4.8 Water Resources

This section describes hydrologic conditions regionally, at INEEL, and at INTEC. It includes groundwater and surface water characteristics, such as drainage patterns, flood plains, physical characteristics and water quality.

4.8.1 SURFACE WATER

Surface water at INEEL consists of intermittent streams and spreading areas, and manmade percolation and evaporation ponds. The following sections describe the regional and local drainage characteristics, local runoff, flood plains, and surface water quality.

4.8.1.1 Regional Drainage

INEEL is located in the Mud Lake-Lost River Basin (also known as the Pioneer Basin). Figure 4-*8* shows major surface water features of this basin. This closed drainage basin includes three main streams—the Big and Little Lost Rivers and Birch Creek. These three streams drain the mountain areas to the north and west of INEEL, although most flow is diverted for irrigation in the summer months before it reaches the site boundaries. Flow that reaches INEEL infiltrates the ground surface along the length of the stream beds, in the spreading areas at the southern end of INEEL, and, if the stream flow is sufficient, in the ponding areas (playas or sinks) in the northern portion of INEEL. During dry years, there is little or no surface water flow on the INEEL. Because the Mud Lake-Lost River Basin is a closed drainage basin, water does not flow off INEEL but rather infiltrates the ground surface to recharge the aquifer or is consumed by evapotranspiration. The Big Lost River flows southeast from Mackay Dam, past Arco and onto the Snake River Plain. On INEEL, near the southwestern boundary, a diversion dam prevents flooding of downstream areas during periods of heavy runoff by diverting water to a series of natural depressions or spreading areas (DOE 1995). During periods of high flow or low irrigation demand, the Big Lost River continues northeastward past the diversion dam, passes within 200 feet of INTEC, and ends in a series of playas 15 to 20 miles northeast of INTEC, where the water infiltrates.

The water in Birch Creek and the Little Lost River is diverted in summer months for irrigation prior to reaching INEEL. During periods of unusually high precipitation or rapid snow melt, water from Birch Creek and the Little Lost River may enter INEEL from the northwest and infiltrate the ground, recharging the underlying aquifer.

4.8.1.2 Local Drainage

INTEC is located on an alluvial plain approximately 200 feet from the Big Lost River channel near the channel intersection with Lincoln Boulevard on INEEL. INTEC is surrounded by a stormwater drainage ditch system (DOE 1998). Stormwater runoff from most areas of INTEC flows through the ditches to an abandoned gravel pit on the northeast side of INTEC. From the gravel pit, the runoff infiltrates and provides potential recharge to the Snake River Plain aquifer. The system is designed to handle a 25-year, 24-hour storm event. DOE built a secondary system around the facility to hold water if the first system overflows. Because the land is relatively flat (slopes of generally less than 1 percent) and annual precipitation is low, stormwater runoff volumes are small and are generally spread over large areas where they may evaporate or infiltrate the ground surface. Annual precipitation at INEEL averaged 8.7 inches from 1951 through 1994. Annual net evaporation from large water surfaces in the Eastern Snake River Plain is 33 inches per year (Rodriguez et al. 1997).

Man-made surface water features at INTEC consist of two percolation ponds used for disposal of water from the service waste system, and sewage treatment lagoons and infiltration trenches for treated wastewater. Service water consists of raw water, demineralized water, treated water, and steam condensate (Rodriguez et al. 1997). The sewage treatment plant receives an average sanitary sewage flow of 42,000 gallons per day. The percolation ponds receive approximately 1.5 to 2.5 million gallons of service wastewater per day and are each approximately 4.5 acres in size (Rodriguez et al. 1997).

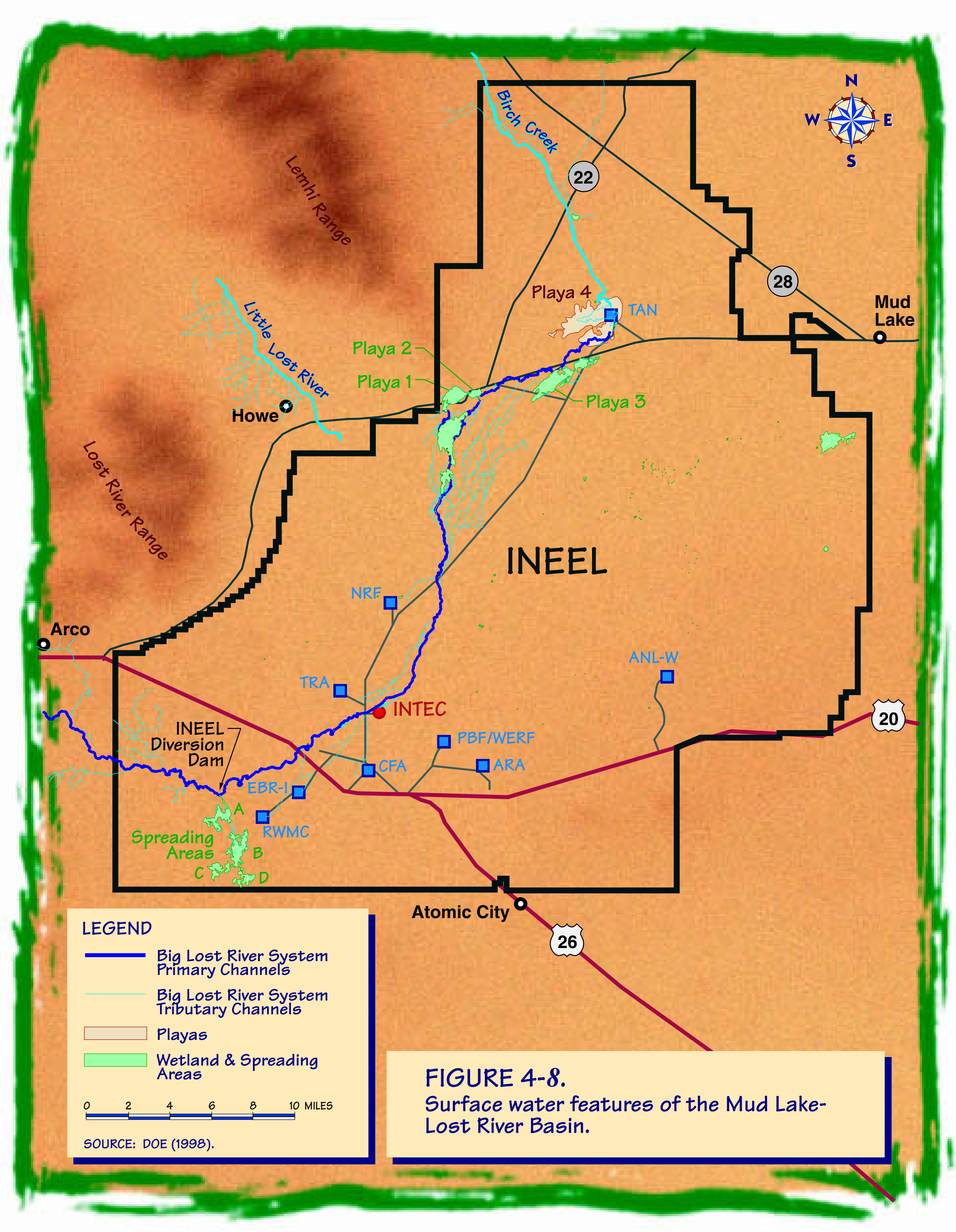


FIGURE 4-8.
Surface water features of the Mud Lake-Lost River Basin.

4.8.1.3 Flood Plains

Flood studies at the INEEL include the examination of the flooding potential at INEEL facilities due to the failure of Mackay Dam, 45 miles upstream of the INEEL ***from a probable maximum flood*** (Koslow and Van Haaften 1986). The U.S. Geological Survey ***has published a preliminary map*** of the 100-year flood plain for the Big Lost River ***on the INEEL*** (Berenbrock and Kjelstrom 1998). ***As a result of this screening analysis, which indicated that INTEC may be subject to flooding from a 100-year flood,*** DOE commissioned additional studies (Ostenaa et al. 1999) ***consistent with the requirements contained in DOE standards for a comprehensive flood hazard assessment (DOE 1996).*** There is no record of any historical flooding at the INTEC ***from the Big Lost River, although evidence of flooding in geologic time exists.***

Flooding from a failure of Mackay Dam on the Big Lost River was evaluated for the potential impact on INEEL facilities (Koslow and Van Haaften 1986). The maximum flood evaluated was assumed to be caused by a probable maximum flood resulting in the overtopping and rapid failure of Mackay Dam. This flood would result in a peak surface water elevation at INTEC of 4,917 feet, with a peak flow of 66,830 cubic feet per second in the Big Lost River measured near INTEC. The average elevation at INTEC is 4,917 feet (ESRF 1997). At this peak water surface elevation, portions of INTEC would be flooded, especially at the north end. Because the ground surface at INEEL and INTEC is relatively flat, floodwaters outside the banks of the Big Lost River would spread over a large area and pond in the lower lying areas. The peak water velocity in the INTEC vicinity was estimated at 2.7 feet per second. Although flood velocities are relatively slow and water depths are shallow, some facilities could be impacted. In particular, in the event of a design basis flood with sufficient magnitude and duration, a potential effect could be the failure of bin set 1. This event is discussed in Section 5.2.7.3.

Debris bulking was not considered in the flow volumes for the probable maximum flood. Other than natural topography, the primary choke points for probable maximum flood flows are the diversion dam on the INEEL and the culverts on Lincoln Boulevard near INTEC. The probable maximum flood would quickly overtop and wash out the diversion dam so there would essentially be no effect on flows downstream of the dam. The Lincoln Boulevard culverts are capable of passing about 1,500 cubic feet per second ***(Berenbrock and Kjelstrom 1998)***. Due to the relatively flat topography in the vicinity of INTEC, debris plugging at the culverts would have little effect on the probable maximum flood elevation at INTEC.

Estimates of the 100- and 500-year flows for the Big Lost River were most recently published by the U.S. Geological Survey (Berenbrock and Kjelstrom 1996) and the U.S. Bureau of Reclamation (Ostenaa et al. 1999). The U.S. Geological Survey 100-year flow estimate is 7,260 cubic feet per second at the Arco gauging station 12 miles upstream of the INEEL Diversion Dam. This estimate is based on 60 years of stream gauge data and conservative assumptions. These assumptions attempt to address the effect of Big Lost River regulation and irrigation, which complicate the use of traditional approaches to flood frequency analysis. The U.S. Geological Survey published a preliminary one-dimensional map of the Big Lost River flood plain (Berenbrock and Kjelstrom 1998) based on the 7,260 cubic feet per second 100 year flow estimate (see Figure 4-9). In this study, it was assumed that the INEEL Diversion Dam did not exist and that 1,040 cubic feet per second would be captured by the diversion channel and flow to the spreading areas southwest of the Diversion Dam. The model then routed the remaining 6,220 cubic feet per second down the Big Lost River channel on the INEEL.

A U.S. Army Corps of Engineers analysis of existing data (Bhamidipaty 1997) and an INEEL geotechnical analysis (LMITCO 1998) both concluded that the INEEL Diversion Dam could withstand flows up to 6,000 cubic feet per second. Culverts running through the diversion dam could convey a maximum of an additional 900 cubic feet per second but their condition and capacity as a function of water elevation is unknown (Bhamidipaty 1997). Although the net capacity of the INEEL Diversion Dam may exceed U.S. Geological Survey 100-year flow estimates, it is not certi-

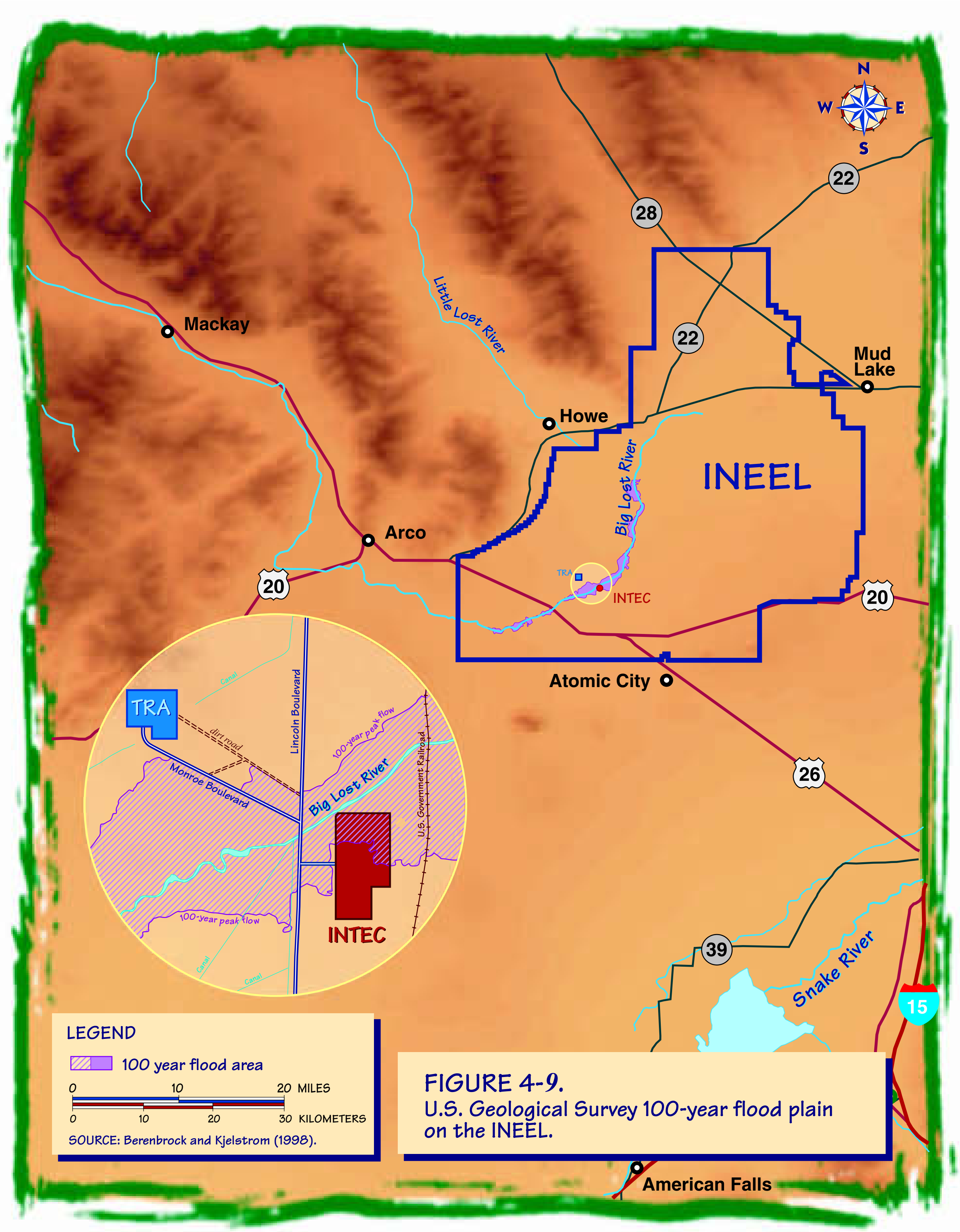


FIGURE 4-9.
U.S. Geological Survey 100-year flood plain on the INEEL.

fied or used as a flood control structure for flood plain mapping purposes.

The flows and frequencies in the U.S. Bureau of Reclamation study are based on statistical analyses with inputs from stream gauge data and two-dimensional flow modeling constrained by geomorphic evidence. Radiocarbon dating indicates that the geologic evidence records Big Lost River flow history over the last 10,000 years. The mean Bureau of Reclamation estimate for the 100-year flow of the Big Lost River is 2,910 cubic feet per second. The flood plain resulting from a flow with a 97.5 percent chance of not being exceeded in 100 years (3,270 cubic feet per second) is shown on Figure 4-10. The mean Bureau of Reclamation estimate for the 500-year Big Lost River flow is 3,669 cubic feet per second. The flood plain resulting from a flow with a 97.5 percent chance of not being exceeded in 500 years (4,086 cubic feet per second) is shown on Figure 4-11.

These flood plain maps were generated assuming one-dimensional flow, no infiltration or flow loss along the Big Lost River flow path, and no diversion dam. Under these conservative assumptions, small areas of the northern portion of the INTEC could flood at the estimated 100 and 500 year flows. Additional work is under way at the INEEL by both the U.S. Geological Survey and the Bureau of Reclamation to further refine flow frequency estimates for the Big Lost River in the vicinity of INTEC.

4.8.1.4 Surface Water Quality

Water quality in the Big Lost River has remained fairly constant over the period of record. Applicable drinking water quality standards for measured physical, chemical, and radioactive parameters have not been exceeded (DOE 1995). The chemical composition of the water reflects the carbonate mineral composition of the surrounding mountain ranges northwest of INEEL and the chemical composition of return irrigation water drained to the Big Lost River (Robertson et al. 1974).

DOE measures surface water quality at INTEC at two stormwater monitoring locations, the percolation ponds and the sewage treatment lagoons. The stormwater monitoring locations are at the inlet to the retention basin on the northeast side of INTEC and on the south side of a coal pile at the discharge to a ditch. The coal pile is located on the southeast side of INTEC.

DOE monitors for metals, inorganics, radiological constituents, and volatile organic compounds in stormwater (LMITCO 1997). EPA-specified nonradiological benchmarks (60 FR 50826; September 29, 1995) and radiological benchmarks from the Derived Concentration Guides from DOE Order 5400.5 form the baseline values from which DOE monitors. INTEC data for 1996 indicate that contaminants are below benchmark levels. Benchmarks are the pollutant concentrations above which EPA and DOE have determined represent a level of concern. The level of concern is the concentration at which a stormwater discharge could potentially impact or contribute to water quality impairment or affect human health as a result of ingestion of water or fish.

Liquid effluents monitored at INTEC include effluent from the service waste system to the percolation ponds and effluent from the sewage treatment plant prior to discharge to the rapid infiltration trenches. Wastewater Land Application Permits from the State of Idaho have been issued for these discharges. Monitoring results for the percolation pond in 1996 indicate the effluent constituent concentrations are within acceptable ranges and annual flow volumes are within the limits specified in the permits (LMITCO 1997). ***In 2000,*** the sewage treatment plant effluent did not exceed the 100 mg/L total suspended solids limit, or the flow limit specified in the permit. ***The 20 mg/L total nitrogen limit for the sewage treatment plant effluent was exceeded in three monthly samples during the calendar year. However, the 2000 total nitrogen average was 15.6 mg/L. As part of the ongoing nitrogen study, an in-depth inventory of nitrogen sources contributing to the INTEC sewage treatment plant was performed. The study did not identify any new sources. Additional corrective actions are planned (DOE 2001).***

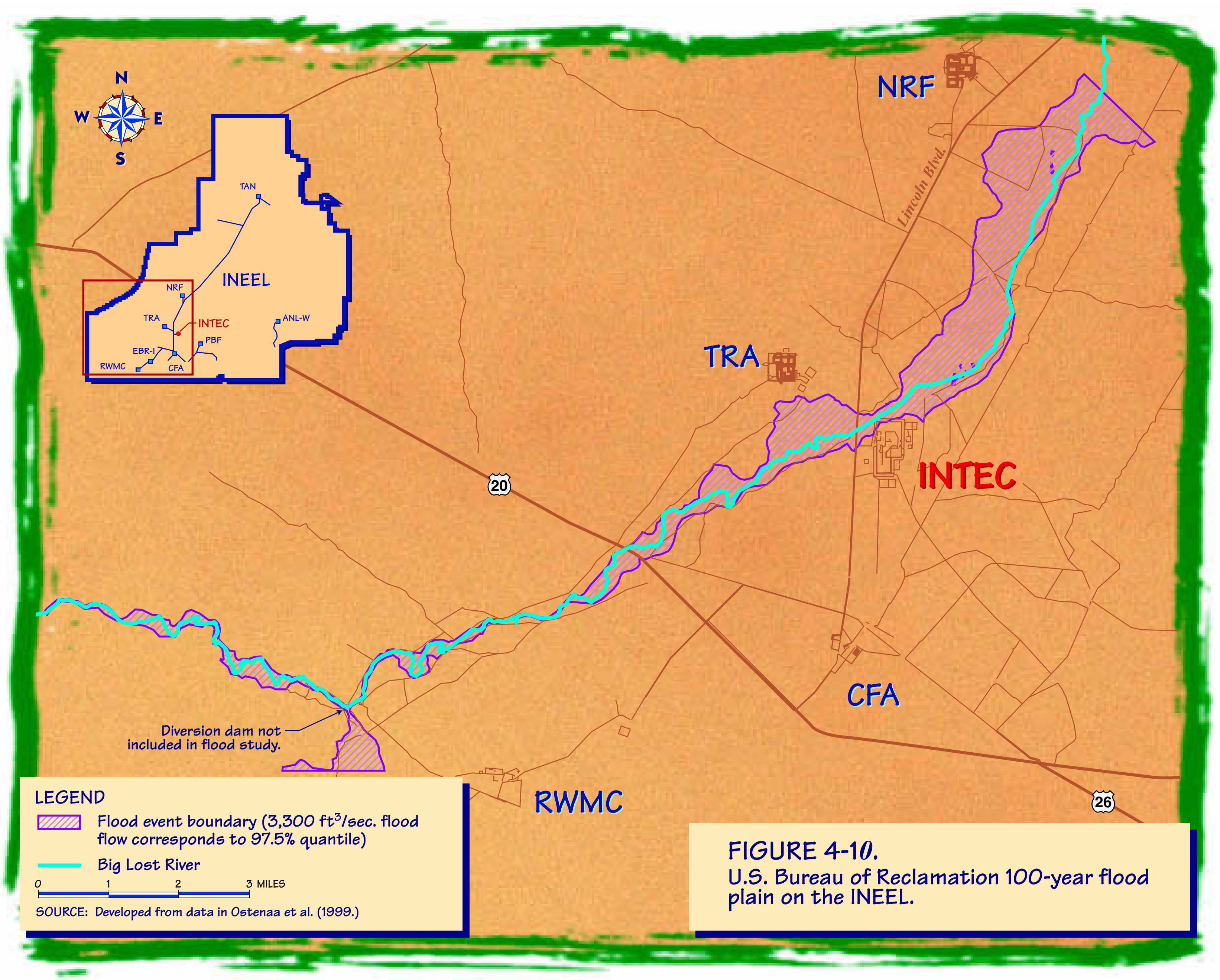


FIGURE 4-10.
U.S. Bureau of Reclamation 100-year flood plain on the INEEL.

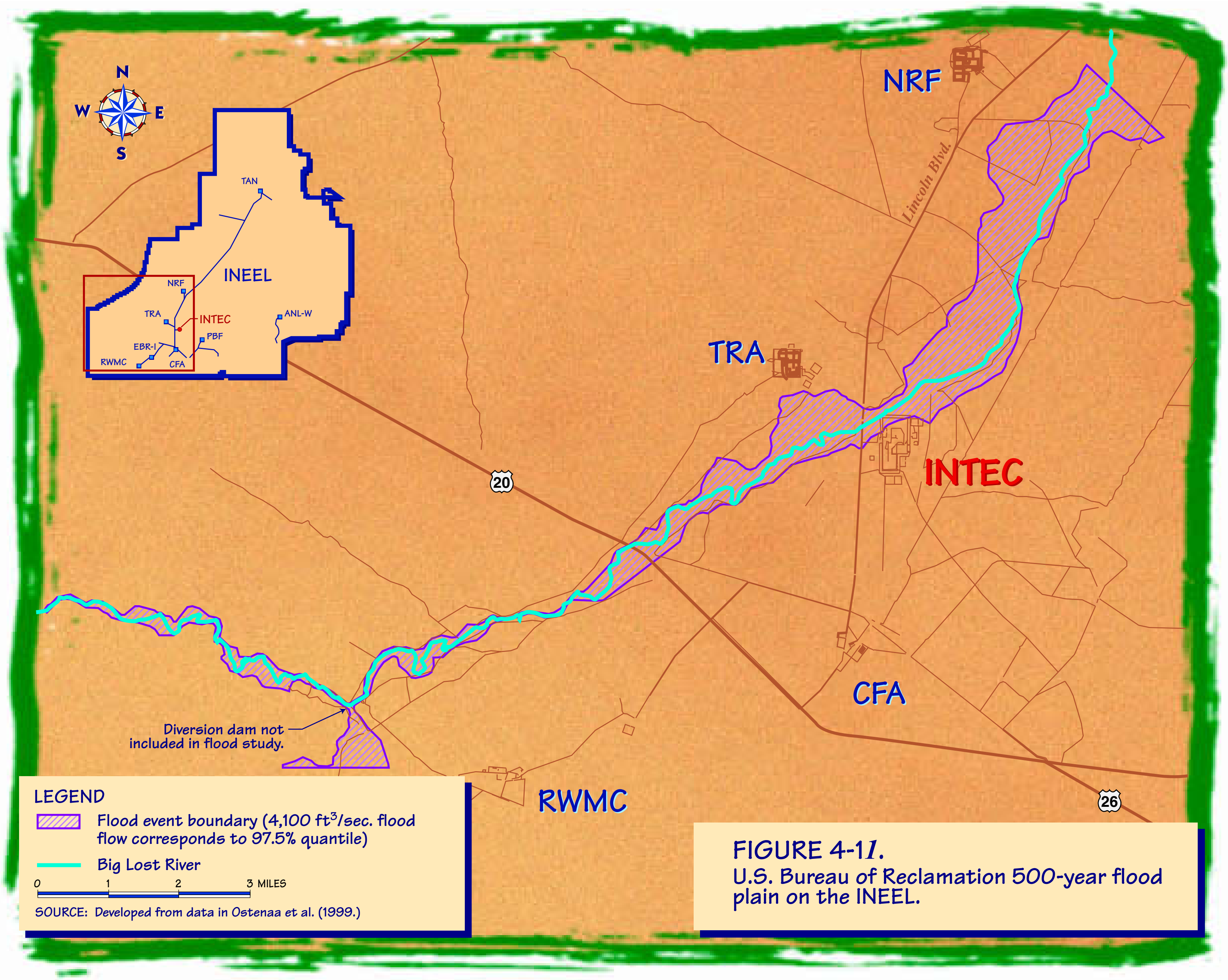


FIGURE 4-11.
U.S. Bureau of Reclamation 500-year flood plain on the INEEL.

4.8.2 SUBSURFACE WATER

Subsurface water at INEEL occurs in the underlying Snake River Plain Aquifer and the vadose zone (area of unsaturated soil and material above the aquifer). This section describes the regional and local hydrogeology, vadose zone hydrology, perched water, and subsurface water quality.

4.8.2.1 Regional Hydrogeology

INEEL overlies the Snake River Plain Aquifer as shown in Figure 4-1*2*. This aquifer is the major source of drinking water for southeastern Idaho and has been designated a Sole Source Aquifer by EPA. The aquifer flows to the south and southwest and covers an area of 9,611 square miles. Water storage in the aquifer is estimated at 2 billion acre-feet, and irrigation wells can yield 7,000 gallons per minute (DOE 1995). Depth to the top of the aquifer ranges from 200 feet in the northern part of INEEL to about 900 feet in the southern part (Orr and Cecil 1991). The aquifer, with estimates of thickness ranging from 250 to more than 3,000 feet (Frederick and Johnson 1996), consists of thin basaltic flows, interspersed with sedimentary layers.

The drainage area contributing to the water volume in the Snake River Plain Aquifer is approximately 35,000 square miles (DOE 1995). The recharge to the aquifer is primarily from irrigation water and by valley underflow from the mountains to the north and northeast of the plain. Some recharge also occurs directly from precipitation (Rodriguez et al. 1997).

Discharge from the aquifer is primarily from springs that flow into the Snake River and pumping for irrigation. Major areas of springs and seepages from the aquifer occur in the vicinity of the American Falls Reservoir (southwest of Pocatello), and the Thousand Springs area (near Twin Falls) between Milner Dam and King Hill (Garabedian 1986).

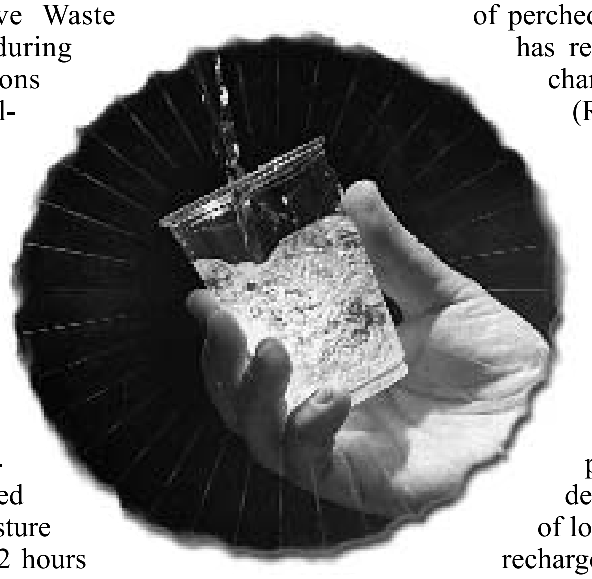
4.8.2.2 Local Hydrogeology

Groundwater directly beneath INTEC generally flows to the southwest and southeast, with some flow to the south. The local groundwater flow is complex and variable, and is influenced by recharge from the Big Lost River (when flow is present), the percolation ponds and sewage ponds, areas of low aquifer transmissivity, and possibly by pumping from the production wells. Groundwater beyond the influence of INTEC recharge sources flows to the south-southwest. The local hydraulic gradient is low, 1.2 feet per mile, compared to the regional gradient of 4 feet per mile (Rodriguez et al. 1997). In the INTEC area the hydraulic conductivity ranges over 5 orders of magnitude (0.10 to 10,000 feet/day), with an average of 1,300 feet/day (Rodriguez et al. 1997). The groundwater velocity beneath INTEC has been estimated at 10 to 25 feet per day (Barraclough et al. 1967). At various locations on and around INTEC in 1995, the depth to the Snake River Plain Aquifer ranged from approximately 460 feet to 480 feet below the ground surface (Rodriguez et al. 1997). Several zones of perched water lie beneath INTEC (see Section 4.8.2.4). These zones are primarily located beneath, and extend outward from, the percolation ponds and the sewage treatment plant lagoons when the Big Lost River is dry. Additional perched water bodies and interactions occur in the northern part of INTEC during periods of flow in the Big Lost River and subsequent infiltration.

FIGURE 4-12
Aquifers of Idaho.

4.8.2.3 Vadose Zone Hydrology

The vadose zone extends down from the ground surface to the regional water table (the top of the Snake River Plain Aquifer). In the vadose zone, the subsurface materials are generally not saturated but contain both air and water. Perched water bodies are the exception (see Section 4.8.2.4 that follows). The vadose zone at INTEC extends from the ground surface to 460 feet to 480 feet below the ground surface. This zone is important because chemical sorption to geologic materials in the vadose zone retards or immobilizes downward movement of some contaminants. During dry conditions, transport of contaminants downward towards the aquifer is very slow. Measurements taken at the INEEL Radioactive Waste Management Complex during unsaturated flow conditions indicated a downward infiltration rate ranging from 0.14 to 0.43 inches per year (Cecil et al. 1992). In another study during near-saturated flow conditions in the same area, standing water infiltrated downward 6.9 feet in less than 24 hours (Kaminsky 1991). During 1994, an infiltration study was conducted at INTEC that showed significant increase in moisture to a depth of 10 feet after 2 hours (LITCO 1995).



4.8.2.4 Perched Water

Perched water occurs in the vadose zone when sediments or dense basalt with low permeability impedes the downward flow of water to the aquifer. Historically at INTEC there have been three zones of perched water, including (1) a shallow perched water zone in the Big Lost River alluvium above the basalt, (2) an upper basalt perched water zone, and (3) a lower basalt perched water zone. Each zone is comprised of a number of smaller perched water bodies that may or may not be hydraulically connected. The perched water zones are thought to be primarily related to wastewater disposal practices at INTEC and the Big Lost River infiltration. The shallow perched water zone in the Big Lost River alluvium in the southern area of INTEC is believed to no longer exist (Rodriguez et al. 1997).

The upper basalt perched water zone occurs between the depths of 100 ***and*** 140 feet. At the northern end of INTEC, there is a body of upper basalt perched water beneath the sewage treatment ponds on the eastern side of INTEC extending towards the west under north central INTEC. The western portion of the northern perched water body receives water from other sources including the Big Lost River, leaking fire water lines, precipitation infiltration, steam condensate dry wells, and lawn irrigation. In the southern area of INTEC, a large body of perched water in the upper basalt has resulted primarily from discharge to the percolation ponds (Rodriguez et al. 1997).

The lower basalt perched water zone occurs in the basalt between 320 ***and*** 420 feet below the ground surface. Two areas of perched water occur in the lower basalt, essentially directly beneath the upper basalt perched water previously described. The northern body of lower basalt perched water is recharged from the sources contributing to the upper perched water. The lower perched water was influenced by the failure of the injection well in the late 1960's and late 1970's that allowed injection of service wastewater directly into the northern lower perched water body. The southern lower basalt perched water body is recharged from the discharge from the percolation ponds (Rodriguez et al. 1997).

4.8.2.5 Subsurface Water Quality

Subsurface water quality is monitored by the U.S. Geological Survey and the ***Bechtel BWXT Idaho, LLC*** Environmental Monitoring Program. An extensive groundwater quality study at INTEC was completed in 1995

(Rodriguez et al. 1997). ***In 2001, a tracer study was conducted on INTEC perched water and monitoring of the Snake River Plan Aquifer was performed (DOE 2002a,b). Results from the groundwater monitoring activities supporting the Remedial Investigation/Feasibility Study and associated Record of Decision are summarized in reports prepared and published by the respective CERCLA Waste Area Groups.*** This section focuses on current groundwater conditions, with emphasis on groundwater quality in the vicinity of INTEC.

DOE performs groundwater monitoring at INTEC and the surrounding area to monitor drinking water, detect unplanned releases to groundwater, identify potential environmental problems, and ensure compliance with Federal, State of Idaho, and DOE groundwater regulations and monitoring requirements. Groundwater monitoring at INEEL is generally divided into four categories: drinking water monitoring, compliance monitoring, surveillance monitoring, and special studies.

DOE monitors drinking water at INTEC to ensure compliance with Federal and State of Idaho drinking water regulations. INTEC drinking water wells are hydrologically upgradient of the INTEC facility. Measured drinking water parameters at INEEL are compared to the maximum contaminant levels established in the Safe Drinking Water Act (40 CFR 141). State regulations are in the Idaho Rules for Public Drinking Water Systems (***DEQ 2001a***). In ***2000***, the most recent year with published data, all drinking water samples collected at INTEC had concentrations below the maximum contaminant levels specified in Federal and State drinking water regulations (***DOE 2001***).

DOE performs compliance groundwater monitoring at INTEC to meet the requirements of the State of Idaho Wastewater Land Application Permits. The two areas monitored include wells in the vicinity of the percolation ponds and near the sewage treatment pond. The permits require compliance with the Idaho Groundwater Quality Standards in specified downgradient groundwater monitoring wells, annual discharge volume and application rates, and effluent quality limits (***DEQ 2001b***). Permit variance limits were granted for total dissolved solids and chloride at the percolation pond compliance monitoring wells. The primary source of total dissolved solids and chloride in the percolation ponds is the INTEC water treatment processes. The data for 1996 indicate that no permit limits (or permit variance limits) were exceeded at the percolation ponds in 1996 (LMITCO 1997).

At the compliance well for monitoring the sewage treatment plant, maximum allowable concentrations were not exceeded. However, at a shallow well (ICPP-MON-P***W***-024) adjacent to the sewage treatment plant, levels of total dissolved solids, chloride, and nitrogen compounds were elevated. DOE monitors this well to evaluate the effectiveness of treatment and to detect unplanned releases. Based on the information obtained from the monitoring data, DOE will alter treatment processes to optimize wastewater treatment and remove elevated nitrogen compounds (LMITCO 1997).

DOE conducts surveillance monitoring at INTEC to meet the requirements of DOE Order 5400.1. This order requires DOE facilities with contaminated (or potentially contaminated) groundwater resources to establish a groundwater monitoring program. The monitoring program is designed to determine and document the impacts of facility operations on groundwater quantity and quality and to demonstrate compliance with Federal, state, and local regulations. Table 4-1*7* summarizes monitoring parameters that exceeded surveillance thresholds. The surveillance thresholds are the Safe Drinking Water Act maximum contaminant levels and secondary maximum contaminant levels.

At the perched-water surveillance wells for the percolation ponds, the constituents elevated above the threshold limits include aluminum, chloride, iron, ***lead***, and strontium-90. The causes for the elevated aluminum and iron concentrations are unknown. The chloride concentration is consistent with historical chloride concentrations and reflects the concentration within the percolation ponds. The source of chloride is the water treatment processes. The strontium-90 concentrations are most likely residual from the historical discharges of radionuclides to the percolation ponds. Most radionuclide discharges to the percolation ponds were discontinued in 1993 when the INTEC Liquid Effluent Treatment and Disposal Facility began operations.

Table 4-17. Monitoring parameters that were exceeded for INTEC surveillance wells.[a]

Location	Exceeded parameter	Maximum concentration	Surveillance threshold[b]
PW-1[c]	***aluminum***	***0.254 mg/L***	***0.05mg/L***
	iron	***26 mg/L***	***0.3 mg/L***
	lead	***0.0036 mg/L***	***0 mg/L***
PW-2[c]	aluminum	***1.49 mg/L***	0.05mg/L
	chloride	287 mg/L	250 mg/L
	iron	***2.2 mg/L***	0.3 mg/L
	strontium-90	8.3 ± 3.4 pCi/L	8.0 pCi/L
PW-4[c]	iron	***2.2 mg/L***	0.3 mg/L
PW-5[c]	***aluminum***	***0.0562 mg/L***	***0.05 mg/L***
	iron	***2.93 mg/L***	***0.3 mg/L***
USGS-036[d]	strontium-90	***9.54 ± 1.34 pCi/L***	8.0 pCi/L
USGS-052[d]	***gross alpha***	***15 ± 3.86 pCi/L***	***15.0 pCi/L***
USGS-057[d]	strontium-90	***21.1 ± 3.43 pCi/L***	8.0 pCi/L
USGS-067[d]	strontium-90	***11.1 ± 1.47 pCi/L***	8.0 pCi/L
ICPP-MON-A-021[e,f]	total coliform	20 col/100mL	<1 col/100mL
ICPP-MON-A-022[e,g]	iron	0.487 mg/L	0.3 mg/L

a. ***Source: DOE (2002a).***

b. Surveillance thresholds are comparison values consisting of maximum contaminant levels and secondary maximum contaminant levels (40 CFR 141).

c. INTEC percolation pond perched water surveillance well.

d. INTEC percolation pond aquifer surveillance well.

e. Source: LMITCO (1997).

f. INTEC upgradient background well (upgradient Sewage Treatment Plant well).

g. INTEC Sewage Treatment Plant surveillance well.

In 1995, surveillance monitoring at the sewage treatment plant wells indicated measurements of total coliform, iron, and strontium-90 above threshold levels. DOE suspects that the total coliform measurement is the result of cross-contamination. The source of iron is unknown. Strontium-90 concentrations are consistent with historical values (LMITCO 1997). ***In 2000, data were available for USGS-52 indicating the gross alpha concentrations were above threshold levels (DOE 2002b).***

Constituents detected above threshold levels in surveillance wells are strontium-90 and tritium. Strontium-90 and tritium values are consistent with historical values and reflect discontinued discharge practices (LMITCO 1997).

In 1995, an in-depth study of soil and groundwater contamination was conducted at INTEC (Rodriguez et al. 1997). ***In 2001, a tracer study was conducted on INTEC perched water and monitoring of the Snake River Plain Aquifer was performed (DOE 2002a,b).*** Tables 4-1***8*** and 4-1***9*** show the maximum concentrations of inorganics and radionuclides in the perched water and the Snake River Plain Aquifer found in ***these studies and monitoring efforts***. The percolation pond perched water body was not monitored as part of the ***1995*** study, but was previously described as part of the discussion of the surveillance monitoring program.

All perched water bodies monitored in the 1995 study had samples exceeding the nitrate/nitrite Federal and state drinking water maximum contaminant level of 10 mg/L. The highest nitrate/nitrite concentration (69.6 mg/L) was found in the northern lower perched water body. For radionuclides, the maximum gross alpha and gross beta concentrations in perched water are in the northern upper perched water body. Tritium, strontium-90, and technetium-99 were found in all perched water bodies.

In 2001, all the perched water bodies again exceeded the maximum contaminant level for nitrate/nitrite. However, only half of the 15 sample results were exceedances. The highest nitrate/nitrite concentration (60.3 mg/L) is

Table 4-18. Maximum concentrations of inorganics and radionuclides in perched water at INTEC.[a]

	Maximum concentration (mg/L or pCi/L)	Well	Perched water body
Inorganics (mg/L)			
Alkalinity	290[b]	MW-5	Northern upper
Carbonate	5.4[b]	MW-17	Southern lower
Chloride	248	PERC Pond B	
Fluoride	0.312	Big Lost River C	Northern lower
Sulfate	12.8	USGS-50	
Total Kjeldahl Nitrogen	1.5[b]	MW-18	Northern lower
Ammonia – N	ND[b]		
NO_3/NO_2 – N	70[b]	MW-1	Northern lower
Aluminum	18.3	MW-20	Northern upper
Antimony	0.0103	MW-6	Northern upper
Arsenic	0.0167	MW-2	Northern upper
Barium	0.541	CPP 37-4	Northern upper
Beryllium	ND	–	
Cadmium	ND	–	
Calcium	114	CPP 37-4	Northern upper
Chromium	2.52	MW-2	Northern upper
Cobalt	0.0509	MW-6	Northern upper
Copper	0.0874	MW-6	Northern upper
Iron	39.5	Central Set B	Northern upper
Lead	0.0338	CPP 37-4	Northern upper
Magnesium	35.9	CPP 37-4	Northern upper
Manganese	6.55	MW-17	Northern lower
Mercury	8.58×10^{-4}	Central Set B	Northern upper
Nickel	0.276	CPP 55-06	Northern upper
Potassium	17.4	MW-17	Northern upper
Selenium	ND	–	
Silver	ND	–	
Sodium	136	Perc Pond B	Southern upper
Thallium	ND	–	
Vanadium	0.0494	MW-2	Northern upper
Zinc	1.73	MW-2	Northern upper
Zirconium	ND	–	
Radionuclides (pCi/L)			
Gross Alpha	1,100 ± 220[b]	MW-2	Northern upper
Gross Beta	5.9×10^5 ± 2,600[b]	MW-2	Northern upper
Tritium	40,400 ± 220	MW-17	Northern upper
Strontium-90	1.36×10^5 ± 18,200	MW-2	Northern upper
Plutonium-238	0.0501± 0.0107	–	
Plutonium-239/240	ND	–	
Americium-241	0.0374 ± 0.0169	PW-5	
Neptunium-237	0.0361 ± 0.012	MW-2	Northern upper
Iodine-129	0.65 ± 0.065	USGS-50	
Technetium-99	457 ± 9.15	MW-18	Northern lower
Uranium-233/234	15.3 ± 1.99	Central Set B	Northern upper
Uranium-235/236	0.142 ± 0.042	CPP 37-4	Northern upper
Uranium-238	6.94 ± 1.21	Central Set B	Northern upper

a. Source: DOE (2002a) unless otherwise noted.

b. Source: Rodriguez et al. (1997).

ND = Not detected.

Table 4-19. Maximum concentrations of inorganics and radionuclides in the Snake River Plain Aquifer in the vicinity of INTEC.

Contaminant	Maximum concentration (mg/L or pCi/L)	Well	Maximum contaminant level[a] (mg/L or pCi/L)	Background[b] (mg/L or pCi/L)
		Inorganics (mg/L)[c]		
Aluminum	ND	–	0.2[d]	
Antimony	4.6×10^{-3}	USGS-59	0.006	
Arsenic	0.011	USGS-59	0.05	
Barium	0.21	USGS-112	2	0.05 - 0.07
Beryllium	ND	–	0.004	
Cadmium	3.0×10^{-3}	USGS-39	0.005	<0.001
Calcium	76	CPP-2	NS	
Chromium	0.039	USGS-39	0.1	0.002 -0.003
Cobalt	1.0×10^{-3}	USGS-85	NS	
Copper	0.014	CPP-2	1.3	
Iron	0.13	USGS-123	0.3[d]	
Lead	0.018	USGS-84	0.015	<0.005
Magnesium	22	USGS-67	NS	
Manganese	0.044	USGS-122	0.05	
Mercury	3.6×10^{-4}[e]	USGS-44	0.002	<0.0001
Nickel	5.0×10^{-3}	USGS-123	0.1	
Potassium	6.80	USGS-122	NS	
Selenium	3.0×10^{-3}	USGS-47	0.05	<0.001
Silver	7.0×10^{-4}	USGS-77	0.1[d]	<0.001
Sodium	77	USGS-59	NS	
Thallium	ND	–	0.002	
Vanadium	0.010	USGS-82	NS	
Zinc	0.45	USGS-115	5[d]	
Zirconium	ND	–	NS	
		Radionuclides (pCi/L)[e]		
Gross Alpha	15 ± 3.86	MW-52	15	0 - 3
Gross Beta	96.5 ± 6	MW-48	<4 mrem/yr[f]	0 - 7
Tritium	1.4×10^{4} ± 771	USGS-114	20,000	0 - 40
Strontium-90	45 ± 7.57	MW-47	8	0
Plutonium-238	ND	–	15	0
Plutonium-239/240	ND	–	15	0
Americium-241	0.742 ± 0.0336	LF2-8	15	0
Neptunium-237	ND	MW-18	15	
Iodine-129	1.06 ± 0.19	LF3-8	1	0
Technetium-99	322 ± 6.6	USGS-52	900	
Uranium-233/234	1.62 ± 0.153	USGS-123	–	
Uranium-235/236	0.146± 0.057	USGS-35	–	
Uranium-238	0.851 ± 0.126	USGS-85	–	

a. Maximum contaminant levels (MCL) from the Safe Drinking Water Act (40 CFR 140) and DOE Order 5400.5 unless otherwise noted.
b. Source: Knobel et al. (1992).
c. Source: Rodriguez et al. (1997).
d. Secondary MCL from the Safe Drinking Water Act (40 CFR 140).
e. Source: DOE (2002b).
f. Beta particle/photon radioactivity shall not produce annual dose equivalent to the total body or internal organ greater than 4 millirem per year.

ND = Not detected; NS = No standard.

slightly lower at the same location (MW-1) of the maximum concentration observed in the 1995 study. The only inorganic found to exceed its maximum contaminant level in perched water was chromium. Chromium exceedances were found in all the perched water bodies. The only organic was methylene chloride from well PW-1. The highest radioactive contaminant levels (strontium-90 and technetium-99) continue to be found in the northern upper perched water body. Tritium is the primary contaminant found in the southern upper perched water body. Gross alpha and beta were not analyzed in 2001. The maximum radiological contaminant levels for strontium-90, technetium-99 and tritium have decreased by as much as 50 percent since the 1995 study (DOE 2002a).

For the Snake River Plain Aquifer, the concentrations measured in the 1995 study are primarily related to the past disposal of waste through the INTEC injection well. The injection well was drilled to a depth of 598 feet (DOE 1993) and was routinely used for disposal of service waste water through 1984, and permanently closed by pressure grouting in 1989. An estimated 22,000 curies of radioactive contaminants were released through the injection well. Most of the radioactivity is attributed to tritium (96 percent). Americium-241, technetium-99, strontium-90, cesium-137, cobalt-60, iodine-129, and plutonium contribute the remaining radioactivity.

Figures 4-1***3***, 4-1***4***, and 4-1***5*** show the 1995 distribution of tritium, strontium-90, and the 1990-1992 distribution of iodine-129 in the aquifer beneath INEEL, respectively (DOE 1997). ***The figures were not updated for 2001 due to the limited data set available for contouring groundwater in 2001 (DOE 2002b).*** Additionally, Table 4-***20*** shows the general trend of decreasing concentrations of these radionuclides over time ***including the most current data from 2001***. The combined tritium disposal to infiltration ponds at INTEC and the Test Reactor Area from 1992 to 1995 averaged 107 curies per year, compared to 910 curies per year from 1952 to 1983 (DOE 1997). The tritium plume with a concentration exceeding 500 picocuries per liter (0.5 picocuries per milliliter) decreased from an area of 45 square miles in 1988 to about 40 square miles in 1991. Since 1991, the concentration has remained nearly unchanged. However, the higher concentration lines have moved closer to their origin at INTEC and the Test Reactor Area.

Prior to 1989, strontium-90 concentrations in the Snake River Plain Aquifer were decreasing. The concentrations from 1992 to ***2001*** have remained fairly constant. This is due to the migration of contamination from the near surface releases into the perched water bodies and subsequently into the Snake River Plain Aquifer (Rodriguez et al. 1997). When the Big Lost River flows the added infiltrating water will tend to reduce the concentrations observed in the Snake River Plain Aquifer due to dilution of the perched water bodies.

Iodine-129 was discharged to the aquifer until 1984 through the injection well previously described. More than 90 percent of the iodine-129 in the aquifer is from the injection well. Smaller contributions include the percolation ponds and contaminated soils. Measurements taken in 1990-1992 indicated the presence of iodine-129 in 32 of 51 wells at INTEC. The concentrations ranged from below the detection limit to 3.82 pCi/L (Rodriguez et al. 1997). ***In 2001, only 2 of 41 wells sampled detected iodine-129 above the maximum contaminant level. The two wells are located south of INTEC at the CFA landfill. In addition, iodine-129 was not detected in the sample analyzed from well USGS-46 as depicted in Table 4-20 (DOE 2002b).*** The Safe Drinking Water Act maximum contaminant level for iodine-129 is 1 pCi/L.

4.9 Ecological Resources

This section discusses the biotic resources of the INEEL including threatened, endangered, and sensitive species, and wetlands. Radioecology studies specific to INTEC are also discussed. A detailed description of INEEL ecology can be reviewed in the Ecological Resources section of Rope et al. (1993) and the SNF & INEL EIS, Volume 2, Part A, Section 4.9 (DOE 1995). ***However, DOE has updated Section 4.9.1, Plant Communities and Associations, with more recent information on range fires that occurred in 1999 and 2000.***

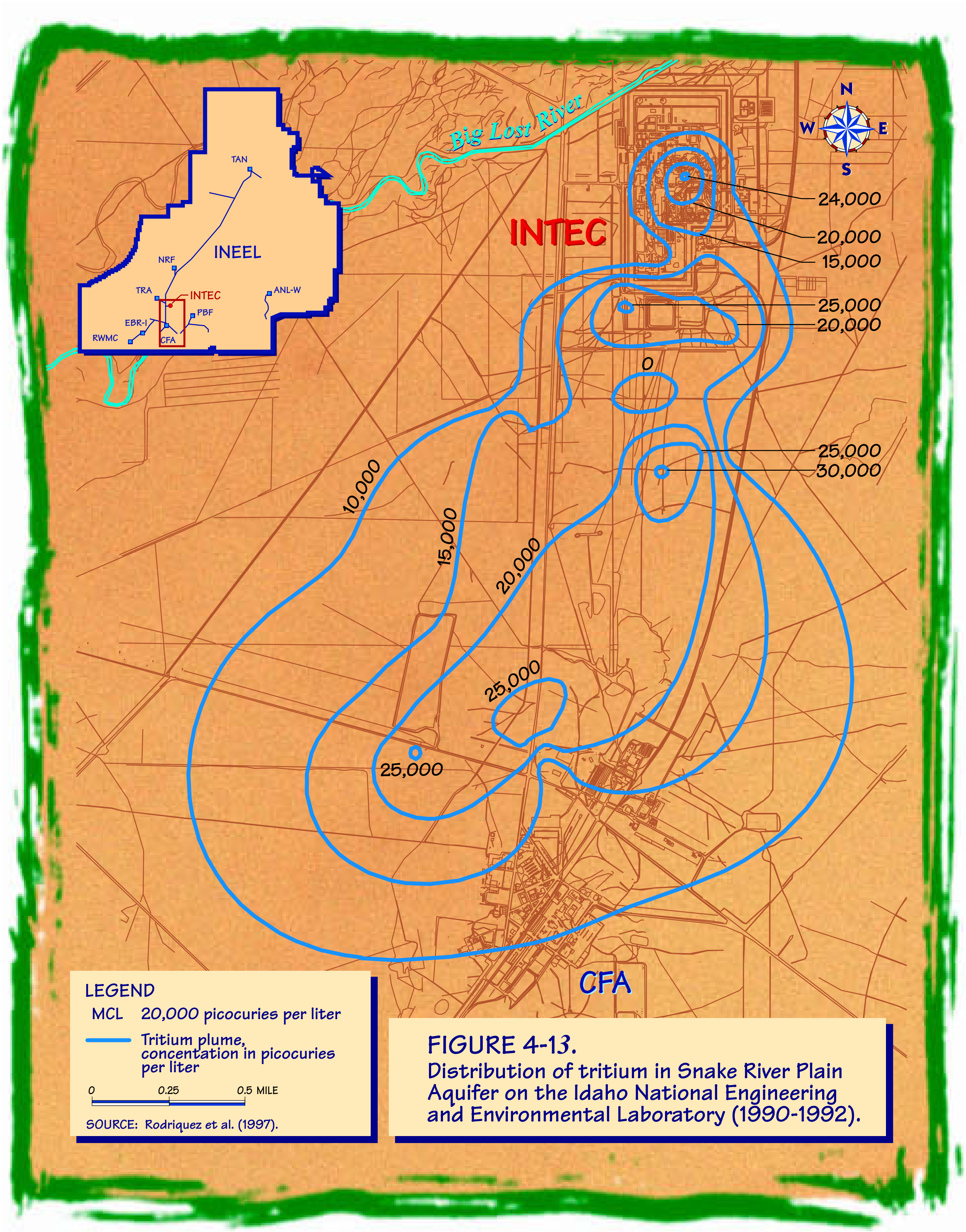


FIGURE 4-13.
Distribution of tritium in Snake River Plain Aquifer on the Idaho National Engineering and Environmental Laboratory (1990-1992).

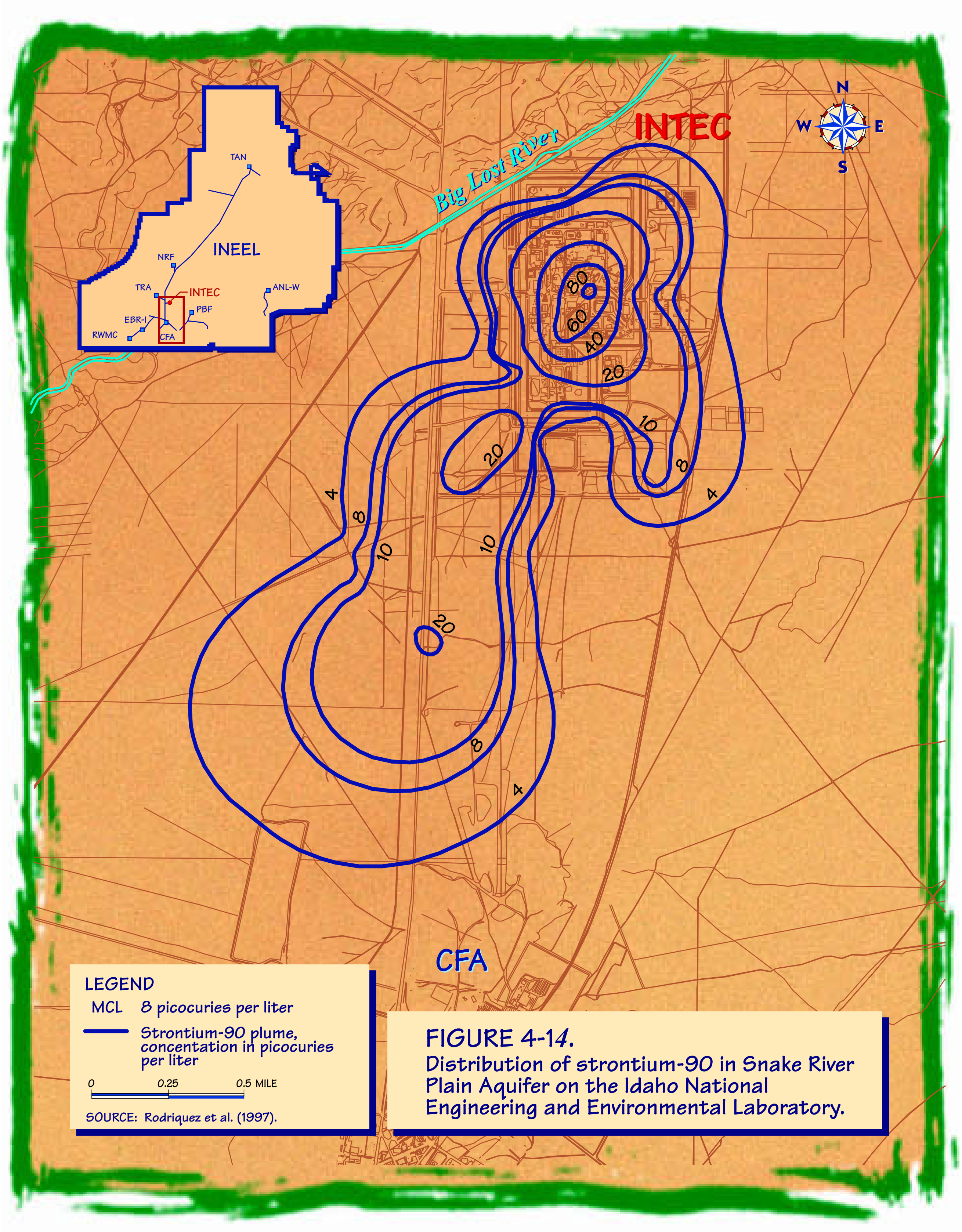


FIGURE 4-14.
Distribution of strontium-90 in Snake River Plain Aquifer on the Idaho National Engineering and Environmental Laboratory.

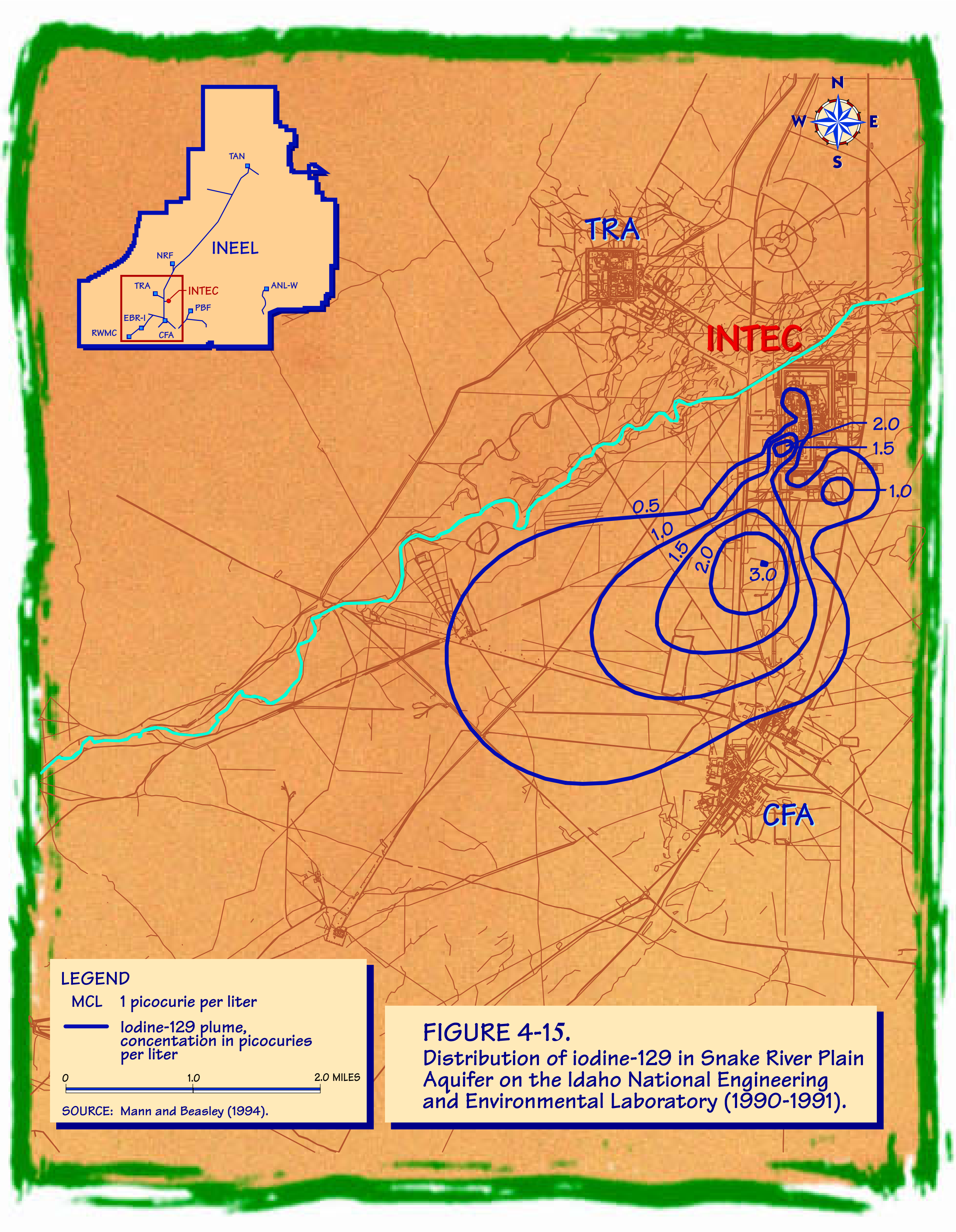


FIGURE 4-15.
Distribution of iodine-129 in Snake River Plain Aquifer on the Idaho National Engineering and Environmental Laboratory (1990-1991).