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).

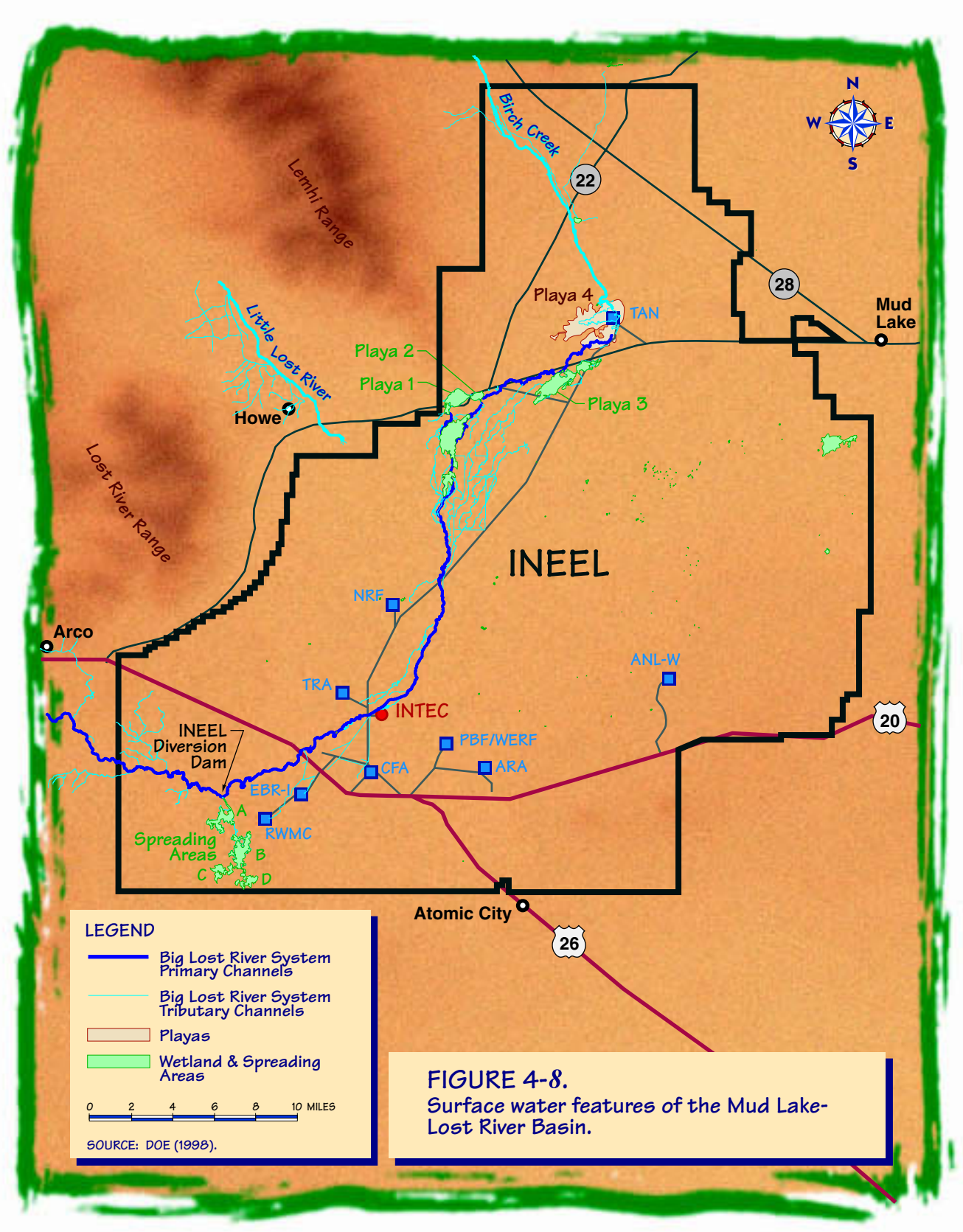

FIGURE 4-8.
Surface water features of the Mud Lake-Lost River Basin.

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-

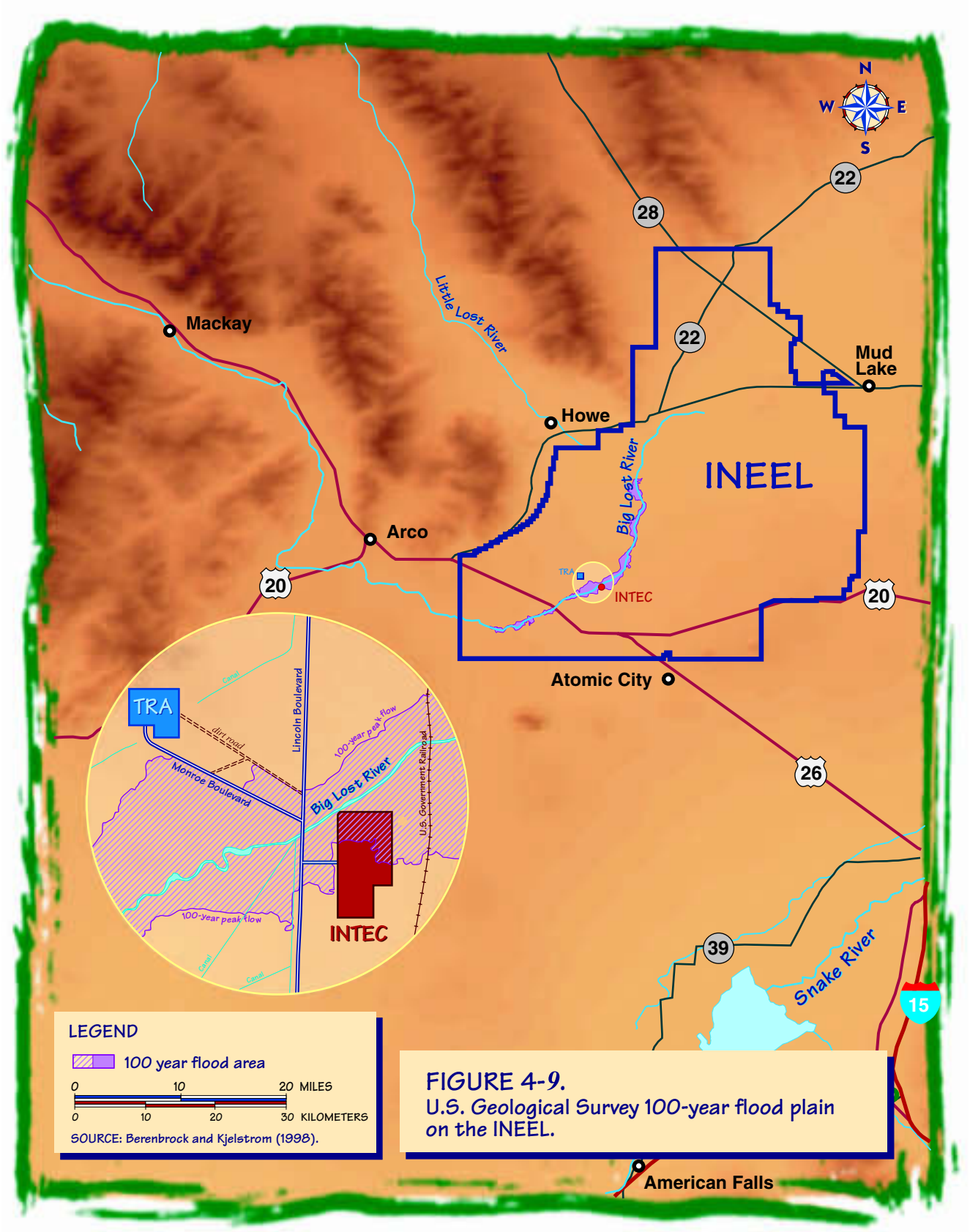

FIGURE 4-9.
U.S. Geological Survey 100-year flood plain on the INEEL.

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).***

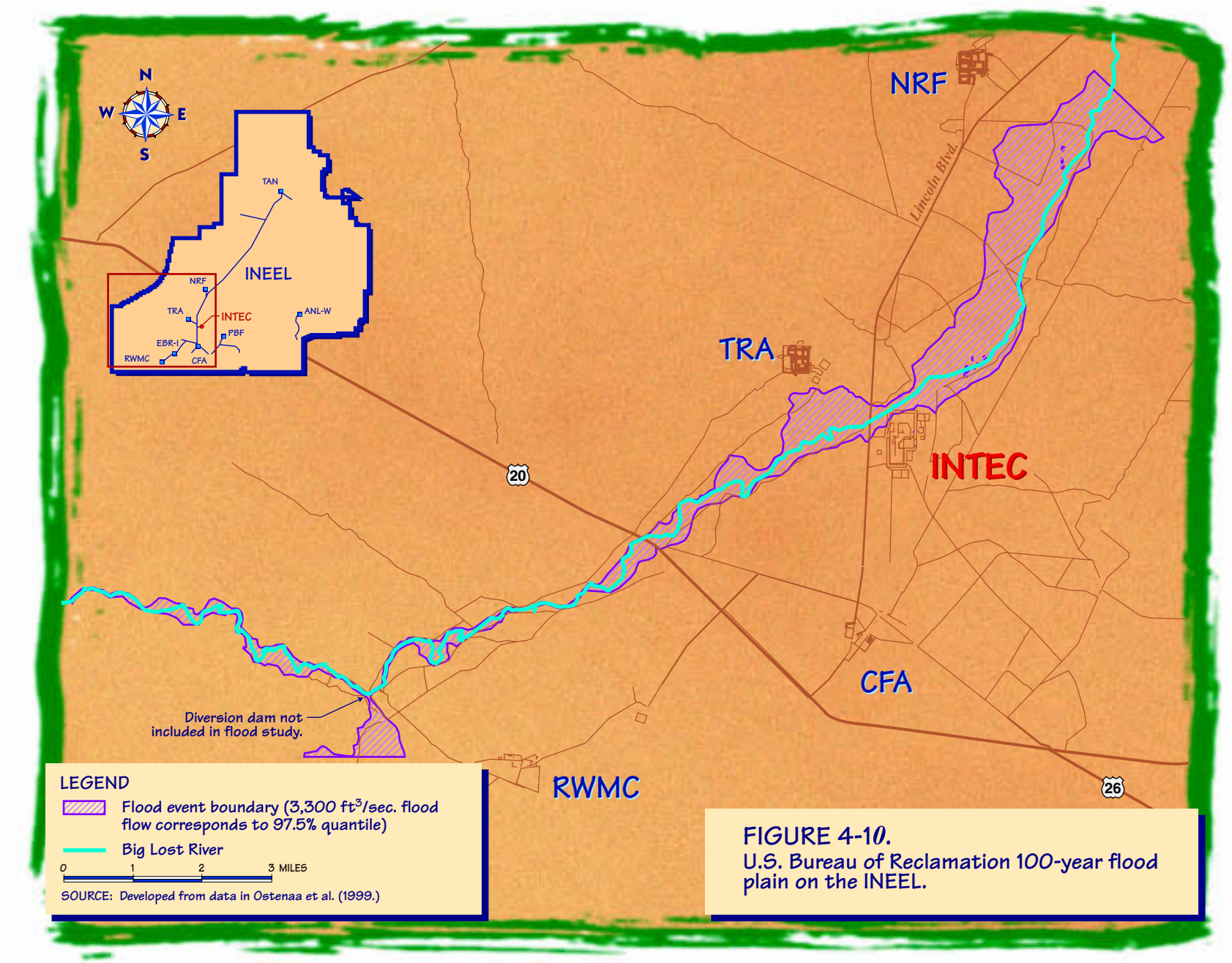

FIGURE 4-10.
U.S. Bureau of Reclamation 100-year flood plain on the INEEL.

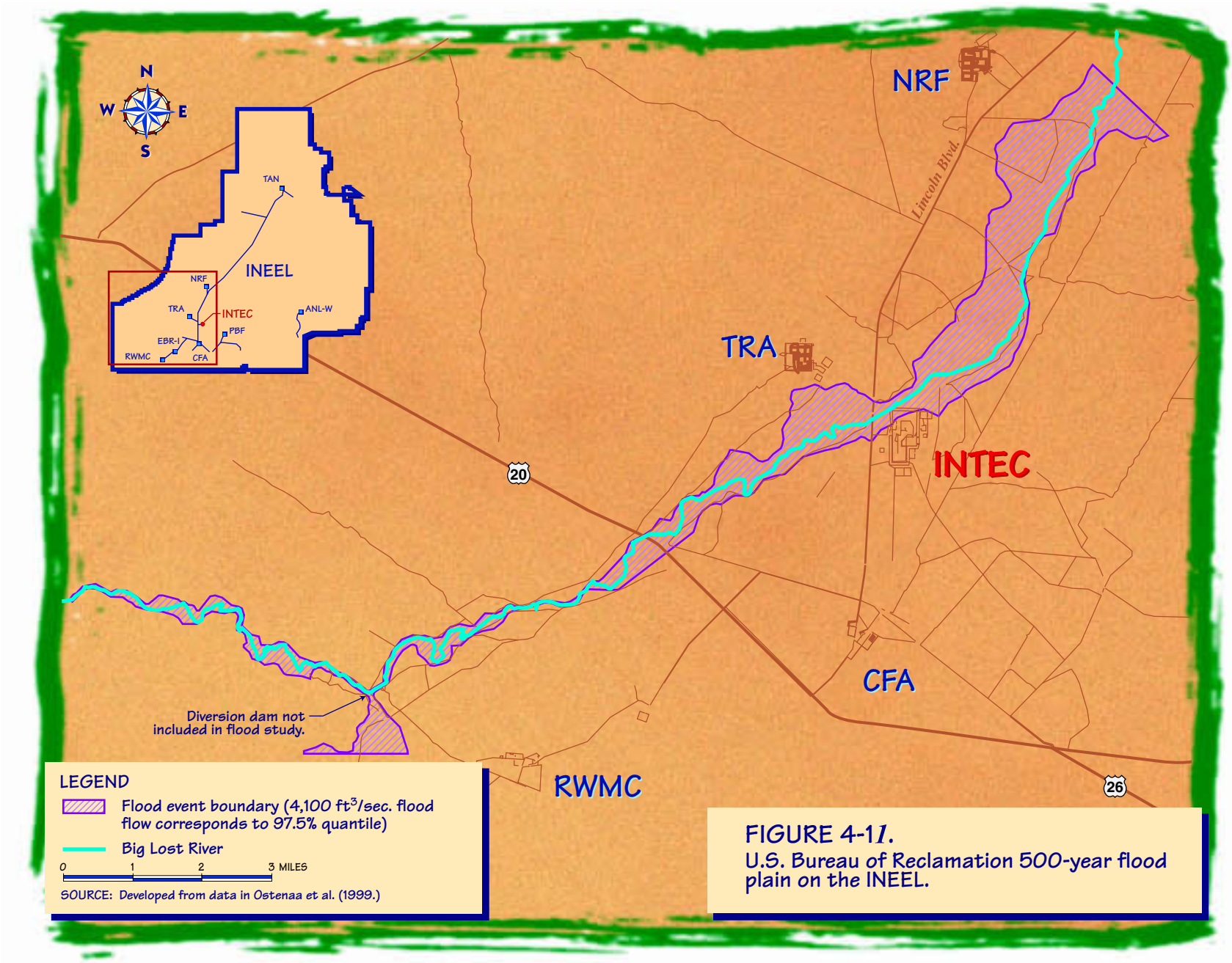

FIGURE 4-11.
U.S. Bureau of Reclamation 500-year flood plain on the INEEL.