WAG 3
NO ACTION
DOCUMENTATION PACKAGE

SOLID WASTE MANAGEMENT UNIT
CPP-43
Grease pit south of CPP-637

WAG 3 ENVIRONMENTAL RESTORATION PROJECT

INEL

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CPP-43
Grease Pit South of CPP-637

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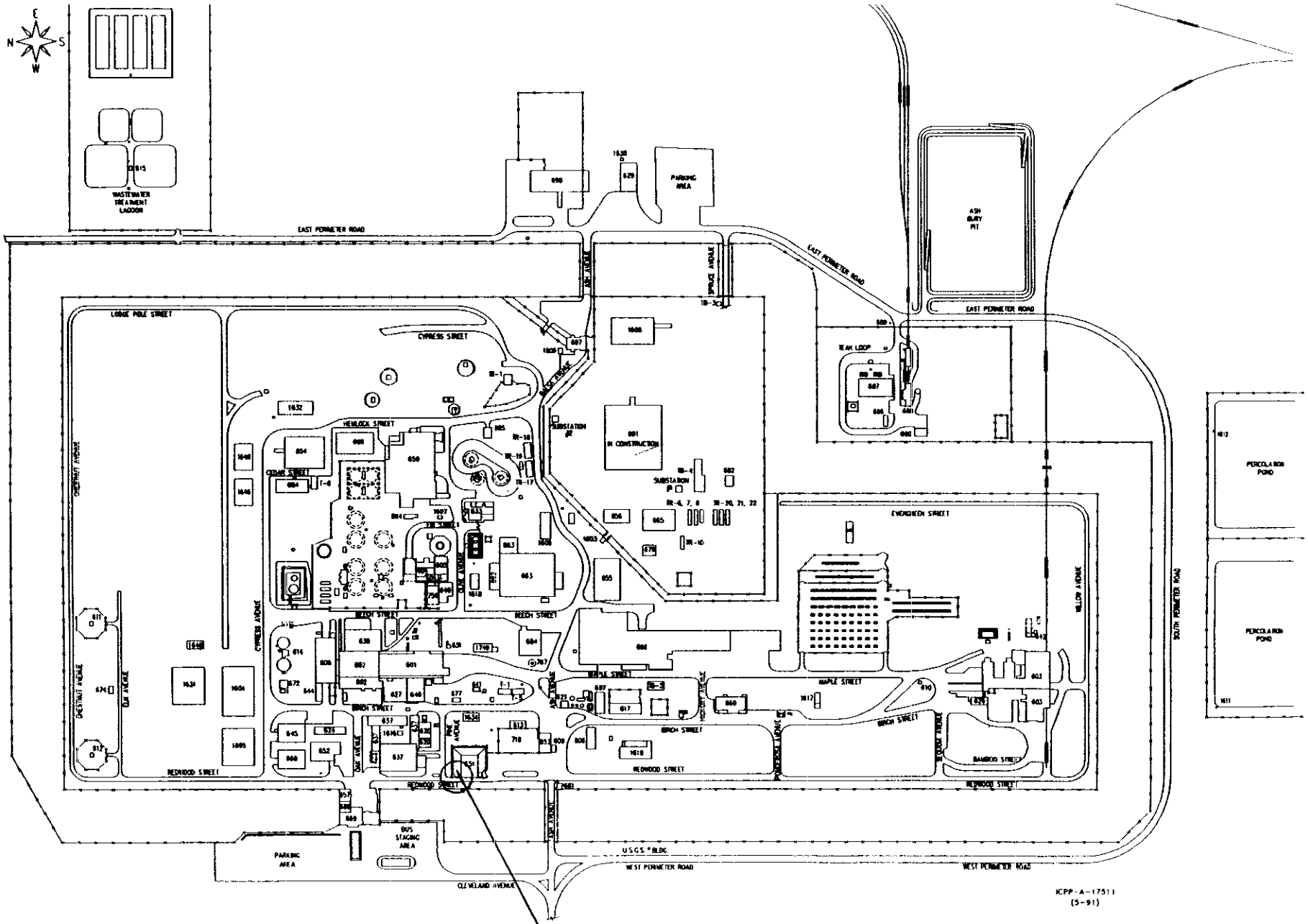

43. Grease pit south of CPP–637

SITE DESCRIPTION

CPP-43 grease pit, was located south of CPP-637, at the present location of CPP-651. The grease pit was used for the disposal of an unknown quantity of oil and grease. The grease pit was filled in when the unirradiated fuel storage building upgrade (CPP-651) was completed in 1975.

SITE CHRONOLOGY

No Action Unit
CPP-43
Grease Pit South of CPP-637

May 1986	The Grease Pit South of CPP-637 was first identified in the Installation Assessessment Report.
October 1986	The unit was scored using the Hazard Ranking System.
April 28, 1987	The unit was summary assessed and submitted with other ICPP Summary Assessments to DOE-ID.
January 5, 1988	The EPA requested more information.
March 31, 1988	Revised Summary Assessments were submitted.
October 16, 1989	EPA again requested additional information about CPP-43.
January 12, 1990	WINCO responded to EPA's request.

NOTE

The final decision to delete this unit from the list of Solid Waste Management Units was never received from EPA. However this document presents all available information for making a decision on this unit.

EXHIBIT 1

INSTALLATION ASSESSMENT REPORT

Idaho Chemical Processing Plant

May 1986

Westinghouse Idaho Nuclear Company

Prepared for the
U.S. Department of Energy
Idaho Operations Office

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1.0 EXECUTIVE SUMMARY

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)[1] provides for the cleanup of inactive hazardous waste disposal sites. The Department of Energy (DOE) issued Order 5480.14, Comprehensive Environmental Response, Compensation and Liability Act Program[2] to provide instructions for implementing the DOE CERCLA program. The first phase of the program requires that a review be conducted to determine the releases that have occurred in the past at each DOE installation. This document is the Installation Assessment for the Idaho Chemical Processing Plant (ICPP) located at the Idaho National Engineering Laboratory (INEL).

1.1 Installation Description

The ICPP is located in southeastern Idaho in the south central portion of the INEL. The ICPP comprises a fenced area of over 100 acres. The primary mission of the ICPP, which began operations in 1953, has been for reprocessing of nuclear fuel, recovery of uranium and krypton, and management of the generated waste. The ICPP is operated for the DOE by Westinghouse Idaho Nuclear Company (WINCO).

1.2 Environmental Setting

Characteristics of the ICPP which impact any potential environmental damage from activities at the ICPP are:

- The ICPP is located in a relatively sparsely populated area. No one resides permanently at the ICPP. No populated area exists within about a 10-mile radius of the ICPP. The nearest permanent residents are in Atomic City (population about 35) which is located to the southeast of the ICPP. The Central Facilities area (CFA) is located 4 miles southwest of the ICPP.

- The average precipitation at the ICPP is 9.1 in. of water. The average annual evaporation rate is about 36 in. The maximum observed 24-hour precipitation amounts are less than 2 inches.

- The surface water from the ICPP area does not leave the INEL. The predominant surface water stream, the Big Lost River which is located north of the ICPP, flows through the INEL until it evaporates or sinks into the ground.

- The Snake River Plain Aquifer is a large body of water located beneath the INEL. The depth to the top of the aquifer at the ICPP is about 450 feet.

- The surface soil surrounding the ICPP consists of alluvial sands and gravels of varying thicknesses near the Big Lost River and windblown deposits elsewhere. Underlying the surface are basalt layers of various thicknesses interbedded with unconsolidated materials.

- No endangered species reside within the ICPP, although the bald eagle and peregrine falcon have been observed on the INEL.

1.3 Methodology for Preparation of Installation Assessment

Information necessary for the compilation of this document was obtained from interviews conducted with personnel familiar with past waste disposal practices, Unusual Occurrence Reports, Significant Operating Occurrence Reports, and Radiation Incident Reports. A computerized data base prepared previously from logbook entries and incident reports also was examined.

1.4 Findings and Conclusions

Based on the sources in Section 1.3 ICPP sites of known releases of hazardous, radioactive, and radioactive/hazardous (mixed) wastes were identified. These sites consisted of operational waste release sites as

well as sites where accidental releases had occurred. The description of the sites is in Section 5. ICPP sites identified as potentially capable of resulting in further environmental damage were rated using the modified Hazardous Ranking System (mHRS).[3] This system is applicable to radioactive, hazardous and mixed wastes and considers such factors as site characteristics, waste characteristics, waste migration, and containment of the waste. The details of the ratings are presented in Appendix D and a summary of the results is shown in Table 1-1. No ICPP sites were found to pose an immediate threat to the environment.

1.5 Recommendations

Characterization studies will be required. These characterizations will consist of subsurface drilling, obtaining samples, and analyzing for chemical and radioactive contaminants. Closure plans and remedial action plans will further identify the work required at each individual site. Continued monitoring may be required in some areas, and surface soil sampling should be expanded.

TABLE 1.1

Ranking of Disposal Units

	Disposal Unit	Numerical Ranking
1.	ICPP Injection Well	34
2.	Tank Farm Contaminated Soil (South of WM-183) - 9/75	18
3.	PCB Transformer Yard (CPP-705)	13
4.	PCB Transformer Yard (CPP-731)	13
5.	PCB Staging Area	13
6.	Paint and Paint Solvent Area (South of CPP-697)	13
7.	Mercury Contaminated Soil (South of T-15)	13
8.	Pilot Plant Tank Release (CPP-637 courtyard)	13
9.	Contaminated Soil - 10/74 by WM-181	13
10.	Contaminated Soil by CPP-604 - 4/74	13
11.	Contaminated Soil Northwest and Southwest of Valve Box B-4	13
12.	Included in Unit 11	-
13.	Contaminated Soil by WL-102 Northeast of CPP-604	13
14.	Contaminated Soil Burial by Northeast Corner of ICPP	11
15.	Asbestos	12
16.	WCF French Drain	11
17.	Leak in Line from WCF to WL-102	11
18.	Kerosene Release	9
19.	CPP-637 Storage Area	9
20.	CPP-608 Grease Pit	9
*21.	CPP-651 Grease Pit	-
22.	PEW Evaporator Overheads	9
23.	Drum Storage Area by CPP-660	8
24.	HF Acid Storage Tank (YDB-105)	8
25.	Limestone Pit by CPP-601 Berm	7
26.	CPP-637 Drainage Ditch	7
27.	HNO_3 Leakage (by CPP-734)	7
28.	Gravel Pits	7
29.	CPP-621 Chemical Storage	7
30.	Peach Bottom Contaminated Soil	7
31.	CPP-603-604 Transport Line Leak-3/78	4
32.	CPP-603 Lay-down Area (Temporary Storage Area)	4
33.	CPP-603 Vault and Drywell	4
34.	Trench by CPP-603	4
35.	WM-181 Transfer Line to Evaporator-1/76	2
36.	Sewage Drain Tiles and Outfall Line	1
37.	Soil - NE Corner of South Basin (CPP-603)	1
38.	Basin Filter System Line Failure (CPP-603)	1

* The grease pit is under CPP-651. No further action.

2.0 INTRODUCTION

2.1 Background

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) was passed by Congress in 1980.[1] This act provided for, among other things, the cleanup of inactive hazardous waste disposal sites. In April 1985, the Department of Energy (DOE) issued Order 5480.14, Comprehensive Environmental Response, Compensation, and Liability Act Program.[2] This order provides instructions for implementing the DOE CERCLA Program. The order provides for five separate phases of activities to be accomplished within ten years of the date of the order. The phases include:

	Phase I:	Installation Assessment
	Phase II:	Confirmation
	Phase III:	Engineering Assessment
	Phase IV:	Remedial Actions
and	Phase V:	Compliance and Verification

This document fulfills the requirements of Phase I of DOE Order 5480.14 and is the Installation Assessment report for the Idaho Chemical Processing Plant (ICPP) at the Idaho National Engineering Laboratory (INEL). It describes the ICPP and the surrounding environment and discusses present and past waste management practices at the ICPP. It identifies and describes past releases to the environment at the ICPP and characterizes them based on available records and interviews with past and present employees. Where appropriate, the modified Hazard Ranking System (mHRS)[3] has been used to rank the releases. Recommendations regarding the need for treatment of each ranked site are given in Section 7.

2.2 Authority

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980, commonly known as "superfund" or "CERCLA" was passed by

Congress and signed into law on December 11, 1980.[1] The law has been amended three times by Public Law 97-216 (July 18, 1982), Public Law 97-272 (September 30, 1982), and Public Law 98-45 (July 12, 1983). On April 26, 1985, the Department of Energy issued DOE Order 5480.14, "Comprehensive Environmental Response, Compensation, and Liability Act Program".[2] This order provides instructions for implementing a DOE CERCLA program. This program requires a five-phase program beginning with an Installation Assessment to be completed within one year of the Order. It also requires a CERCLA site list. Westinghouse Idaho Nuclear Company, Inc. (WINCO), as operating contractor for the ICPP, has prepared this Installation Assessment Report in compliance with DOE Order 5480.14.

2.3 Purpose

The purpose of this document is to identify and assess releases of contaminants to the environment at the ICPP. All known major environmental releases are described, and those which are the most significant are ranked using the modified Hazard Ranking System.[3]

2.4 Scope

This document pertains only to releases within the ICPP. Sites outside the ICPP fenced boundary are covered in similar documents prepared by other INEL contractors. This document describes the ICPP activities, waste disposal practices, environment, and releases to the environment. It ranks the environmental releases where appropriate to determine which releases require attention first.

2.5 Methodology for Preparation of Installation Assessment

Determining releases from a plant that has operated for over thirty years is obviously not an easy task. Significant changes in processes, practices, personnel, regulations, and reporting procedures have occurred over this time period. In general, past records were obtained and re-

viewed, and present and past operating personnel were interviewed. Records were not always available or as complete as desired; however, log books, significant operating occurrence reports, Unusual Occurrence Reports, investigation reports, letters, safety analysis reports, environmental impact reports, miscellaneous studies, and radioactive incident reports (beginning in 1953) provided valuable information. A review of past ICPP records was completed to identify problems which had been experienced at the ICPP.[4,5] These data were placed in a computer data base for ready access. The data base included shift supervisor logbooks (1965-1981), HP logbooks (1980-1981). Significant Operating Occurrence Reports and Unusual Operating Occurrence Reports (1972-1982), Maintenance Job Requests (1978-1981), Monthly Reports (1965-1981), and Run Reports (1965-1981).

The record review, originally completed as part of the justification for the ICPP Fuel Processing Restoration Project, consisted of logging each unusual operating occurrence. This computer data base current as of January 1, 1982, was reviewed for identification of any events resulting in discharge of wastes to the environment.

Interviews with personnel also provided information not otherwise available. Based on these sources, and based on past and present operations, a list of sites of releases of radioactive, hazardous, and radioactive/hazardous (mixed) wastes sites was prepared. Specific site data from all available sources were summarized, and each site was evaluated based on the modified Hazard Ranking System (mHRS)[3] for radioactive sites or sites containing both radioactivity and chemical hazards and the Hazard Ranking System for nonradioactive sites. The Hazard Ranking System[6] (HRS) is used to evaluate hazardous waste sites that fall within the jurisdiction of CERCLA. It is described in 40 CFR 300 (Appendix A) and evaluates the hazard of a site by applying a score based on the potential for a pollutant to reach the environment by groundwater, surface water, air, fire, explosion, or direct contact. The number of people involved, uses of water, stability of the pollutant, and other factors are considered in scoring the site.

3.0 INEL AND ICPP DESCRIPTION

3.1 INEL Description

The Idaho National Engineering Laboratory (INEL), formerly the National Reactor Testing Station (NRTS), was established in 1949 by the U.S. Atomic Energy Commission (AEC) as an area to build, test, and operate various nuclear reactors, fuel processing plants, and support facilities with maximum safety and isolation. In 1974, the NRTS was redesignated as the INEL to reflect the broad scope of engineering activities conducted at the site.

The U.S. Government used portions of the Site prior to its being established as the NRTS. During World War II, the U.S. Navy used about 270 square miles of the Site as a gunnery range. An area southwest of the naval area was once used by the U.S. Army Air Corps as an aerial gunnery range. The present INEL Site includes all of the former military area and a large adjacent area withdrawn from the public domain for use by the Department of Energy (DOE). The former Navy administration shop, warehouse, and housing area is today the Central Facilities Area (CFA) of the INEL.

The INEL Site covers approximately 890 square miles of sagebrush and basalt-covered land of the Snake River Plain in southeastern Idaho (see Figure 3.1). The nearest INEL boundary is 29 miles west of Idaho Falls, 32 miles northwest of Blackfoot, 50 miles northwest of Pocatello, and 7 miles east of Arco. The site encompasses portions of five Idaho counties: Butte, Jefferson, Bonneville, Clark, and Bingham. Figure 3.2 provides a vicinity map of the INEL.

There are no permanent residents within the INEL; the nearest populated area is Atomic City (about 35 residents), located less than one mile from the southern boundary. Figure 3.3 shows the population distribution within a 50 mile radius around the INEL, with the radii centered

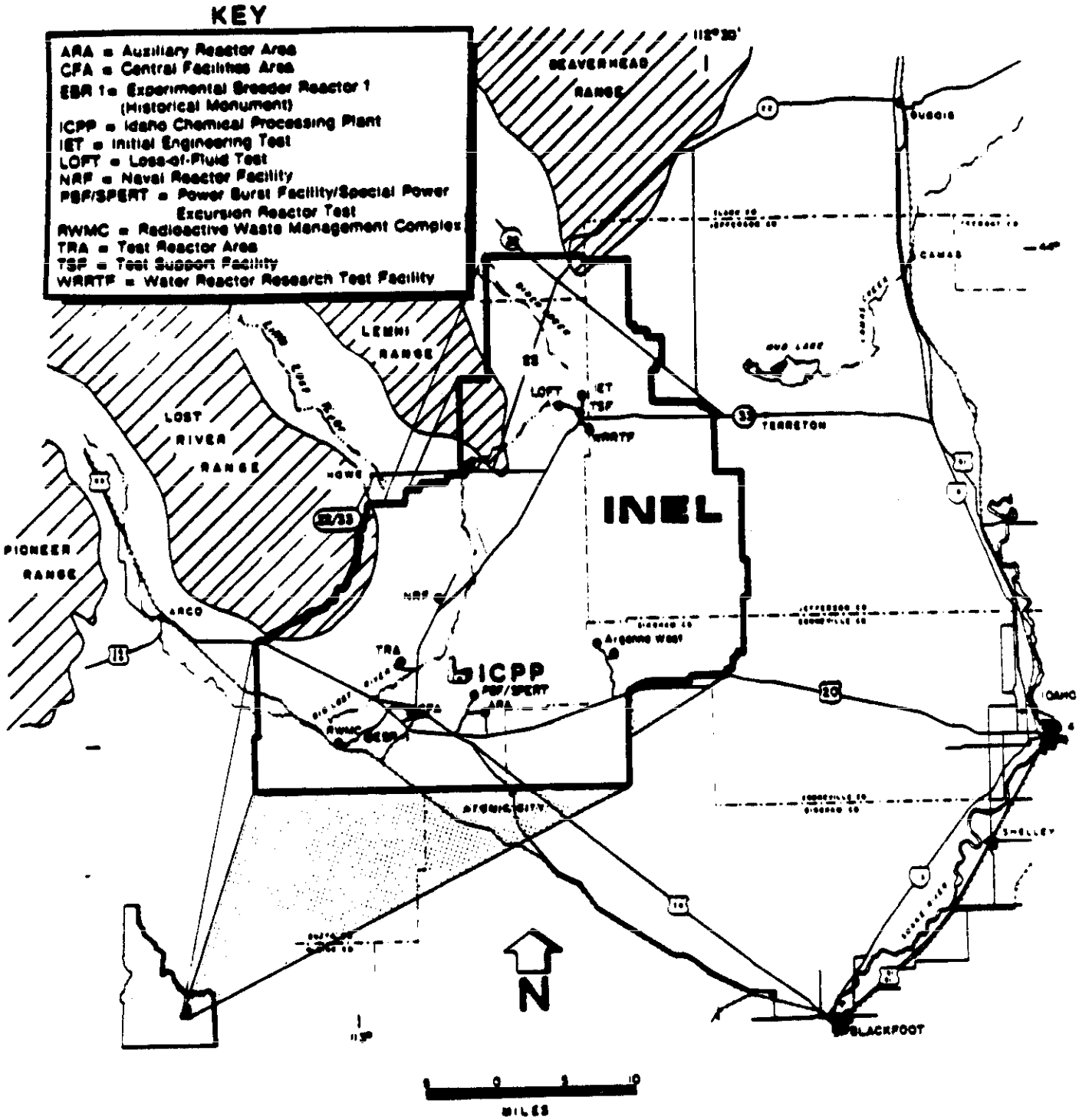

Figure 3-1. Location Map of the INEL.

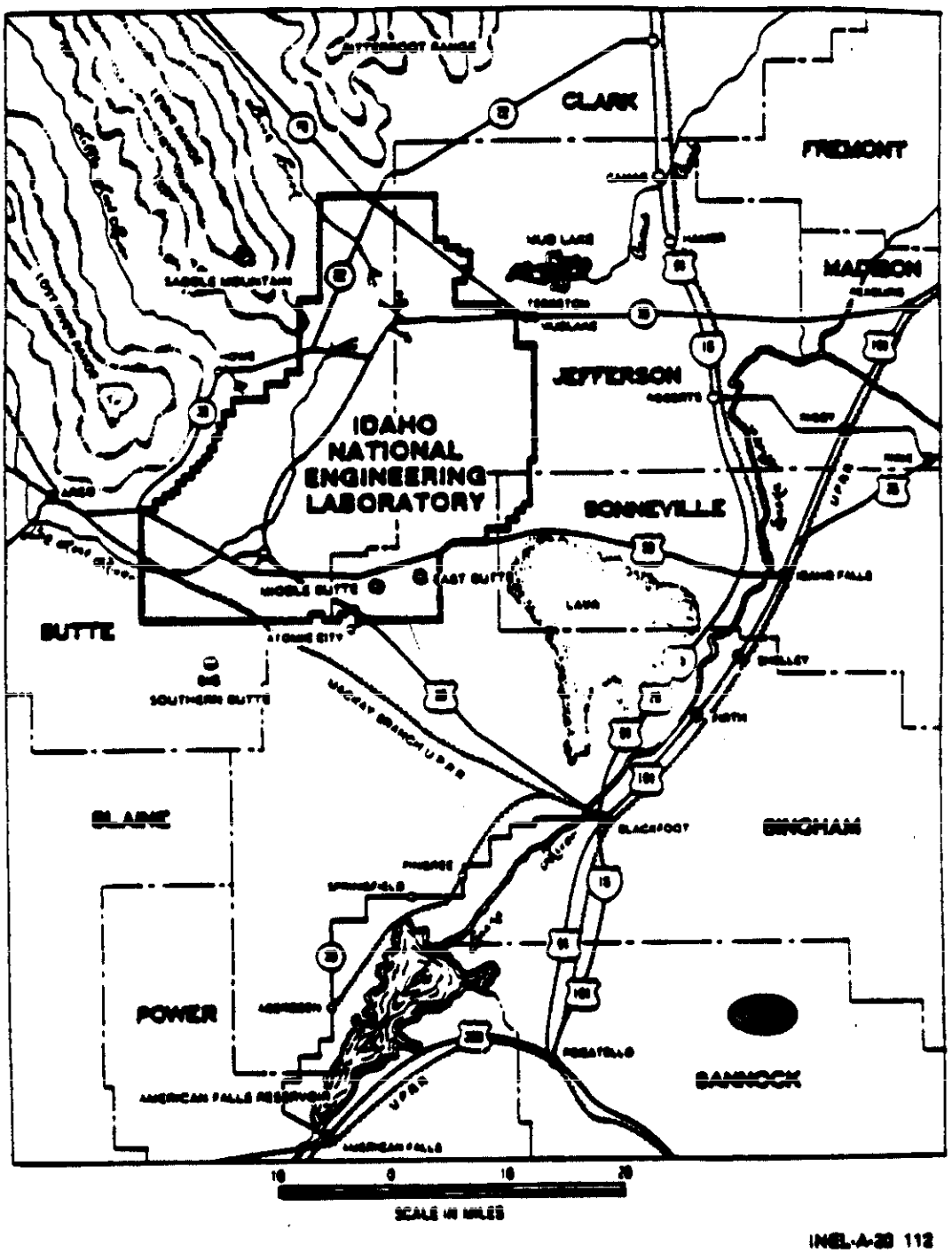

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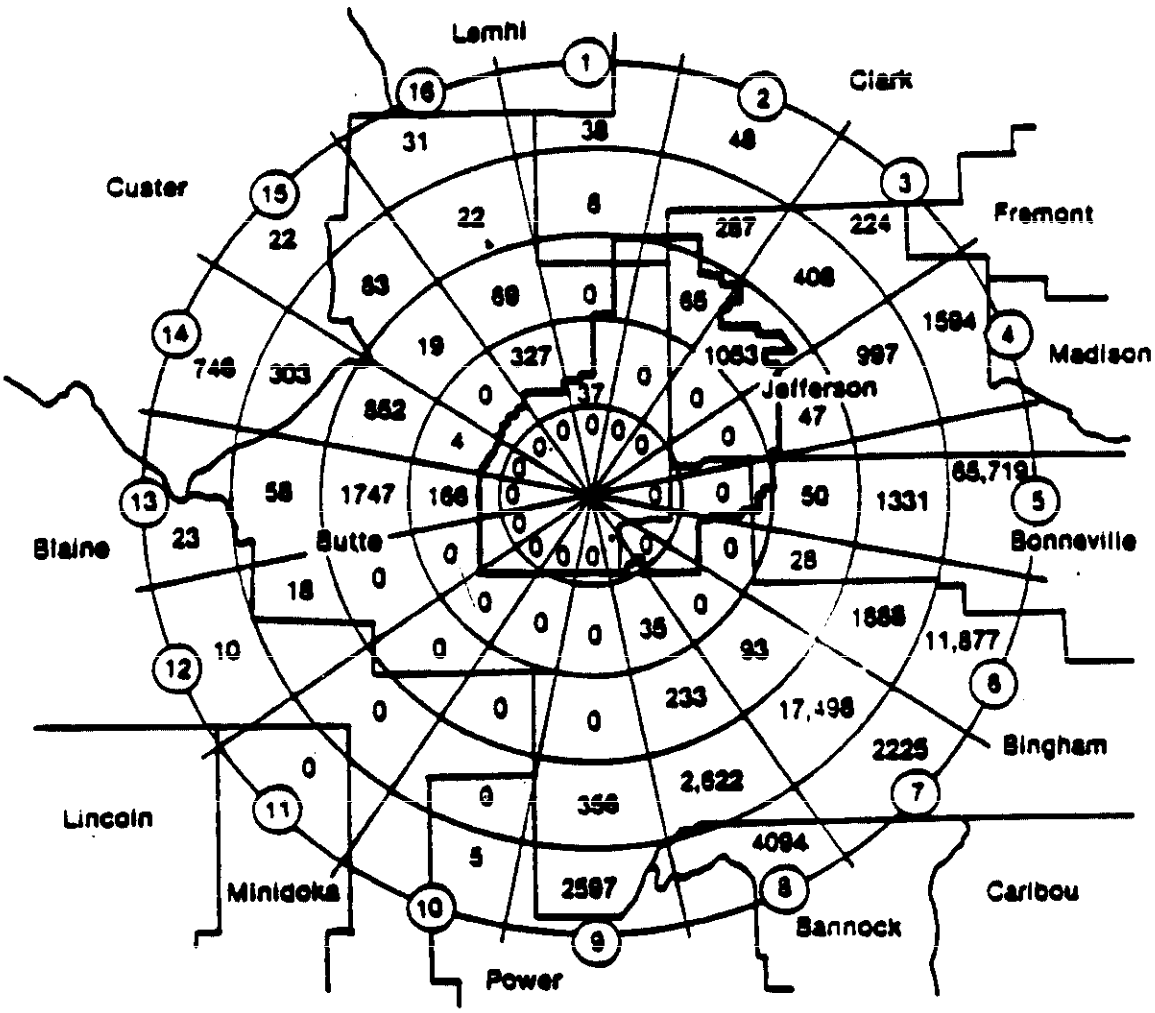
FIGURE 3.2 Vicinity Map of the INEL



*The computer listing of six persons living in this area is erroneous, because of the program's assumption that persons within a given mi^2 section are uniformly distributed in that area. No persons reside in this area.

INEL 4 4892

FIGURE 3.3 Population Distribution Around the INEL

in the south-central portion of the Site in the area of the Test Reactor Area (TRA) - Idaho Chemical Processing Plant (ICPP) complex. Population estimates are based on the 1980 census but include a growth prediction by the Idaho Chamber of Commerce of a growth rate of 2.7% per year for the City of Idaho Falls. This projection adds an additional 4,452 people to the fifth sector at the 40- to 50-mile segment through CY 1984. It is assumed that the population in other sectors will remain stable. The population residing within a 30- mile radius is shown in Figure 3.3 to be 4,625, and 50- mile radius, 119,957.

As of June 1984, the INEL employed 9,986 people, including both Site and offsite workers. Approximately 6,500 employees are present at the INEL during the day shift; about 700 are on site during each of the other shifts. These are average numbers that vary with changes in operational requirements and construction work. No one is allowed to reside on the INEL. Employees live in more than 30 communities adjacent to the INEL, the largest percentage residing in Idaho Falls. Contractor-operated bus service is provided from the major communities. Westinghouse Idaho Nuclear Company (WINCO) employes about 1,370 permanent employees with about 1,200 of these working at the ICPP.

The INEL was established as an area where nuclear reactors and support plants could be constructed, operated, and tested. The INEL was chosen because of its isolation, low annual rainfall, and absence of surface streams draining away from it. The Snake River Plain, on which the INEL is located, is relatively flat. The ground structure underlying the INEL consists of porous lava flows, and the soil of the area has excellent ionexchange and retention capacity. Except for the Snake River Plain Aquifer which underlies the Site, the INEL is hydrologically isolated. Surface streams disappear through porous surface soil and basalt after entering the Site. No surface streams exit the Site.

3.2 ICPP Description

The ICPP is located in the southeastern, central part of the INEL. It is in a fenced security area of over 100 acres. The facilities at the

ICPP are designed to recover unused uranium from irradiated nuclear fuels. The fuel is dissolved, and the uranium is separated from the fission products and cladding materials. The uranium is further purified, and the waste is stored first as a liquid and then converted to a solid and stored in stainless steel bins.

The ICPP, shown in Figure 3.4, is operated for the Department of Energy by Westinghouse Idaho Nuclear Company, Inc. (WINCO).

3.3 ICPP Process Description

Nuclear fuels are received at the ICPP in heavily shielded casks. The fuel is unloaded and stored underwater in large, concrete fuel storage basins. When ready for processing, the fuel is transported to the fuel dissolution area where the entire fuel element is dissolved in acid. The dissolver solution is then sent to an extraction process where the uranium is removed. The uranium is stored for further purification, and the waste material, consisting of fission products and cladding material in an acid solution, is sent in underground encased lines to stainless steel tanks inside concrete vaults until it can be converted to a granular solid. The solid calcine is pneumatically transported to bins inside concrete vaults where it is stored until a disposal decision is made. Other liquid radioactive waste, containing low levels of radioactivity, is processed by evaporation, with the vapor being released to the environment through a surface percolation pond, and the evaporator bottoms are sent to storage tanks to await calcination. Before 1984, the waste and cooling water were discharged to an injection well. Off gases from the process are discharged through a stack to the atmosphere after being filtered and monitored.

3.4 INEL Organization and ICPP Mission

The INEL facilities are operated by one of five government contractors: Argonne National Laboratory-West (ANL-W); EG&G Idaho, Inc. (EG&G); Exxon Nuclear Idaho Company (ENICO); Westinghouse Electric Corporation (WEC); and Westinghouse Idaho Nuclear Company (WINCO).

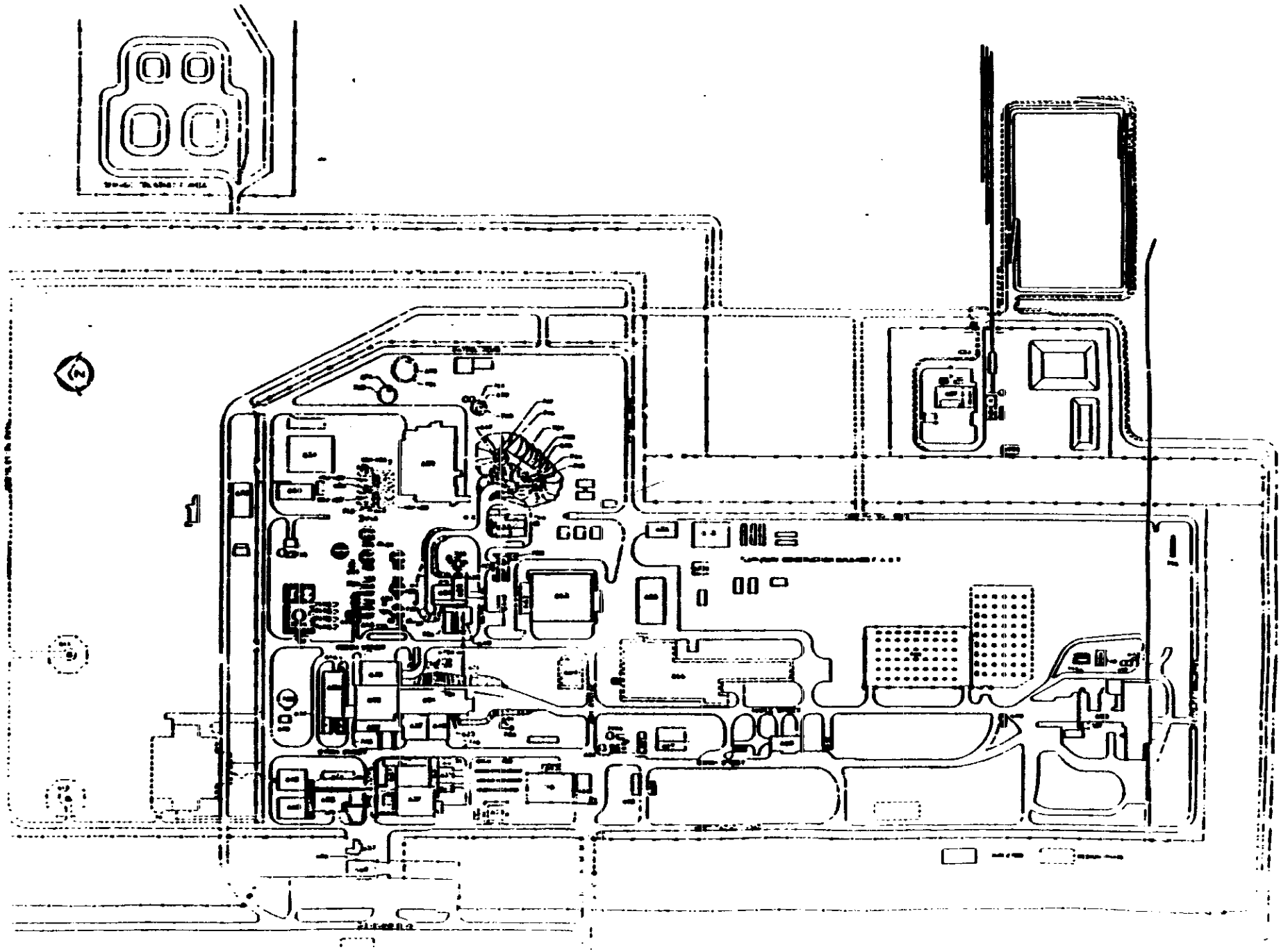


FIGURE 3.4 ICPP Plot Plan

These contractors conduct various programs at the INEL under the administration of three DOE offices: Idaho Operations Office (ID), Pittsburgh Naval Reactors Office (PNRO), and Chicago Operations Office (CH). Another government contractor, American Protective Services (APS), provides security services for the INEL under the administration of DOE-ID.

DOE-ID is the INEL Site manager and is responsible for common Site services, Site environmental control and management, and overall Site safety and emergency planning functions. It provides certain of these services directly and the rest through its prime operating contractor, EG&G. However, the other DOE program/project operations offices (PNRO and CH) working at the INEL are responsible for activities within their own designated test facility boundaries. DOE-ID performs functions or services at these designated sites only through interface agreements with the other DOE operations offices.

The ICPP is operated by WINCO. The general mission of the ICPP is the safe, timely, and cost effective performance of five specific tasks:

1. Receive and store nuclear fuels.

2. Recover the fissile material for these fuels for reuse by DOE.

3. Recover the Krypton-85 from appropriate fuels for resale by DOE.

4. Safely manage radioactive wastes.

5. Perform research, development, and specialized services as requested by DOE and other government agencies or contractors.

4.0 ENVIRONMENTAL SUMMARY OF THE INEL

The INEL site was selected partially because of its advantageous environmental characteristics. These include distance from population centers, low rainfall, high evaporation, favorable soil characteristics, distance from the surface to the aquifer, stable geology, and similar items. Meteorology, geology and soils, hydrology and hydrogeology, air and water quality, environmentally sensitive conditions, and biological pathways are described in the following sections:

4.1 Meteorology

4.1.1 Data Source. The National Oceanic and Atmospheric Administration (NOAA) and its predecessor, the U.S. Weather Bureau, have operated a meteorological observation program at the INEL since 1949. Meteorological data have been collected at over 40 locations on and near the INEL since that time. The weather station at Central Facilities Area (CFA) was the first on-site station and appears on National Climatic Center records as "Idaho Falls 46 W." In addition to recording day-to-day weather data and providing daily operational forecasts for the INEL, the NOAA staff maintains an intensive research and development program to improve the reliability of prediction and measurement of meteorological parameters which influence safe conduct of operations on the INEL. A number of meteorological stations are location throughout the INEL to measure simultaneously the spatial variation of several meteorological parameters such as temperature and wind speed and direction, up to a height of 250 ft.

4.1.2 General Climatology. The location of the INEL in a flat valley surrounded by mountains, its altitude above sea level, and its latitude affect the climate and the day-to-day weather systems. All air masses entering the Snake River Plain first cross a mountain barrier, usually precipitating a large percentage of their moisture. Annual rainfall at the INEL is light, and the region has semiarid characteristics. The local northeast-southwest orientation of the plain and bordering mountain ranges tends to channel prevailing west winds so that a

southwest wind predominates over the INEL; the second most frequent winds come from the northeast. The relatively dry air and infrequent low clouds permit intense solar heating of the surface during the day and rapid radiational cooling at night. These factors combine to give a wide diurnal range of temperature near the ground. Due to the moderating influence of the Pacific Ocean, most of the air masses flowing over this area are usually warmer during winter and cooler in summer than air masses flowing at a similar latitude in the more continental climate east of the Continental Divide. The Centennial and Bitterroot Mountain Ranges keep most of the shallow, but intensely cold, winter air masses from entering the Eastern Snake River Plain (ESRP) when they move southward from Canada. Occasionally, however, the cold air can spill over the mountains. When this happens, the cold air is then held in the ESRP by the surrounding mountains, and the INEL experiences low temperatures for periods lasting a week or longer.

4.1.3 Meteorological Overview.

4.1.3.1 Temperature. Monthly and annual average temperatures for the INEL are provided in Table 4.1. Average monthly maximum temperatures range from 87°F in July to 28°F in January. Average Monthly minimum temperatures range from 49°F in July to 4°F in January. The warmest temperature recorded was 101°F and the coldest through January 1982 has been -40°F.

4.1.3.2 Wind. Wind directions at the INEL are mostly from the southwest or northeast quadrants, due to airflow channeling by the bordering mountains. During the summer months a very sharp diurnal reversal in wind direction occurs. Winds blowing from the southwest (upslope) predominate during daylight hours, and northeasterly winds persist at night. Winter winds are controlled almost exclusively by either large scale weather systems or by stagnation, which show no significant diurnal characteristics. The record of average wind speeds shows a minimum of about 5 mph in December and maximum of 9 mph in April and May. The highest maximum hourly average speed was 51 mph--measured at the 20-ft level at CFA from the west-southwest. Peak gusts of 78

TABLE 4.1

MONTHLY AND ANNUAL TEMPERATURE AVERAGES AND EXTREME AVERAGES

	Maximum (°F)			Average (°F)			Minimum (°F)		
	High	Average	Low	High	Average	Low	High	Average	Low
January	37.9	27.6	19.5	25.1	15.8	6.5	13.1	3.8	-8.8
February	45.9	34.0	25.6	34.2	21.6	9.9	22.4	9.1	-6.5
March	51.5	42.9	33.6	37.5	30.7	19.1	24.6	8.4	4.5
April	64.7	55.3	46.1	45.9	41.3	35.4	32.0	27.2	22.5
May	76.1	66.3	59.9	58.3	51.3	46.7	40.7	36.2	33.3
June	85.3	76.1	69.9	67.5	79.9	46.2	49.7	43.7	40.4
July	91.2	87.0	82.5	71.8	68.2	66.1	53.1	49.3	46.5
August	90.2	84.8	75.4	70.2	65.9	60.3	53.4	47.1	43.2
September	81.2	73.4	64.1	61.1	55.5	48.6	45.2	37.4	31.9
October	67.7	60.5	53.7	49.2	43.5	38.2	32.1	26.5	21.2
November	50.7	42.5	37.8	36.4	29.9	24.5	24.3	17.3	10.3
December	37.1	31.2	22.3	26.8	19.6	10.2	17.6	7.5	-1.9
ANNUAL	59.5	59.0	53.8	44.3	41.8	39.1	29.9	28.1	24.0

[a] Based on National Weather Service (NWS) archived CFA data from April 1954 through December 1982.

and 87 mph were observed. Calm conditions prevail 11% of the time. Figure 4.1 provides seasonal wind roses as measured at CFA.

4.1.3.3 Precipitation. The average annual precipitation is 9.07 in. of water. The yearly totals range from 4.50 to 14.40 in. Individual months have had as little as no precipitation to as much as 4.42 in. Maximum observed 24-h precipitation amounts are less than 2.0 in. and maximum 1-h amounts are just over 1.0 in. Table 4.2 summarizes the average monthly and annual precipitation.

About 26.0 in. of snow falls each year. The maximum yearly total was 40.9 in. and the smallest total was 11.3 in. The greatest 24-h total snowfall was 8.6 in. The greatest snow depth observed on the ground was 27 in. January and February average about 7.0 in. for a monthly maximum depth on the ground. The ground is usually free of snow from mid-April to mid-November.

4.1.3.4 Evaporation. While extensive evaporation data have not been collected on the INEL, evaporation information is available from Aberdeen and Kimberly in southeastern Idaho. These data, which should be representative of the INEL region, indicate that the average annual evaporation rate is about 36 in. About 80% of this 29 in/yr occurs from May through October.

4.1.3.5 Severe Weather Conditions. On the average, two or three thunderstorm days occur during each of the months from June through August. The surface effects from thunderstorms over the Snake River Plain are usually much less severe than are experienced east of the Rocky Mountains or even in the mountains surrounding the plain. Strong wind gust can occur in the immediate vicinity of thunderstorms. These gusts are usually quite localized and of short duration. The highest instantaneous speed record at 20 ft above the ground was 87 mph from the west-southwest. Although some hail frequently accompanies the thunderstorms, damage from hail has not occurred at the INEL.

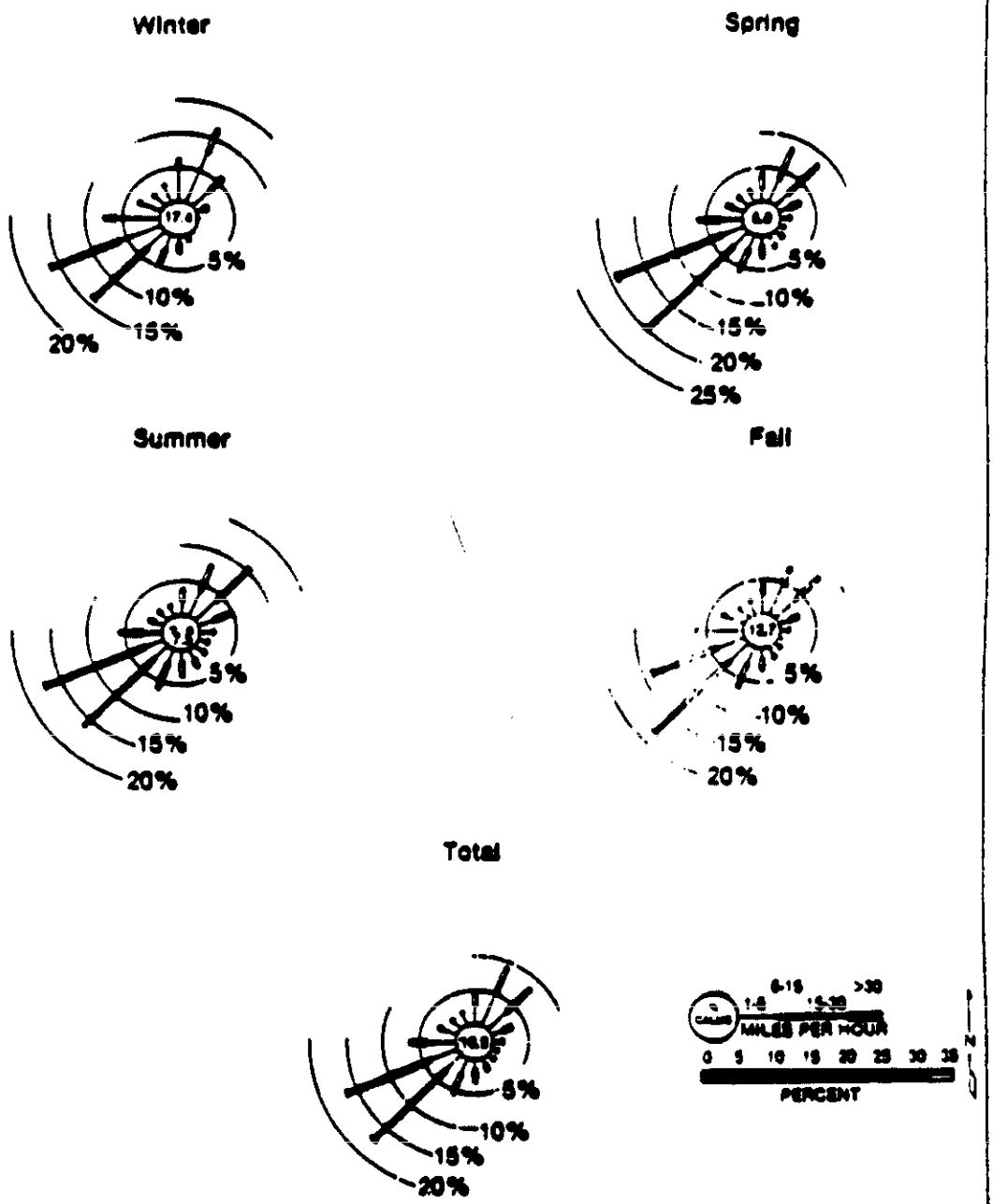


FIGURE 4.1 CFA 20-ft-level Wind Roses

TABLE 4-2

MONTHLY AND ANNUAL PRECIPITATION AT INEL[a]

	Average[b] (in.)	Highest (in.)	Lowest (in.)
January	0.81	2.56	Trace
February	0.64	2.40	0.01
March	0.59	1.44	0.07
April	0.78	2.50	0.00
May	1.28	4.42	0.07
June	1.27	3.89	0.02
July	0.40	1.70	0.00
August	0.56	3.27	Trace
September	0.70	3.52	0.00
October	0.54	1.53	0.00
November	0.55	1.53	0.00
December	0.85	3.43	0.05
ANNUAL[c]	9.07	14.40	4.50
Mean uncertainty in monthly totals[d]	±0.07	±0.12	±0.02

a. From January 1950 through December 1982.

b. Average based on data measured from March 1954 through December 1982.

c. Considers only full calendar year.

d. Based on 1950-1982 values.

Five funnel clouds (vortex clouds which do not reach the ground) and two tornadoes (which caused no damage) have been documented in the 23-yr period of observation at the INEL.

4.2 Geology and Soils

4.2.1 Setting. The Snake River Plain is the largest continuous structural element in southern Idaho. It stretches from the Oregon border in a curving arc across Idaho to Yellowstone National Park in northwestern Wyoming. It slopes upward from an elevation of about 2,500 ft at the Oregon border to over 6,500 ft at Henry's Lake near the Montana-Wyoming border. The plain can be roughly divided into eastern and western parts lying east and west of Bliss, Idaho. The Snake River has cut a valley through Tertiary basin-fill sediments and interbedded volcanic rocks from Bliss west to the Oregon border. The stream drainage is well developed except in a few areas covered by recent thin flows of Snake River basalt. East of Bliss, the complexion of the plain changes as the Snake River carves a vertical-walled canyon through thick sequences of Quaternary basalt. Drainage on the plain is in a youthful state. The central portion of the plain is generally higher than the north and south edges. The Snake River flows along the southern and southeastern edges of the plain, pushed south by basalt flows.

Located entirely on the northern side of the eastern Snake River Plain, the INEL adjoins mountains to the northwest that comprise the northern boundary of the plain. Three mountain ranges end at the northern and northwestern boundaries of the INEL Site: the Lost River and Lemhi Ranges and the Beaverhead Mountains of the Bitterroot Range (see Figure 4.2). Saddle Mountain, near the southern end of the Lemhi Range, reaches an altitude of 10,795 ft and is the highest point in the area. Birch Creek, Little Lost River, and Big Lost River all descend southeastward into the Snake River Plain from the mountains adjacent to the INEL (see Figure 4.3).

The part of the plain occupied by the INEL Site may be separated into three minor physical subdivisions: a central trough that extends to the

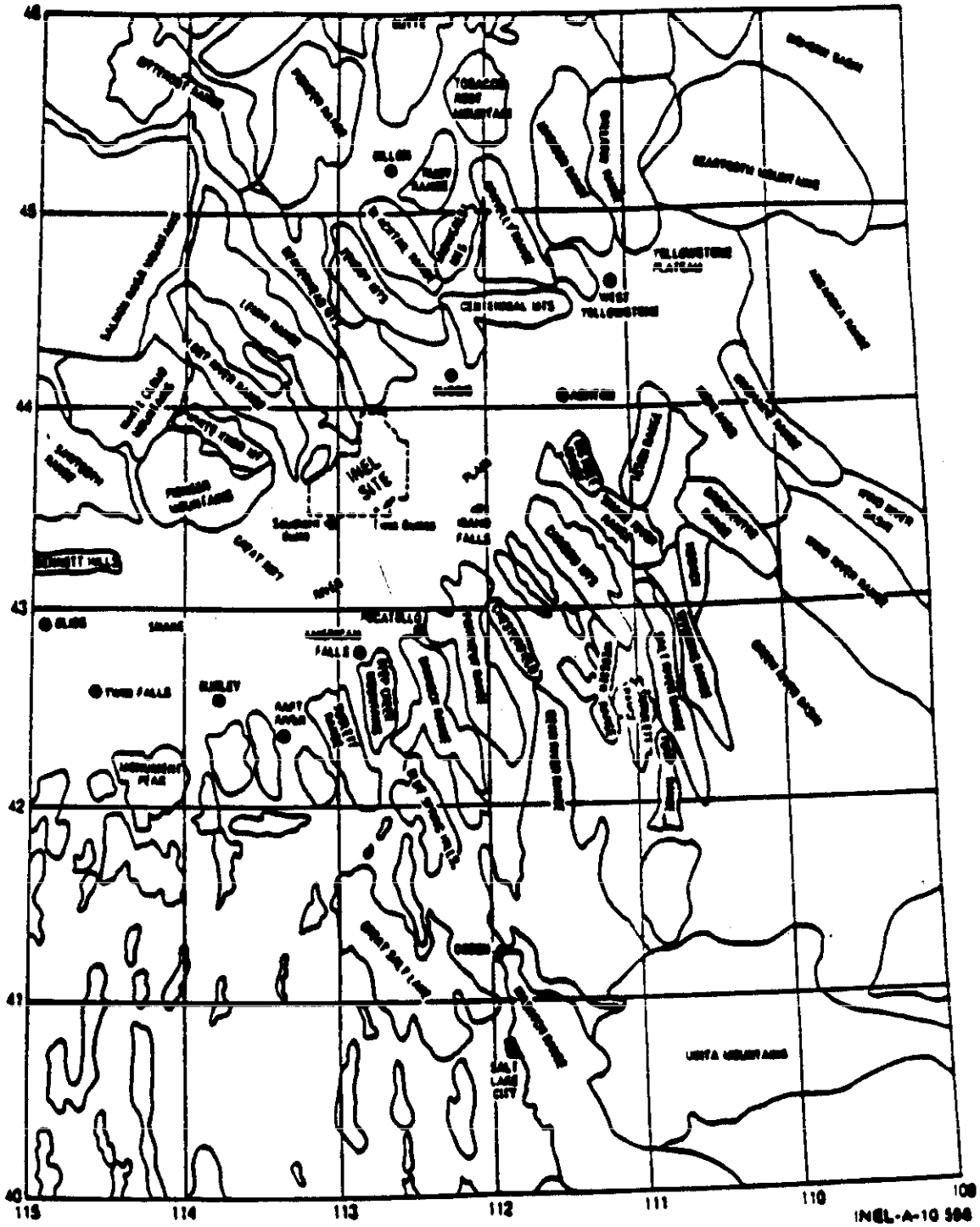


FIGURE 4.2 Physiography in the INEL Region

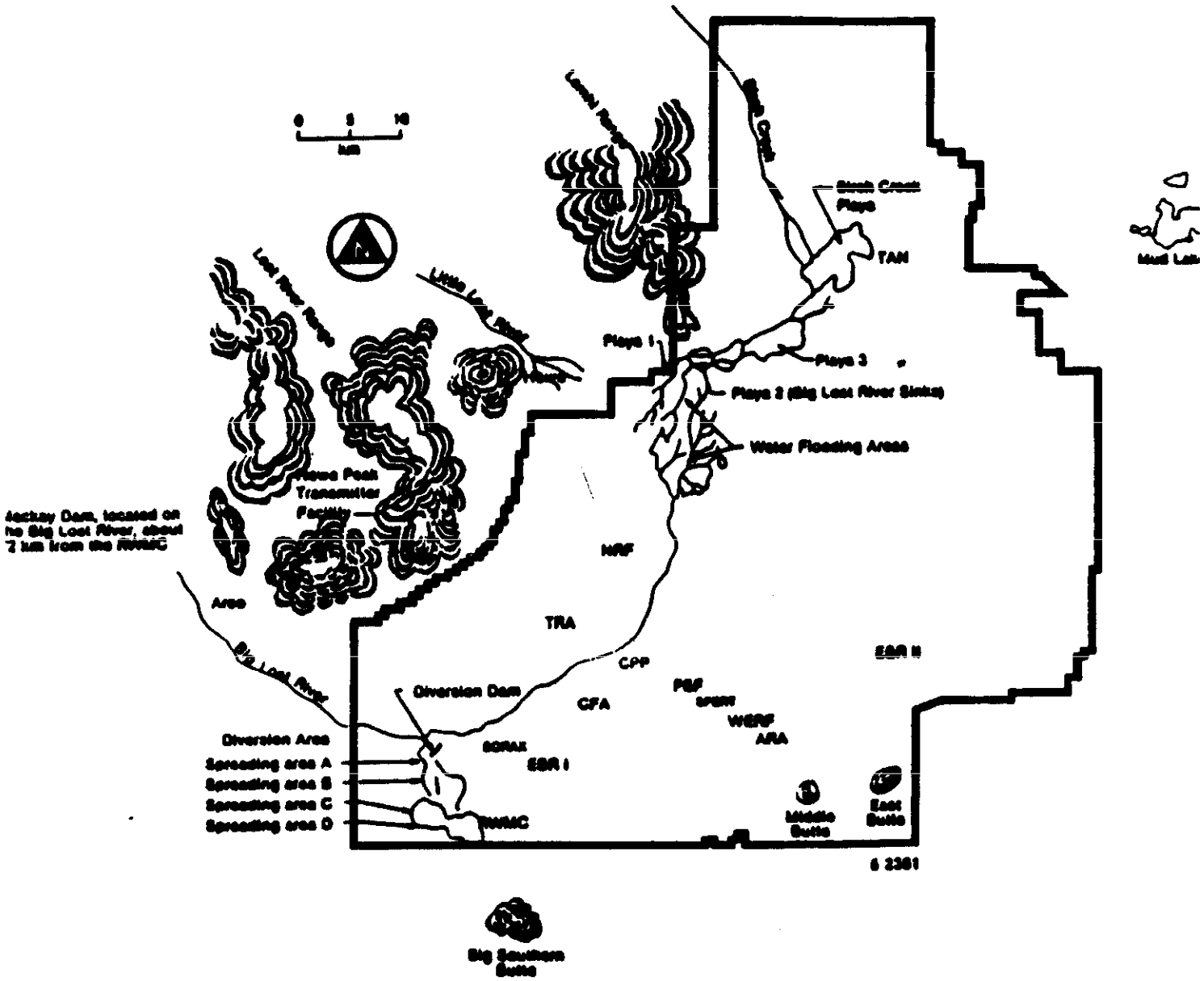


FIGURE 4.3 Major Facilities and Surface Water Features in the INEL Vicinity

northeast through the Site, and two flanking slopes that descend to the trough, one from the mountains to the northwest and the other from a broad ridge on the plain to the southeast. The slopes on the northwest flank of the trough are mainly alluvial fans from the mountains and the valleys of Birch Creek and the Little Lost River; however, some basalt flows (see Figure 4.4), like that on the west side of the valley of Birch Creek, have spread from the mountains toward the plain. The slopes of the southeast flank of the trough are basalt flows which spread from an eruption zone that extends northeastward from Cedar Butte. The lavas which erupted along this zone built up a broad topographic swell that pushed the Snake River to the southern and southeastern edges of the plain. Big Southern Butte and Middle and East Buttes are aligned roughly along this zone; however, they are formed of volcanic rocks older than the surface basalts of the plain.

The central lowland of the INEL Site broadens to the northeast and joins the extensive Mud Lake basin. The waters of the Big and Little Lost Rivers and Birch Creek drain into this trough and toward a broad depression between Howe and Circular Butte. The streams flow through playalike depressions on the INEL where their waters are dissipated by seepage and evaporation. The lowest part of the INEL Site, at an altitude of about 4,755 ft, is in this trough.

4.2.2 Snake River Plain Formation. The Snake River Plain began to form in mid-Tertiary time. The Pleistocene age (the last million or so years) has been marked by sporadic outbursts of lavas, which have led to the accumulation of several thousand feet of basalt on the INEL Site. The basalt is formed chiefly from fluid (low-viscosity--approximately 1 poise), high-temperature (1650 to 2190°F) pahoehoe lavas. The flows have been extruded from rifts and from volcanoes whose locations are rift-controlled. These form layers of hard rock of varying thicknesses, 10 to 100 ft. The physical characteristics and horizontal distribution of the flows also vary. Unconsolidated material, cinders, and breccia are interbedded with the basalt. The size and pattern of flows, when considered in space and time, indicate that individual flows are small when compared with the entire plain and were separated in time by

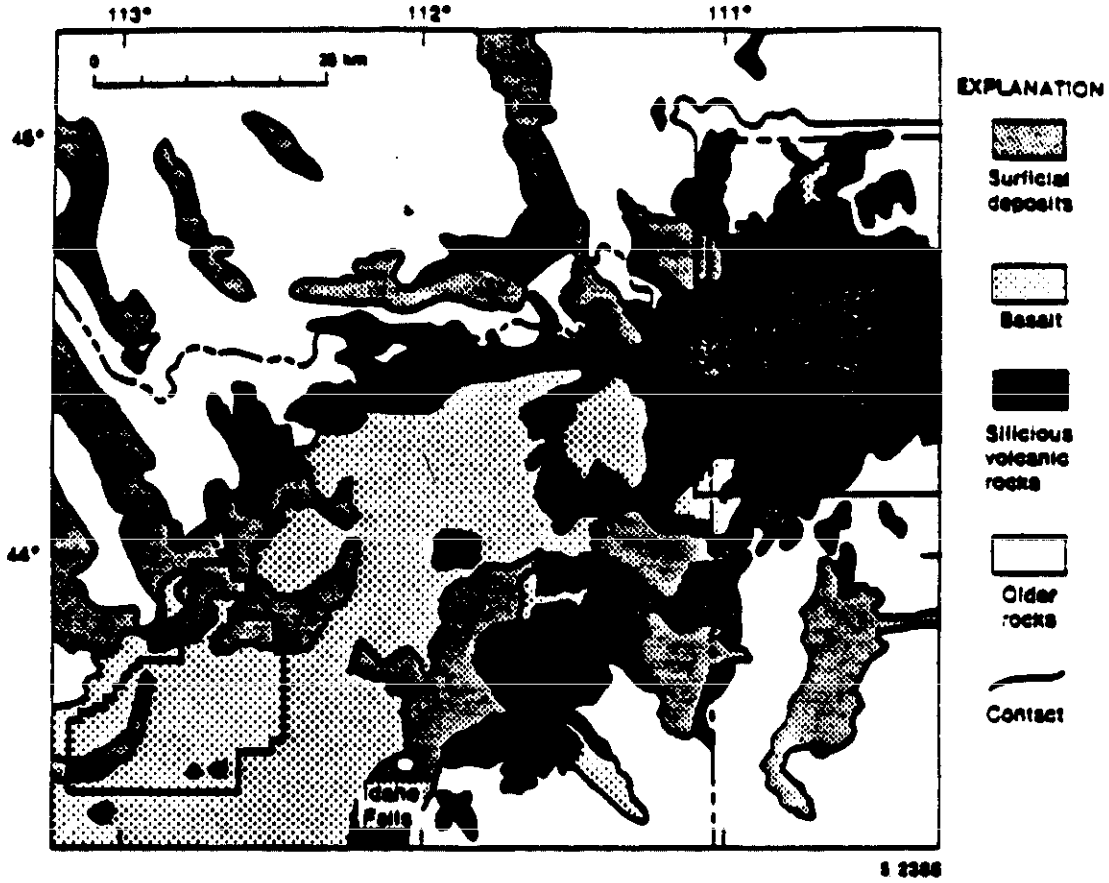


FIGURE 4.4 Generalized Geologic Map of the Eastern Snake River Plain

hundreds or thousands of years. Separate flows are interbedded with sediments of aeolian, lacustrine, and fluvial origins (windblown, lake, and stream deposits, respectively).

Thus, underlying the plain are composite layers of interbedded volcanic and sedimentary rocks, principally basaltic lava flow, and interflow beds of sedimentary materials. These layers partly fill a basin of older limestone and volcanic rocks. The older rocks, which are not waterbearing, are exposed in the mountains northwest and southeast of the plain and presumably underlie all of the plain at depths that may be as great as 5,000 ft.

Mountain ranges bordering the plain consist of Mesozoic miogeosynclinal rocks folded during Laramide orogenesis and later uplifted along normal faults during basin and range tectonism. These ranges terminate abruptly against both sides of the low-lying basalt and sediment-filled Snake River Plain. Except for narrow strips of green along the banks of the Snake River where irrigation makes farming practicable, clumps of dry sage cover the plain, interrupted by hummocks of basalt flows. Formation of the plain and filling to an unknown depth with tuffs, lavas, and sediments began in middle Pliocene and apparently continues at present. The last volcanic eruption at Craters of the Moon, 13 miles southwest of the INEL Site, occurred about A.D. 400.

4.2.3 Soils. As described previously, a central trough extending northeastward through the INEL Site intercepts the Big and Little Lost Rivers and Birch Creek which descend from the mountain ranges northwest of the Site. The surface soils and mantle rock along the streams are made up of alluvial sands and gravel of varying thicknesses. These grade into more finely textured sediments toward the terminal ends of the streams. The surface soils over the remainder of the INEL are formed by windblown deposits of varying thicknesses. Sandy soils derived from windworked beach and bar deposits formed in old playa lakes or ponds are especially common in the northern part of the INEL. In many places, the basalt is not covered. Local playa areas contain deposits 10 to 15 ft thick. Alluvial fans occur along the mountain fronts.

4.3 Hydrology and Hydrogeology

4.3.1 Surface Water. Most of the INEL is located in the Pioneer Basin, an informally named and poorly defined closed drainage basin. Surface water at the Site consists mainly of streams draining through intermountain valleys to the northwest and into Pioneer Basin. The major streams are the Big Lost River, Little Lost River, and Birch Creek (see Figure 4.3). Local rainfall and snowmelt contribute to surface water, mainly during the spring months. Most of the flow from the Little Lost River and Birch Creek is diverted for irrigation purposes prior to reaching the INEL. However, in very high flow years, Birch Creek flows into the Birch Creek Playa (Playa 4 in Figure 4.3) on the north end of the INEL and infiltrates into the subsurface.

The Little Lost River flows on site during high-flow years and infiltrates into the subsurface. The flow of Birch Creek is remarkably uniform because it is primarily fed by groundwater inflow. During periods of extremely rapid thawing and runoff, such as happened in the early spring of 1969, water from the Birch Creek drainage can become a flood threat to facilities at Test Area North (TAN) which is on the southeast edge of the Birch Creek Playa. The high runoff in 1969 was caused almost entirely by rapid snowmelt on the lower reach of the Birch Creek valley, not from the discharge of Birch Creek. The flow over Highway 22 was estimated at 500 cfs in April 1969. The average discharge for Birch Creek is about 57,000 acre-ft/yr. For comparison, the Big Lost River discharges an average of 210,800 acre-ft/yr. Birch Creek and Little Lost River have a minimal effect on INEL hydrology. Therefore, most of the interest in surface water at INEL is directed toward the Big Lost River.

The Big Lost River flows southeastward through the Big Lost River Basin past Arco, and passes onto the Eastern Snake River Plain. The river flows onto the INEL near its southwest boundary, curves to the northeast, and flows northward to the Big Lost River Playas (sinks). After nearing the plain, the river continuously loses water by infiltration through the channel bottom and sides. Therefore, depending on discharge and infil-

tration conditions, sometimes flow does not even reach the INEL, and at other times, it continues as far as Playa 3 or even overflows into Playa 4. As flow approaches Playas 1 and 2, the channel branches into many tributaries, and the flow spreads over several flooding and ponding areas.

Storage and diversion systems on the Big Lost River include Mackay Dam (an earthen structure used primarily for the impoundment of irrigation water) 30 mi upstream of Arco, several irrigation diversions between Mackay and the plain, and the INEL flood-diversion dam. The INEL flood diversion system was built in 1958 to divert high flows on the Big Lost River that might create flood hazards to INEL facilities. This system consists of a small dam which diverts flow from the main river channel into four spreading areas (A, B, C, and D in Figure 4.3). Nearly all flow is diverted during winter months to avoid ice jams in the main river channel. The effectiveness of the INEL flood-control system was calculated in 1972 by the U.S. Geological Survey by means of mathematical models. Results indicated that floods in the Big Lost River would have overflowed the INEL diversion dam about once every 55 years. However, dikes were raised 6 ft in January and February 1984, providing a diversion system that will be able to contain a flood with an average return period well in excess of 300 yr.

As part of recent environmental studies for a new facility at the INEL, a detailed flood-routing analysis was conducted for a hypothetical failure of Mackay Dam. Results indicate potential flooding of some locations on the INEL in the event of the probably maximum flood. The analysis determined flood conditions resulting from an assumed inflow to Mackay Reservoir equal to the probable maximum flood for the watershed and subsequent failure of Mackay Dam. The failure mode was assumed to be overtopping and subsequent breaching of the earthen structure. Figure 4.5 illustrates the approximately extent of the flood inundating for the probably maximum flood conditions analyzed. It should be noted that Figure 4.5 not only depicts a conservative estimate of the probable maximum flood, but it was accomplished before the INEL flood diversion system was upgraded; a physical change that would increase the system's ability to handle high flows.

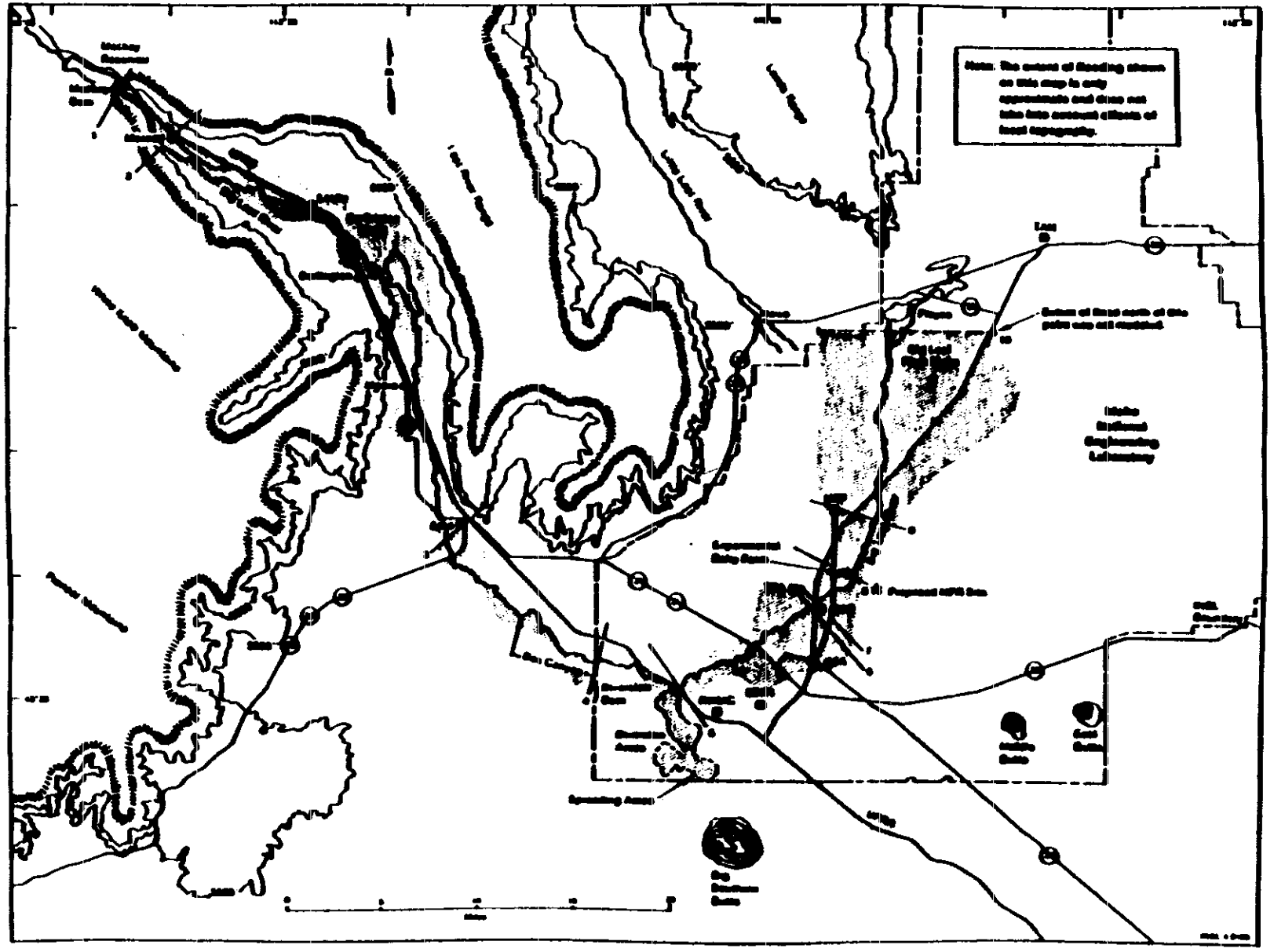


FIGURE 4.5 Base Case Inundation Map

4.3.2 Subsurface Water. The Snake River Plain Aquifer (see Figure 4.6), which flows beneath the INEL, is approximately 206 mi long, 30 to 60 mi wide and covers an area of about 9600 mi^2. The aquifer is composed of a series of thin basalt flows interbedded with sediments of aeolian, fluvial, and lacustrine origin. Aquifer permeability consists of intergranular and intercrystalline pore spaces, fractures, fissures, and other voids. The hydraulic properties of the aquifer are not spatially homogenous and the direction of local groundwater movement is complicated. However, the overall flow pattern is to the south and southwest.

The aquifer could contain 2×10^9 acre-ft of water, of which about 5×10^8 acre-ft are recoverable. The aquifer discharges about 6.5×10^6 acre-ft annually through springs in the area from Milner to Bliss, and from Blackfoot to American Falls Reservoir in the region west of Pocatello. Groundwater pumpage for irrigation totals about 1.5×10^6 acre-ft annually. The discharges from the springs significantly contribute to the flow of the Snake River downstream of Twin Falls, Idaho.

Groundwater flows to the south and southwest at 5-20 ft/day. The average slope of the aquifer is about 0.2% from the northeast to southwest. The aquifer transmissivity, measured in wells on the INEL, ranges from 3×10^4 to 1.8×10^7 gallons per day per ft (gpd/ft). Storage coefficients range from 0.001 to 0.06. Generalized altitude contours are shown in Figure 4.7. Depth to the water table from land surface ranges from about 200 ft in the northeast corner of the INEL to 1000 ft in the southeast corner. At the ICPP, the depth to the aquifer is about 450 ft.

In 1983, the entire INEL water supply was provided by 24 production wells which tapped the Snake River Plain Aquifer. The wells pumped a total of 1.8×10^9 gallons for the year. Over half of the volume pumped was returned to the surface or subsurface by waste disposal operations. An additional unknown amount also returns underground by infiltration from lawn irrigation and other water uses. A significant amount (about one third) of the pumped water is consumed by evaporation and transpiration

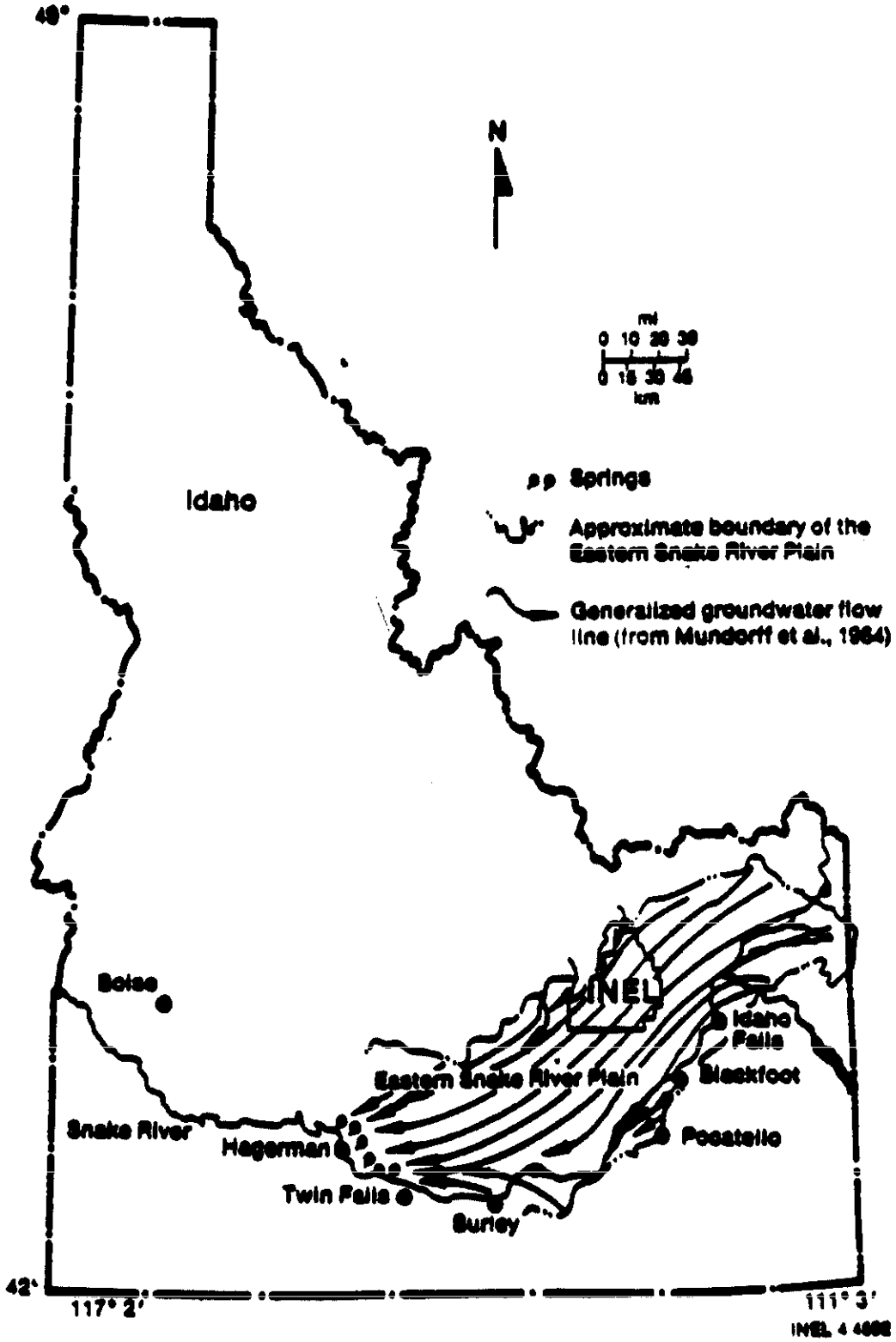


FIGURE 4.6 Location of Generalized Groundwater Flow Lines Hypothesized for the Snake River Plain Aquifer

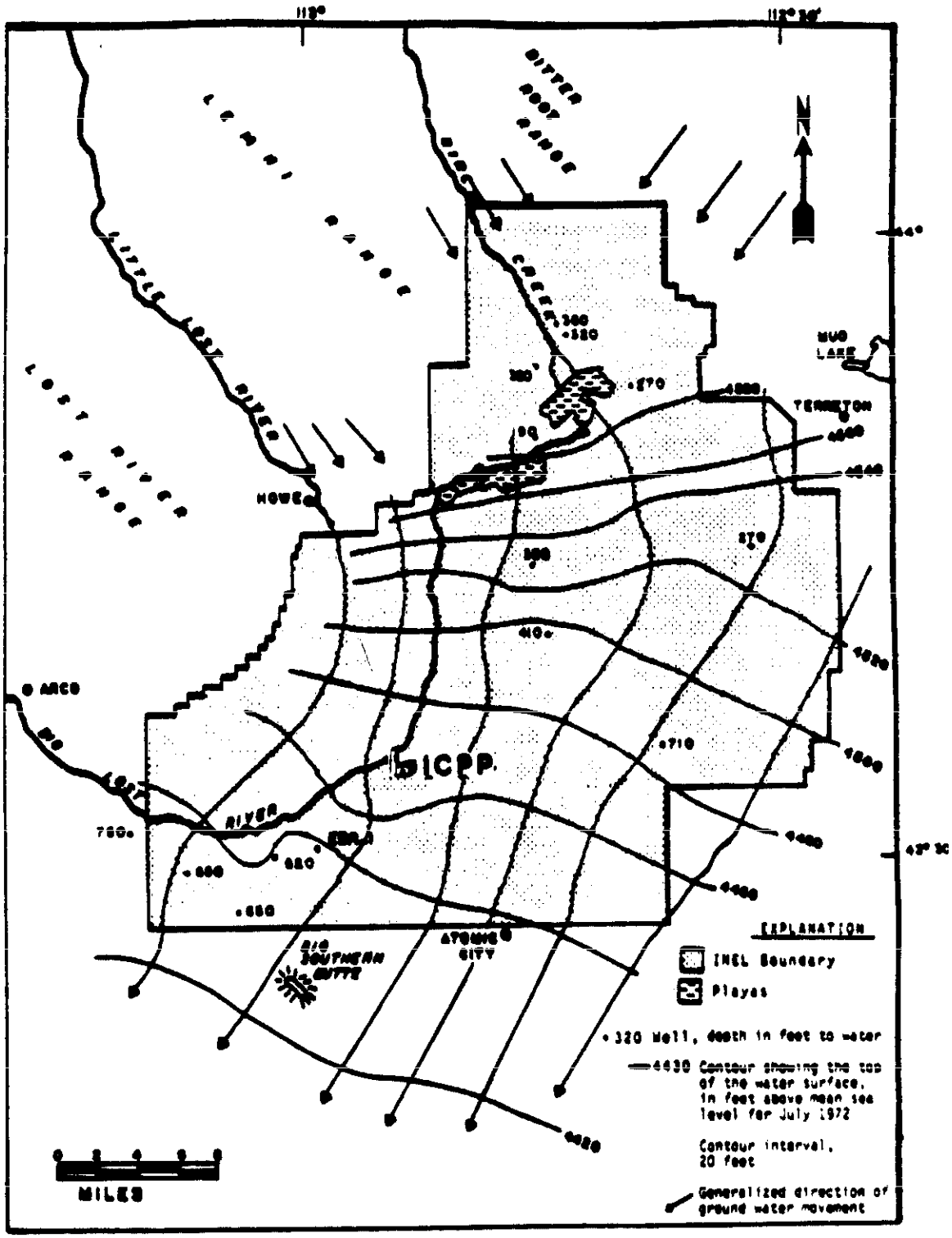


FIGURE 4.7 Generalized Altitude Contours on the Regional Water Table INEL and Vicinity

to the atmosphere, principally from reactor cooling towers. It has been calculated that roughly 2,000 cfs flows beneath the INEL Site at its widest point which is equivalent to 6.4×10^{10} ft^3/yr. Therefore, in 1983 the INEL pumped less than 1% of the INEL underflow and less than 0.1% of the volume that surfaces as springs down gradient from the Site.

Recharge to the Snake River Plain Aquifer is primarily in the form of infiltration from the rivers and streams draining the areas to the north, northwest, and northeast of the Eastern Snake River Plain. Significant recharge from increased flows in the Big Lost River has caused a regional rise in the groundwater table over much of the INEL. Water levels in some wells rise as much as 6 ft within a few months following very high flows in the river.

Perched water tables occur beneath the surface but above the aquifer in areas where water infiltrating the ground surface is delayed by layers of fine-grained sediments with low permeability. Perched water occurs below the Big Lost River, the waste-seepage ponds at the Test Reactor Area (TRA), the ICPP and other areas of the INEL.

Two such bodies of water have been identified in the past at the ICPP. One resulted from water released when the ICPP injection well casing failed. The top of the body was at a depth of 348 ft below the surface. The body of water formed a cone-shaped lens about 165 ft thick extending 4000 ft in radius from the well. Repair of the well lining, and discontinuation of the use of the well have likely shrunk the size of the body.

A second body of perched water was formed west of CPP-603. This body was caused by discharges of water to a seepage pit west of CPP-603, which was terminated long ago. This body of water was located about 22 ft below the surface and was 30 ft deep. The new percolation ponds in the same general area have formed perched water bodies.

4.4 Air and Water Quality

4.4.1 Air Quality. Air pollutant emissions which result from industrial operations at INEL or from surrounding communities are small. In addition, atmospheric dispersion at INEL is not constrained by topography, and the site has no significant air stagnation problems. The air quality at INEL is very good; data available indicates the air quality is well within Primary and Secondary Standards as established by EPA.

Since air quality is within established guidelines, no parts of the INEL have been designated as non-attainment areas by the State of Idaho. The closest such area to the INEL is Pocatello, about 50 miles to the south. The area of Pocatello has been identified as a non-attainment area for not meeting the total suspended particulate standards. However, this is a localized condition and does not impact air quality at the INEL.

4.4.2 Water Quality. The chemical quality of groundwater of the INEL reflects the different sources of recharge and the minerals dissolved from rocks with which it comes in contact. Chemical analyses of surface waters from the Big Lost River, Little Lost River, and Birch Creek are given in Table 4.3. These rivers flow through fractured carbonate rocks consisting of relatively soluble calcite and dolomite. As a result, surface waters from this region contain calcium and magnesium bicarbonate. Small quantities of sodium, potassium and silica are also present.

Water from the Snake River Plain Aquifer containing a relatively larger percentage of sodium and potassium underlies the eastern half of the INEL. Some of this water originates in the mountains to the north and northeast. The mountainous recharge areas are underlain by silicic volcanic rocks which are much higher in sodium, potassium, and silica than are the rocks to the west.

TABLE 4.3

CHEMICAL ANALYSES OF SURFACE WASTE AND GROUNDWATER
FROM THE REGION AROUND THE INEL

Analyses	Big Lost River Near Moore, ID 08/27/63 (1020 h)	Little Lost River Near Howe, ID 09/03/63 (1020 h)	Birch Creek South of Blue Dome 09/03/63 (1145 h)	Medicine Lodge Creek Near Medicine Lodge 09/03/63 (1305 h)	Well 2N26E 36aal Near Arco, ID 08/30/57 (Depth: 57.g m)
Silica	12.0	12.0	8.8	18.0	24.0
Calcium	48.0	39.0	39.0	64.0	67.0
Magnisium	11.0	15.0	14.0	17.0	18.0
Sodium	6.9	6.7	5.0	8.6	9.0
Potassium	1.4	1.2	1.0	2.5	1.8
Bicarbonate	192.0	177.0	164.0	233.0	274.0
Carbonate	0.0	0.0	0.0	0.0	0.0
Sulfate	18.0	16.0	25.0	48.0	24.0
Chloride	3.5	8.8	4.5	6.0	7.5
Fluoride	1.9	0.2	0.2	0.1	0.3
Nitrate	0.5	0.6	0.6	0.1	1.7
Specific conductance (μmhos at 25°C)					
pH (pH units)	7.7	7.7	8.0	7.8	7.6
Residue on evaporation at 180°C	191.0	192.0	186.0	284.0	289.0
Temperature °C	--	12.2	14.4	12.8	13.0

A. Analyses in mg/L, except as indicated.

The waters from the Snake River Plain Aquifer on the INEL are relatively low in dissolved constituents (an average of slightly more than 200 mg/L). The low mineralization reflects the moderate-to-abundant precipitation in the mountainous source areas, the absence of extensive deposits containing soluble minerals, and the low solubility of the basalt that forms the principal aquifer system. The water in the aquifer is of high quality and with modest treatment can be made suitable for most uses. Table 4.4 provides the high, low, and average chemical analysis values for groundwater samples taken at various locations in the area of the INEL. The data are based upon single-sample results from 35 different wells. The individual samplings occurred at various dates from 1951 to 1968.

The Snake River Plain Aquifer is the only source of water used at the INEL. Water pumping and the effect on water levels in the aquifer are closely monitored by the U.S. Geological Survey. Pumping has very limited and localized effect on annual water-level changes in the aquifer in the vicinity of the INEL because the amount pumped is a small portion of the total storage and recharge.

4.5 Environmentally Sensitive Conditions

4.5.1 Protection of Ground Water Quality. The single most sensitive environmental characteristic associated with hazardous waste disposal practices at the INEL is the Snake River Plain Aquifer. As described in Section 4.3.2, this vast aquifer underlies the entire INEL and provides all of the industrial, irrigation and culinary water for the Site. The down-gradient portion of the aquifer also provides the primary source of water for the arid plain area stretching southwest from the Site to the area around Hagerman where the aquifer surfaces in springs. At that point, the surfacing water contributes significantly to the flow in the Snake River. The aquifer is considered a valuable natural resource of the State and its contamination could have far-reaching impacts.

TABLE 4.4

Chemical Analyses of the Snake River Aquifer in the Vicinity of the INEL

Analyses[a]	Average	High	Low
Dissolved Solids			
Ca	39.6	93.0	26.0
Mg	15.6	43.5	3.9
Na	13.2	42.0	6.3
K	3.0	6.9	1.2
HCO_3	162.0	218.0	81.0
CO_3	0.5	9.8	0.0
SO_4	24.9	57.0	9.1
Cl	19.7	160.0	6.5
NO_3	2.9	29.0	0.5
F	0.3	0.9	0.03
SiO_3	25.8	39.0	15.0
Fe	0.08	0.52	0.0
Hardness as $CaCO_3$			
Total	161.8	368.0	94.0
Noncarbonate	26.7	215.0	0.0
pH (no units)	7.9	8.4	7.6
Specific Conductance (mhos at 25°C)	356.0	963.0	225.0
Residue on evaporation at 180°C	226.0	583.0	153.0
Temperature when collected (°C)	12.8	16.7	10.0

[a] In mg/L unless otherwise noted.

The U.S. Geological Survey routinely monitors the Snake River Plain Aquifer around the INEL and has documented the migration of radionuclide contamination caused by operations here. A limited number of nonradioactive parameters are considered in the routine sampling; their migration has also been well documented. Concentrations of tritium, which is not diminished by sorption on earth minerals, have been detected in the aquifer as far as 9 mi down gradient from their point of disposal; resulting from a migration that may have started as early as 1952. Other radionuclides have migrated shorter distances. Some chemical wastes that have been measured, such as sodium, chloride, sulfate, and nitrate, have also formed waste plumes. However, none of these wastes can be detected more than about 5 mi from the disposal site. Radionuclide plume size and concentrations are controlled by aquifer flow conditions, the quantity discharged, radioactive decay, sorption, dilution by dispersion, and perhaps other chemical reactions. Chemical wastes are subject to the same processes except for radioactive decay.

4.5.2 Seismology. Prior to 1970 the INEL was classified in Seismic Zone 2 of the Uniform Building Code of the International Conference of Building Officials. In 1970 the classification was changed to the higher-risk Zone 3, which imposed more stringent design criteria on facilities constructed thereafter. Data cataloged by the national Geophysical and Solar Terrestrial Data Center of the National Oceanic and Atmospheric Administration (NOAA) indicated that regional earthquakes are historically centered around, but do not occur on, the Eastern Snake River Plain. However, ground motion produced by earthquakes in the mountains can be transmitted onto the plain.

The largest historical earthquake event in the Idaho seismic zone, which lies north and northwest of the INEL, occurred on October 28, 1983, and had a Richter magnitude of 7.3. The epicenter for this event was located along the western flank of Borah Peak in the Lost River Range approximately 40 mi northwest of Arco. Another major earthquake occurred August 17, 1959 at Hebgen Lake, approximately 100 mi northeast of the INEL and had a Richter magnitude of 7.1. Shocks from both earthquakes were felt at the INEL, but neither caused structural or safety-related damage.

The data compiled by NOAA and other studies accomplished since 1970 appear to suggest that the plain is rather aseismic. Although the plain is certainly not free of seismic risk, many had felt all factors pointed toward there being less risk than the Zone 3 classification would imply. Therefore, in October 1981 the INEL and surrounding area were again reclassified, this time back to a Seismic Zone 2.

4.5.3 Flooding Potential. The potential for flooding problems on the INEL was discussed in Section 4.3.1. In 1962 and again in 1969 rapid snow melt and heavy precipitation caused flooding in the southwest corner of the INEL. Since those events, significant work has been done on the Big Lost River drainage to prevent flooding problems, but the possibility of diversion structure or upstream dam failure, although slight, does exist. Flooding in the northern area of the INEL from Birch Creek is also a potential problem. With much of the INEL located in a closed drainage basin, the possibility of surface water accumulations in some areas of the Site is of some concern.

4.5.4 Endangered Species. Two species of milk vetch currently under Federal review for endangered or threatened status were found on the INEL (*Astragalus ceramicus apus* and *Astragalus purshii* var., *ophigenes*). These species were located during a 1981-1982 survey of rare plants on the INEL conducted by the University of Idaho. Three taxa on the Idaho State Watch List are also found on the INEL, and four other species were found and recommended for the list. Taxa on the Idaho State Watch List are considered rare and of special interest, but their populations are not in jeopardy and they may be common elsewhere.

The bald eagle and the American peregrin falcon are the only species observed on the INEL that are classified as endangered or threatened wildlife. Several bald eagles (endangered status) usually winter on or near the INEL. The peregrin falcon (endangered status) has been observed infrequently on the northern protion of the INEL. Several species of wildlife observed on the INEL are of special concern to the Idaho Department of Fish and Game and the Bureau of Land Management. These species include the ferruginous hawk, merlin, falcon, osprey, burrowing owl, white-

faced ibis, long-billed curlew, and bobcat. However, only the ferruginous hawk, burrowing owl, long-billed curlew and bobcat occur regularly on the INEL.

No endangered species are present within the ICPP fenced area.

4.6 Biological Pathways

The biological pathway of primary concern at the INEL is through the water of the aquifer underlying the Site. This is because of the aquifer's extent and its wide usage on site and off site (down gradient). This water is used extensively as a source for humans, animals, and irrigation. On the other hand, naturally occurring surface waters on site have no significant downstream usage and terminate on site where they either evaporate or become part of the aquifer by infiltration.

Another biological pathway results from process waters being discharged to evaporation/seepage ponds which are then used by animals. This pathway can be extended to humans if game animals use these waters and subsequently move off site where they are harvested and consumed by hunters. This potential transport of radioactivity to individuals has been studied for many years. These studies suggest that ingestion of meat from waterfowl that have resided on contaminated ponds presents the most important pathway through game animals. Transport by mourning doves, sage grouse and antelope residing for some time on site and eventually being killed and consumed has also been studied.

Air transport and direct vegetation uptake of contaminants also present potential biological pathways. Air dispersion of dry pond or spill sediments, subsurface contaminants brought up by burrowing animals, and other such materials, as well as their uptake by vegetation, are possible. The fact that the INEL is remote and has no permanent population and no agricultural usage makes the significance of these potential pathways minimal.