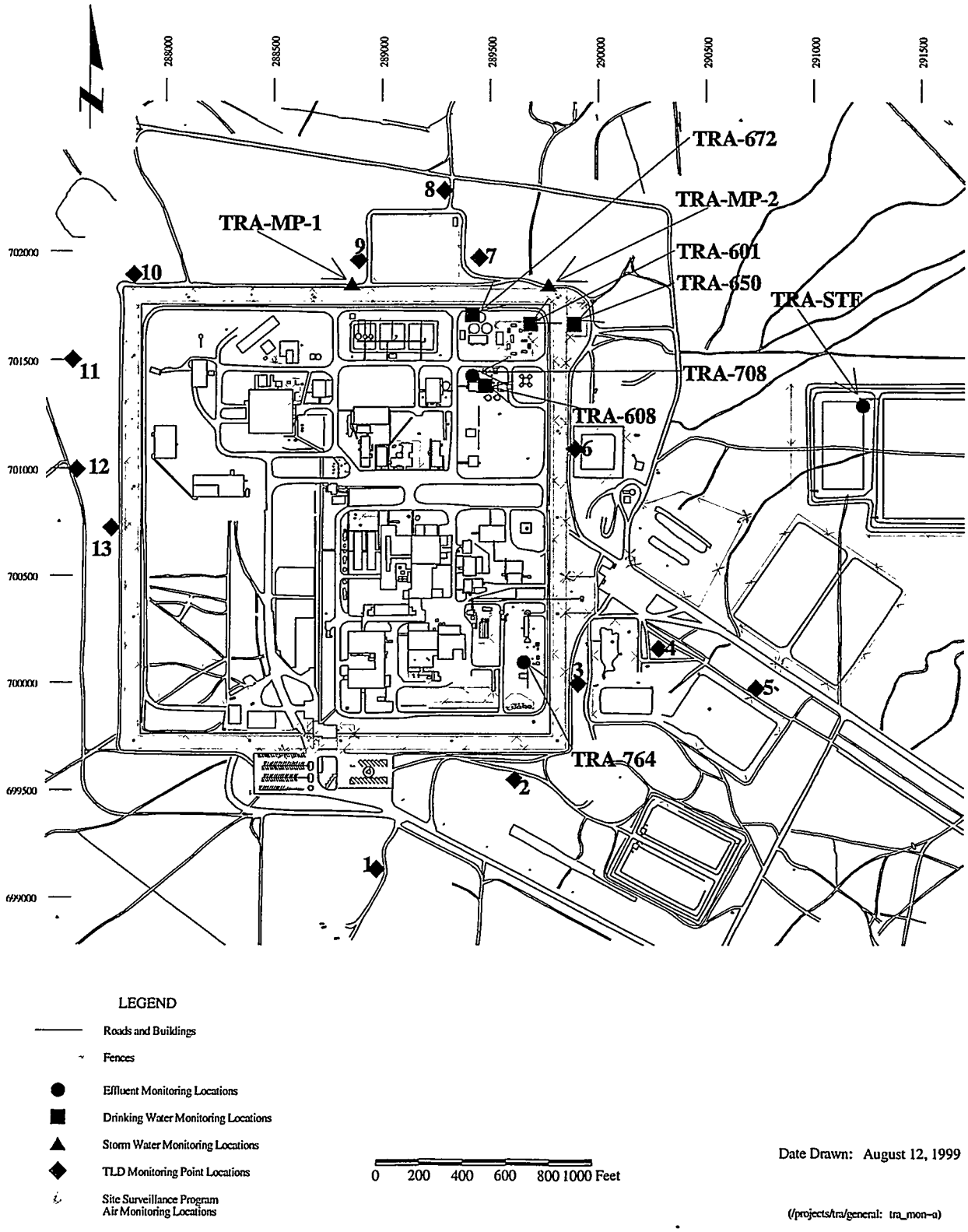

Figure A-15. Test Reactor Area monitoring locations.

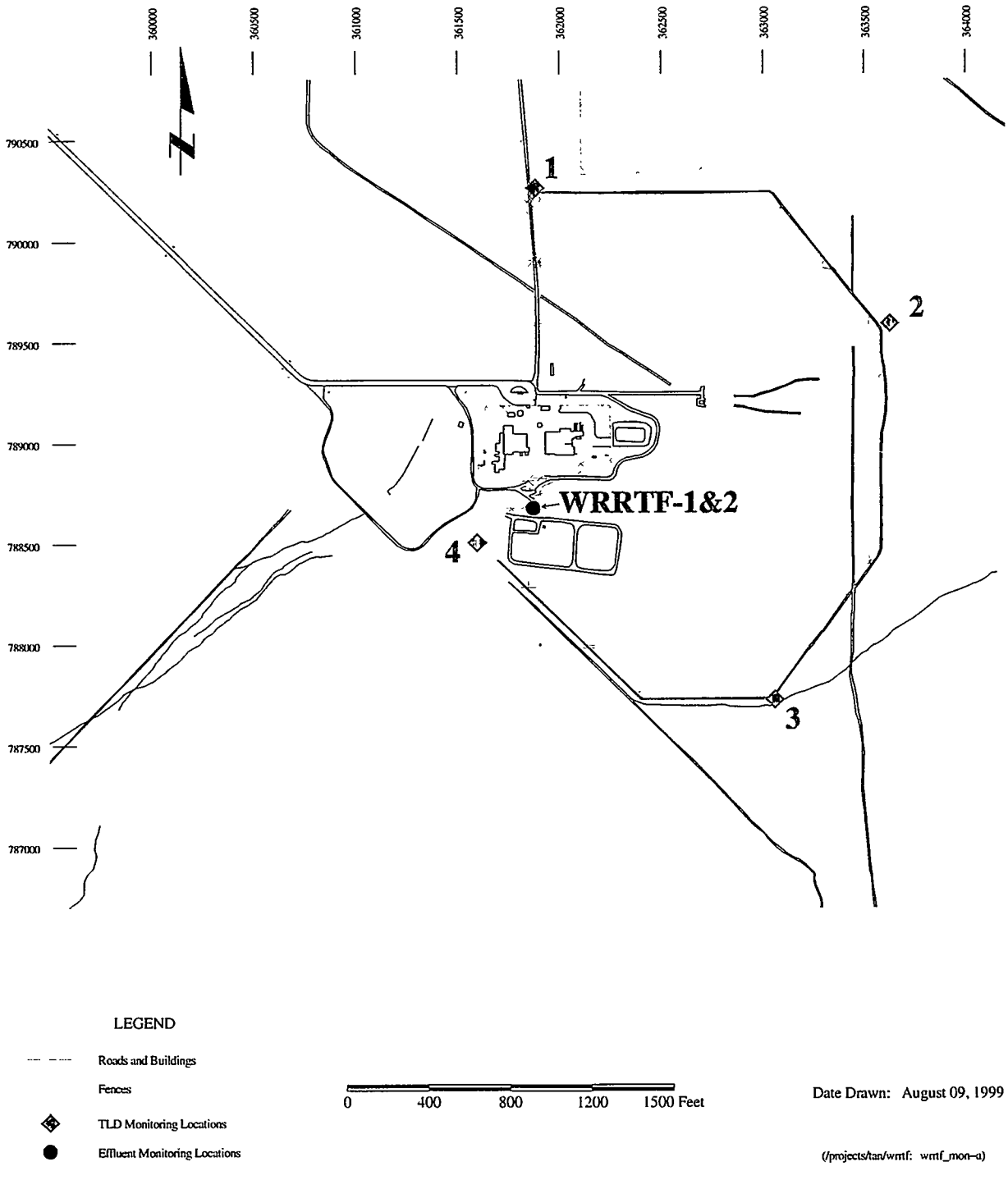

Figure A-16. Water Reactor Research Test Facility monitoring locations.

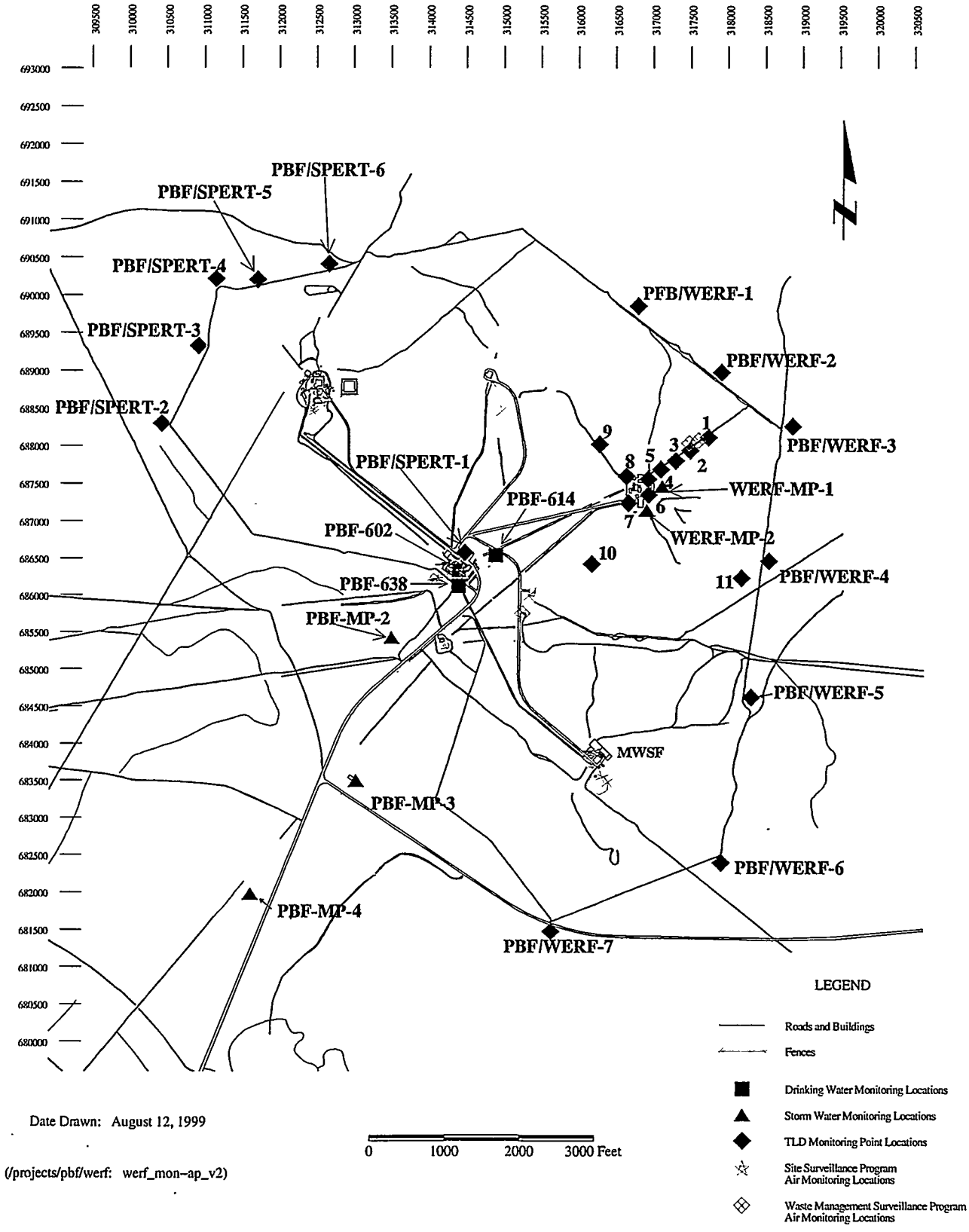

Figure A-17. Waste Experimental Reduction Facility monitoring locations.

Appendix B

Statistical Analyses Methods

Appendix B

Statistical Analyses Methods

B-1. INTRODUCTION

This appendix summarizes the statistical methods used to analyze programmatic data presented in this report.

B-2. LIQUID EFFLUENT MONITORING PROGRAM

B-2.1 Data Pretreatment and Validation

Liquid Effluent Monitoring Program data are validated following validation procedures to determine the quality of the analytical results. After the quality of the data is determined, program personnel assess the usability of the data. Data entry is also verified to prevent using inaccurate data results due to entry errors.

B-2.2 Control Charts

The control chart is a statistical tool used primarily to study a continuous process. For the Liquid Effluent Monitoring Program, the concentrations of analytes in the wastewater streams are the continuous processes of interest. While the concentrations of the analytes of interest for a specific stream are known to vary over time, plotting the values on a control chart can help assess the data for changes that might indicate a loss of process control or an unplanned release.

For each stream currently monitored, control charts are generated for each nonvolatile organic compound/nonradiological analyte with sufficient historical data to establish control limits. Available historical data from 1986 forward are used to generate the control limits. Current year data are charted with the control limits to assess possible changes from historical stream characteristics. Currently, control limits are not calculated for radionuclides or volatile organic compounds due to the number of measurements below the detection limit and the lack of historical data prior to 1992.

By using control charts, it is assumed that the process is in control. Therefore, historical data are screened to exclude outliers and data from known periods when the effluent process changed. With the exception of pH, the concern is for unusually high concentrations. The control charts for these parameters are generated with a center line (based on the average of the historical data) and two upper control limits. The Level 1 upper control limits are calculated such that there is less than a 5% chance of exceeding the limit due to random fluctuations in the analyte concentration. For the Level 2 upper control limit, there is less than a 1% chance of exceeding the limit due to random fluctuations. Unusually low or high concentrations are both concerns for pH. Therefore, the pH control charts are generated with a lower and upper control limit. These limits are calculated such that there is less than a 1% chance that a concentration will fall outside either limit due to random fluctuations in the pH for the effluent.

Current year concentrations that exceed the Level 2 control limit (or either the upper or lower limit for pH) fall outside what is expected based on historical stream characteristics, but do not necessarily indicate an adverse environmental consequence. Instances where monitoring data exceed the Level 2 control limit (or either limit for pH) are reviewed to determine if a significant change occurred in the effluent stream or to determine if there are possible adverse environmental consequences. In most cases,

no concern is identified. When the change is substantial and environmental or regulatory issues are identified, appropriate followup action is taken.

B-3. ENVIRONMENTAL SURVEILLANCES

B-3.1 Data Pretreatment

Before statistical analyses, data are screened to identify gross data errors, such as transcription errors, missing values, and out-of-range data points that do not meet other specific criteria, and to eliminate data from instruments that do not meet the minimum required operating characteristics as specified in the data quality objectives. After the initial screening, the data are screened for outliers. Graphical techniques, such as probability plots, stem and leaf plots, box plots, and other exploratory data analyses techniques, are the primary tools used for detecting potential data outliers. In cases where outliers are traceable to a specific error, a corrected value may be used to replace the outlier. If no correlation is possible, then the point may be deleted from the data set. However, outliers with unattributable causes are rarely eliminated from data sets. Such outliers may be truly accurate data measurements indicative of unusual but important phenomena. Typically, two sets of analyses are performed, one with and one without the outlying data, and the two results are compared.

B-3.2 Trend Analyses

To visually evaluate long-term trends, cumulative data are presented graphically. For waste management surveillance gross alpha and gross beta air data, concentration data for specific locations are plotted over the year of interest.

For thermoluminescent dosimeter (TLD) data, cumulative six-month exposure data from specific locations, with background data (or distant community), are plotted over time. All historical data are smoothed and plotted on a linear scale to reveal the trend over time.

B-3.3 Comparisons Between Groupings

B-3.3.1 Penetrating Radiation Data from TLDs

Differences in yearly TLD data, either seasonally or by facility location, are analyzed using the nonparametric Kruskal-Wallis test for differences in medians. Nonparametric analyses are performed because the data are not expected to follow a normal distribution. Changes among groups are considered to be statistically significant if the p-value, associated with the null hypothesis, is less than 0.05. The null hypothesis is that the different samples in the groupings were from the same distribution or from distributions with the same median.

The statistical significance of changes in median exposure values from the previous year to the current year is determined by facility. Facility groupings consist of background (or distant community) data, as well as individual waste management locations. Since the TLDs are changed every six months, the significance of the differences in the median seasonal exposure values (either spring or fall) is also of interest.

Box and whisker plots graphically display the differences in median values between groups (either by facility or season). For each grouping, the median value of all the data is shown on the box and whisker plots, along with a box indicating the 25–75 percentile range based on all the data. The whiskers on the plots indicate the (nonoutlier) minimum and maximum values within each grouping. For the box

and whisker plots, the word outlier defines those data values that are either greater than or less than 1.5 times the range of the box. This type of graph is used because it visually depicts differences in the medians of the groupings; therefore, the outliers are not shown since the scale required to show them would mask most of the visual differences in the median values. Even though the outliers are not shown on the box and whisker plots, they are included in the calculation of the median values.

B-3.3.2 Airborne (Gross Alpha and Gross Beta) Data

Differences in year-to-year median concentrations for facility groupings of airborne data are also analyzed using the Kruskal-Wallis test for differences in medians. Data from the current year are grouped by facility for each contaminant and monitor type (that is, gross alpha or gross beta and PM_{10} or SP monitor). Differences in groupings are also graphically displayed using the box and whisker plots discussed above.

Appendix C

Detection Limits

Appendix C
Detection Limits

ENVIRONMENTAL SURVEILLANCE PROGRAM GAMMA SPECTROMETRIC ANALYSES DETECTION LIMITS

Tables C-1 and C-2 give absolute detection limits in the right-hand column for each sample type. The absolute detection limits are the total activities that may be present in the sample aliquot taken for analyses. These activities should be detected under the counting conditions described and calculated according to the definition of L. A. Currie. This definition is as follows:

$$Detection\ limit = \frac{2.71 + 4.66\,B^{1/2}}{t \times E \times P \times 2.22}$$

where

B = Total correction in counts (Compton, background, blanks, etc., for the same counting time)

t = Counting time in minutes

E = Counting efficiency as a fraction

P = Gamma-ray emission probability for the particular gamma ray being measured

2.22 = dpm/pCi.

The figures in the left-hand column of each sample type give the same detection limits expressed in terms of pCi/unit weight or volume for the average sample sizes expected to be analyzed. The absolute detection limits must remain constant for a given counting time and efficiency; therefore, the detection limits in terms of concentrations become higher or lower as the sample size actually used in the analyses becomes smaller or larger. Tables C-3 and C-4 present descriptions of environmental monitoring samples for gamma spectrometry analyses and counting conditions for stated detection limits.

ENVIRONMENTAL SURVEILLANCE PROGRAM RADIOCHEMICAL ANALYSES DETECTION LIMITS

Tables C-1 and C-4 list approximate detection limits of present methods used to analyze the samples discussed in this report. These limits are based on sample sizes and forms as described in this report. Actual detection limits may vary depending upon background, yield, counting time, and sample volume.

The detection limits given in Table C-4 in terms of activity per unit weight or volume are derived from the total activities in microcuries (μCi) that must be present in the sample aliquot. The detection limits are calculated under the following conditions:

- A counting time of 1,000 minutes
- A counting efficiency of about 25%

- A chemical yield of about 80%
- Clean detector and reagent blanks that give not more than about 5 counts in 1,000 minutes in any given energy interval
- The calculation performed according to the definition of detection limits given by L. A. Currie as follows:

$$Detection\ limit = \frac{2.71 + 4.66\,B^{1/2}}{t \times E \times Y \times 2.22E + 6}\,\mu Ci$$

where

B	=	Total background and blank correction
t	=	Counting time in minutes
E	=	Counting efficiency as a fraction
Y	=	Chemical yield as a fraction
$2.22E+6$	=	dpm/μCi.

These absolute detection limits, in terms of total microcuries per sample, are approximately 3E-6 for Sr-90 and approximately 3E-8 for all alpha-emitting nuclides. To determine the detection limits as activity concentration, the absolute detection limits must be divided by the sample size taken for analyses. On samples, the activity found is divided by the actual sample size analyzed or reported in terms of total activity per sample.

Table C-1. Waste management surveillances of air, water, and soil samples for gamma spectrometry.

	Air Filters		Water Filtrate		Water Insoluble		Soils	
Radionuclides	E-9 pCi/mL	Total pCi	E-2 pCi/mL	Total pCi	E-4 pCi/mL	Total pCi	pCi/g	Total pCi
Sc-46	1	6	0.2	8	5	2	0.19	120
Cr-51	5	3	1.1	44	20	8	0.5	300
Mn-54	0.5	3	0.5	20	3	1.2	0.1	60
Co-58	0.5	3	0.09	3.6	4	1.6	0.1	60
Fe-59	0.9	5.4	1.5	60	7	2.8	0.11	60
Co-60	0.8	4.8	0.8	32	6	2.4	0.2	120
Zn-65	1	6	0.5	20	15	6	0.2	120
Nb-94	0.5	3	0.15	6	4	1.6	0.1	60
Nb-95	0.5	3	0.11	4.4	80	32	0.1	60
Zr-95	0.8	4.8	0.3	8	7	2.8	0.11	60
Ru-103	0.7	4.2	0.16	6.4	4	1.6	0.1	60
Ru-106	5	30	0.12	4.8	40	1.6	0.5	300
Ag-110m	0.5	3	0.15	6	5	20	0.1	60
Sb-124	0.5	3	0.13	5.2	5	2	0.1	60
Sb-125	1.5	9	0.3	12	15	6	0.2	120
Cs-134	0.6	3.6	0.09	3.6	4	1.6	0.1	60
Cs-137	0.8	4.8	0.3	12	20	8	0.1	60
Ce-141	0.9	5.4	0.3	12	6	2.4	0.1	60
Ce-144	5	30	1.0	40	20	8	0.4	240
Eu-152	2	12	0.5	20	15	6	0.2	120
Eu-154	2	12	0.3	12	15	6	0.3	180
Eu-155	2	12	0.8	32	10	4	0.3	180

Table C-1. (continued).

	Air Filters		Water Filtrate		Water Insoluble		Soils	
Radionuclides	E-9 pCi/mL	Total pCi	E-2 pCi/mL	Total pCi	E-4 pCi/mL	Total pCi	pCi/g	Total pCi
Hf-181	0.6	3.6	0.12	4.8	6	2.4	0.1	60
Ta-182	2	12	0.5	20	20	8	0.4	240
Hg-203	0.5	3	0.15	6	2	0.8	0.1	60
Am-241	4	24	1.5	60	40	16	1.2	700
Gross beta	9.5	NA	NA	NA	NA	NA	NA	NA
Gross alpha	3.3	NA	NA	NA	NA	NA	NA	NA

Table C-2. Waste management surveillance of biotic samples for gamma spectrometry.

	Small Mammals		Vegetation	
Radionuclide	pCi/g	Total pCi	pCi/g	Total pCi
Sc-46	0.2	12	0.07	12
Cr-51	1.4	84	0.4	67
Mn-54	0.18	11	0.05	8.4
Co-58	0.3	18	0.05	8.4
Fe-59	0.6	36	0.08	14
Co-60	1	60	0.1	17
Zn-65	0.7	42	0.13	22
Nb-94	0.2	12	0.05	8.4
Nb-95	0.2	12	0.04	6.7
Zr-95	0.3	18	0.07	12
Ru-103	0.2	120	0.04	6.7
Ru-106	2	12	0.5	84
Ag-110m	0.2	12	0.05	8.4
Sb-124	0.2	12	0.04	6.7
Sb-125	0.7	42	0.11	18
Cs-134	0.3	18	0.04	6.7
Cs-137	1.3	78	0.13	22
Ce-141	0.2	12	0.05	8.4
Ce-144	1.1	66	0.16	27
Eu-152	0.6	36	0.1	17
Eu-154	0.7	42	0.15	25
Eu-155	0.6	36	0.1	17
Hf-181	0.2	12	0.04	6.7
Ta-182	1.1	66	0.3	50
Hg-203	0.16	96	0.05	8.4
Am-241	2	120	0.3	50

Table C-3. Description of waste management surveillance samples for gamma spectrometry analyses.

Media	Sample Description	Counting Conditions
Air	Sampled at approximately 4 cfm for 2 weeks on 4-in. Versapor 1200 membrane filters for a total of 3×10^9 cc per filter	Monthly composite samples of two 4-in. filters containing a total of about 6×10^9cc of air are held flat over the detector and counted for 12 to 16 hours depending on the detector system used.
Water	4-L collapsible polyethylene container containing 25 mL of conc. HNO_3 for 4,000 mL of water	The sample is shaken vigorously to dislodge all material from the sides and bottom of the container and filter. The filtrate is transferred to a 4-L Marinelli beaker and counted for 16 hours. The filter is also counted for 16 hours in contact with detector. Sample size 4,000 mL.
Soil	16-oz squat jar filled to the bead below the threads after settling	The sample is counted in the squat jar for 2 hours with the jar being rotated as close to the detector as possible. Sample size approximately 700 g.
Vegetation	16-oz squat jar filled to the bead below the threads after settling	The dry sample is counted in the squat jar for 16 hours with the jar being rotated as close to the detector as possible. Sample size about 150 g, average.

Table C-4. Waste management surveillance samples for radiochemical analyses.

Media	Sample Description	Method of Treatment	Detection Limits (μCi/g or mL)	
Air	Sampled approximately at 4 cfm for 2 weeks on Versapor 1,200 filters, 6 filters per quarter for a total of ~1.7E+10 cc of air.	Dry ash, dissolve and analyze the total sample of 6 filters.	Sr-90 Pu-238 Pu-239 Am-241	3.5 E-17 2 E-18 2 E-18 2 E-18
Water	4-L collapsible polyethylene container containing 25 mL of conc. HNO_3 for 4,000 mL water.	Separate and dissolve paper pulp, reconstitute sample, and boil down to 100 mL. Analyze ½ sample or 2-L equivalent.	Sr-90 Pu-238 Pu-239 Am-241	3 E-10 2 E-11 2 E-11 2 E-11
Soil	At least 25 g in appropriate container. Larger quantities are permissible if convenient.	Analyze 10-g sample.	Sr-90 Pu-238 Pu-239 Am-241	6 E-8 3 E-9 3 E-9 3 E-9
Vegetation	16-oz squat jar filled to rim below threads (avg wt 150 g).	Dry ash and dissolve the total sample completely. Analyze the equivalent of 50 g of original sample.	Sr-90 Pu-238 Pu-239 Am-241	1.2 E-8 6 E-10 6 E-10 6 E-10
Animal tissue	16-oz squat jar containing 10 dried deer mice, or 1 dried ground squirrel (avg wts: mice, 170 g; squirrel, 100 g).	Dry ash, dissolve, and analyze the equivalent of 50 g of the original sample.	Sr-90 Pu-238 Pu-239 Am-241	1.2 E-8 6 E-10 6 E-10 6 E-10

Appendix D

Environmental Standards

Appendix D
Environmental Standards

ENVIRONMENTAL SURVEILLANCE PROGRAM

Radionuclide concentrations in air and runoff samples are compared with Derived Concentration Guide (DCG) values for air and water.[1] The DCG values listed are provided as reference values for conducting radiological protection programs at operational DOE facilities and sites.

Table D-1 lists applicable DCGs. The DCGs represent the concentrations of radioactivity in air inhaled or water ingested continuously during a year that resulted in a 100-mrem, 50-year committed effective dose equivalent. The DCGs are used as a point of reference only. Comparing individual measurements to the DCGs gives the maximum dose a person could receive at the location where the sample was collected, given the following two assumptions: (1) the concentration was at the DCG level continuously for the entire year, and (2) the person receiving the exposure was at that location for the entire year, continually drinking the water or inhaling the air. In practice, DCGs are rarely, if ever, exceeded for even a short period during the year. In addition, the radionuclide concentration at any area accessible to the public will be even less due to the dispersion from the facility boundary (where the sample was collected) to the site boundary (the closest location where the public has unrestricted access).[2] DOE Order 5400.5[1] contains the principle standards and guides for release of radionuclides at the INEEL. Table D-2 shows the DOE and EPA standard. Table D-3 shows the ambient air quality standards.

Table D-4 lists environmental concentration guidelines for the radionuclides in soil that are most likely to be found in environmental samples. The concentration guides in Table D-4 are based on a homestead scenario. This scenario considers the radiation dose to the homesteader from inhaling and ingesting radionuclides, as well as external radiation. Since the hypothetical homesteader is assumed to live on a uniformly contaminated area that is large enough for subsistence farming, this scenario results in very conservative concentration guides. The homestead scenario overestimates the actual doses that would be received by off-homestead individuals from radionuclides in soil.

WATER

The following environmental regulations apply to the Drinking Water Program:

- Federal Safe Drinking Water Act[3]
- Code of Federal Regulations (40 CFR Parts 141-143)[4, 5, 6]
- Idaho Regulations for Public Drinking Water Systems, IDAPA 16.01.08000-.08999[7]
- DOE Order 5400.5[8]
- *Environmental Compliance Planning Manual.*[9]

Table D-5 lists the parameters monitored, regulated, and reported.

The City of Idaho Falls developed an Industrial Pretreatment Program in accordance with 40 CFR 403 and the Clean Water Act. Industrial Wastewater Acceptance Forms issued by the City authorize discharges to the City of Idaho Falls sewer system in compliance with Chapter 1, Section 8, of the City of

Idaho Falls Sewer Ordinance. Table D-6 lists the 1998 concentration limits for discharges to the City of Idaho Falls sewer.

Table D-7 lists the EPA benchmarks used as voluntary comparison criteria for the Storm Water Monitoring Program data. The EPA benchmark concentrations are from the 1995 Storm Water Multi-Sector General Permit in the *Federal Register*.[10]

Table D-1. Derived Concentration Guides.

Radionuclide	DCGs for the Public[a,b] DCG for Air (μCi/mL)	DCG for Water (μCi/mL)
H-3	1 E-7	2 E-3
Sc-46	6 E-10	2 E-5
Cr-51	5 E-8	1 E-3
Mn-54	2 E-9	5 E-5
Co-58	2 E-9	4 E-5
Fe-59	8 E-10	2 E-5
Co-60	8 E-11	5 E-6
Zn-65	6 E-10	9 E-6
Sr-90[c]	9 E-12	1 E-6
Nb-95	3 E-9	6 E-5
Zr-95	6 E-10	4 E-5
Ru-103	2 E-9	5 E-5
Ru-106	3 E-11	6 E-6
Ag-110m	2 E-10	1 E-5
Sb-125	1 E-9	5 E-5
I-129	7 E-11	5 E-7
I-131	4 E-10	3 E-6
Cs-134	2 E-10	2 E-6
Cs-137	4 E-10	3 E-6
Ce-141	1 E-9	5 E-5
Ce-144	3 E-11	7 E-6
Eu-152	5 E-11	2 E-5
Eu-154	5 E-11	2 E-5
Ra-226	1 E-12	1 E-7
Pu-238	3 E-14	4 E-8
Pu-239[c]	2 E-14	3 E-8
Am-241	2 E-14	3 E-8
U-235	1 E-13	6 E-7
U-238	1 E-13	6 E-7
Gross alpha	2 E-14[c]	—
Gross beta	9 E-12[c]	—

a. This table contains the air and water DCGs based on concentrations that could be continuously inhaled or ingested, respectively, and do not exceed an effective dose equivalent of 100 mrem/yr.

b. DCGs apply to radionuclide concentrations in excess of those occurring naturally or due to fallout.

c. The DCGs of Pu-239 and Sr-90 are the most restrictive for alpha- and beta-emitting nuclides, respectively, and are appropriate to use for gross alpha and gross beta DCGs.

Table D-2. Radiation standards for protection of the public at the INEEL.

	Effective Dose Equivalent	
	mrem/yr	mSv/yr
DOE standard for routine DOE activities[a] (all pathways)	100	1
EPA standard for site operations (airborne pathway only)	10	0.1

a. The effective dose equivalent for any member of the public from all routine DOE operations including remedial activities and release of naturally-occurring radionuclides shall not exceed this value. Routine operations refers to normal, planned operations and does not include accidental or unplanned releases.

Table D-3. Environmental Protection Agency ambient air quality standards.

Pollutant	Type of Standard[a,b]	Sampling Period	EPA ($\mu g/m^3$)[c]
SO_2	S	3-hour average	1,300
	P	24-hour average	365
	P	Annual average	80
NO_X	S&P	Annual average	100
	S	24-hour average	150
Total particulates	S&P	Annual average	50

a. National primary (P) ambient air quality standards define levels of air quality to protect the public health. Secondary (S) ambient air quality standards define levels of air quality to protect the public welfare from any known or anticipated adverse effects of a pollutant.

b. The primary and secondary standard to the annual average applies only to "particulates with an aerodynamic diameter less than or equal to a nominal 10 micrometers."

c. The State of Idaho has adopted these same ambient air quality standards.

Table D-4. Environmental concentration guidelines for common radionuclides found in environmental soil samples.

Radionuclide	Environmental Concentration Guides for Soil[a] (μCi/g)
Mn-54	4 E-6
Co-58	4 E-6
Co-60	1 E-6
Ru-106	2 E-5
Sb-125	8 E-6
Cs-134	2 E-6
Cs-137	6 E-6
Ce-144	6 E-5
Eu-152	3 E-6
Am-241	4 E-5
Sr-90	6 E-6
U-232	2 E-6
U-233	2 E-4
U-234	2 E-4
U-235	2 E-5
U-238	1 E-4
Pu-238	8 E-5
Pu-239, -240	8 E-5

a. See Reference 2. Concentrations correspond to a 50-yr dose commitment of 100 mrem/yr to a homesteader beginning in the first year after release from facility. This concentration assumes uniform contamination of an area adequate for subsistence farming.

Table D-5. Parameters and maximum contaminant levels.[a]

Parameter	Maximum Contaminant Level
REGULATED VOCS	
Benzene	0.005 mg/L
Vinyl chloride	0.002 mg/L
Carbon tetrachloride	0.005 mg/L
1,2-dichloroethane	0.005 mg/L
Trichloroethylene	0.005 mg/L
1,1-dichloroethylene	0.007 mg/L
1,2,4-trichlorobenzene	0.07 mg/L
1,1,1-trichloroethane	0.200 mg/L
1,1,2-trichloroethane	0.005 mg/L
Para-dichlorobenzene	0.075 mg/L
Cis-1,2-dichloroethylene	0.07 mg/L
1,2-dichlorpropane	0.005 mg/L
Dichloromethane	0.005 mg/L
Ethylbenzene	0.7 mg/L
Chlorobenzene	0.1 mg/L
o-dichlorobenzene	0.6 mg/L
Styrene	0.1 mg/L
Tetrachloroethylene	0.005 mg/L
Toluene	1.0 mg/L
Trans-1,2-dichloroethylene	0.1 mg/L
Xylenes (total)	10.0 mg/L
MICROBIOLOGICAL	
Total coliform	If less than 40 samples per month collected, no more than 1 positive
INORGANIC	
Asbestos	7 million fibers per liter (>10 μm)
Fluoride	4 mg/L
Cadmium	0.005 mg/L
Chromium	0.1 mg/L
Mercury	0.002 mg/L
Selenium	0.05 mg/L

Table D-5. (continued).

Parameter	Maximum Contaminant Level
Arsenic	0.05 mg/L
Barium	2 mg/L
Lead	0.015 mg/L
Nitrate	10 mg/L (as nitrogen)
Nitrite	1 mg/L (as nitrogen)
Copper	1.3 mg/L
Antimony	0.006 mg/L
Beryllium	0.004 mg/L
Nickle	0.1 mg/L
Thallium	0.002 mg/L
Cyanide	0.2 mg/L
ORGANICS	
Alachor	0.002 mg/L
Atrazine	0.003 mg/L
Carbofuran	0.04 mg/L
Chlordane	0.002 mg/L
Dibromochloropropane (DBCP)	0.0002 mg/L
2,4-D	0.07 mg/L
Ethylene dibromide (EDB)	0.00005 mg/L
Heptachlor	0.0004 mg/L
Heptachlor epoxide	0.0002 mg/L
Lindane	0.0002 mg/L
Methoxychlor	0.04 mg/L
Polychlorinated biphenyls (PCBs)	0.0005 mg/L
Toxaphene	0.003 mg/L
2,4,5-TP (silvex)	0.05 mg/L
Pentachlorophenol	0.001 mg/L
Aldicarb	0.003 mg/L
Aldicarb sulfone	0.002 mg/L
Aldicarb sulfoxide	0.004 mg/L
Dalapon	0.2 mg/L
Dinoseb	0.007 mg/L
Diquat	0.02 mg/L

Table D-5. (continued).

Parameter	Maximum Contaminant Level
Endothall	0.1 mg/L
Endrin	0.002 mg/L
Glyphosate	0.7 mg/L
Oxamyl (vydate)	0.2 mg/L
Picloram	0.5 mg/L
Simazine	0.004 mg/L
Benzo(a)pyrene, (PAH)	0.0002 mg/L
Di(2-ethylhexyl), (adipate)	0.4 mg/L
Di(2-ethylhexyl), (phthalate)	0.006 mg/L
Hexachlorobenzene	0.001 mg/L
Hexachlorocyclo-pentadience (HEX)	0.05 mg/L
2,3,7,8-TCDD (dioxin)	0.00000003 mg/L
RADIONUCLIDES	
Radium-226/228	5 pCi/L
Gross alpha particle activity (including radium-226, but excluding radon and uranium)	15 pCi/L
Beta particle/photon radioactivity	Shall not produce annual dose equivalent to the total body or internal organ greater than 4 millirem/year
Tritium	20,000 pCi/L
Strontium-90	8 pCi/L
DISINFECTION BY-PRODUCTS	
Total trihalomethanes (the sum of the concentrations of bromodichloromethane, dibromochloromethane, tribomomethane [bromoform] and trichloromethane [chloroform])	0.10 mg/L
SECONDARY DRINKING WATER STANDARDS	
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 color units mg/L
Copper	1.0 mg/L
Corrosivity	Noncorrosive
Fluoride	2.0 mg/L

Table D-5. (continued).

Parameter	Maximum Contaminant Level
Foaming agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5–8.5 mg/L
Silver	0.1 mg/L
Sulfate	250 mg/L
Total dissolved solids (TDS)	500 mg/L
Zinc	5 mg/L

a. 40 CFR 141.24, "Organic Chemicals Other Than Total Trihalomethanes, Sampling and Analytical Requirements," July 31, 1997.

Table D-6. City of Idaho Falls Sewer Code effluent concentration limits for 1998.

Parameter	Sewer Limit (mg/L)
pH	5.5–9.0
Arsenic	0.07
Cadmium	0.69
Chromium, total	2.77
Copper	3.38
Cyanide	1.20
Lead	0.62
Mercury	0.25
Methylene chloride	0.1
Phenol	0.5
Nickel	3.98
Silver	0.45
Tetrachloroethylene	0.099
Total heavy metals	5
Oil and grease (petroleum or mineral oil products)	100
Oil and grease (animal and vegetable based)	250
Trichloroethylene	0.099
Zinc	2.61
Stoddard solvent	0.099

Table D-7. EPA benchmark concentrations for storm water monitoring parameters.[a]

Chemical	NPDES Benchmark (mg/L)
Aluminum	0.75
Antimony	0.636
Arsenic	0.168
Beryllium	0.13
Cadmium	0.0159
Copper	0.0636
Iron	1.0
Lead	0.0816
Nickel	1.417
Selenium	0.2385
Silver	0.0318
Zinc	0.117
Mercury	0.0024
Solids, total suspended	100
Nitrogen, nitrate + nitrate	0.68
Phosphorous, total	2
Oil and grease, total	15
Oxygen demand, biochemical	30
Oxygen demand, chemical	120
Hydrogen ion (pH)	6.0 to 9.0

a. Benchmark concentrations, are from 1995 NPDES Storm Water Multi-Sector General Permit, *Federal Register*, Vol 60, #189, p. 50826, Sept. 29, 1995.[10]

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1. DOE Order 5400.5, "Radiation Protection of the Public and the Environment," U.S. Department of Energy, February 8, 1990.

2. EG&G Idaho, Inc., *Development of Criteria for Release of Idaho National Engineering Laboratory Sites Following Decontamination and Decommissioning*, EGG-2400, August 1986.

3. Public Law 99-339, *Safe Drinking Water Act Amendments of 1986*, June 19, 1986.

4. 40 CFR 141, "National Primary Drinking Water Standards," *Code of Federal Regulations*, Office of the Federal Register, June 18, 1996.

5. 40 CFR 142, "National Primary Drinking Water Regulations Implementation," *Code of Federal Regulations*, Office of the Federal Register, June 18, 1996.

6. 40 CFA 143, "National Secondary Drinking Water Regulations," *Code of Federal Regulations*, Office of the Federal Register, June 18, 1996.

7. IDAPA 16.01.08000-.08999, Idaho Regulations for Public Drinking Water Systems, December 5, 1992.

8. DOE Order 5400.5, Change 2, "Radiation Protection of the Public and the Environment," U.S. Department of Energy, January 7, 1993.

9. U.S. Department of Energy Idaho Operations Office, *Environmental Compliance Planning Manual*, May 1995.

10. 60 FR 189, "Final National Pollutant Discharge Elimination System Storm Water Multi-Sector General Permit for Industrial Activities," *Federal Register*, U.S. Environmental Protection Agency, September 1995, p. 50804.