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Revision 2

Idaho National Laboratory Comprehensive Land Use and Environmental Stewardship Report

July 2015

Idaho National Laboratory

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Idaho National Laboratory Comprehensive Land Use and Environmental Stewardship Report

Prepared by
INL Campus Development Office

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Infrastructure Optimization, Integration, and Planning
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EXECUTIVE SUMMARY

Land and facility use planning and decisions at the Idaho National Laboratory (INL) Site are guided by a comprehensive site planning process in accordance with U.S. Department of Energy Order 430.1B, "Real Property Asset Management," which outlines the vision and strategy to transform INL to deliver world-leading capabilities that will enable the U.S. Department of Energy to accomplish its mission. Land use planning is the overarching function within real property asset management that integrates the other functions of acquisition, recapitalization, maintenance, disposition, real property utilization, and long-term stewardship into a coordinated effort to ensure current and future mission needs are met.

All land and facility use projects planned at the INL Site are considered through a formal planning process that supports the INL Ten-Year Site Plan. This Comprehensive Land Use and Environmental Stewardship Report describe that process. The land use planning process identifies the current conditions of existing land and facility assets and the scope of constraints across the INL Site and in the surrounding region. Current land use conditions are included in this report and facility assets and scope of constraints are discussed in the Ten-Year Site Plan. This report also presents past, present, and future uses of land at the INL Site that are considered during the planning process, as well as outlining the future of the INL Site for the 10, 30, and 100-year timeframes.

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ACRONYMS

AEC	Atomic Energy Commission
ARA	Auxiliary Reactor Area
ATR	Advanced Test Reactor
BLM	Bureau of Land Management
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFA	Central Facilities Area
CITRC	Critical Infrastructure Test Range Complex
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
DOE-EM	U.S. Department of Energy Office of Environmental Management
DOE-ID	U.S. Department of Energy Idaho Operations Office
DOE-NE	U.S. Department of Energy Office of Nuclear Energy
EBR	Experimental Breeder Reactor
FFA/CO	Federal Facility Agreement and Consent Order
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
MFC	Materials and Fuels Complex
NRF	Naval Reactor Facility
NRTS	National Reactor Testing Station
R&D	research and development
REC	Research and Education Campus
RWMC	Radioactive Waste Management Complex
SNF	spent nuclear fuel
TAN	Test Area North
TYSP	Ten-Year Site Plan
USFWS	U.S. Fish and Wildlife Service
WAG	Waste Area Group

Idaho National Laboratory Comprehensive Land Use and Environmental Stewardship Report

1. BACKGROUND

The land that comprises the Idaho National Laboratory (INL) Site has experienced a long and varied history. Located in a high desert area (about 5,000-ft elevation) known as the Snake River Plain, the INL Site has served both prehistoric and modern man. For thousands of years, prehistoric Native American populations, consisting of nomadic hunter/gathers, moved through the area seasonally as part of their annual subsistence round, exploiting available wildlife and plant resources. Modern use of this land changed in 1943 when the site was selected as an artillery test range in support of World War II military activities and was referred to as the Naval Proving Ground. The National Reactor Testing Station (NRTS) was later created in 1949 when the Atomic Energy Commission (AEC) selected the Naval Proving Ground site as its location to perform safety tests on a variety of nuclear reactors. Over the years, 52 nuclear reactors were constructed and tested at the INL Site and thousands of experiments and tests were performed, resulting in production and accumulation of hazardous and radioactive materials.

Today, INL is a science-based, multi-program national laboratory dedicated to supporting U.S. Department of Energy (DOE) missions in nuclear and energy research, science, and national defense. The mission of INL is to ensure the nation's energy security with safe, competitive, and sustainable energy systems and unique national and homeland security capabilities. INL's vision is to be the preeminent nuclear energy laboratory with synergistic, world-class, multi-program capabilities and partnerships.

DOE's vision is that INL will do the following:

- Become the preeminent, internationally recognized nuclear energy research, development, and demonstration laboratory
- Become a major center for national security technology development and demonstration
- Become a multi-program national laboratory with world-class capabilities
- Foster academic, industry, government, and international collaborations to produce the investment, programs, and expertise needed to ensure this vision.

Ongoing operations at INL include separate missions for DOE's Office of Environmental Management (DOE-EM) and Office of Nuclear Energy (DOE-NE) research and security. DOE-NE activities are generally focused on nuclear energy research, sustainable energy systems, and unique national and homeland security that will transform INL into the preeminent nuclear energy laboratory. DOE-NE activities are managed by Battelle Energy Alliance, acting on behalf of DOE as the INL landlord.

DOE-EM activities are generally focused on waste management of various hazardous and radioactive materials, spent nuclear fuel (SNF) management, and environmental remediation of contaminated soils and groundwater sites, primarily from legacy projects at the INL Site. DOE-EM activities are currently carried out through the Idaho Cleanup Project that is managed by CH2M-WG Idaho, LLC for DOE-EM.

2. LAND USE PLANNING

Land use planning is the overarching function within real property asset management that integrates the other functions of acquisition, recapitalization, maintenance, disposition, real property utilization, and long-term stewardship into a coordinated effort to ensure current and future mission needs are met. To achieve their full potential, DOE sites are given, under the life-cycle asset management approach, the responsibility of tailoring the process to local conditions and to existing activities that impact planning for DOE's land and facility assets.

The INL Site has tailored their land use planning process based on DOE Order 430.1B, "Real Property Asset Management." Briefly, all projects planned at the INL Site are considered through a formal planning process (Figure 1). The planning process includes land use committees from both DOE-NE (through Battelle Energy Alliance) and the DOE Idaho Operations Office (DOE-ID). Requests are submitted to DOE-NE (via the Campus Development Office), which uses a standard consideration process to look at mission goals, existing and past uses, resources of concern, and many other factors in relation to the requested project. The Facilities Information Management System database and iMap play an important role in this planning process because multiple data and information sources can be evaluated in detail when considering a project. Both DOE and the contractor have a land use committee. These committees, composed of individuals representing the interests of DOE-NE and DOE-EM, review proposals that may have an impact on the INL Site lands and issue recommendations to senior leadership, who make the final decision on the proposed project.

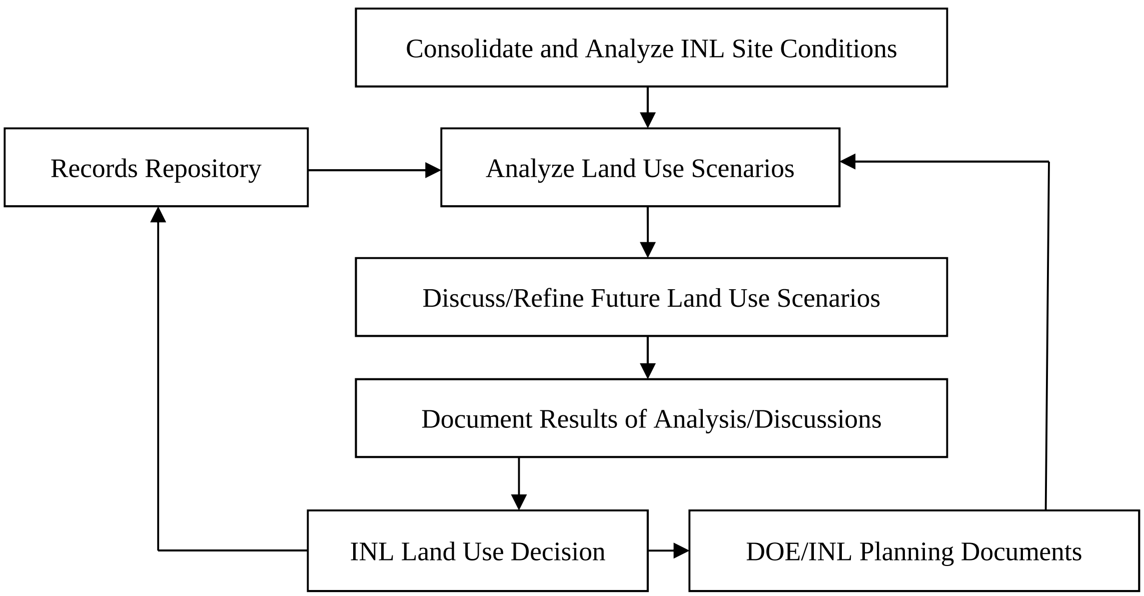

Figure 1. Summary of land use planning process.

Section 3 of this report presents the past, present, and future uses of land at the INL Site that are considered during this planning process. Section 4 presents a number of resources that are considered during the planning process. The maps in Section 4 are presented for informational purposes only; detailed geographic information system layers would be used to produce site-specific maps for the proposed project area.

2.1 Department of Energy Order 430.1B

The planning process for each site will guide land and facility use decisions. The INL produces a *Ten-Year Site Plan* (TYSP), in accordance with DOE Order 430.1B, which states that the results of real property asset site planning and performance must be documented in a TYSP that is kept current and covers a 10-year planning horizon. INL will deliver the Fiscal Year (FY) 2015 TYSP in July 2015. The updated TYSP will document the vision and strategy for transforming INL to deliver world-leading capabilities that will enable DOE-NE to accomplish its mission.

The TYSP describes the approach for managing real property assets to meet DOE-NE's mission as outlined in DOE strategic plans. These plans include the *Nuclear Energy Research and Development*

Roadmap (DOE 2010a) and the *Facilities for the Future of Nuclear Energy Research: A Twenty-Year Outlook* (DOE 2009). The 2010 DOE-NE Roadmap established DOE-NE's principal mission as advancing nuclear power as a resource capable of making major contributions in meeting the nation's energy supply, environmental, and energy security needs.

The TYSP provides a long-term vision that clearly links the research and development (R&D) mission goals and infrastructure requirements (single and multi-program) to the INL core capabilities; establishes the 10-year, end-state vision for the three primary INL campuses; and identifies and prioritizes capability gaps, as well as proposes efficient and economic approaches to closing those gaps. The 2015 update to the TYSP incorporates the updated and DOE-NE-approved core capabilities developed in support of the DOE National Laboratory Operations Board infrastructure assessment. The TYSP links DOE-NE's R&D mission goals to the INL core capabilities and infrastructure, evaluates current asset condition, and identifies and prioritizes infrastructure and capability gaps, as well as the most efficient and economic approaches for closing those gaps. The TYSP proposes an infrastructure that can be maintained within projected funding levels and builds on the existing infrastructure, where possible, before building new, stand-alone facilities and capabilities.

With the TYSP, INL has institutionalized a planning effort that has identified the needs for additional facilities in each of the three campuses over the next 20 years. In some instances, activities to establish these capabilities are well underway, have been approved by DOE-NE, or are proposed within the 10-year window of the TYSP. In other instances, a potential need for capabilities and facilities has been identified; however, the data are not mature enough to include in the TYSP. All proposed projects are subject to National Environmental Policy Act analysis.

The comprehensive land use planning process identifies the current condition of existing land and facility assets and the scope of constraints across the INL Site and in the surrounding region. Current land use conditions are included in this *Comprehensive Land Use and Environmental Stewardship Report*; facility assets and the scope of constraints are discussed in the TYSP.

2.2 Stakeholder Participation

The comprehensive land use planning process described in DOE policy and guidance encourages stakeholder involvement to provide diverse ideas and values in all phases. This report maintains the basic land use tenets and land planning assumptions that existed in the Comprehensive and Facility Land Use Plan that underwent extensive public review and approval, as well as bringing in new assumptions from the TYSP.

This will be used as a communication tool to support TYSP implementation. All proposed projects are subject to National Environmental Policy Act and its public involvement processes. In addition, land use plans will be available to the public, including federal, tribal, state, and local stakeholders sharing an interest in INL Site land use. Land use planning will remain a current and living process by using adaptive management techniques that adjust management practices and direction to changes in environmental, mission, economic, cultural, and social factors.

2.3 Assumptions and Environmental Considerations

When developing long-term land use scenarios, assumptions must be made to provide a basis on which future development patterns can be formulated. The intent of these assumptions is to address the inherent uncertainty that is associated with future events. Over time, these assumptions may require modification as unanticipated events occur or conditions change.

Several considerations formed the basis for current INL Site land use planning assumptions. These include prior land use planning assumptions from the original Comprehensive and Facility Land Use Plan, public input from the INL Site Environmental Management Citizens Advisory Board and the Environmental Management Site-Specific Advisory Board, and incorporation of DOE and the INL Site management team's strategic vision for the INL Site. The following planning assumptions are based on planning assumptions developed in the original Comprehensive and Facility Land Use Plan:

- INL will achieve its vision of becoming the preeminent nuclear research, development, and demonstration laboratory, a major center for national security technology development and demonstration, and remain a multi-program national laboratory.
- The INL Site and its associated 2,303 km^2 (889 mi^2) will remain under federal government management and control through at least the year 2095.
- Portions of the INL Site will remain under federal government management and control in perpetuity.
- The DOE-EM footprint will be reduced at the INL Site as the DOE-EM cleanup mission continues to completion in the year 2035.
- New buildings will be constructed to provide state-of-the-art research capabilities that are necessary to fulfill the INL Site mission.
- New building construction may include structures in existing facility areas and construction of new facility areas.
- To the extent practical, new building construction will be encouraged in existing facility areas (i.e., the Research and Education Campus [REC] in Idaho Falls and the Advanced Test Reactor [ATR] Complex and the Materials and Fuels Complex [MFC] at the INL Site) to take advantage of existing infrastructure.
- Construction of new facility areas should occur in the identified core infrastructure areas.
- As the INL Site implements its mission, R&D advancements will result in obsolescence of existing buildings.
- As contaminated facility areas become obsolete, environmental remediation, decommissioning, and decontamination will be required.
- The environmental remediation, decommissioning, and decontamination process will be completed in accordance with the existing regulatory structure.
- The federal government will authorize and appropriate sufficient funds to provide adequate controls (i.e., institutional controls or engineered barriers) for areas that pose a significant health or safety risk to the public and workers until the risk diminishes to an acceptable level for the intended purpose.
- Regional economic development is closely related to the activities of the INL Site. The significance of the INL's Site influence on the region depends on the diversity and strength of the regional economy.
- Cooperative partnerships between the public and private sectors may be developed to support modernization and expansion of the INL Site R&D facilities.
- In accordance with DOE Order 144.1, Administrative Change 1, "Department of Energy American Indian Tribal Government Interactions and Policy," DOE recognizes that a trust relationship exists between federally recognized tribes and DOE. DOE will consult with tribal governments to ensure that tribal rights and concerns are considered prior to DOE taking actions, making decisions, or implementing programs that may affect the tribes.
- No residential development will occur within INL Site boundaries, although potential development may occur in Idaho Falls.
- Grazing will be allowed to continue on the INL Site in designated areas.

- DOE-ID has a Candidate Conservation Agreement with the U.S. Fish and Wildlife Service (USFWS) to protect greater sage-grouse and its habitats on the INL Site.
- To protect human health and the environment, INL Site operations, including onsite disposal, will remain in full compliance with applicable environmental laws, regulations, and other requirements.

In addition to the assumptions listed above, the following underlying assumptions from the TYSP also were considered when contemplating the capabilities necessary to support the DOE-NE Roadmap and desired end-state in 2022:

- The INL Site will continue to manage its infrastructure as a shared national resource and expand the user facility concept to encompass the broader capabilities of the INL Site beyond fuels and materials.
- Out-year budget profiles will remain relatively constant for all major entities at the INL Site (i.e., DOE-NE, DOE-EM, and DOE Office of Naval Reactors).
- The number of uncleared, onsite visitors and collaborative partners will grow, increasing the need for unrestricted access to experimental capabilities and data visualization in an open campus environment as much as possible within REC (e.g., Center for Advanced Energy Studies, a proposed new National Scientific User Facility building, the Energy Systems Laboratory, and the planned Research Education Laboratory).

It is assumed further that during the planning process, potential impacts to resources and uses that may be affected by implementation of a project will be considered. The planning process will typically consider existing resources/environmental characteristics (e.g., topography, bedrock geology, surface soils, water resources, biota, and cultural resources; existing uses of the land; and natural hazards) wildland fires, floodplains, and seismicity. These resources are described in Section 4 of this report. Analysis of potential impacts to these resources will occur on a site-specific basis through the National Environmental Policy Act process or other available avenues.

3. LAND USE

3.1 Location

The INL Site is located in southeastern Idaho where it occupies approximately 2,303 km^2 (889 mi^2) (Figure 2). The property of the INL Site lies within five southeastern Idaho counties: Bingham, Bonneville, Butte, Clark, and Jefferson (Figure 2). The INL Site measures approximately 58 km (36 mi) from north to south and approximately 58 km (36 mi) from east to west at its broadest point. The INL Site is 212 km (132 mi) southwest of Yellowstone National Park, 72 km (45 mi) northwest of the Fort Hall Indian Reservation, 377 km (234 mi) north of Salt Lake City, Utah, and 319 km (198 mi) east of Boise, Idaho. The eastern boundary of the INL Site is 39 km (24 mi) west of Idaho Falls, Idaho. In addition to the site, INL currently maintains a number of buildings within the City of Idaho Falls, Idaho. The functions performed at these facilities include basic research, applied engineering, and administrative services.

The land that comprises the INL Site has experienced a long and varied history that ranges from prehistoric times, when it was inhabited by nomadic groups of Native Americans, to modern times, where it is the location of a world-class nuclear research center. A detailed history of the INL Site was compiled by Susan Stacy in *Proving the Principle — A History of the Idaho National Engineering and Environmental Laboratory 1949–1999* (Stacy 2000). Information from that compilation and the "INL Cultural Resource Management Plan" (DOE/ID-10799) is presented in the following sections.

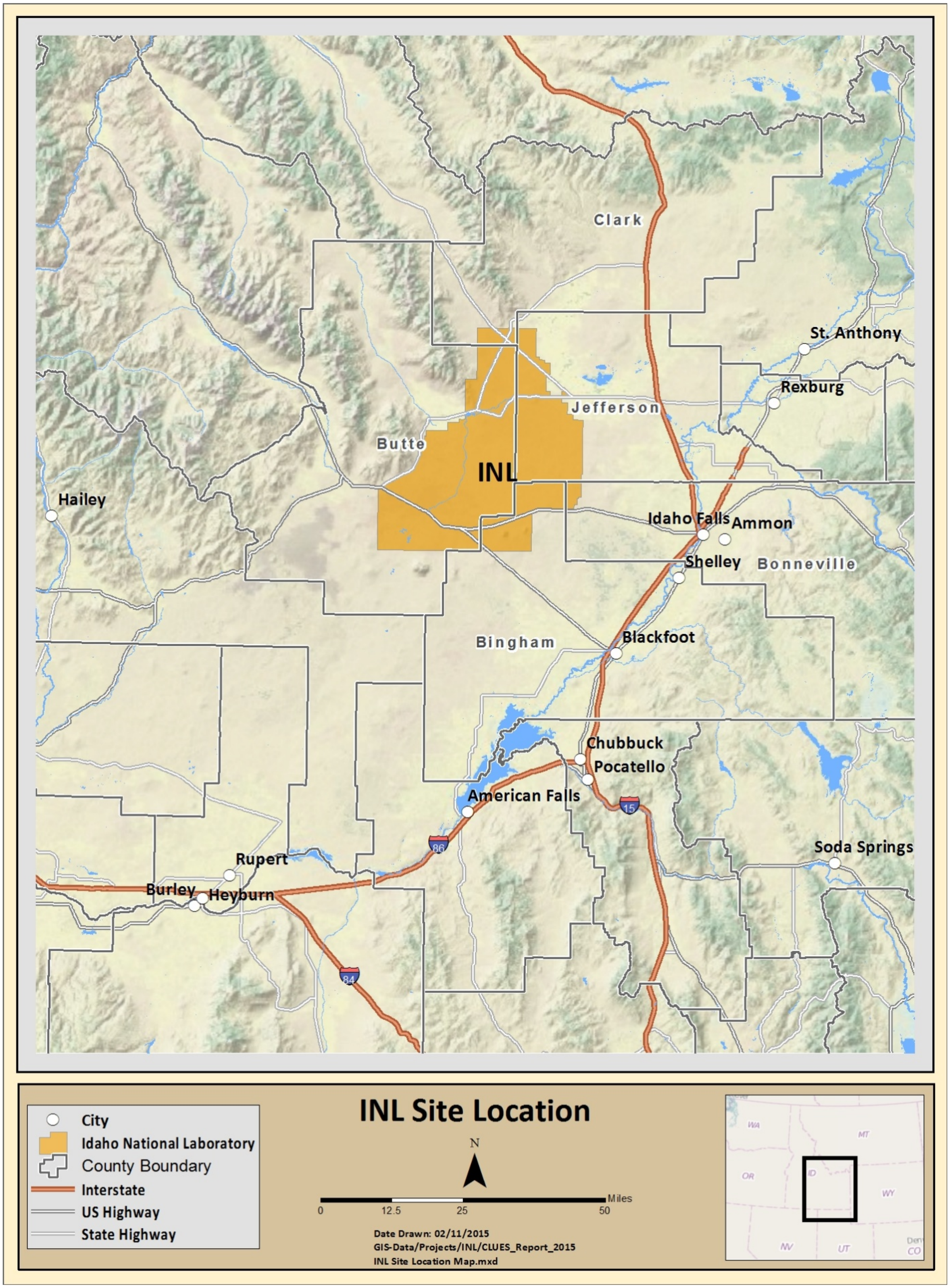

Figure 2. Idaho National Laboratory Site location.

3.2 Historical Land Use

3.2.1 Land Acquisition History

The boundary of the current INL Site was created through several land transfers. Beginning in 1943, the U.S. Department of the Navy withdrew a 61,609-hectare (152,238-acre) area from public domain. This area was commissioned as the Naval Proving Ground on August 2, 1943. In January 1949, an additional 231 hectares (571 acres) were withdrawn.

On February 18, 1949, AEC, a predecessor agency to DOE, approved the Idaho site as its new NRTS. That same year, AEC increased the size of the new NRTS and began important nuclear energy research and engineering. By 1950, jurisdiction over land within the Naval Proving Ground had been transferred from the Navy to AEC and an additional 94,161 hectares (232,678 acres) had been transferred from the public domain to AEC for use in atomic energy R&D. Over the next 10 years, AEC made additional land acquisitions. In 1958, a withdrawal of about 48,702 hectares (120,345 acres) was made and added to the INL Site lands, bringing the total land withdrawn from the public domain to 204,703 hectares (505,832 acres) (which is 89% of the current-day INL Site). In 1974, changing missions led the NRTS reserve to be renamed the Idaho National Engineering Laboratory. In 1975, the Energy R&D Administration replaced AEC and, in 1977, DOE replaced the Energy R&D Administration.

At the INL Site, public land owned by the federal government is administered by the U.S. Department of Interior. As such, the Bureau of Land Management (BLM) has certain administrative responsibilities, including administration of grazing permits on the land; granting utility rights-of-way across the land; extracting materials; and controlling wildfires, weeds, insects, and predators.

Congress has authorized the Department of Interior to “withdraw,” or set aside, public land to meet the needs of federal agencies such as DOE. Withdrawals occur through a mechanism known as a public land order. The INL Site lands were withdrawn from the public domain through Public Land Orders No. 318, 545, 637, and 1770. The public land orders do not have specific time limitations; therefore, authority to administer these lands is expected to remain with DOE for the foreseeable future.

In addition to the land that was withdrawn from the public domain, several parcels of state-owned land (8,623 hectares [21,308 acres]) and land from private parties (15,713 hectares [43,275 acres]) were obtained to form the intact land area comprising the current boundaries of the INL Site.

The eastern boundary of the INL Site changed slightly in the late 1970s and again in the mid-1990s. The first change was made to compensate farmers who had lost productive farmland because of the catastrophic failure of the Teton Dam. The second change involved the sale of land to Jefferson County for a regional landfill. For both of these transfers, DOE relinquished that portion of their land withdrawal back to BLM, who, in turn, sold the land. The current-day INL Site land area consists of 230,321 hectares, or 569,135 acres (2,303 km^2 [889 mi^2]). Figure 3 illustrates land ownership status of the INL Site.

3.2.2 Prehistoric Uses

This unique environment’s most prominent physical feature consists of three volcanic buttes known as the Big Southern, Middle, and East Buttes. An abundance of lava rock located throughout the region provides further evidence of the area’s past volcanic activity. The Big Lost River and Birch Creek, along with early spring rains that variably fill the numerous playas, provide the necessary water to sustain wildlife populations. Many animals make their homes in the sagebrush-steppe habitat, including pronghorn, deer, elk, coyotes, bobcats, rabbits, rodents, reptiles, and many birds. Prehistorically, populations of now-extinct animals, including mammoth, bison, camel, and horse, also inhabited the area.

For thousands of years, human populations consisting of nomadic hunters/gatherers moved through the area seasonally as part of their annual subsistence round, using available wildlife and plant resources. Their activities here have been well-documented and cultural evidence consisting of campsites and associated artifacts are numerous and scattered non-randomly on the landscape (DOE-ID 2004). Additional information concerning the cultural resources associated with these lands is included in Section 4.16.1.

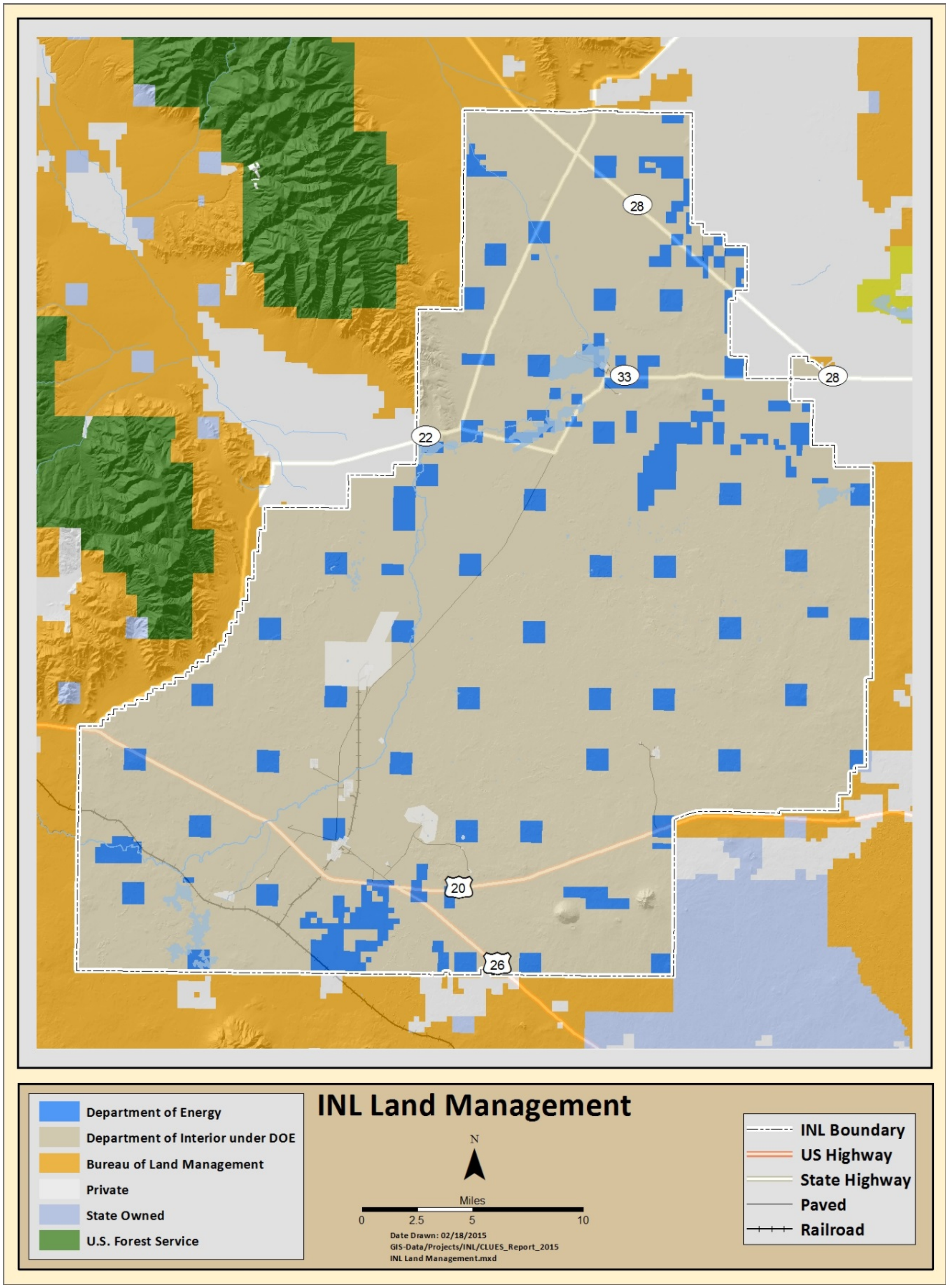

Figure 3. Idaho National Laboratory land management.

3.2.3 Naval Proving Grounds

A 702-km^2 (271-mi^2) area was withdrawn from public domain on August 2, 1943, and commissioned by the U.S. Department of the Navy as the Naval Proving Ground. This site was used as an artillery test range in support of World War II military activities. Sixteen-inch diameter battleship guns, along with 3 and 5-in. diameter guns from the Pacific Fleet, were shipped to the Naval Ordnance Plant in Pocatello, Idaho, where they were relined and re-rifled. The Navy needed an area where they could be test fired after being refurbished. INL Site land was used from 1943 through 1947 for testing of these weapons, with a significant amount of Navy artillery being fired across various portions of the site. This testing resulted in deposition of large numbers of both exploded and unexploded ordnance in various regions of the site. Beginning in August 1944 and continuing through 1946, stationary explosive testing was conducted for the Army-Navy Safety Board, now called the U.S. Department of Defense Explosives Safety Board. The tests were critical in assisting with modification of the U.S. Explosive Safety Quantity-Distance Standards that were originally developed in 1928. In April 1947, the Naval Proving Grounds were designated as the depot for stockpiling of surplus manganese for the U.S. Treasury and additional non-nuclear ordnance testing continued until AEC took over the land from the Navy in 1949.

In support of artillery and explosives testing, a portion of the land was used for support services and residences. A rail service center was established to deliver materials and equipment to the site from Pocatello. In addition, small houses and barracks were built for the permanent officers, their families, and ordnance workers, and a red brick barrack housed the Marines who guarded the Naval Proving Ground. Workshops, storage buildings, a security building, and cafeteria also were constructed to support operations at this remote location. This center was named Scoville after Navy Commander John A. Scoville, who was the officer in charge of construction at the test site.

In support of the Vietnam War, the U.S. Navy decided to reline a number of the 16-in. barrels on its battleships. To accomplish this relining, the Naval Ordnance Plant in Pocatello was reactivated to fabricate the new liners. From 1968 to 1970, the relined barrels were test fired toward the Big Southern Butte from an area south of Highway 20 and the Central Facilities Area (CFA).

During World War II, two high-altitude aerial bombing ranges were located adjacent to the Naval Proving Ground. B-24 Liberators and, later in the war, B-17 Flying Fortresses flew north from the Pocatello Army Air Base and dropped 100-lb test sand bombs on and near pyramid-shaped targets. The remnants of the sand bombs are scattered south and southeast of MFC on both sides of Highway 20 and near the Big Lost River several miles to northwest of the Radioactive Waste Management Complex (RWMC).

3.2.4 National Reactor Testing Station

NRTS was created in 1949 when the newly formed AEC selected the Naval Proving Ground site as its location to perform safety tests on a variety of nuclear reactors. The Idaho site's conditions (i.e., remote, yet well serviced via the railroad spur to the Scoville center) satisfied the needs of AEC. The site's large size allowed nuclear power test reactors to be located far enough apart to support various safety tests without adversely affecting other facilities.

Over the years, 52 different nuclear reactors were constructed at NRTS. Additional information about these nuclear reactors is available on INL's webpage (INL 2011). In general, these reactors were used in tests to determine the viability of nuclear power and their performance and response to severe accident conditions. Because of the nature of the testing, the prevailing strategy of the time was to isolate the test reactor facilities away from other operations. An example of this strategy is evidenced at the Experimental Breeder Reactor-I (EBR-I). On December 20, 1951, EBR-I made history by producing the first usable amounts of electricity from atomic energy. Today, EBR-I is preserved as a National Historic Landmark site.

In addition to reactor viability, performance, and safety, testing at the NRTS heavily focused on other aspects of nuclear technology. Much of this work was performed at the Test Reactor Area (now the ATR Complex), the Idaho Chemical Processing Plant (now the Idaho Nuclear Technology and Engineering Center [INTEC]), and Test Area North (TAN).

3.2.5 National Laboratory

The NRTS became the Idaho National Engineering Laboratory in 1974, reflecting the site's multi-program national laboratory status. This designation highlighted the broad range of technical activities conducted at the site. This work included large engineering system testing and demonstration work, as well as national security and environmental restoration work. In 1975, the Idaho National Engineering Laboratory was designated as a National Environmental Research Park, recognizing the ecological diversity and research potential of the large and relatively undisturbed land area included within its boundaries.

In 1997, the site was renamed the Idaho National Engineering and Environmental Laboratory to reflect the major environmental management effort occurring at the site. Environmental restoration efforts included locating and removing ordnance left from the Naval Gunnery Range, nuclear facility decontamination and decommissioning (D&D) from the NRTS, waste management of various hazardous and radioactive materials, SNF management, and environmental remediation of contaminated soils and groundwater sites.

In 1999, the U.S. Secretary of Energy designated a large portion of the Idaho National Engineering and Environmental Laboratory as a "Sagebrush-Steppe Ecosystem Reserve," recognizing the important and largely undisturbed natural resource inventories located there.

In February 2005, with separation of the national laboratory and environmental restoration missions into two separate contracts, the Idaho National Engineering and Environmental Laboratory was renamed INL, its current designation. At that time, the research capabilities of the Idaho National Engineering and Environmental Laboratory and Argonne National Laboratory-West were combined. Operation of the INL Site and the environmental restoration efforts were split into two contracts to allow each mission to remain focused. Battelle Energy Alliance, LLC was selected by DOE to manage the site through 2015 and transform it into the preeminent nuclear energy laboratory. DOE recently exercised an option in the original 10-year contract to extend the Battelle Energy Alliance contract an additional 5 years. CH2M-WG Idaho, LLC, was selected by DOE to manage the environmental restoration operations at the site through 2015.

3.3 Current Operations

Operations at INL currently take place at facilities scattered across the INL Site and in Idaho Falls (Figure 4). This section describes the primary regulatory agreements and permits that govern operations and summarizes the cleanup activities and mission-related operations taking place at the INL Site.

3.3.1 Regulatory Agreements and Permits

Current INL Site operations include environmental remediation and ongoing research, testing, and development activities that are conducted pursuant to regulatory agreements and permits. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, was enacted by Congress on December 11, 1980, and governs environmental remediation, including remediation of federal facilities such as the INL Site.

The INL Site was placed on the National Priorities List in November 1989. This required DOE to enter into a Federal Facility Agreement and Consent Order (FFA/CO) with the Environmental Protection Agency and the State of Idaho for effective management of the INL Site. The INL Site FFA/CO was signed December 9, 1991. Among other things, the purpose of the FFA/CO is to ensure that the environmental impacts associated with historical releases of hazardous and radioactive contaminants into the air, groundwater, and soils of the INL Site from projects supporting Cold War activities over the last 50 years are thoroughly investigated and that appropriate response actions are undertaken and completed as necessary to protect public health and welfare and the environment.

Figure 4. Idaho National Laboratory Site facilities.

A Settlement Agreement was signed on October 16, 1995, to resolve issues with the State of Idaho related to SNF and waste management. This Settlement Agreement detailed how DOE would specifically disposition transuranic waste, high-level waste, and spent fuel; it also identified deadlines for accomplishing these milestones. It includes a process for INL's receipt of SNF to prepare it for shipment outside of Idaho. It also recognizes DOE's commitment under the FFA/CO to complete all major environmental restoration activities for the INL Site.

Operating facilities at the INL Site are needed to fulfill its environmental management mission and to support the research, development, and testing mission. Operations are governed by hazardous waste and air quality permits issued by the State of Idaho. The hazardous waste permit contains requirements for each treatment, storage, and disposal unit located across the INL Site. Air quality permits are required prior to construction of major facilities; the INL Site also has received an air quality operating permit that addresses requirements for continuing operations of air emissions sources across the INL Site.

The INL Site also follows a Site Treatment Plan and Consent Order for development of capacity to treat mixed waste (i.e., hazardous and radioactive). The Site Treatment Plan and Consent Order implement the Federal Facility Compliance Act, which provides a framework for DOE sites to establish treatment capability for their mixed waste by planning, scheduling, and implementing treatment projects in accordance with enforceable milestones.

3.3.2 Comprehensive Environmental Response, Compensation, and Liability Act Waste Area Groups

An action plan was developed to implement the FFA/CO. For management efficiency of environmental remediation activities under the FFA/CO, the INL Site is divided into waste area groups (WAGs). WAGs 1 through 9 generally correspond to INL Site operational facilities (Figure 4), while WAG 10 corresponds to overall concerns associated with the Snake River Plain Aquifer, plus those surface and subsurface areas that are not included within the bounds of the facility-specific WAGs. A number of major environmental remediation efforts have been completed at the INL Site since signing the FFA/CO and others are ongoing. Each of the WAGs and their associated remedies and cleanup activities are briefly described in the following subsections. The current status of cleanup activities related to the WAGs can be accessed at the following website: http://ar.inel.gov. Environmental remediation work under the FFA/CO, including D&D activities, is conducted by the Idaho Cleanup Project contractor.

3.3.2.1 Waste Area Group 1 — Test Area North. WAG 1 is the TAN area located in the northern portion of the INL Site. In general, TAN consisted of facilities originally built for handling, storing, examining, researching, and developing SNF. It included the Technical Support Facility; Initial Engine Test Facility; Contained Test Facility, formerly the Loss-of-Fluid Test Facility; Specific Manufacturing Capability Facility; Water Reactor Research Test Facility; and the adjacent surface and subsurface areas where operations associated with these facilities may have taken place. The U.S. Air Force and AEC Aircraft Nuclear Propulsion Program, which supported nuclear-powered aircraft research, originally built TAN between 1954 and 1961. After that research was terminated in 1961, the major program at TAN was the Loss-of-Fluid Test, which performed reactor safety testing and behavior studies. The Loss-of-Fluid Test Program ended in 1985. However, beginning in 1980, the area also was used to conduct work with material from the Three-Mile Island reactor accident (that work was completed in 2001). The Process Experimental Pilot Plant, a facility originally built to determine the capabilities of processing transuranic waste destined for the Waste Isolation Pilot Plant, also was located there.

Establishment of remedial actions was completed for WAG 1 in 2007; D&D of the remaining facilities without an operational mission was completed in 2008. The remedy components that continue to be implemented for the contaminated groundwater plume beneath WAG 1 are in situ bioremediation, groundwater pump and treat, and monitored natural attenuation.

3.3.2.2 Waste Area Group 2 — Advanced Test Reactor Complex. WAG 2 is the ATR Complex, formerly the Test Reactor Area. The ATR Complex was established in the early 1950s in the southwestern portion of the INL Site and houses extensive facilities for studying the effects of radiation on materials, fuels, and equipment, including high-neutron-flux nuclear test reactors. Three major reactors have been built at the ATR Complex: (1) the Materials Test Reactor, which operated from 1952 to 1970; (2) the Engineering Test Reactor, which operated from 1957 to 1982; and (3) ATR, which began operations in 1967 and is the only major operational reactor within the ATR Complex.

Major remedial actions were completed at the ATR Complex in 1999. D&D of facilities without an operational mission was also completed at WAG 2, including the Engineering Test Reactor, the Materials Test Reactor, and the associated hot cells.

3.3.2.3 Waste Area Group 3 — Idaho Nuclear Technology and Engineering Center. WAG 3 is INTEC, formerly the Idaho Chemical Processing Plant, and is situated in the south-central portion of the INL Site. From 1952 until 1992, operations at INTEC were primarily related to the reprocessing of SNF from defense projects involving extraction of reusable uranium from spent fuels. After fuel dissolution and extraction, high-level liquid waste was stored in stainless steel underground tanks in the tank farm. The high-level liquid waste was calcined and the resultant granular solids (calcine) were stored in stainless steel bins encased in thick concrete vaults. In 1992, DOE announced that the reprocessing component of the INTEC mission would be phased out, which led to the phase-out of all related processes at INTEC. The current mission for INTEC is to receive and temporarily store SNF and radioactive waste for future disposition, manage waste, and perform remedial actions.

Known contaminant releases at WAG 3 are the result of SNF reprocessing; storage, research, and ancillary activities; and releases associated with the INTEC tank farm. Tank farm remediation is ongoing. The WAG 3 remedy includes the Idaho CERCLA Disposal Facility, which accepts CERCLA waste (primarily soil and debris) from cleanup at INTEC and other WAGs. Long-term monitoring of soil and groundwater is conducted. Activities continue to eliminate sources of water releases to the perched water zone. D&D of excess buildings also is being conducted as funds become available.

3.3.2.4 Waste Area Group 4 — Central Facilities Area. WAG 4 is CFA, which is situated in the south-central portion of the INL Site. CFA has been used since 1949 to house many of the support services for all operations at the INL Site. Functions housed at CFA include laboratories, security operations, fire protection, a medical facility, communication systems, warehouses, a cafeteria, vehicle and equipment pools, and the bus system. The types of CERCLA sites at WAG 4 included landfills, underground storage tanks, aboveground storage tanks, drywells, disposal ponds, soil contamination sites, and a sewage treatment plant.

Monitoring is conducted to evaluate the continued effectiveness of the remedy at WAG 4, which included installation of native soil covers over three former landfill sites. Data obtained as a result of this monitoring effort are used to evaluate the effectiveness of the landfill covers and to monitor for other potential contaminants that might be present in the groundwater from previous activities at CFA.

3.3.2.5 Waste Area Group 5 — Power Burst Facility/Auxiliary Reactor Area. WAG 5 is the Power Burst Facility/Auxiliary Reactor Area (ARA), which is located in the south-central portion of the INL Site. The Power Burst Facility area is the site of the Special Power Excursion Reactor Tests that examined nuclear reactor behavior under abnormal operating conditions and safety on light-water-moderated, enriched-fuel reactor systems from the late 1950s until 2004. It is comprised of five sub-areas.

The Special Power Excursion Reactor Test-I reactor operated from 1955 to 1964. It was decommissioned in 1964 and demolished in 1985. The Power Burst Facility replaced it in 1970. The Special Power Excursion Reactor Test-II reactor was operated from 1960 to 1964. After the reactor was removed, the facility was converted for research purposes and was later replaced by the Waste Engineering Development Facility/Waste Reduction Operations Complex Lead Storage Facility for the temporary storage of uncontaminated lead in outdoor cargo containers. The Special Power Excursion Reactor Test-III reactor operated from 1958 to 1968. The reactor building was decontaminated in 1982, and the building was modified to contain the Waste Experimental Reduction Facility incinerator. D&D of the incinerator was completed in 2003.

The fifth sub-area, the Control Area, was centrally located and was the Special Power Excursion Reactor Test reactor control center. It was later converted into administrative office space and included raw water storage and distribution facilities, mechanical work areas, and data acquisition resources.

The ARA also was an experimental reactor facility built in the 1950s. The ARA-I facility was built in 1957 to support the Stationary Low-Power Reactor No. 1. The Stationary Low-Power Reactor No. 1 was built at ARA-II in 1957 and operated intermittently from 1958 until it was destroyed by a nuclear accident in January 1961. At that time, ARA-I became the staging area for the emergency response to the 1961 Stationary Low-Power Reactor No. 1 reactor accident and cleanup. Construction of the ARA-III facility was completed in 1959 to house the Army Gas-Cooled Reactor Experiment research reactor. That reactor was deactivated in 1961 and the facility was modified in 1963 to support the ARA-IV reactor until the Army Reactor Program was phased out in 1965. The ARA-IV facility was built to accommodate the

Mobile Low-Power Reactor I and was active from 1957 until 1964. The Nuclear Effect Reactor at ARA-IV operated from 1967 to 1970. In 1999, D&D of ARA was completed.

The remedy for WAG 5 is in place. Long-term monitoring is conducted for locations that are controlled for contaminated soil. D&D activities have been completed. This portion of the INL Site has now been designated for use as the Critical Infrastructure Test Range Complex (CITRC).

3.3.2.6 Waste Area Group 6 — Experimental Breeder Reactor No. 1. WAG 6 is located in the southwestern portion of the INL Site and consists of EBR-I and the nearby Boiling Water Reactor Experiment Area, which includes the sites of five separate experimental reactors that are no longer used. Cleanup at WAG 6 included the Boiling Water Reactor Experiment-1 Burial Ground. Long-term monitoring is conducted to assess the continued effectiveness of the barrier over the site of the burial ground.

3.3.2.7 Waste Area Group 7 — Radioactive Waste Management Complex. WAG 7 is RWMC, which is located in the southwestern corner of the INL Site. It is divided into three separate areas according to function: the Subsurface Disposal Area, the Transuranic Storage Area, and the Administration area. Historical operations included disposal of transuranic waste and mixed waste, much of which was received from the Rocky Flats Plant nuclear weapons production facility in Colorado. Since 1970, the mission has been to dispose of low-level waste and to store, treat, and prepare stored transuranic waste for offsite shipment and disposal. Construction of the Advanced Mixed Waste Treatment Project expanded the RWMC waste management operations to include treating and preparing 65,000-m^3 of stored transuranic waste for shipment out of Idaho.

Remediation work at RWMC is being conducted in accordance with the 2008 Record of Decision for Operable Unit 7-13/14. Targeted waste retrieval and disposition continues at the Accelerated Retrieval Projects. In situ grouting of 21 locations has been completed. Subsurface solvent vapor extraction continues to operate. Environmental monitoring and institutional controls have been put in place. The final remedial actions will include construction of an evapotranspiration surface barrier over the Subsurface Disposal Area. Long-term surveillance, maintenance, monitoring, and institutional controls will preserve the integrity of the surface barrier, limit access, and enforce land use restrictions to ensure continued effectiveness of the remedy. Long-term management and control of RWMC will continue after construction of the surface barrier is complete and the remedy is declared operational and functional.

3.3.2.8 Waste Area Group 8 — Naval Reactors Facility. WAG 8, located in the west-central sector of the INL Site, is the Naval Reactors Facility (NRF). It is comprised of the Expended Core Facility buildings, three former prototypes used to train Navy personnel, laboratories, warehouses, technical and administrative support buildings, and craft shops. NRF was established in the early 1950s to support development of naval nuclear propulsion by carrying out several functions, including receipt and examination of navy SNF, examination of expended core components, development of material test specimens, and examination of irradiated material test specimens. NRF, although resident on the INL Site, operates as a special-purpose facility separate from other INL Site activities. The facility operates under the direct supervision of DOE’s Office of Naval Reactors.

All remedial actions were completed for WAG 8 by 2004 under two records of decision. Under the 1994 Record of Decision, engineered soil covers were constructed over three inactive landfill areas. Monitoring (i.e., soil-gas and groundwater), maintenance, and institutional controls were implemented to ensure the effectiveness of these remedies.

Under the 1998 Record of Decision, the removal of contaminated soil, concrete, and pipe; offsite disposal of debris; consolidation onsite of soils above remediation goals; and construction of engineered earthen covers was conducted at radiologically contaminated locations. Monitoring (i.e., soil moisture, and groundwater), maintenance, and institutional controls were also implemented. Five-year reviews are conducted for WAG 8 to assess the continuing protectiveness of the remedies.

3.3.2.9 Waste Area Group 9 — Materials and Fuels Complex. WAG 9 is MFC, formerly Argonne National Laboratory-West/EBR-II research reactor. It was established in the 1950s by AEC to support advanced nuclear reactor and nuclear fuel design and testing, including EBR-II. MFC is located in the southeastern portion of the INL Site.

All WAG 9 CERCLA remediation activities have been successfully completed and two CERCLA sites that contained radionuclides remain under institutional control per the signed record of decision. D&D of excess facilities continues.

3.3.2.10 Waste Area Group 10 — Miscellaneous. WAG 10 includes miscellaneous surface sites throughout the INL Site that are not included in the bounds of the facility-specific WAGs. Hazards associated with WAG 10 include potential unexploded ordnance and associated explosive contaminants remaining from munitions-testing activities. This hazard area is extensive and composed of approximately 217,000 acres. WAG 10 includes the INL Site area that falls outside of the boundaries of the other WAGS, and also includes INL Site-related concerns about the Snake River Plain Aquifer that cannot be addressed on a WAG-specific basis. Consequently, WAG 10 comprises a large area, much of which is uncontaminated.

A record of decision, including decisions for Operable Unit 10-04, was signed in 2002. This record of decision included a remedy for unexploded ordnance of detection, removal, and institutional controls. Institutional controls would be maintained until the unexploded ordnance hazard is removed or reduced to acceptable levels.

A record of decision was signed for Operable Unit 10-08 in 2009 and addresses groundwater monitoring. DOE-ID will monitor INL Sitewide groundwater to confirm that there is no unacceptable threat to human health or the environment from commingled plumes or along the southern INL Site boundary. Groundwater monitoring will rely on the network of monitoring wells that currently exists and on data from other WAGs.

The CERCLA 5-year review for the INL Site WAGs (except WAG 8) and long-term ecological monitoring across the site are conducted as part of WAG 10 activities. Annual reviews are conducted to assess the status and conditions of institutional controls and operations and maintenance.

3.3.3 Long-Term Stewardship

Long-term stewardship refers to all activities that are necessary to ensure protection of human health and the environment following completion of cleanup, disposal, or stabilization of a site or a portion of a site. Following completion of major environmental remediation efforts at the INL Site, many locations will require long-term stewardship because residual contamination will remain at levels that prohibit unrestricted access. INL expects to have responsibility for long-term stewardship of the INL Site once the DOE-EM cleanup mission is complete. The INL Site, as part of its overall landlord responsibility, will manage these activities.

There are two ways sites typically become subject to long-term stewardship requirements. The first is when a site has been remediated and its remedial action objectives are completed or when its remedy is operating at steady-state (for instance, a groundwater pump and treat facility). A number of sites at the INL Site have been remediated to the point that no hazards remain following completion of remedial operations. The second is when a site is newly identified as a No Further Action site not requiring remediation, but requiring ongoing operations and maintenance or the use of institutional controls because hazards remain, thus precluding release of these sites for unrestricted use.

Long-term stewardship includes all engineered and institutional controls designed to contain or to prevent exposures to residual contamination and waste, such as surveillance activities, record-keeping activities, inspections, groundwater monitoring, ongoing pump and treat activities, cap repair, maintenance of entombed buildings or facilities, maintenance of other barriers and containment structures, access control, and posting of signs.

Currently, the Idaho Cleanup Project contractor is responsible for implementing engineered and institutional controls at the INL Site through its *INL Sitewide Institutional Controls and Operations and Maintenance Plan for CERCLA Response Actions* (DOE-ID 2010). The Institutional Control Sites database is used to track the status of institutional control sites at the INL Site. Information contained in the Institutional Control Sites database includes the CERCLA site name, the location of the site, a description of the site, the contaminants of concern, the record of decision-selected remedy, controls, the objective of the controls, and the WAG under which the institutional control sites were developed. The Institutional Control Sites database is reviewed annually to verify that site requirements data are accurate. The Institutional Control Sites database is available electronically at https://cleanup.icp.doe.gov/ics (ICP 2015). Figure 5 depicts the areas of the INL Site currently under institutional control requirements.

Another aspect of long-term stewardship is environmental monitoring to verify that residual hazards are managed or mitigated. Monitoring for compliance with cleanup objectives and general environmental surveillance activities are both key components of long-term stewardship for the INL Site. DOE Order 450.1 requires that DOE implement sound stewardship practices that are protective of the air, water, land, and other natural and cultural resources that have been impacted by DOE operations. Long-term environmental monitoring is the mechanism used to verify that the contaminant concentrations are within acceptable limits and contamination is not migrating beyond acceptable boundaries. Environmental monitoring at the INL Site is performed in accordance with the requirements identified in DOE Order 450.1.

The Environmental Surveillance, Education, and Research Program under Gonzales-Stoller Surveillance LLC, conducts, manages, and coordinates ecological and environmental research, offsite environmental surveillance, and environmental education for the INL Site. This program produces an annual site environmental report that provides consolidated information and results for effluent monitoring and environmental surveillance of air, water, soil, vegetation, biota, and agricultural products for radioactivity. The results are compared with historical data, background measurements, or applicable standards and requirements in order to verify that the INL Site does not adversely impact the environment or the health of humans or biota.

Monitoring activities associated with long-term stewardship requirements also include groundwater monitoring and ecological monitoring conducted by the Idaho Cleanup Project as part of the cleanup program. The majority of these groundwater monitoring requirements were derived from cleanup activities performed under the individual WAGs at the INL Site. Additional groundwater monitoring is performed to determine the appropriateness for consumption of water from the production (i.e., drinking water) wells. Ecological monitoring at the INL Site is conducted to verify that the objectives of the INL Site remedial actions are maintained and to verify that the long-term sitewide ecological impact of residual contamination at the INL Site is within acceptable limits.

3.3.4 Non-Comprehensive Environmental Response, Compensation, and Liability Act Environmental Management Operations

Operations are conducted at the INL Site in support of the non-CERCLA environmental management commitments and milestones for management of waste and SNF. These operations are summarized in the following subsections.

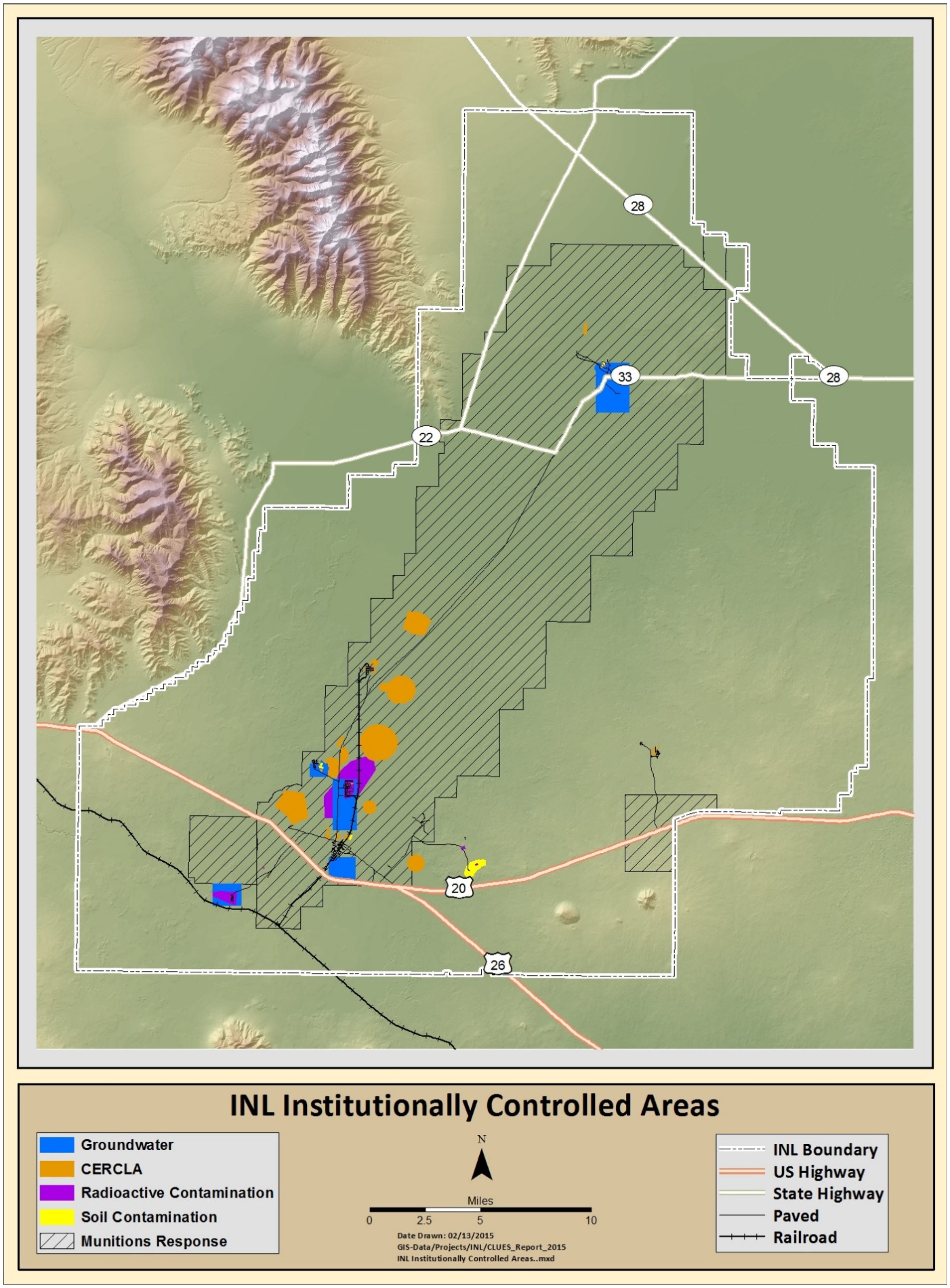

Figure 5. Idaho National Laboratory institutionally controlled areas.

3.3.4.1 Spent Nuclear Fuel Operations. The INL Site was NRTS from 1949 through 1974. Fifty-two reactors were built and operated on the site. Three reactors are currently operated at the ATR Complex and MFC. Over 285 metric tons heavy metal of SNF from these reactors; from other Department of Defense, DOE, and foreign and domestic university research reactors; and from commercial reactors are managed by the INL Site at INTEC, ATR Complex, MFC, NRF, and in a Nuclear Regulatory Commission-licensed facility near Ft. St. Vrain, Colorado. The Idaho Settlement Agreement requires that all SNF be in dry storage by 2023 and be removed from the state of Idaho by 2035. DOE-EM has completed transfer of all their assigned SNF to dry storage in six storage configurations located at INTEC and the Ft. St. Vrain facility. Recently generated SNF from ATR is stored in the fuel canal next to the reactor and in the INTEC CPP-666 basin. SNF from the EBR-II reactor also is stored in the CPP-666 basin and is being transferred to MFC for treatment in an electrometallurgical system. MFC also maintains a library of SNF.

The DOE baseline for disposal of SNF was packaging, transport to, and placement in the geologic repository. The Idaho Site planned to construct the Idaho Spent Fuel Facility at INTEC to package and load into transport casks all Idaho-managed SNF. In January 2010, the Blue Ribbon Commission on America's Nuclear Future was established by the Secretary of Energy to conduct a comprehensive review of policies for managing SNF and high-level nuclear waste. DOE will remove all spent fuel, including Naval and Three Mile Island spent fuel, from Idaho by January 1, 2035.

3.3.4.2 Sodium-Bearing Waste Treatment. Approximately 900,000 gallons of radioactive liquid waste remain in storage in underground tanks at INTEC as a result of spent fuel processing operations that ceased in 1992. Treatment of this waste is required as part of the Idaho Settlement Agreement. Emptying the tanks is required under a consent order because the tanks do not meet current requirements for secondary containment under hazardous waste laws. The Integrated Waste Treatment Unit has been constructed to treat the sodium-bearing waste. This permitted hazardous waste unit is scheduled to begin operation in 2016. The Integrated Waste Treatment Unit involves a steam-reforming technology, placement of the treated material into waste canisters, and interim storage of the estimated 650 to 700 remote-handled canisters in concrete vaults to await shipment out of the state. The Integrated Waste Treatment Unit will be operated to meet a milestone in the Settlement Agreement to complete treatment of sodium-bearing waste. A decision on whether the canisters will be managed as transuranic waste and disposed of at the Waste Isolation Pilot Plant or be managed as high-level waste will be made for final disposition of the waste.

3.3.4.3 Calcine Treatment. Except for the sodium-bearing liquid waste remaining in tanks at INTEC, the liquid waste from SNF processing operations at INTEC has been processed to a solid granular form called calcine and stored in bin sets. The calcine (about 4,400 m^3) is subject to commitments in the Settlement Agreement and the Site Treatment Plan to prepare it for final disposition. In accordance with a Settlement Agreement milestone, DOE has selected the treatment technology of hot-isostatic press to convert the calcine to a glass-ceramic waste form. DOE has initiated the process of designing and permitting the facility. Under the Settlement Agreement, a hazardous waste permit application was submitted to the State of Idaho in December 2012. An independent alternatives analysis for the treatment of calcine is being undertaken. The final milestone for calcine is to have it ready for transport outside of Idaho by 2035. This treated waste will be managed as high-level waste requiring disposal in a geologic repository.

3.3.4.4 Advanced Mixed Waste Treatment Project. The Advanced Mixed Waste Treatment Project mission is to retrieve, characterize, treat, package, and ship Idaho legacy transuranic and mixed low-level waste stored at the RWMC Transuranic Storage Area. The Advanced Mixed Waste Treatment Project is a DOE-EM-funded project managed and operated by Idaho Treatment Group, LLC. Beginning in 1970, approximately 65,000 m^3 of waste in 55-gallon drums, boxes, and bins were placed on asphalt pads for interim storage at the RWMC Transuranic Storage Area. DOE and Idaho Treatment Group, LLC are working to meet the requirements of the Idaho Settlement Agreement, which states that the waste must be removed from Idaho by December 31, 2018 (State of Idaho 1995).

3.3.5 Department of Energy Office of Nuclear Energy Onsite Operations

Operations are conducted at the INL Site in support of the DOE-NE commitments and milestones for onsite operations. These operations are summarized in the following subsections.

3.3.5.1 Idaho National Laboratory Facility Development. Based on the 2005 designation of the INL Site as the national lead laboratory for nuclear energy research, development, and demonstration, the INL Site is in the process of modernizing and optimizing its facility use to create an environment that fosters academic, industrial, government, and international collaborations. It is currently envisioned that INL will be composed of three modern campuses located on the INL Site and in the City of Idaho Falls. These campuses will support three primary activities: (1) nuclear energy research, development, and demonstration; (2) national and homeland security system and technology development and testing; and (3) science and technology research. These campuses include REC located in Idaho Falls, ATR Complex, and MFC (Figure 4). Though located in separate areas, these campuses are connected by capability and function. More information about each of these campuses is included in the following subsections.

3.3.5.2 Research and Education Campus. Since 2005, INL's in-town capabilities have been consolidated into REC (Figure 6), which serves as the "front door" to the INL Site and comprises diverse laboratories that support research in nuclear energy, national and homeland security, and energy and environment. REC research often supports research underway in higher-hazard or larger-scale facilities at the other campuses and at U.S. universities and other national laboratories.

REC is home to a range of research capabilities and facilities and INL administrative functions. The Engineering Research Office Building and Willow Creek Building are the main office buildings for INL staff. The Radiological Environmental Science Laboratory contains both laboratory and office space for DOE scientists and engineers.

The Energy Innovation Laboratory is a (148,000-ft^2) laboratory, was commissioned in FY 2014, and is the R&D showcase for INL. An award-winning, Leadership in Energy and Environmental Design Platinum-certified facility, Energy Innovation Laboratory provides state-of-the-art laboratory and office space and a one-story meeting center. This facility consolidates laboratories needed for fundamental R&D activities and centralizes key research functions at REC. Specifically, this laboratory supports catalysis chemistry, nanotechnology, water chemistry, advanced microscopy, control systems, high-temperature testing, thermal hydraulics, materials testing and characterization, separations technology, and advanced instrument training.

The Energy Systems Laboratory is a (91,000-ft^2) laboratory and office facility that began operations in FY 2013. It houses multiple research programs for advancing energy security and reducing risks that may be associated with new technologies. The Energy Systems Laboratory expands current capabilities and provides state-of-the-art high bays and laboratory space for programs formerly housed in the INL Research Center and the Bonneville County Technology Center. The Energy Systems Laboratory enables research and demonstration in bioenergy feedstock processing, advanced battery testing, and hybrid energy systems integration.

The INL Research Center (280,000 ft^2) is a collection of laboratories that support advanced research, process development, and applied engineering in biology, chemistry, metallurgy, robotics, materials characterization, modeling and computational science, physics, and high-temperature electrolysis production of hydrogen for nuclear and non-nuclear energy applications. Its large footprint, including high-bay areas for small-scale pilot plant research, enables advancement of basic research and bench-scale concepts into viable, integrated systems (e.g., hybrid energy systems). INL has evaluated utilization options and has developed a plan to repurpose space in the INL Research Center to meet nuclear energy, environmental, and energy security multi-program R&D needs in the near term, while planning for significant investment needed to upgrade critical utilities systems.

The Center for Advanced Energy Studies (55,000 ft^2) (a $17-million research facility partially funded by the State of Idaho) opened in 2008. A collaborative partnership between Idaho's public universities and the INL Site, the Center for Advanced Energy Studies (along with the National Scientific User Facility Program) serves as a gateway to the research capabilities of the INL Site and a center for cross-organizational and peer-to-peer technical collaboration.

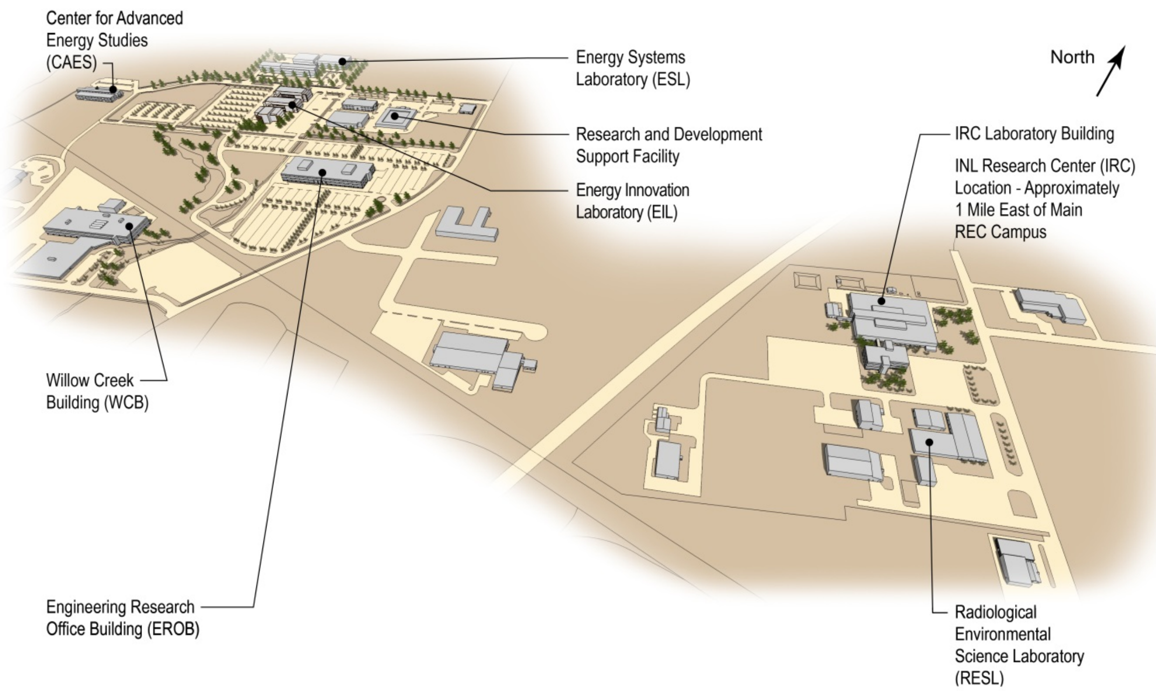

Figure 6. Research and Education Campus.

REC also includes four facilities dedicated to INL's National and Homeland Security mission that were acquired since 2005 to house researchers and program capabilities requiring secure locations for machining, fabricating, assembly, and systems operations. A new R&D support facility has been acquired under lease arrangement to support the National and Homeland Security mission. National and Homeland Security missions take place at REC, CFA, CITRC, and MFC, while clean energy systems development and integration and synergistic environment research is concentrated at REC.

3.3.5.3 Advanced Test Reactor Complex. Located 72 km (45 miles) west of Idaho Falls, the ATR Complex houses ATR, one of the world's most versatile materials test reactors (Figure 7). A low-temperature, pressurized, water-cooled reactor for steady-state irradiation, ATR is fully subscribed, meeting the needs of DOE-NE, Naval Reactors, the National Nuclear Security Administration, and many other research users. Other facilities in the ATR Complex include the associated ATR Critical Facility, a Test Train Assembly Facility, and a supporting radioanalytical laboratory that began operation in 2010.

The ATR Complex historically has supported fuel development for the Navy's nuclear propulsion program. Over the last decade, its use has expanded into other mission areas that include particle fuel development for the high-temperature gas reactor, minor actinide-bearing fuel development, and low-enriched fuel for the National Nuclear Security Administration's Reduced Enrichment for Research and Test Reactor Program, which is part of the Global Threat Reduction Initiative. In addition, ATR is one of two test reactors designated by a DOE record of decision as suitable for future production of Pu-238.

The ATR Life Extension Program is pursuing activities that provide long-term sustainability to ATR while improving its operational reliability. After concluding these specific activities in FY 2015, ATR will continue to implement ongoing maintenance and repair activities and the core internals change-out that is periodically performed. The next core internals change-out is anticipated to occur in the 2019 to 2020 timeframe.

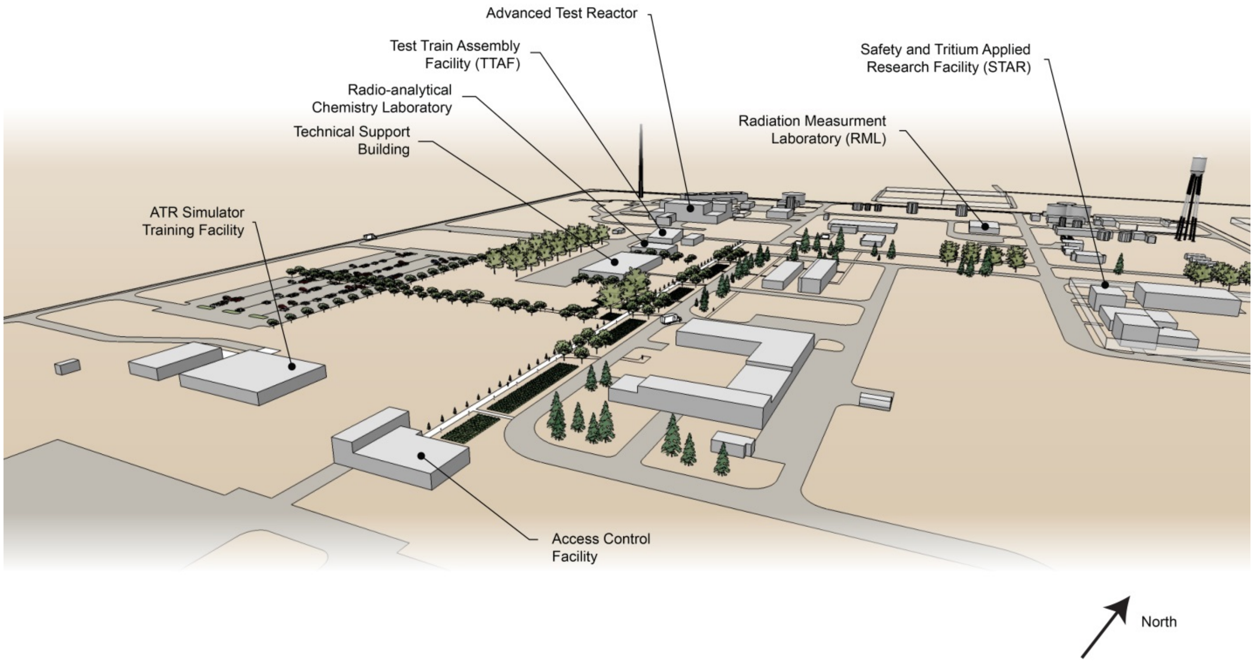

Figure 7. Advanced Test Reactor Complex.

In recent years, the following sustainability actions were performed:

- Seismic strengthening of a key control room wall
- Replacement of neutron instrumentation and control components
- Replacement of the ATR digital control and annunciation systems
- Conversion of the facility to commercial power, removing the requirement for a continuously running diesel generator
- Development and implementation of a condition-based maintenance program to improve operational reliability
- Establishment of an emergency shutdown capability remote to the reactor control room.

ATR is a mission-critical facility and supports Core Capabilities 1, 5, and 7.

3.3.5.4 Materials and Fuels Complex. MFC is located 28 miles west of Idaho Falls and houses one-of-a-kind hot cell capabilities within the Hot Fuel Examination Facility and the Fuel Conditioning Facility for conducting world-class nuclear research (Figure 8). Additional hot cell capabilities reside in the Analytical Laboratory and the Fuels and Applied Science Building. Recent addition of the Irradiated Materials Characterization Laboratory and ongoing installation of research equipment addresses a previously identified capability gap and allows for preparation of fuel samples for testing.

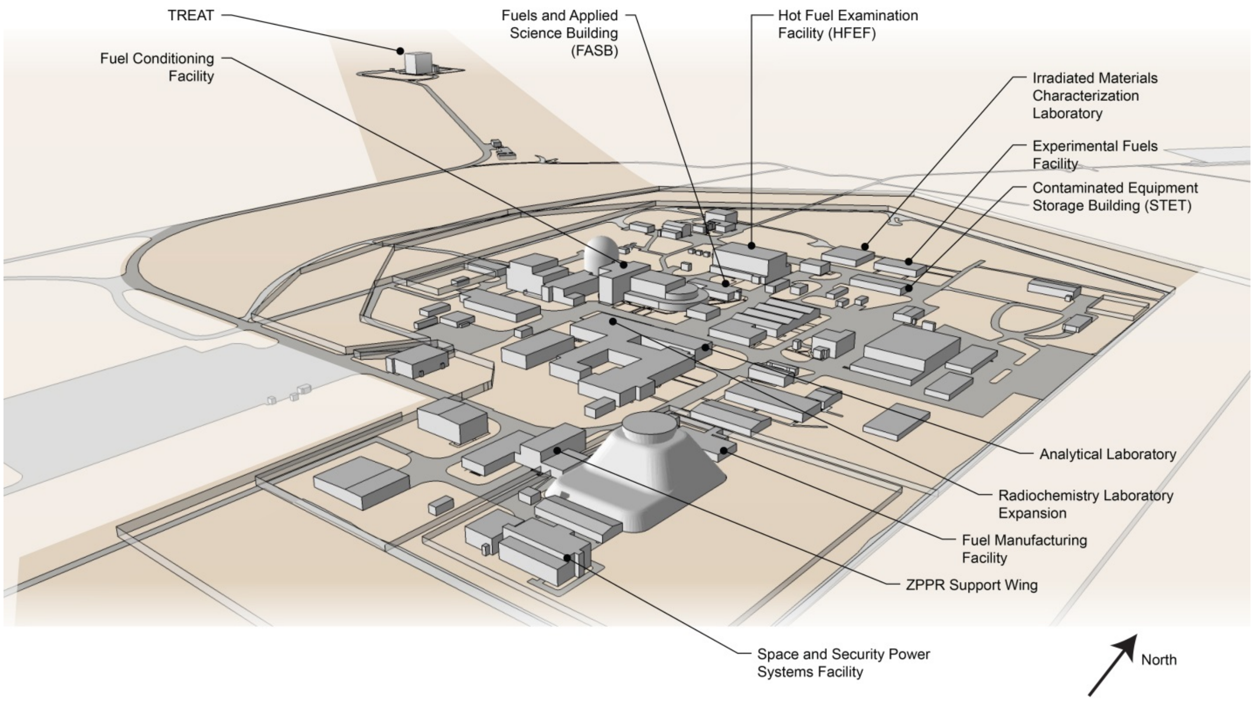

Figure 8. Materials and Fuels Complex.

Facilities at MFC also include analytical laboratories (including mass separators), the Electron Microscopy Laboratory for isotopic and nanometer-scale microstructural and microchemical analysis of material samples from its research facilities, and collocated fuel fabrication glovebox lines (e.g., Fuel Manufacturing Facility and Fuels and Applied Science Building). In addition, MFC operates the Space and Security Power Systems Facility for final assembly and testing of radioisotope power systems and provides capabilities supporting National and Homeland Security R&D.

Significant infrastructure investment has occurred and will continue to occur at MFC. Mission need for critical post-irradiation examination capabilities to enhance existing resources at MFC has been approved and a decision regarding final scope for the planned Sample Preparation Laboratory is expected in 2015, with construction anticipated in the 2016 to 2020 timeframe. Additionally, a near-term (i.e., 2016 to 2017) need for a Science and Engineering Facility has been identified. Upgrade to the Zero Power Physics Reactor documented safety analysis will allow for correction of ventilation deficiencies and installation of seismically qualified racks for materials. Resumption of transient testing is anticipated to begin in FY 2018 at the Transient Reactor Test Facility.

Key MFC facilities include the following:

- Fuel Conditioning Facility and Hot Fuel Examination Facility (two large hot cell facilities)

- Analytical (Chemistry) Laboratory
- Electron Microscopy Laboratory
- Fuel Manufacturing Facility (now used for experiments and nuclear materials storage)
- Engineering Development Laboratory
- Radioactive Scrap and Waste Facility (SNF and radioactive waste storage facility)
- Sodium Processing Facility (waste sodium processing facility)
- Neutron Radiography Reactor
- Transient Reactor Experiment and Test Facility
- Space and Security Power Systems Facility.

3.3.5.5 Balance of Site Capabilities. Facilities and capabilities located at other INL Site facilities also are part of INL Site operations. CFA is the main services and support area for the DOE-NE R&D campuses at the ATR Complex and MFC. Support services provided from CFA include medical, fire suppression, transportation, security, communications, electrical power, craft support, warehousing, and instrument calibration (Figure 9). The INL Site is developing a consolidation and revitalization plan for CFA that will include space to support National and Homeland Security missions and other site/operations.

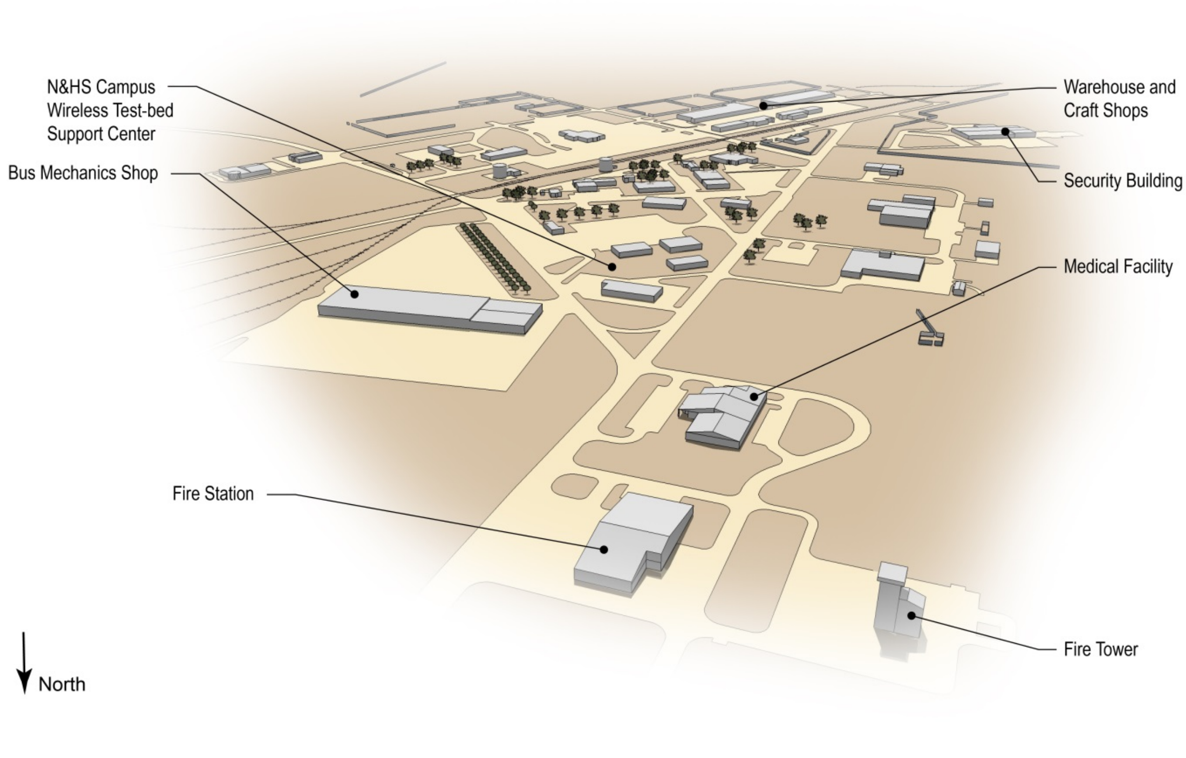

Figure 9. Central Facilities Area.

CITRC supports the National and Homeland Security missions of the INL Site, including program and project testing (i.e., critical infrastructure resilience and nonproliferation testing and demonstration). Wireless test-bed operations, power line and grid testing, unmanned aerial vehicle testing, accelerator testing, explosive detection, and radiological counterterrorism emergency-response training occur at the

CITRC area. A future electric-grid test bed is planned at the INL Site near the CFA/CITRC area, including a new reconfigurable test substation and several miles of transmission and distribution lines. An area north of TAN is being developed for a future accelerator experiment to detect illicit transport of shielded nuclear materials. An area north of MFC is being planned as a test range to test the effects of explosives on structures protective barriers and the effectiveness of potential countermeasures.

Closure of concrete vaults at the RWMC Subsurface Disposal Area, which provide onsite remote-handled LLW disposal capability, is anticipated. DOE expects that the vaults will reach capacity by 2020, which will have an impact on DOE-NE and DOE Office of Naval Reactors missions. Therefore, DOE-NE and the DOE Office of Naval Reactors are developing a replacement facility located adjacent to the ATR Complex to provide up to 20 years of additional storage capacity. Construction is scheduled to commence in 2015, with operations commencing in 2019.

At TAN, the Specific Manufacturing Capability facility manufactures armor packages for the U.S. Army. This facility includes state-of-the-art equipment and capabilities that include light and heavy metal rolling, metal fabrication equipment, in-house engineering and quality department, a state-of-the-art metallurgical laboratory, and experienced manufacturing support crafts.

AT INTEC, DOE-EM owns a suite of facilities whose capabilities would provide affordable, secure, and remotely located infrastructure to meet the DOE-NE revitalization mission for the next 20 years (Figure 10). These facilities are, or will become, surplus to DOE-EM's Idaho Cleanup Project mission. INL plans to use the Unirradiated Fuel Storage Building (CPP-651) and several surrounding buildings for low-enriched uranium disposition product from electrometallurgical processing SNF.

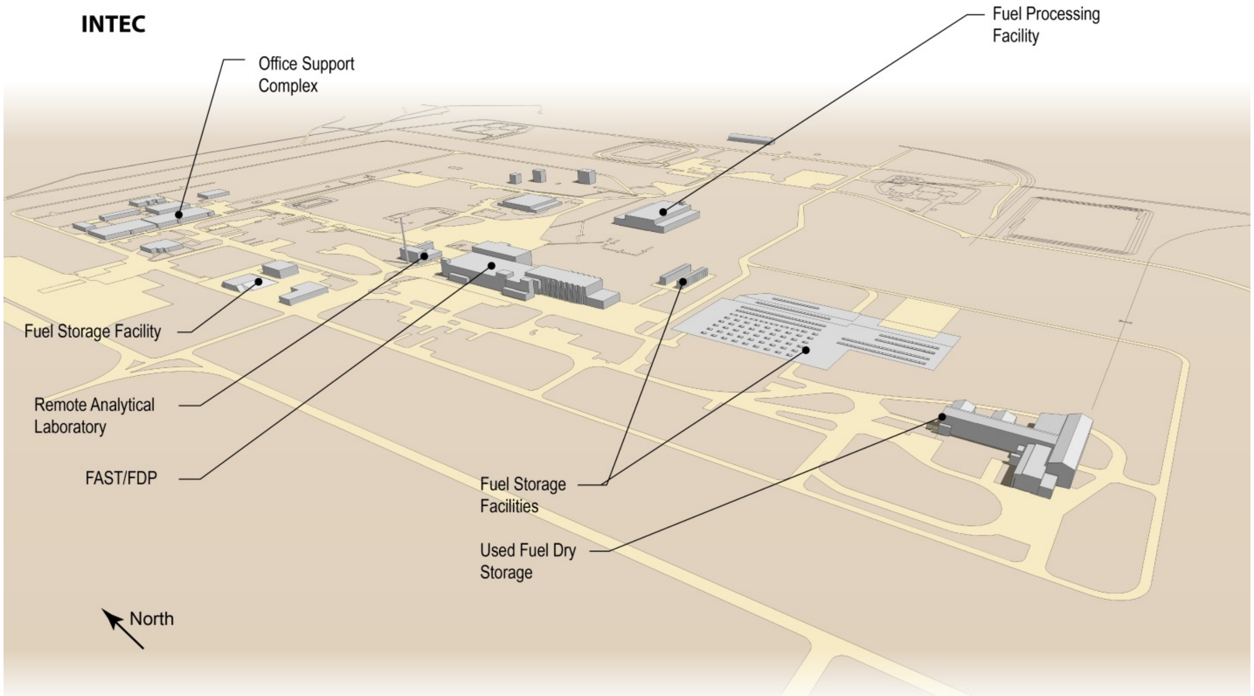

Figure 10. Idaho Nuclear Technology and Engineering Center.

Other INTEC facilities under consideration for future use include the pool at the Fluorinel Dissolution Process and Fuels Storage (CPP-666) facility, which is necessary for storage of ATR used fuel. Along with the fuel storage capabilities of the Fluorinel Dissolution Process and Fuel Storage facility, the Fuel Dissolution Process cell, which provides shielded capabilities with manipulators that could be used in the future to investigate and test advanced separations technologies, conduct extended used fuel storage studies, and develop monitoring and inspection systems for used fuel storage. The CPP-603 facility and the 2707 pad would allow the capability to extract fuels, reseal casks, and store casks for extended storage studies. Additionally, INL plans to obtain the Remote Analytical Laboratory, which is designed for a wide range of organic, inorganic, and radioanalytical capabilities and has a modern hot cell. This laboratory offers versatility to meet near-term and continuing needs for radiochemistry work and longer-term needs for laboratory and bench-scale testing of separations technologies.

3.3.5.6 Planning Principles and Priority Investments. The INL Site land, campus, and space planning is a critical element in transforming the INL Site to meet DOE national nuclear R&D goals. The major objective for land, campus, and space utilization is to consolidate and collocate like activities and to plan and prepare to support future mission needs. The guiding principles for land, campus, and space planning are to provide the following:

- A collaborative environment to foster scientific innovation
- Flexible and modern facilities that are reconfigurable to meet changing research needs
- Environmentally and operationally sustainable facilities
- Compliance with federal land use requirements.

The INL Site continues to revitalize and enhance its enduring research capabilities to ensure achievement of mission objectives and outcomes. Planned investments in existing research capabilities include the following:

- Update and modernize the ATR Critical Facility control room
- Upgrade the Zero Power Physics Reactor documented safety analysis
- Restart the Transient Reactor Test Facility
- Upgrade the wireless test bed
- Expand the National and Homeland Security grid
- Enhance the national security test range.

The INL Site is also preparing and positioning for the future by investing in the build-out of energy systems demonstration capabilities and to fill previously identified capability gaps by building the following new assets:

- Sample Preparation Laboratory
- MFC Science and Engineering Facility
- National and Homeland Security UB-5 Building
- Remote-Handled Low-Level Waste Facility
- Collaborator for Energy Transitions and Transformations.

The INL Site plans additional investments to address base infrastructure needs (i.e., modernization, refurbishment, major maintenance and repair, and reduction of deferred maintenance). Priority investments in critical enabling infrastructure are planned for the following:

- INL grid major maintenance and repair
- MFC firewater upgrade
- MFC electrical distribution Loop A Phases 2 and 3
- Completion of REC power loop

- Land mobile radio
- REC transportation connectors
- Sustainment projects for roofs, roads, etc.

3.4 Projected Land Use Scenarios

As previously discussed, the INL Site is in the process of modernizing and optimizing its facility use to create an environment that fosters academic, industrial, government, and international collaborations. Although the intent is to consolidate activities at REC, MFC, and the ATR Complex, the INL Site will not be able to eliminate all operations at the other facility areas in the near term. Therefore, despite this footprint (building) reduction, the INL Site boundaries, and its associated 2,303 km^2 (889 mi^2), are anticipated to remain under federal government management and control for at least the next 100 years, with portions of the INL Site (e.g., INTEC and RWMC) remaining under federal government management and control into perpetuity.

Specific details regarding site modernization and transformation are available in the INL TYSP. The TYSP outlines the infrastructure transformation planned for the INL Site. This includes Idaho Cleanup Project footprint reduction activities across the site and INL infrastructure modernization being planned.

The Idaho Cleanup Project is focusing on footprint reduction activities across the site, including deactivation, decontamination, and demolition at TAN and INTEC, closure of the Subsurface Disposal Area and other related cleanup at RWMC, and cleanup and facility demolition across the site. The INL Site is planning infrastructure modernization at the main three campuses, footprint reduction at CFA, and additional facilities to support missions for customers such as the Department of Homeland Security.

There are numerous transformation issues being addressed at the INL Site. Some of the major ones include disposal of past and future mission-related waste once the Subsurface Disposal Area is closed, treatment and disposal of the current waste inventory, and demolition of major facilities such as EBR-II. Current planning and forecasted work execution is covered in the TYSP.

3.4.1 Idaho National Laboratory Land Use at 2025

The INL TYSP provides a long-term vision that clearly links R&D mission goals and infrastructure requirements (single and multi-program) to the INL Site core capabilities; establishes the 10-year end-state vision for the three primary INL campuses; and identifies and prioritizes capability gaps, as well as proposes efficient and economic approaches to closing those gaps. The TYSP identifies the core capabilities that are operational, in progress, or planned at the INL Site. The 10-year, end-state vision for investment in the INL Site core capabilities and supporting infrastructure for the laboratory can be summarized as follows:

- INL is DOE-NE’s national nuclear capability. INL’s world-leading core capabilities provide the majority of DOE’s unique nuclear R&D capabilities and are viewed as a shared national resource.
- INL is the DOE-NE National Scientific User Facility. INL serves as DOE-NE’s user facility and provides access to the broad nuclear energy R&D enterprise, which includes universities, industry, national laboratories, international research organizations, and other federal agencies.
- INL is a multi-program laboratory. Core capabilities are used for government and private sector customers in nuclear energy, national and homeland security, and energy and environmental research.

The INL TYSP links DOE-NE’s R&D mission goals to INL’s core capabilities and infrastructure, evaluates their current condition, and identifies and prioritizes infrastructure and capability gaps, as well as the most efficient and economic approaches to closing those gaps. The TYSP proposes an infrastructure that can be maintained within projected funding levels and builds on the existing infrastructure, where possible, before building new, stand-alone facilities and capabilities.

The strategy and details outlined in the TYSP are based on a laboratory-wide analysis that links missions to existing capabilities, needed capabilities, and recommended approaches to filling the gaps. Significant progress has occurred over the last 5 years while implementing the vision. In the next decade, INL Site continue to develop advanced tools and instruments, replace equipment and instrumentation, and upgrade existing systems, including, for example, the utility services at MFC.

It is anticipated that over the next 10 years new onsite development will occur, major facility D&D will occur, and specific environmental remediation will be completed (Figure 11). The INL facility infrastructure also will be reduced over the next 10 years. These footprint reductions will occur within existing operations areas. RWMC, INTEC, TAN, and other sitewide areas will continue with Resource Conservation and Recovery Act/CERCLA closure and proceed with D&D. Included in this scenario is the transformation of existing operations areas to decommissioned and institutionally controlled areas.

Land use in these areas will remain primarily industrial (DOE-ID 2004). INL seeks to build on existing capabilities and underlying infrastructure, as well as the economy of resource co-location, over the next decade to establish the capabilities that will be needed over the next 20 years. Future development is anticipated to occur at the ATR Complex, MFC, INTEC, CFA, and REC. As INL continues to consolidate capabilities around the three main campuses, they will continue to make targeted investments that will deliver additional capacity and facilitate user access and collaboration. The strategic vision for INL builds on the current strength of each of the three main campuses. Investments to modernize each area are designed to create the form, aesthetics, and function of a campus environment that will attract and retain researchers and foster collaboration, communication, and connectivity both internally and with outside experts. A cooperative research environment will be facilitated by contemporary office space integrated with modeling and simulation capabilities, lower-hazard laboratory space acquired under lease arrangements, and data links between nuclear energy R&D capabilities in town and those at MFC.

Within the WAGs, end-state land use scenarios that guide cleanup objectives support eventual unrestricted (i.e., residential) use over most of the site. The exceptions are RWMC, the tank farm at INTEC, and discrete parts of other WAGs where institutional controls are used to restrict use until cleanup objectives are achieved. Specific details regarding WAG end states are identified in WAG-specific CERCLA documents, including records of decision and proposed plans, both of which involve extensive public participation and can be accessed through INL's administrative record for cleanup (http://ar.inel.gov). The *Institutional Control and Operations and Maintenance Plan* (DOE-ID 2010) and an Institutional Controls Sites database (ICP 2015) provide information on how cleanup remedies will be maintained and how institutional controls will be implemented to achieve the land use end states.

Significant D&D has occurred in some areas of the site and consolidation at the three campuses will continue. Some new construction and new infrastructure improvement continues; however, at other sites such as CFA and INTEC, these sites will continue to function though at a significantly reduced scale. While these areas will remain, their individual boundaries will not likely expand. The INL Site will continue to maintain two enabling capabilities: (1) utilities and supporting infrastructure, and (2) nuclear materials management. The INL Site 10-year vision includes proposals for several investments in significant new capabilities, which will affect the underlying utilities and supporting infrastructure. During the planning process, the supporting infrastructure (e.g., office and service buildings, roadways, and parking lots) and utilities (e.g., electrical substations, transformers, switches, communications and data links, and water and sewer systems) are being identified and included as part of the investment strategy. As part of the 10-year vision, the INL Site is committed to taking a positive approach to maintaining utilities and infrastructure, upgrading them to a mission-ready state, and extending their useful life to support the mission needs defined in the DOE-NE Roadmap. The objectives of this approach are to effectively manage enduring assets; efficiently disposition non-enduring assets; and invest in new supporting infrastructure and utilities to make new mission capabilities possible.

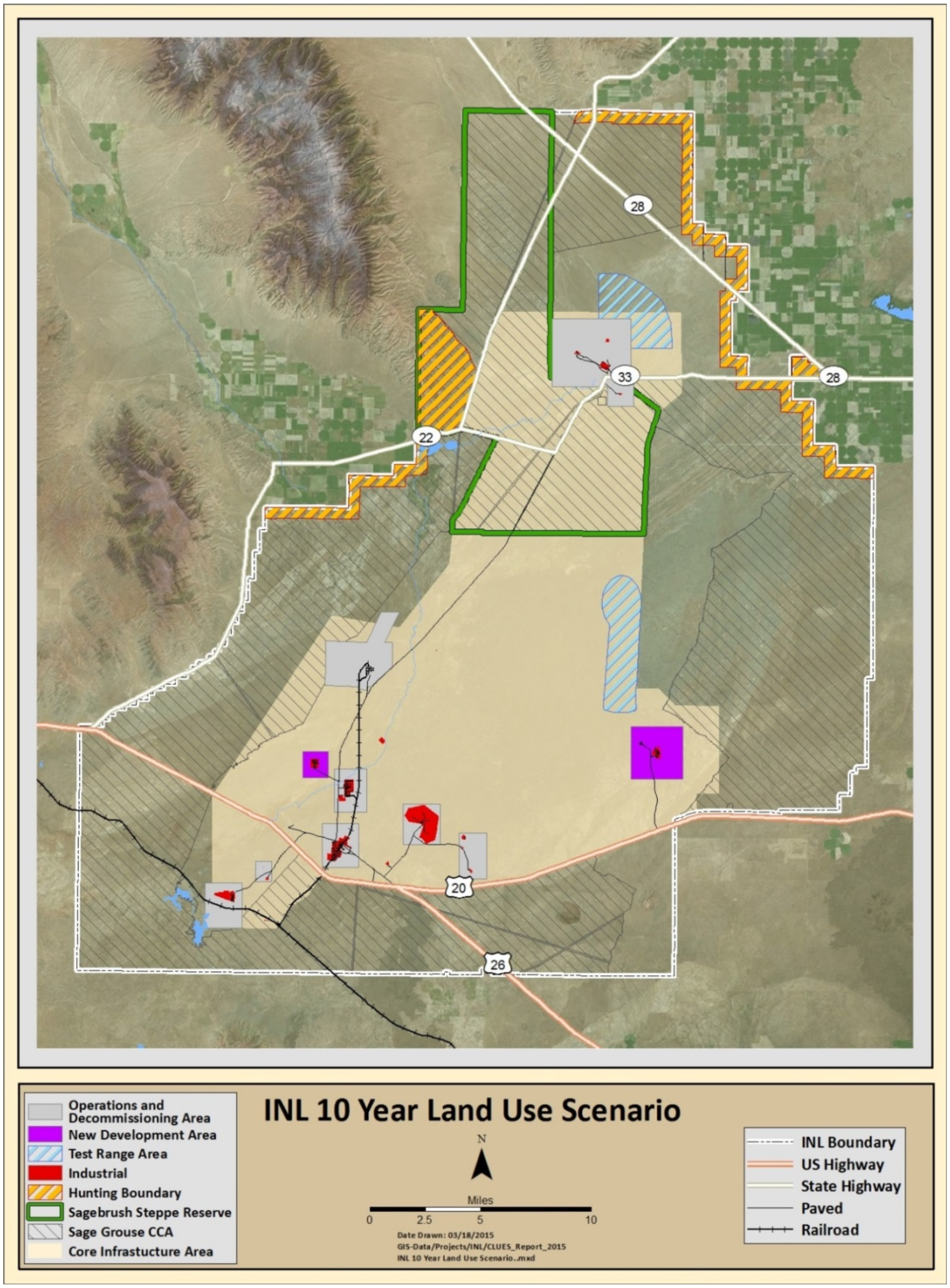

Figure 11. Idaho National Laboratory 10-year land use scenario.

3.4.2 Idaho National Laboratory Land Use at 2045

Land use changes within the next 30 years (Figure 12) are anticipated to be consistent with the 10-year forecast. Specific changes beyond the 10-year horizon include completion of a number of critical environmental remediation efforts. These achievements are noted in the transition of operations/ decommissioning areas to decommissioned areas/new development areas (ATR Complex and MFC) and will continue to serve as the operational staging areas for current and new development within the core infrastructure area.

Footprint reductions will continue to occur within existing operations areas and some areas will be transformed to decommissioned and institutionally controlled areas. Some sites, such as CFA and INTEC, will continue to function at a significantly reduced scale. In the 30-year land use scenario, these areas will remain, but their individual boundaries are not expected to expand.

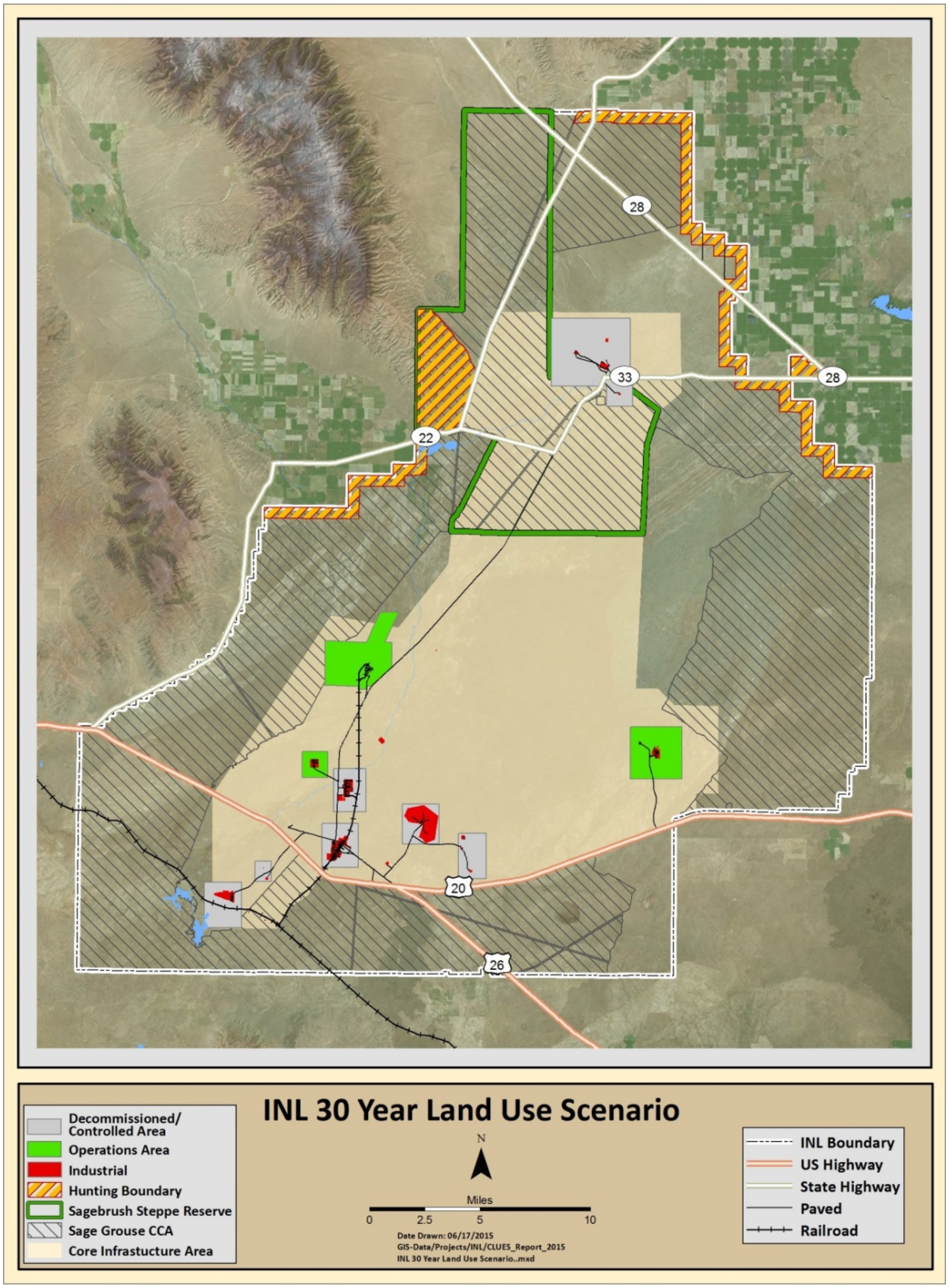

Figure 12. Idaho National Laboratory 30-year land use scenario.

3.4.3 Idaho National Laboratory Land Use at 2115

The INL Site land use for the 100-year scenario (Figure 13) remains consistent with the 30-year scenario. The decommissioned/controlled areas will be the primary focus of the INL Site long-term stewardship functions. These activities will be coupled with sitewide administrative controls and the operational areas of the ATR Complex and MFC.

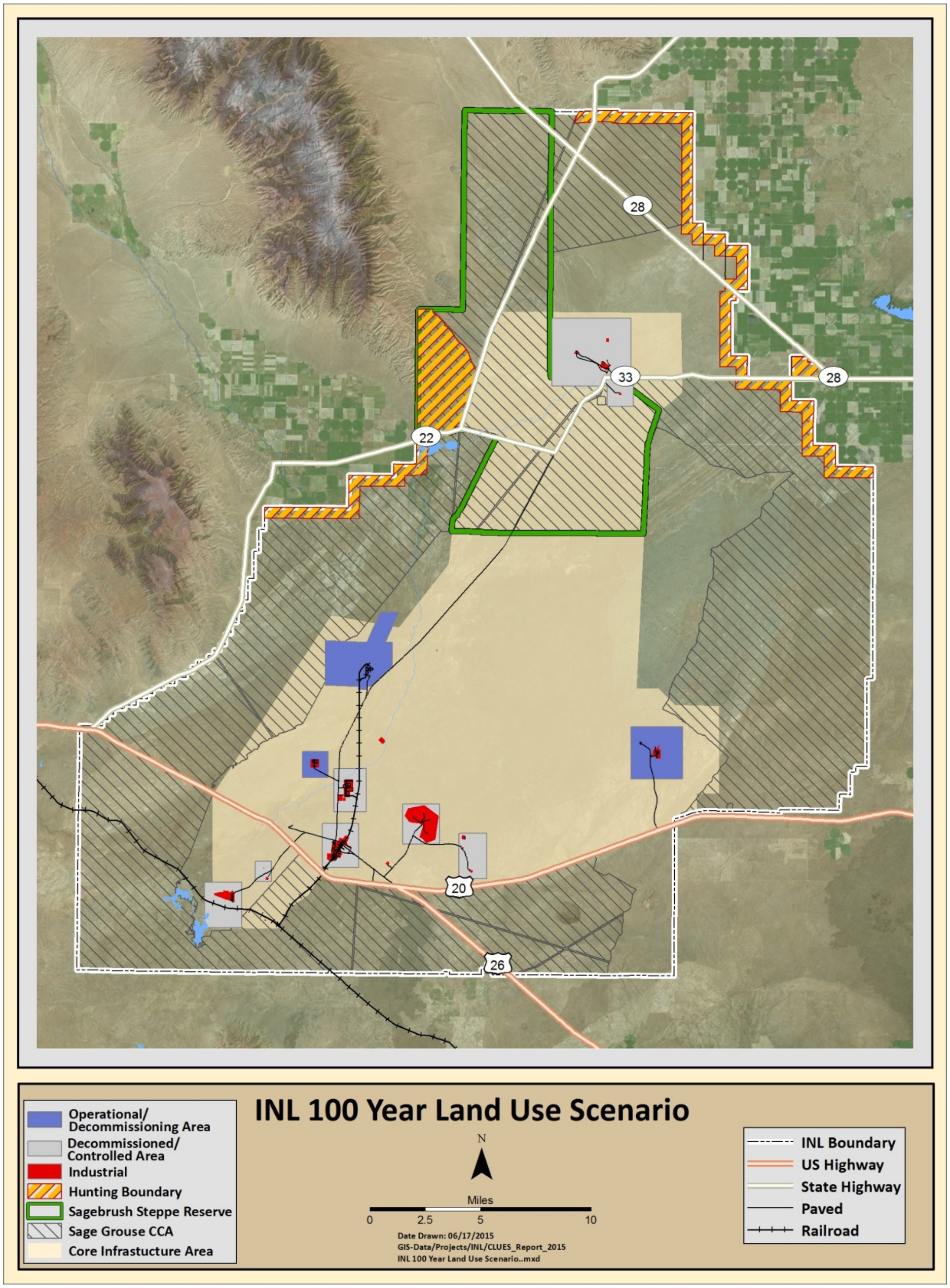

Figure 13. Idaho National Laboratory 100-year land use scenario.

4. ENVIRONMENTAL RESOURCE CONSIDERATIONS

A number of environmental factors/resources at the INL Site need to be considered during planning because of the potential for impacts to these resources from actions that may result from planning. The types of factors that are considered include the following: regional considerations such as population, land uses, and socioeconomic conditions; sitewide area infrastructure such as transportation routes, power distribution systems, communication systems, utility systems, and other land uses; resources such as soils, water resources, biota, and cultural resources; and natural hazards at the INL Site such as wildland fire, seismic hazards, and floods. Brief descriptions of existing land uses and resources present at the INL Site are presented in the following subsections and figures are provided for some of the resources. The Land Use Planning Committee will consider the effects on these resources in future site-specific land use planning. More detailed resource information would be used by the Land Use Planning Committee, including current geographic information system layers to analyze the potential for conflicts based on existing resource conditions.

4.1 Regional Population

There are 16 counties within 80 km (50 mi) of the INL Site (Figure 14). Fifteen of these counties are in the State of Idaho and one is in the State of Montana. This 16-county region has a low population density. In 2010, the population for this region was 390,608 (Census Bureau 2011). Nearly 48% of this population resides in the two most populous counties: Bonneville and Bannock.

The largest regional cities are Idaho Falls (located in Bonneville County), with a 2010 estimated population of 56,891 residents, and Pocatello (located in Bannock County), with a 2010 estimated population of 54,224 residents. These two cities represent approximately 28% of the regional population. The Fort Hall Indian Reservation is located south of the INL Site. It has a 2010 estimated population of 3,201.

The entire INL Site is an administratively controlled area. In general, admittance to the INL Site and its facilities is permitted only on an "official business" basis. The Shoshone-Bannock Tribes have been granted access to an area around, and including, the Middle Butte Cave and public access is allowed in rights-of-way associated with highways, the Big Lost River rest area, and at the EBR-I visitor center. There are no human residences on INL Site property. A regional perspective of the INL Site and surrounding population centers is shown in Figure 14.

4.2 Regional Land Use

The region adjacent to the INL Site boundary is a combination of public and private land. Approximately 75% of the land adjacent to the INL Site is managed by the federal government and administered by BLM. This federally managed land provides wildlife habitat and is used for mineral and energy production, grazing, and recreation. Approximately 1% of the adjacent land is owned by the State of Idaho and is used for the same purposes as the federal land. The remaining 24% of the land adjacent to the INL Site is privately owned and primarily is used for grazing and crop production. In 2007, approximately 993,195 acres of cropland were in use each year within the five-county area that encompasses the INL Site (U.S. Department of Agriculture 2007). Population densities are generally low, with urban and suburban land uses spatially distant. The Big Southern Butte is south of the INL Site border and the Middle and Eastern Buttes are within the INL Site near the south border. Significant portions of these primarily federal-owned lands adjacent to the INL Site are used for recreational purposes, such as hunting, fishing, boating, hiking, cross-country skiing, and camping. Specific recreational and tourism sites are located near the INL Site at the Craters of the Moon National Monument, Hell's Half-Acre Wilderness Study Area, Black Canyon Wilderness Study Area, Camas National Wildlife Refuge, Market Lake State Wildlife Management Area, Mud Lake Wildlife Management Area, and the Birch Creek Camping Area. The Big Southern Butte and Hell's Half Acre are designated as National Natural Landmarks. EBR-I is a National Historic Landmark. In addition, there are two national forests, Challis-Salmon and Targhee-Caribou, within 80 km (50 mi) of the north and west INL Site boundaries, respectively.

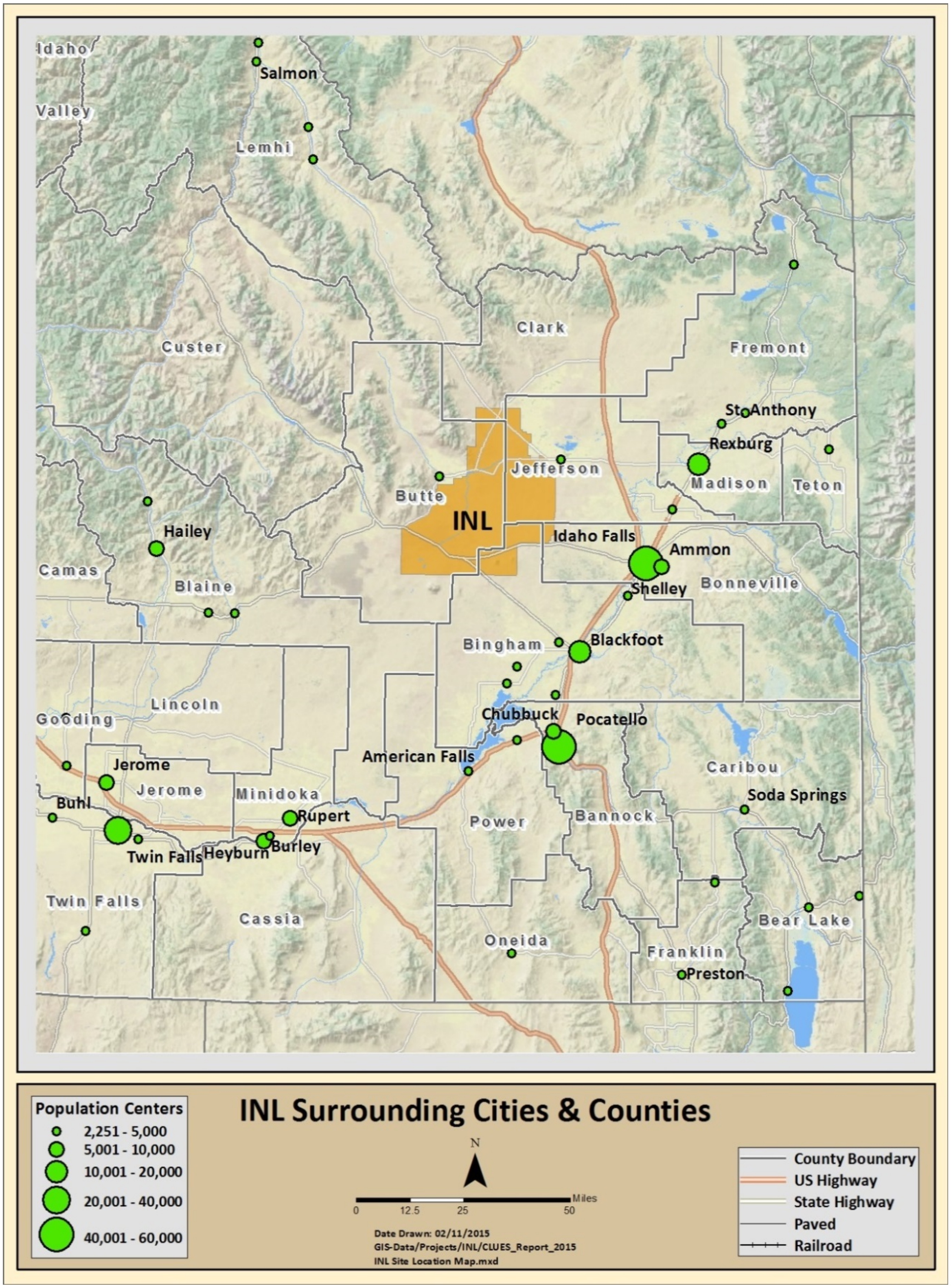

Figure 14. Idaho National Laboratory regional map.

4.3 Regional Economy

In 2010, an analysis of INL's impacts on the economy of Idaho was conducted (BSU 2010). The analysis showed that the annual impacts of INL operations on employment, output, and income in Idaho are large by any measure. They are especially significant in Idaho's largely rural economy and crucial to the economy of eastern Idaho. The lab's 8,016 employees made INL the second-largest employer in Idaho in 2009, ranking only behind the state government. In total, the combined direct, indirect, and induced effects of INL's activities are estimated to be responsible for 24,149 jobs in the state on an annual basis. With approximately 683,000 jobs in Idaho, INL annually accounts for over 3.5% of all jobs in the state. The effect on employment is even greater in eastern Idaho, where INL is responsible for over 15% of all jobs in the region.

In addition to INL's impact on employment, the direct, indirect, and induced effects of its operations contribute nearly $2.9 billion to Idaho's production, amounting to about 6% of the state's total output. Additionally, INL contributes $1.83 billion to personal income in the state, amounting to 3.5% of all personal income in Idaho.

The presence of INL and its workforce has changed the employment composition of eastern Idaho and the state as a whole, making Idaho more economically diverse. Without INL, the eastern part of the state would be more reliant on agricultural production, agricultural inputs, and transportation services. Economic fluctuations in any given sector have less impact on other parts of the economy due to the presence of a more diverse economy.

4.4 Transportation Routes

4.4.1 Roadways

Commercial transportation systems at the INL Site include road and highway systems, railroad systems, and an airfield. Approximately 6% of INL Site land (approximately 13,736 hectares [34,000 acres]) is devoted to public roads and utility rights-of-way crossing the INL Site.

U.S. Highways 20 and 26 cross the southern portion of the INL Site, while Idaho State Highways 22, 28, and 33 cross the northern portion (Figure 15). These paved public highways measure approximately 145 km (90 miles). The INL Site has an additional 140 km (87 miles) of nonpublic paved roads within its boundaries, approximately 29 km (18 miles) of which are considered service roads. Finally, an additional 161 km (100 miles) of unpaved roads and trails provide additional access for emergency, security, and service vehicles. Road use is restricted to employees and visitors on official business.

In 2010, DOE approved a project to create an additional route within INL Site boundaries to transport shipments of materials and waste expected over the next 10 years between MFC and other INL Site facilities. The 21-km (13-mile) road is a nonpublic road encompassed entirely within the INL Site (DOE 2010b).

4.4.2 Railways

The INL Site has several railways that cross its property (Figure 15). The Union Pacific Railroad's Mackay Branch Line services the southern portion of the INL Site through the Scoville Spur. The 23 km (14 miles) of the Mackay Branch Line, which terminates in the southern part of the INL Site, services the Union Pacific Railroad's main lines, which run from Butte, Montana, on the north to Pocatello, Idaho, and Salt Lake City, Utah, on the south. Interconnections are made from these locations throughout the United States.

A DOE-owned railroad track also passes north at Scoville Siding from Mackay Branch through CFA past the east side of INTEC and terminates within NRF. A spur line runs west to connect this track through the south end of the INTEC Fuel Storage Facility and to the coal-fired plant. A portion of this line is presently out of service.

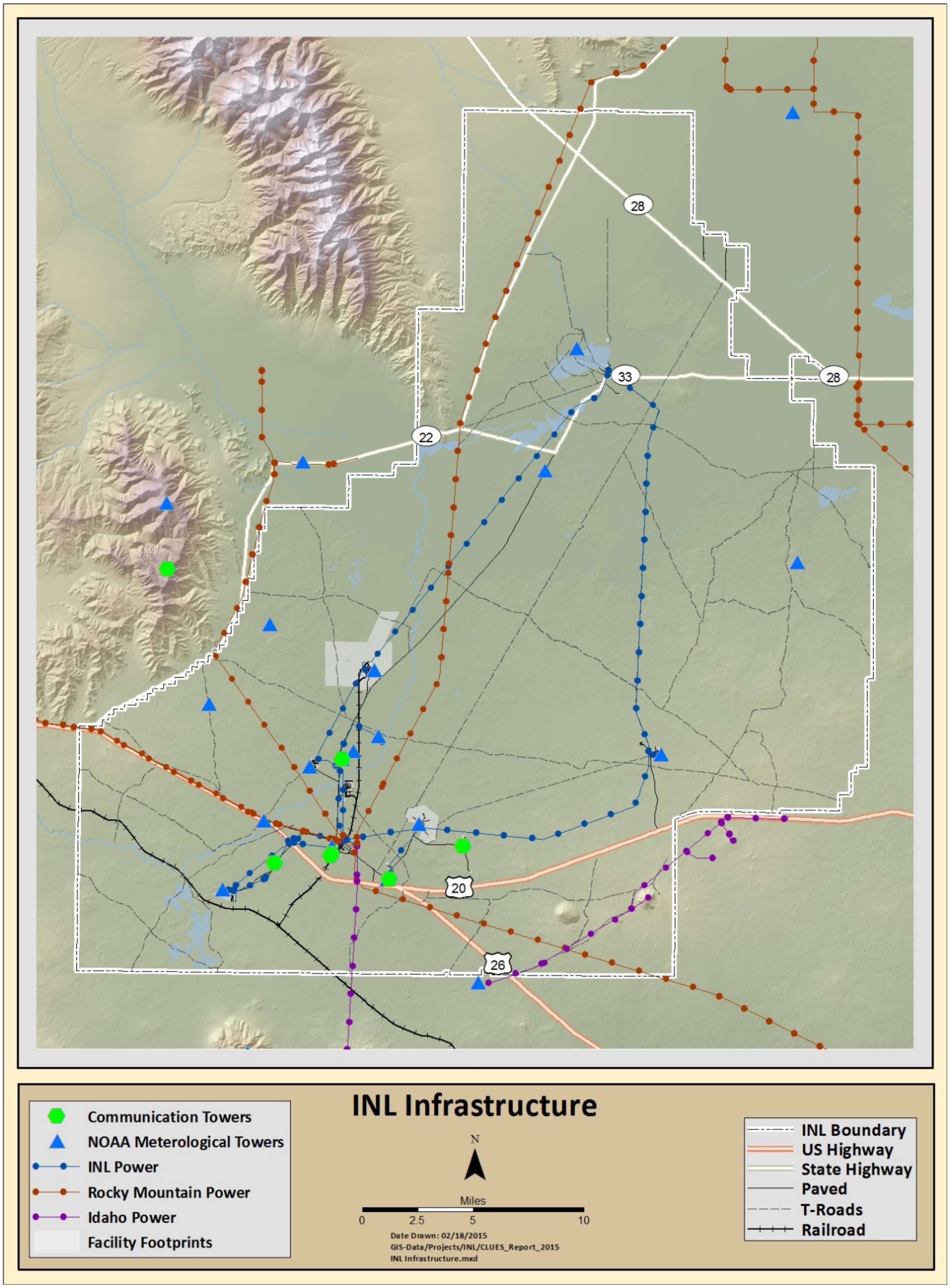

Figure 15. Idaho National Laboratory infrastructure.

4.4.3 Airways

The cities of Idaho Falls and Pocatello both have airports that provide passenger and cargo service in the vicinity of the INL Site. The Federal Aviation Administration requests that pilots avoid flights below 1,800 m (6,000 ft) above mean sea level when crossing the INL Site. The INL Site operates a 305 × 30-m (1,000 × 100-ft) airfield for testing of unmanned aerial vehicles.

4.5 Utilities

Commercial electric power is delivered to the operating areas at the INL Site by an extensive power transmission and distribution system (Figure 15). Offsite power is fed into the INL Site power transmission system through the Scoville substation. Power to the Scoville substation (and therefore the INL Site) is provided via two transmission lines from Rocky Mountain Power's Antelope substation.

The INL Site power system includes a 138-kV transmission loop that is 100 km (62 miles) long and feeds high-voltage substations. A separate 10-km (6.2-mile), 138-kV line feeds the RWMC area with capacity in excess of 20 MW. The distribution system ranges in voltage from 13.8 to 2.4 kV and is composed of approximately 97 km (60 miles) of overhead lines and several miles of underground lines. The transmission loop capacity is 50 MW. There are no gas or oil lines on the INL Site, although individual facilities may have propane or fuel storage tanks.

4.6 Environmental Research Park

The INL Site is a designated National Environmental Research Park. A National Environmental Research Park is an outdoor laboratory that offers opportunities for environmental studies on protected lands that serve as buffers around DOE facilities. The National Environmental Research Park system provides protected lands for research and education, particularly to demonstrate the compatibility of energy technology development and a quality environment. INL's designation as a National Environmental Research Park has allowed the INL Site to serve as an outdoor laboratory for environmental scientists to study evidence of at least 13,500 years of human land use and Idaho's native plants and wildlife in an intact and relatively undisturbed ecosystem. Because of the INL Site's established facilities, a security buffer that protects research, long-term records of environmental conditions, and partnerships with universities and industry, the Idaho National Environmental Research Park provides exceptional opportunities for research.

4.7 Sagebrush-Steppe Ecosystem Reserve

The INL Site lies within the largest sagebrush-steppe region within North America. Sagebrush-steppe is a type of dry habitat characterized by sagebrush and other shrubs and short grasses. The National Biological Service identified the sagebrush-steppe ecosystem as critically endangered across its entire range in 1995. On July 17, 1999, the Secretary of Energy and representatives of USFWS, BLM, and the Idaho Department of Fish and Game designated a portion of the INL Site as the Sagebrush-Steppe Ecosystem Reserve. The Sagebrush-Steppe Ecosystem Reserve, which covers approximately 300 km^2 (115 mi^2) in the northwest corner of the INL Site, was designated to ensure this portion of the ecosystem receives special consideration. Figure 16 shows the location of the Sagebrush-Steppe Ecosystem Reserve at the INL Site. Because of the inherent ecological benefits of such a large tract of protected and relatively undisturbed habitat, the scientific community recognizes this acreage as providing an excellent opportunity for research.

BLM and DOE have prepared a management plan for the INL Sagebrush-Steppe Ecosystem Reserve with input from the Idaho Department of Fish and Game, USFWS, and Native American Tribes. The Sagebrush-Steppe Ecosystem Reserve is managed as a laboratory where all native ecosystem components, cultural resources, and Native American tribal values are conserved, yet opportunities for scientific investigation of the resources present on the INL Site are provided. The *Sagebrush-Steppe Ecosystem Reserve Final Management Plan* (2004) discusses wildfire suppression, livestock grazing, road management, weed control, and protection of cultural resources. The management plan identified four management goals that are used as a framework for facilitating long-term health of this unique ecosystem. The first goal identified in the management plan was addressed with the release of a Sensitive Animal Species Inventory, in November 2007, on the INL Sagebrush Steppe Ecosystem Reserve, which establishes “a baseline of resource data to identify and prioritize immediate needs for management adjustment.”

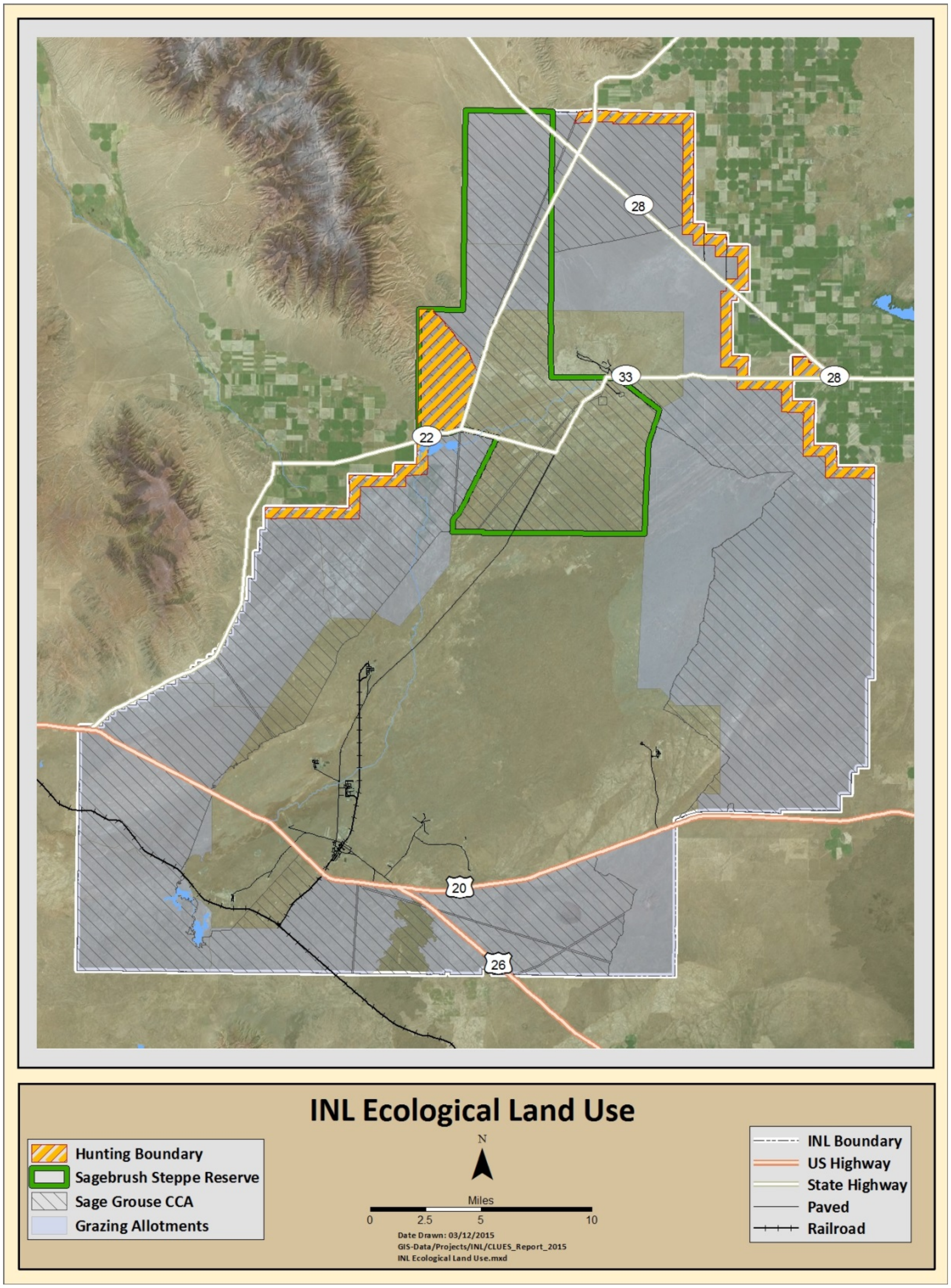

Figure 16. Idaho National Laboratory ecological land use.

4.8 Agricultural Uses

Up to 137,360 hectares (340,000 acres) of the INL Site are leased for cattle and sheep grazing; grazing permits are administered by BLM. Grazing is not permitted within 0.8 km (0.5 mi) of any primary facility boundary or within 3.22 km (2 miles) of any nuclear facility. Figure 16 illustrates the current grazing boundaries at the INL Site. In addition, the U.S. Sheep Experiment Station uses 364 hectares (900 acres) as a winter feedlot for sheep. This area is located at the junction of Idaho State Highways 28 and 33.

4.9 Permitted Public Use

The INL Site provides an important habitat for big game. However, big game use of adjoining farmlands has resulted in depredation concerns. In an effort to control this situation and reduce crop damage caused by wild game on adjacent private agricultural lands, DOE cooperates with the Idaho Department of Fish and Game in allowing limited, controlled hunts for elk and antelope. These hunts, managed in accordance with an existing DOE/Idaho Department of Fish and Game memorandum of agreement, represent a form of limited and permitted public use of the INL Site. This use is restricted to certain species and specific locations (illustrated in Figure 16).

Thirty-four species observed at the INL Site are considered game species. Of these, waterfowl constitutes the largest number of species present. Waterfowl use wetland and riparian habitat associated with the Big Lost River and ponds or impoundments at INL Site facilities. However, the most common game species are pronghorn and mourning dove found in upland habitats.

The INL Site does not lie within any of the land boundaries established by the Fort Bridger Treaty of 1868. The provision in the Fort Bridger Treaty that allows the Shoshone-Bannock Tribes to hunt on unoccupied lands of the United States does not presently apply to any land where the INL Site is located because the entire INL Site is considered to be occupied by DOE. The Shoshone-Bannock Tribes and DOE have an agreement-in-principle that encourages regular interactions between the INL Site and the tribes on issues of mutual concern. The tribes also have a memorandum of agreement for special tribal access to the area around Middle Butte Cave on the INL Site.

4.10 Mineral Rights Ownership

The subsurface mineral rights associated with the INL Site are managed by BLM. Additional information regarding management of these resources is available from the local Idaho Falls BLM office.

4.11 Topography

Figure 17 details the topography of the INL Site. The Lost River and Lemhi Ranges and the mouths of the valleys of the Big Lost and Little Lost Rivers bound the INL Site on the west and northwest. On the north, the mouth of the Birch Creek Valley and the southern tip of the Beaverhead Mountains of the Bitterroot Range bound the INL Site on the Idaho-Montana border. Features to the south and east of the site are similar to those found on the site, characterized by relatively flat topography punctuated by several prominent volcanic buttes and numerous basalt flows. The average surface elevation on the INL Site is approximately 1,500 m (5,000 ft) above sea level, although isolated buttes reach elevations of nearly 2,000 m (6,600 ft).

Peaks to the immediate north and west of the site borders approach 3,300 m (11,000 ft). The predominant topographic features within the boundaries of the INL Site are the Twin Buttes (Middle and East Buttes). Big Southern Butte, located approximately 4 km (2.5 miles) south of the site boundary, is the tallest surface feature within the Snake River Plain, reaching an elevation of 2,300 m (7,600 ft). These buttes provide the most conspicuous evidence of the volcanic origin of the Snake River Plain, although numerous smaller buttes, cinder cones, lava outcrops, and lava tubes may be found in the area.

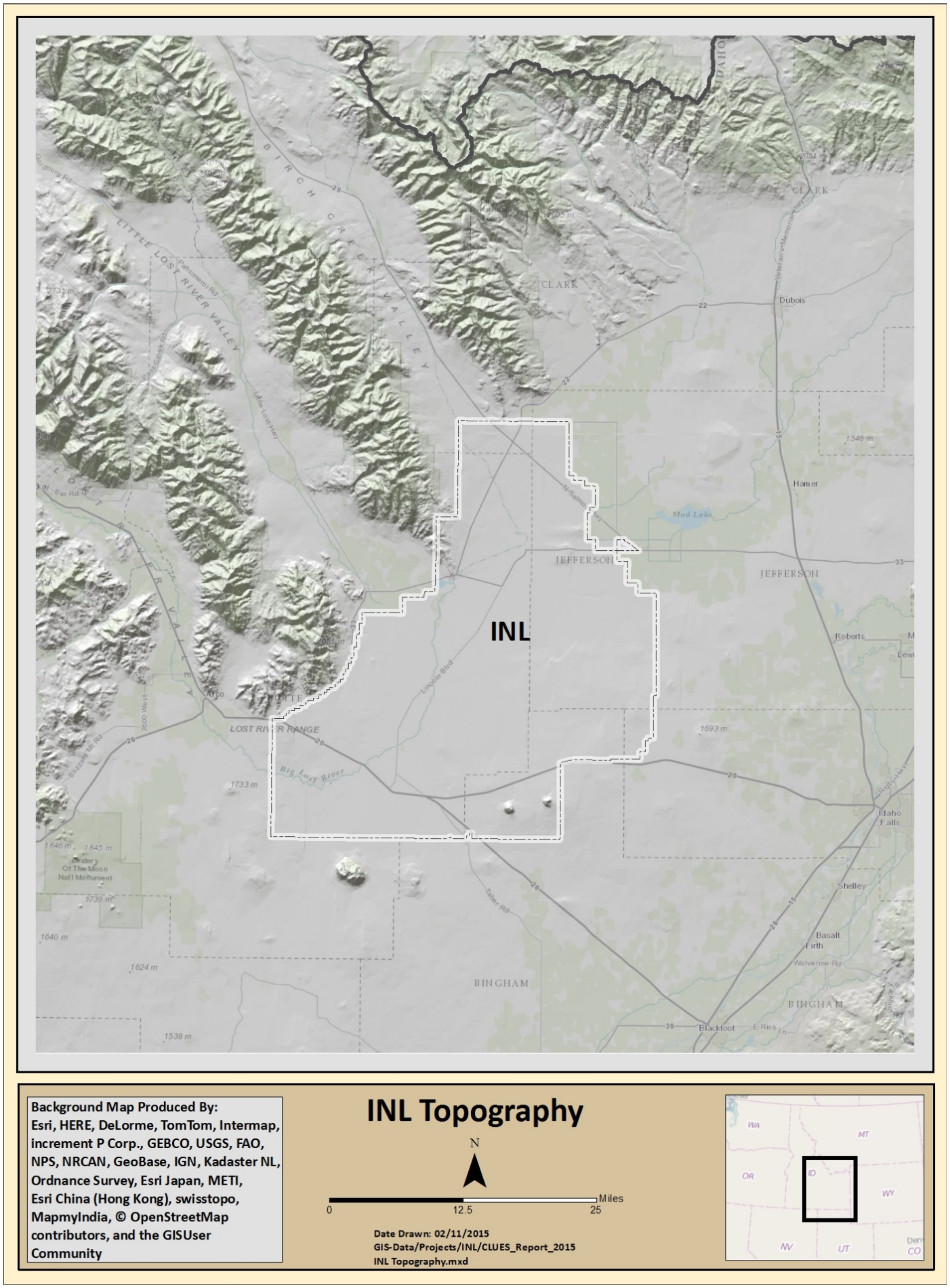

Figure 17. Idaho National Laboratory topography.

4.12 Bedrock Geology

Geologically, the Snake River Plain is thought to have been formed by the southwestward migration of the North American tectonic plate over a stationary hot spot in the earth's mantle, forming a linear volcanic province extending from Yellowstone National Park to southwestern Idaho (Pierce and Morgan 1992). Explosive volcanic activity in the area between 4 and 7 million years ago formed silicic lava flows and pyroclastic deposits extending to depths of at least 2,500 m (8,200 ft) below the surface (Hackett and Smith 1992). These rhyolite rocks underlie the more recent basalt lava flows, which are interbedded with sediment, thus forming a highly permeable aquifer (Link and Phoenix 1994).

The most recent basalt flow in the INL Site area was the Cerro Grande flow, which occurred approximately 13,000 years ago (Kuntz et al. 1994). In contrast, the Hell's Half-Acre flow immediately east of the INL Site is only about 5,200 years old and flows at the nearby Craters of the Moon National Monument are as recent as 2,100 years old. The much older basalt plains characteristic of the southern portion of the INL Site are between 200,000 and 730,000 years old (Hackett and Smith 1992). Basalt on the northern portion of the INL Site is at least a million years old.

In addition to the locally generated basalt outcrops and flows, the principle surface materials at the INL Site include alluvium, lakebed or lacustrine sediment, slope wash sediment and talus, silicic volcanic rocks, and sedimentary rocks.

4.13 Surface Soils

Despite the fact that the subsurface geology of the INL Site is dominated by basalt, most soils found on the INL Site are derived from older silicic volcanic and Paleozoic rocks from the surrounding mountains. These materials are deposited as sediment transported to the area by wind, water, or gravity.

A thin layer of eolian, or wind-borne sediment, covers virtually all of the INL Site area. The soils formed by this sediment ranges in texture from the fine-grained, wind-blown glacial loess left behind by retreating glaciers during the Pleistocene to sand believed to have originated from the Big Lost River and Snake River and from the shorelines of the ancient Lake Terreton. Because of the uneven, broken surface of the basalt base, the depths of eolian deposits vary from a few centimeters to over 2 m (6.5 ft).

In addition to this long-term eolian deposition, the INL Site and surrounding areas have been subject to at least two distinct episodes of major loess deposition during the past 200,000 years, with the most recent episode occurring some 10,000 years ago (Kuntz et al. 1994). Soils derived from these two major depositional events are markedly distinct; subsoils in the younger deposits contain high amounts of carbonates accumulated over many years of low rainfall and high evaporation rates, whereas soils from the older loess deposits developed during periods of higher precipitation. In these soils, salts have been leached out of the subsoil and fine particles (clays) have been deposited from the surface to the subsoil. Subsoil horizons of the older soil have relatively high amounts of clay rather than carbonates.

Alluvial soils are the result of deposition of water-borne sediment. On the INL Site, most alluvial soils are found on the western and northern portions of the site, specifically near the Big Lost River floodplain, on the small alluvial fans below the bordering mountains, and within the large alluvial fan of Birch Creek (S.M. Stoller Corporation 2005). The Big Lost River and Birch Creek, as well as the Little Lost River, originally fed the ancient Lake Terreton, which occupied much of the northern part of the INL Site. Because the area is a closed basin, water cannot flow out of the area. Loss of water is through downward percolation into the aquifer or via evaporation, both of which leave sediment in place.

The areas of the basin where water from the Big Lost River historically collected are referred to as the Big Lost River Sinks. Historically, water entering the INL Site from the Big Lost River first reached the Big Lost River Sinks area. In times of heavy flow, water was able to flow from the Big Lost River Sinks into a series of three playas, marking the bottom of the undrained desert basin — portions of the ancient bed of Lake Terreton. Similarly, water from Birch Creek naturally flowed into a fourth playa, also known as the Birch Creek Playa, near TAN. In very heavy runoff years, the Birch Creek playa connected with the third Big Lost River playa. The Little Lost River also historically terminated in a series of sinks and playas, but these are located northwest of the INL Site boundary.

All of these sink and playa areas contain substantial alluvial deposits, including bars, spits, and hooks from the ancient Lake Terreton that are well preserved on the modern landscape near TAN. These alluvial deposits are generally quite saline and support a variety of salt-tolerant plant species. Sediment in the playas and lakebeds of the ancient Lake Terreton generally is fine-textured loams or clay loams with relatively high clay content. Playa or desert lake basins are characteristic of another major surface soil type at the INL Site. Playas, in general, are attractive for development because of the deep silty deposits. Soils from the playas may be easily excavated for fill materials, but care must be taken to determine the shrink-swell capacity.

Colluvial soils formed from sediment originating from bordering mountains are found along the base of the mountain slopes on the western edge of the INL Site and surrounding the East and Middle Buttes. Generally, the colluvial soils in these deposits are gravelly. Very little information is available regarding the soils within these deposits, and the total area within the INL Site that is dominated by colluvial soils is small. Although a comprehensive survey of the soils at the INL Site has not been conducted, information from county surveys and numerous other sources has been compiled recently (Olson et al. 1995). This compendium indicates that most INL Site soils are *Aridisols*, with Calciorthids being the most common great group; *Entisols*, namely Torriorthents and Torrifluvents; and *Mollisols*, including Calcixerolls and Haploxerolls.

4.14 Water Resources

4.14.1 Surface Hydrology

Using the U.S. Geological Survey's surface water classification scheme, the INL Site straddles portions of six (possibly seven) watersheds. These watersheds include American Falls, Big Lost River, Birch Creek, Idaho Falls, Little Lost River, Medicine Lodge, and possibly a small portion of Lake Walcott (see Table 1). Of these watersheds, only four contain significant surface water bodies that flow onto or near the INL Site, including the Big Lost River, Birch Creek, Little Lost River, and Medicine Lodge watersheds. All surface water within them is lost to evapotranspiration or via infiltration to their local aquifers and the regional Eastern Snake River Plain Aquifer near or beneath the INL Site.

Table 1. Watersheds and aquifers directly associated with the Idaho National Laboratory Site.

Watershed Name[a]	Drainage at the INL Site (%)	Aquifer Name[a]
American Falls	39	Snake River Plain
Big Lost	34	Big Lost
		Copper Basin
		Snake River Plain
Birch Creek	14	Birch Creek
Medicine Lodge	9	Snake River Plain
		Snake River Plain
Little Lost	3	Little Lost
		Snake River Plain
Idaho Falls	1	Snake River Plain
Lake Walcott	[b]	Snake River Plain

a. Aquifer names from Graham and Campbell (1981).
b. It is unclear whether Lake Walcott intersects the INL Site.

The American Falls watershed drains approximately 39% of the INL Site, primarily around MFC and the Power Burst Facility. It is a relatively large watershed that straddles the north and south sides of the Snake River.

The Big Lost watershed is a 4,921-km^2 (1,900-mi^2) watershed that drains approximately 34% of the INL Site. Flows in the Big Lost River are usually diminished by evaporation, irrigation diversions, and infiltration losses along the river channel. Generally, Big Lost River flows do not reach the INL Site boundary during periods of low runoff. However, during periods of medium to high runoff, the river flows onto the INL Site. Depending on the amount of water flowing in the river, a portion or all the flows can be diverted to the INL Site Diversion System. Flows that remain in the river channel then flow northeastwardly in a concave arch toward its terminus in the Big Lost River playas near TAN. The Big Lost River is important to the INL Site because most major INL Site facilities are located along the Big Lost River corridor.

The Birch Creek watershed drains approximately 14% of the INL Site. It is a long, thin 1,792-km^2 (692-mi^2) watershed originating north of and incorporating TAN. Historically, Birch Creek flows terminated in the Birch Creek Playas; however, in 1969, the INL Site constructed some channels and began diverting the water to several gravel pits east of TAN. Several TAN facilities are located in this watershed.

The Medicine Lodge watershed drains approximately 9% of the INL Site. It is a long, thin 2,466-km^2 (952-mi^2) watershed east of TAN. The most significant surface water resource in this unit is Mud Lake, just north of the town of Terreton and east of the INL Site. No permanent streams are on or near the INL Site, and no INL Site facilities are located in this watershed.

The Little Lost River watershed drains approximately 3% of the INL Site. It is a 2,479-km^2 (957-mi^2) watershed originating on the eastern slope of the Lost River Mountains and the western slope of the Lemhi Mountains. This watershed does not include any INL Site facilities, and the Little Lost River is not known to have flowed onto the INL Site.

The Idaho Falls watershed drains approximately 1% of the INL Site east/southeast of MFC. It is a 2,953-km^2 (1,140-mi^2) watershed that straddles the east and west sides of the Snake River. No INL Site facilities are located in this watershed.

The Lake Walcott watershed may or may not drain a portion of the INL Site. The Lake Walcott watershed is a relatively large watershed that straddles the north and south sides of the Snake River. If it does intersect the INL Site boundary, only a very minor portion (less than 1%) of it would be associated with the INL Site. No INL Site facilities are located in this watershed.

4.14.2 Wetlands

The Environmental Protection Agency defines wetlands as “areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions” (40 CFR 230.3(t)).

The USFWS, as part of a 1992 preliminary survey, conducted an evaluation of aquatic habitats at the INL Site for the National Wetlands Inventory. This inventory identified and mapped approximately 135 areas within the boundaries of the INL Site. Of these areas, 121 INL Site wetlands were surveyed, grouped into five wetland categories (i.e., palustrine and lacustrine, riverine, manmade, unmapped, and unclassified). Jurisdictional wetlands, governed by the Clean Water Act (33 USC 1251-1376), are those wetlands that exhibit: (1) a prevalence of hydrophytic plants, (2) hydrological conditions suited to such plants, and (3) the presence of hydric soils. The only area of the INL Site identified as potential jurisdictional wetlands is the Big Lost River Sinks. Additional information concerning this mapping can be obtained in *A Preliminary Survey of the National Wetlands Inventory as Mapped for the Idaho National Engineering Laboratory* (Hampton et al. 1995).

4.14.3 Groundwater Hydrology

Five aquifers are associated with the INL Site: the Big Lost River Valley Aquifer, Birch Creek Valley Aquifer, Copper Basin Aquifer, Little Lost River Valley Aquifer, and the Eastern Snake River Plain Aquifer. The Big Lost River, Little Lost River, Birch Creek, and Medicine Lodge aquifers are tributary to the Eastern Snake River Plain Aquifer. The exact boundaries between these tributary aquifers and the Eastern Snake River Plain Aquifer are not well known.

The Eastern Snake River Plain Aquifer is the most significant aquifer relative to the INL Site because it underlies the vast majority of the INL Site. All of the water used by the INL Site is supplied by the Eastern Snake River Plain Aquifer in accordance with a Federal Reserve Water Right negotiated between DOE and the State of Idaho (U.S. Department of Justice 1990). The INL Site is permitted a water-pumping capacity of 80 ft^3/s and a maximum water consumption of 35,000 acre-ft per year. However, on average, the INL Site withdraws approximately 6,229 acre-ft per year. About 65% of these withdrawals are eventually returned to the aquifer via percolation. Consequently, the annual consumptive usage of water withdrawn from the aquifer is about 2,200 acre-ft per year.

The Environmental Protection Agency has designated the Eastern Snake River Plain Aquifer as a sole-source aquifer, meaning that it supplies at least 50% of the drinking water consumed in the area overlying the aquifer. Under the Sole-Source Aquifer Program (40 CFR 149 2005), the Environmental Protection Agency reviews all projects for which federal financial assistance has been requested. However, this designation does not affect the INL Site because it is operated through direct federal funding, not through federal financial assistance projects. Groundwater protection requirements of the Safe Drinking Water Act are met through negotiated compliance authorized under other provisions of the law (e.g., CERCLA).

The depth to the Eastern Snake River Plain Aquifer below the INL Site varies from about 61 m (200 ft) in the northern portion near TAN to more than 274 m (900 ft) at the southwestern corner of the Site near RWMC.

In addition to the regional aquifer, "perched water" or groundwater that is separated from the underlying regional aquifer by an interval of unsaturated rock or sediment exists at numerous areas beneath the INL Site. Water from these zones flows downward through low-permeability layers of fine-grained sediment and basalt flows to the aquifer. Perched water zones are known to exist below the Big Lost River and below wastewater discharge operations at INTEC, the ATR Complex, TAN, NRF, and MFC.

4.15 Biota

4.15.1 Flora

The natural vegetation at the INL Site primarily consists of a shrub overstory with an understory of perennial grasses and forbs. Most vegetation communities within the site boundaries are dominated by various species or subspecies of sagebrush, although some communities that are dominated by saltbush, juniper, crested wheatgrass, and Indian rice grass are present and distributed throughout the INL Site. The INL Site supports over 420 species of flowering plants (S.M. Stoller Corporation 2011a). Considerable information on vegetation communities and plant species found on the INL Site are available elsewhere, including the web-based INL Environmental Surveillance, Education, and Research Program site.

The INL Site occupies one of the largest tracts of relatively undisturbed sagebrush-steppe rangeland in the United States, with the most common shrub on the INL Site being Wyoming big sagebrush, although basin big sagebrush may dominate or be codominant with Wyoming big sagebrush on sites having deep soils or sand accumulations (Shumar and Anderson 1986). Wyoming big sagebrush communities occupy most of the central portions of the INL Site. Green rabbitbrush is the next most abundant shrub, and other common shrubs include winterfat, spiny hopsage, gray rabbitbrush, broom snakeweed, and horsebrush. Communities dominated by Utah juniper and three-tipped sagebrush, black sagebrush, or both are limited to areas along the INL Site periphery, specifically on the slope of the buttes and on the foothills of adjacent mountain ranges to the northwest. Salt-desert shrub communities may be found on the sediment in the sinks and playas associated with the Big Lost River and Birch Creek. These communities are dominated by shadescale, Nuttall saltbush, or winterfat.

The understory grasses include natives such as thick-spiked wheatgrass, bottlebrush squirreltail, Indian rice grass, needle-and-thread grass, and Nevada bluegrass. Creeping wild rye and western wheatgrass may be locally abundant. Communities dominated by basin wild rye are common in depressions between lava ridges and in other areas having deep soils. Bluebunch wheatgrass is common at slightly higher elevations southwest and east of the INL Site.

Vegetation communities within the INL Site boundaries contain an unusually high diversity of forbs largely due to the exclusion of livestock grazing common throughout the sagebrush-steppe region. Forb species are numerous, but not abundant in many areas. Common forbs include tapertip hawksbeard, Hood’s phlox, prickly phlox, hoary false yarrow, globe-mallow, evening primrose, bastard toadflax and various paintbrushes, buckwheats, lupines, milkvetches, and mustards.

A system of sinks and playas of the Big and Little Lost Rivers and Birch Creek are believed to have once supported an extensive, diverse, and unique wetland system. However, only minimal surveys of the presence and abundance of plant species have ever been conducted in this area, including two surveys in 1995 and 1997 conducted by an INL team inventorying plants and aquatic invertebrates in the area.

A total of 11 Idaho noxious weeds have been identified on the INL Site and several other non-native species also are present. Non-native species are quick to colonize new disturbance and successfully compete with native species, making them difficult to eradicate once present. Exotic plant species (such as cheatgrass and Russian thistle) that are well established, particularly within disturbed areas, may be altering the overall structure of the plant communities in the region, and, in the case of cheatgrass, also may be dramatically altering the fire regime. Crested wheatgrass, a European bunchgrass seeded in the late 1950s, dominates many disturbed areas where it was used to provide cover and to hold soils.

4.15.1.1 Special Status Plants. The USFWS provides a list, by county, of threatened and endangered species and other species of concern for the State of Idaho. The most recent USFWS list (December 2010) (USFWS 2015) includes one threatened plant species that may occur within the five counties that encompass the site: Ute ladies’-tresses (*Spiranthese diluvialis*). In addition, there are several sensitive plant species that may be present on the INL Site (Idaho Department of Fish and Game 2015).

4.15.2 Fauna

Estimates of the total number of species of vertebrate fauna found on the INL Site vary. Perhaps the most reliable information on vertebrate fauna on the INL Site is provided by the INL Environmental Surveillance, Education, and Research Program (S.M. Stoller Corporation 2011b), which describes some 211 vertebrate species (i.e., 5 fish, 1 amphibian, 9 reptile, 37 mammal, and 159 bird species) as having been documented on the INL Site. Of these species, 56 are considered to be year-round residents, whereas the rest are partial-year residents that were observed during specific seasons or during migration. Most of the migratory species are birds. An additional nine fish, five amphibian, five reptile, 13 bird, and 14 mammal species are considered as possibly occurring at the site, because portions of their range overlap the INL Site area or they have been reported within 30 km (18 miles) of the INL Site. However, no verified observations of these species have been reported on the INL Site.

Fish species reported on the INL Site are limited to the Big Lost River during years when water flow is sufficient (Reynolds et al. 1986). However, periods of drought and upstream water diversion for agricultural and flood-prevention purposes has severely restricted the flow of the Big Lost River on the

INL Site, thereby restricting the presence of native fish species. Similarly, the Great Basin spadefoot toad, the INL Site's only reported resident amphibian, is limited by water flow in the Big Lost River. Reptiles include five species of snake, three species of lizards, and the western skink.

Birds represent the largest group of vertebrates found on the INL Site, although as pointed out above, many bird species are seasonal residents. Raptors, songbirds, and waterfowl are all well represented and comprise important ecological components of the sagebrush-steppe community. The INL Site is inhabited by 14 species of sparrows and allies, six species of swallows, 20 species of ducks and geese, and 24 species of raptors (Idaho Department of Fish and Game 2015). Among these species is the bald eagle, which is seen on or near the INL Site during winter. Sage-grouse is another species of importance that is present on the INL Site (see Section 4.15.2.1).

Although most of the 37 mammal species reported on the INL Site are small mammals, several important large mammals (such as mule deer) are present. Approximately 30% of Idaho's pronghorn populations use the INL Site and surrounding areas for winter range (DOE 1997). In addition, a small population of elk has become resident on the INL Site. Some small mammal species (such as the black-tailed jackrabbit) exhibit large population fluctuations and influence the abundance, reproduction, and migration of predators such as the coyote, bobcat, and raptors. Other observed predators include mountain lions and badgers.

Several vertebrate species are considered to be sagebrush obligates (i.e., they live only in sagebrush communities). These sagebrush obligates include sage-grouse, sage sparrow, and pygmy rabbit. Rock outcroppings associated with these communities also provide habitat for species such as bats and wood rats. Grasslands serve as habitat for species that include the western meadowlark and mule deer. Facility structures at the INL Site also provide important wildlife habitat. Buildings, lawns, ornamental vegetation, and ponds are used by a number of species such as waterfowl, raptors, rabbits, and bats. Aquatic vertebrates are supported year-round by habitat provided by facility treatment ponds, waste ponds, and facility drainages (Cieminski 1993).

In 1995 and 1997, an INL team conducted surveys in the area of the INL Site that contains a system of sinks and playas of the Big and Little Lost Rivers and Birch Creek. Although by no means comprehensive, the field team observed 18 species of waterfowl and shorebirds (including over 500 ducks, some with broods) and several other bird species, including two peregrine falcons. Thousands of ephemeral Great Basin spadefoot toads were observed, as were invertebrates representing many different orders. Although remnants of these systems remain, the long-term impact of the various water diversion systems on the aquatic communities is uncertain.

The biological diversity of invertebrate fauna at the INL Site has not been investigated extensively; however, 740 insect species have been collected and identified at the INL Site. The harvester ant, in particular, has received attention during the past decade because of its general importance in desert ecosystem nutrient cycling and energy flow (Clark and Blom 1988, 1992). At the nearby Craters of the Moon National Monument, where a thorough inventory of invertebrates has been obtained, 2,064 species were found; therefore, many more insect species may be present at the INL Site.

4.15.2.1 Special Status Wildlife. The USFWS provides a list, by county, of threatened and endangered species and other species of concern for the State of Idaho. The most recent USFWS list (October, 2011) includes two threatened and endangered species and three candidate species that may occur within the five counties that encompass the INL Site (USFWS 2015). The Canada lynx (*Lynx canadensis*) and the grizzly bear (*Ursus arctos horribilus*) are threatened species. Neither is expected to be present on the INL Site. The gray wolf (*Canis lupus*) was delisted on May 5, 2011, and is no longer afforded protection under the Endangered Species Act in Idaho; wolf populations in Idaho are managed by the State. Greater sage-grouse (*Centrocercus urophasiunus*), yellow-billed cuckoo (*Coccyzus americanus*), and the wolverine (*Gulo gulo*) are candidate species. The yellow-billed cuckoo is a riparian-obligate species and is primarily associated with willow-cottonwood riparian forest.

The INL Site is a refuge for the beleaguered sage-grouse, the INL Site's 890 mi^2 are mostly wide-open and wild; roads and buildings, such as INL's ATR, occupy only 3% of the land. The INL Site consists of good sagebrush habitat surrounded by wheat fields, potato fields, and degraded rangelands. In the last 100 years, the sage-grouse population has fallen by at least 67% to just a few hundred thousand birds. The sage-grouse is in trouble because its habitat, the sagebrush steppe, is in trouble from development of aggressive non-native species such as cheat grass. Recently, USFWS concluded that the sage-grouse warrants protection under the Endangered Species Act, but action should wait until the agency can help other imperiled species first. The sage-grouse is currently on the list of species that are candidates for Endangered Species Act protection. USFWS supports efforts to keep the sage-grouse off the endangered species list by protecting its habitat to increase sage-grouse numbers.

In 2014, DOE-ID voluntarily entered into a Candidate Conservation Agreement with USFWS to protect greater sage-grouse and its habitats on the INL Site, while allowing DOE flexibility in conducting its current and future missions. This was the first such agreement signed in Idaho for sage-grouse. The Candidate Conservation Agreement complements Idaho's State Alternative, developed in 2012 by Governor C. L. "Butch" Otter's task force, and other efforts to preclude the need for sage-grouse to be listed under the Endangered Species Act. The INL Site conservation framework protects lands within a 1-km (0.6-mi) radius of all known active leks (i.e., traditional breeding grounds) on the INL Site and establishes a sage-grouse conservation area that limits infrastructure development and human disturbance in approximately 68% of remaining sagebrush-dominated communities. Leks protected by the sage-grouse conservation area support an estimated 74% of the sage-grouse that breed on the INL Site. In addition to establishing a conservation framework, the Candidate Conservation Agreement identifies primary threats to sage-grouse and its habitats on the INL Site and introduces a set of new conservation measures that DOE commits to implement to minimize those threats. Successful implementation will promote preservation of sagebrush habitat, reduce or eliminate threats to sage-grouse, and increase understanding of habitat and population trends through long-term research and monitoring.

Several other animal species were designated as sensitive that may be present on the INL Site. The bald eagle (*Haliaeetus leucocephalus*) was delisted in 2007, but is still protected under the Bald and Golden Eagle Protection Act. This species often winters in the Little Lost River Valley just north of the INL Site and several have been known to winter on the INL Site. The American peregrine falcon (*Falco peregrinus*) (delisted, but being monitored) has been observed infrequently on the northern portion of the INL Site.

Among the mammal species recognized by other agencies that might be found on the INL Site are Merriam's shrew *(Sorex merriami),* pygmy rabbit (*Brachylagus idahoensis*), bobcat (*Lynx rufus*), Townsend's big-eared bat (*Corynorhinus townsendii*), long-eared myotis (*Myotis evotis*), and small-footed myotis (*Myotis subulatus*). Bird species of concern include ferruginous hawk (*Buteo regalis*), long-billed curlew (*Numenius americanus*), northern goshawk (*Accipiter gentilis*), ferruginous hawk (*Buteo regalis*), osprey (*Pandion haliaetus*), gyrfalcon (*Falco rusticolus*), merlin (*Falco columbarius*), white-faced ibis (*Plegadis chihi*), long-billed curlew (*Numenius americanus*), burrowing owl (*Athene cunicularia*), prairie falcon (*Falco mexicanus*), and loggerhead shrike (*Lanius ludovicianus*). The northern sagebrush lizard (*Sceloporous graciosus*) is the single reptile on the USFWS list (USFWS 2015).

4.16 Cultural Resources

The INL Site is home to a rich cultural heritage spanning at least 13,500 years of human occupation in southeastern Idaho. Several types of cultural resources exist across the landscape, including prehistoric and historic archaeological sites and artifacts; sites and artifacts of importance to the Shoshone-Bannock Tribes and others, such as the California and Oregon Trail Association; and historic architectural properties from the World War II timeframe. Resources representing America's pioneering nuclear era, including structures, buildings, objects, artifacts, and documents, also are present. Natural landforms and native plants and animals of the INL Site region also may be of traditional importance to Native Americans, and, although rare, human burials have been found on the INL Site and are of special importance. DOE allows access to certain areas of the INL Site to Shoshone-Bannock tribal members for activities related to the maintenance of tribal heritage, education of tribal members, and exercise of traditional cultural activities.

The thousands of prehistoric archaeological sites within the INL Site boundaries range in age from more than 13,500 to 150 years old. Evidence of homesteads, stage stations, irrigation attempts, and trails also are extant. The INL Cultural Resource Management archives include documentation of nearly 3,000 archaeological resources and nearly 300 historic buildings and other structures, and the newly established INL Archive Center houses artifacts such as engineering and architectural drawings, 16-mm films, and photographic negatives (INL 2010). DOE-ID is tasked, by law, with managing this important cultural heritage in accordance with federal and state requirements and internal orders and directives (NHPA 1966). The INL Site is committed to protecting and preserving cultural resources across the site.

Strategies for effective management of INL Site cultural resources have been developed in conjunction with pertinent INL programs and are detailed in DOE-ID's Cultural Resource Management Plan (DOE-ID 2009). A tailored approach to management of these resources and compliance with applicable federal and state law are included in the INL Cultural Resource Management Plan, which is the basis of the programmatic agreement among DOE-ID, the Idaho State Historic Preservation Office, and the Advisory Council on Historic Preservation, as well as an Agreement-in-Principle between DOE-ID and the Shoshone-Bannock Tribes.

4.16.1 Prehistoric and Historic Archaeological Sites and Artifacts

Efforts to inventory INL Site cultural resources are ongoing. These investigations have been completed in project-specific localities and areas identified within research designs. To-date, approximately 10% of the 2,303-km^2 (889-mi^2) INL Site has been inventoried for archaeological sites, resulting in an inventory of nearly 3,000 resources. Archive and collections management for INL Site cultural resources is conducted on a variety of levels. Legal guidelines are followed to ensure preservation of these important materials in perpetuity for the benefit of the American people.

4.16.2 National Historic Landmark Buildings

Over 500 INL Site buildings have been surveyed and assessed for their eligibility to the National Register of Historic Places, and nearly 300 were identified as historic and potentially eligible for nomination. At present, the only INL Site properties formally listed as National Historic Landmarks are the EBR-I reactor and guardhouse. The EBR-I National Historic Landmark is open to the public daily from Memorial Day through Labor Day each year. It offers educational displays and guided tours on INL's historic nuclear past and on nuclear power in general.

Aviators Cave, an important Native American resource and sensitive archaeological site, also has been listed. Many other archaeological resources on the INL Site are potentially eligible for nomination.

Fifteen other INL Site architectural properties have been designated as signature properties. A signature property is a term coined by DOE that denotes its most historically important properties across the complex or those properties that are viewed as having tourism potential. The 15 signature properties are as follows:

1. Materials Test Reactor (TRA-603) demolished
2. Manufacturing and Assembly Building (TAN-607) demolished
3. Nuclear Airplane Hanger (TAN-629)
4. Loss-of-Fluid Test Control Building (TAN-630) demolished

5. Loss-of-Fluid Test Dome (TAN-650) demolished
6. Marine Barracks (CFA-606)
7. Commanding Officer's House (CFA-607)
8. Commanding Officer's Garage (CFA-632)
9. Officers' Quarters (CFA-613)
10. Proofing Area (CFA-633)
11. Central Facilities World War II Pumphouse (CFA-642)
12. Central Facilities World War II Pumphouse (CFA-651)
13. Chemical Processing Building (CPP-601) demolished
14. Heat Transfer Reactor Experiment (HTRE-2)
15. Heat Transfer Reactor Experiment (HTRE-3).

These signature properties at CFA are planned for demolition due to their deteriorating condition and lack of need for future use. Preservation of the historic nature of these properties is addressed under a memorandum of understanding with the Idaho State Historic Preservation Office (IDWR 2015).

4.17 Wildland Fires

The hot, dry summers characteristic of eastern Idaho predispose sagebrush-steppe communities to a history of recurring fire. Estimates of fire return intervals for sagebrush-steppe systems range from around 20 to over 100 years (Houston 1973, Wright and Bailey 1982, and Wright et al. 1979). It has been hypothesized that the natural interval between fires in these systems must be sufficiently long to allow big sagebrush, which does not resprout, to regain dominance through recolonization of burned sites from seed. Otherwise, these areas would become dominated by root-sprouting shrubs such as horsebrush or rabbitbrush (Wright et al. 1979).

Numerous fire scars are evident in aerial photographs and satellite images of the INL Site. The scars of several fires that have burned during this century have been mapped from satellite imagery or aerial surveys. Wildfires have been aggressively controlled at the INL Site since 1950, which may have decreased the area that otherwise would have burned. One of the large fires occurred in 1994, starting near the junction of Highways 20 and 22 on the western boundary of the INL Site and extending a distance of almost 25 km (15.5 miles). Since the 1994 fire, the INL Site has seen a number of other large wildfires. In fact, approximately 25% of the INL Site has burned since that time. A 16,160-hectare (40,000-acre) fire (164 km^2 or 63 mi^2) burned on the INL Site in 1999 and 2000. In 2010, two wildfires swept through INL Site lands, including the largest fire in INL Site history and another that burned near and over Middle Butte Cave. Driven by extremely high winds, the July 13, 2010, Jefferson Fire burned 32,053 hectares (79,339 acres) on the INL Site and 11,924 hectares (29,516 acres) off the INL Site. The August 27, 2010, Middle Butte Fire burned 5,255 hectares (13,008 acres) on the INL Site and 457 hectares (1,131 acres) off the INL Site. The 44,037 hectares (109,000 acres) Jefferson Fire that occurred in 2010 is the single largest blaze in INL Site history. Information on these and other fires can be found on the Environmental Surveillance, Education, and Research Program website (S.M. Stoller Corporation 2005). A map of the more recent large fire scars on the INL Site is illustrated in Figure 18.

Fires on the INL Site have heightened concerns because of the potential to burn through radiologically contaminated areas, posing a hazard to firefighters and the public. Exposure to windblown contaminated dust from fire-eroded landscapes is another concern.

The INL Site maintains an onsite fire department to provide wildfire management in cooperation with BLM and local municipalities. Restrictions are in place to minimize the potential for human-caused fires when vegetation is most susceptible to fire. For more information about specific fire restrictions, refer to the INL Wildfire Management Guide (INEEL 2002).

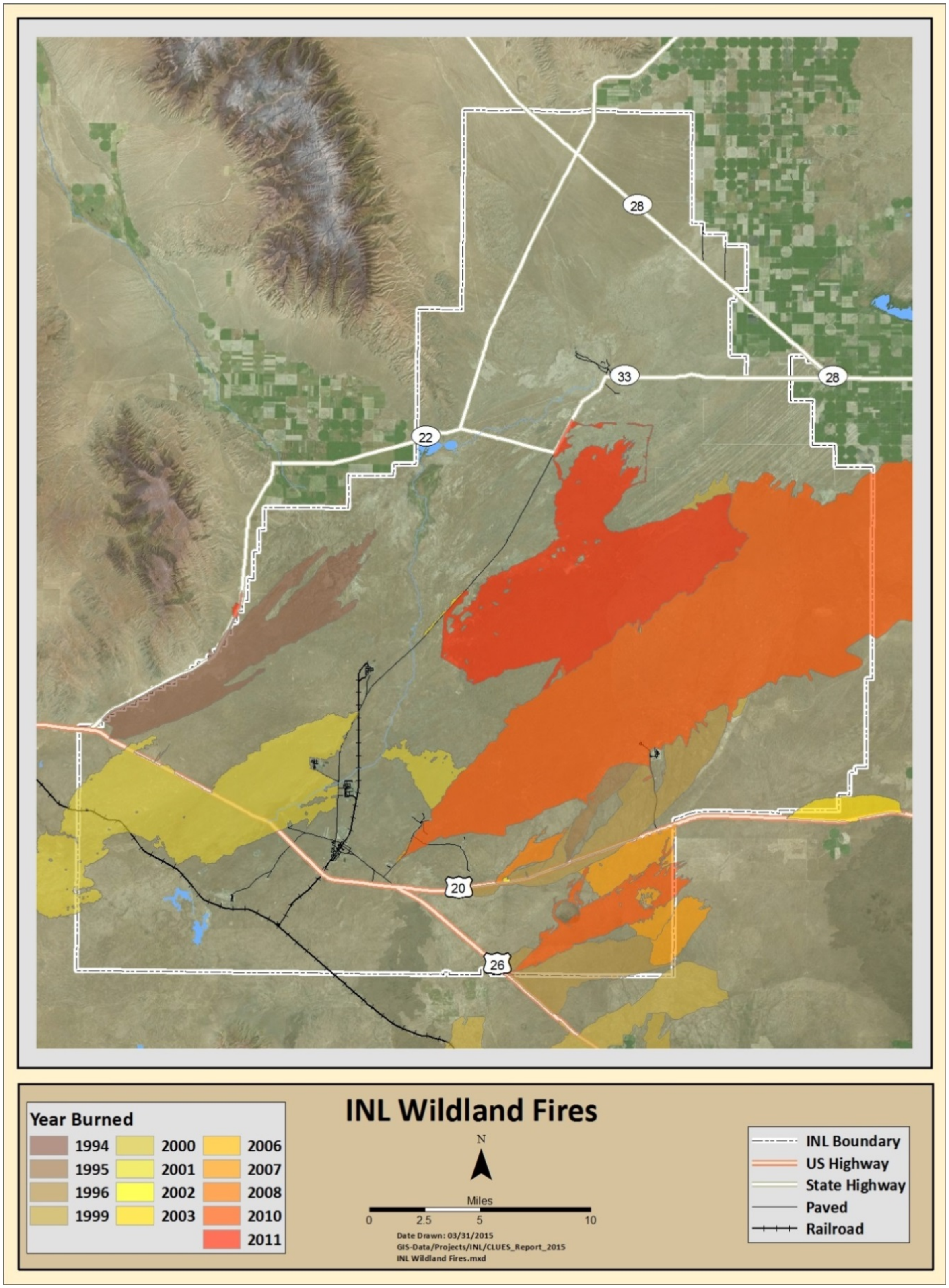

Figure 18. Idaho National Laboratory wildland fires.

4.18 Floodplain

Floodplains are lowland and relatively flat areas adjoining inland and coastal waters. Federal agencies are required to avoid adverse impacts on floodplains and to their occupants. The need for developing riverine flood control at the INL Site was first recognized in the 1950s when the ATR Complex and INTEC were threatened by flooding as a result of ice jams on the Big Lost River.

In 1958, the INL Site diversion system was constructed to divert high-runoff flows from the Big Lost River to protect downstream facilities. The diversion system consists of a diversion dam, two gated culverts, three dikes, four spreading areas, and two interconnecting channels. The dam and dikes were upgraded in the early 1980s to handle larger flow volumes. When flows exceed 377 ft^3/s at the diversion system headgate, which is approximately 3.22 km (2 miles) northwest of RWMC, some of the river will naturally flow into the diversion channel and into the RWMC spreading areas. The amount diverted can be regulated by the diversion dam headgates. Water diverted to the spreading areas either evaporates or infiltrates to the Eastern Snake River Plain Aquifer. The diversion channel is capable of carrying 7,200 ft^3/s from the river into the spreading areas (Bennett 1986). Two low swales located southwest of the main channel can carry an additional 2,100 ft^3/s, producing a combined diversion capacity of 9,300 ft^3/s (Bennett 1986). Water diverted to the spreading areas either evaporates or infiltrates to the aquifer. Water remaining in the Big Lost River channel continues to flow northeastwardly to the Big Lost River playas near TAN.

Riverine flooding also has occurred along Birch Creek near TAN as a result of ice jams. In 1969, because of concerns about the potential for flooding at TAN, the INL Site constructed channels and began diverting the water to several gravel pits east of TAN. Most of the flows are lost to seepage in the lower portions of the valley before flowing onto the INL Site boundary. However, Birch Creek does flow onto the INL Site during high water years, and it can negatively impact several TAN facilities if not diverted, especially when there is severe icing in the channel.

4.18.1 Big Lost River 100-Year Flood

Several studies have calculated the potential magnitude of a 100-year flood for the Big Lost River at the Arco gauging station (a station 22.5 km [14 miles] upstream from the INL Site diversion dam). The first calculated value of the mean 100-year flood magnitude range from 3,700 to 7,200 ft^3/s (Tullis and Koslow 1983, U.S. Army Corps of Engineers, Stone et al. 1992, and Hortness and Rousseau 2002). This range is attributed to the type of analysis, the data sets being used, the region of the river being analyzed, and other inherent assumptions used in the analysis. A study using paleohydrologic data collected from several stream reaches along the Big Lost River below the Arco station, in combination with historical stream gauge data from the Arco station, estimates a magnitude of 3,300 ft^3/s for the 100-year flood for the Big Lost River at the Arco station (Ostenna et al. 1999). Subsequently, the U.S. Geological Survey revised their estimate to be 3,740 ft^3/s with a 95% uncertainty ranging from 1,395 to 6,250 ft^3/s. Comments on topographic data (Stone et al. 1992) prompted a revision to their previous estimate. After revisiting the basin topography, the newest estimate of the 100-year flood magnitude is 3,070 ft^3/s (U.S. Department of the Interior 2005). Flooding at the INL Site is further complicated by construction of the INL Site diversion dam. This dam was built to control flow onto the INL Site, protecting the downstream facilities from flooding. Gates placed on two large, corrugated steel culverts control flow onto the INL Site and limit the flow of the Big Lost River to less than 900 ft^3/s downstream of the diversion dam (Lamke 1969). Although the INL Site diversion channel was designed to handle flows in excess of 7,200 ft^3/s (U.S. Department of the Interior 2005), a recent field investigation pertaining to the structural integrity of the INL Site diversion dam by the Army Corps of Engineers (Berger 1997) indicates the safe holding flowrate at the diversion dam is now thought to be about 7,300 ft^3/s. The diversion dam control of the flow of the Big Lost River and mean value of the most recent estimate of the 100-year flood (3,070 ft^3/s) on the Big Lost River suggest that the 100-year flood would be contained by the diversion dam, posing no flood threat to INL Site facilities.

4.18.2 Big Lost River Floods with Return Periods Greater than 100 Years

Ostenna et al. (1999) performed a Bayesian flood-frequency analysis that indicates peak flows on the Big Lost River with return periods of 500, 1,000, and 10,000 years are 4,000, 4,400, and 5,300 ft^3/s, respectively. These results suggest that exceedance of the estimated maximum capacity of the INL Site diversion dam of 9,300 ft^3/s (U.S. Department of the Interior 2005) has an extrapolated annual exceedance probability smaller than 0.00001 (or greater than the 100,000-year return period). Assuming a safe holding capacity of 5,000 ft^3/s for the INL Site diversion dam, the annual exceedance probability is 0.0002 (or a 5,000-year return period).

4.19 Seismicity

The mountains and valleys of southeastern Idaho lie within the Intermountain Seismic Belt and tectonic belts II and III of the Yellowstone Tectonic Parabola. This is one of the most earthquake prone regions of Idaho.

The INL Seismic Monitoring Program documents earthquake activity on and around the eastern Snake River Plain in the vicinity of the INL Site. To achieve this, the INL Site maintains and operates 27 seismographs, 32 strong-motion accelerographs, and 13 global positioning system stations. Earthquake data acquired by the INL Seismic Monitoring Program are used to evaluate seismic hazards at INL. Data collected by the INL seismic stations provide information on earthquake sources (such as locations, magnitudes, depths, fault dimensions, faulting style, and stress parameters), crustal structure, rock properties, and energy dissipation (or attenuation) characteristics of the subsurface. INL's strong-motion accelerographs determine the levels of earthquake ground shaking and responses of buildings to ground shaking. Global positioning system data help identify active regions of more frequently damaging earthquakes relative to less active regions.

The INL Seismic Monitoring Program provides the following:

- Immediate notification of magnitude, location, and levels of ground shaking (accelerations) to INL Site operations in the event of a large earthquake.
- An early warning system for potential future basalt volcanism within the eastern Snake River Plain.
- Earthquake data for seismic hazards assessments and development of INL seismic design criteria.
- Validation of INL seismic design criteria in the event of a nearby moderate to large magnitude earthquake.
- Quarterly summaries and an annual report on earthquake activity.

Figure 19 illustrates the location of southeastern Idaho's major faults and historical earthquakes. Additional information can be obtained at the INL Seismic Monitoring webpage (INL 2015).

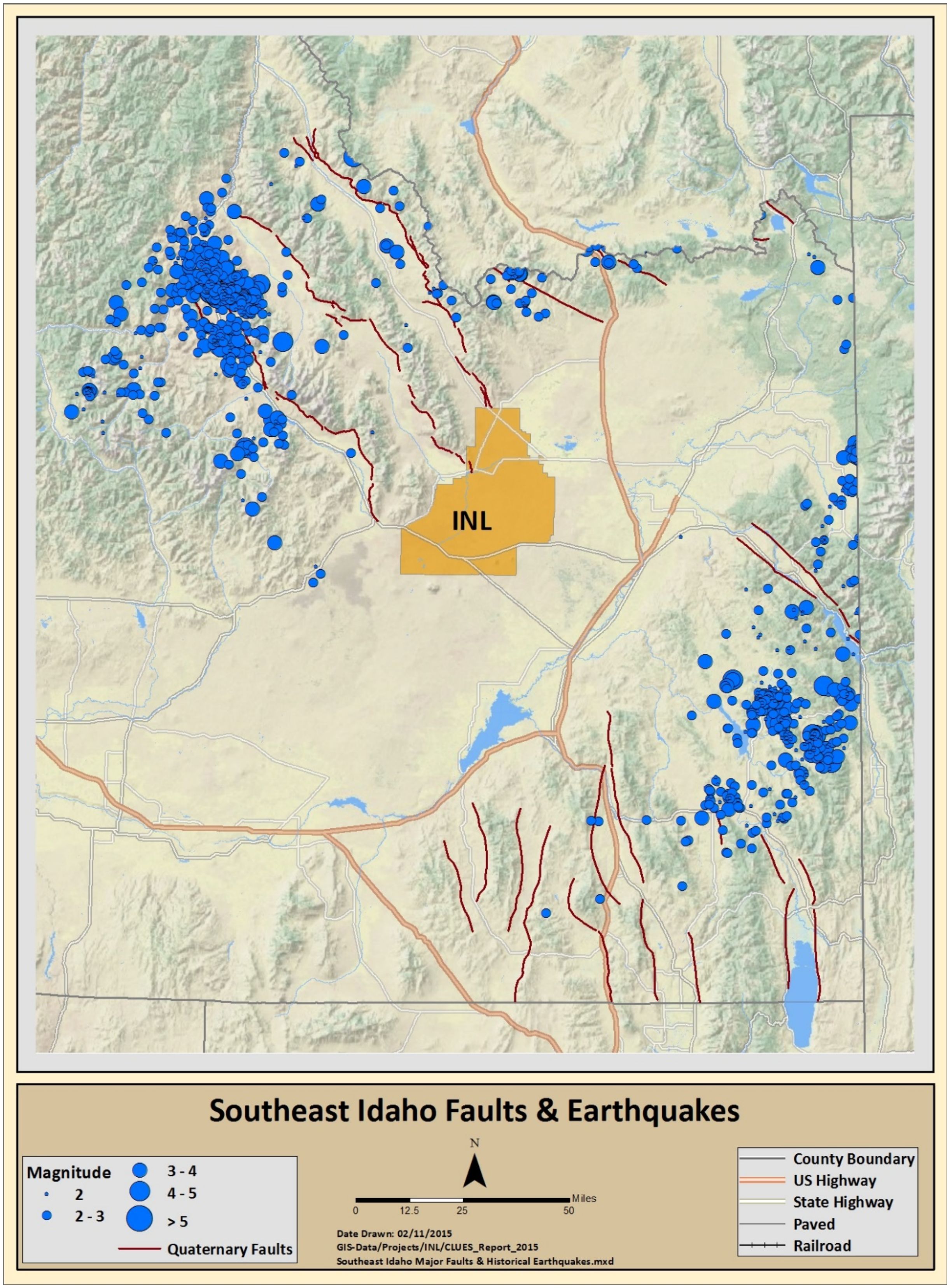

Figure 19. Southeastern Idaho's major faults and historical earthquakes.

5. REFERENCES

40 CFR 149, "Sole-Source Aquifer Program," *Code of Federal Regulations*, Office of Federal Register, August 2005.

40 CFR 230.3(t), "Definitions," Code of Federal Regulations, Office of Federal Register, August 1993.

BSU, 2010, "INL Impacts an analysis of the effects of Idaho National Laboratory site operations on Idaho's economy," http://cobe.boisestate.edu/files/2010/12/Impacts_Brochure-Web1.pdf, 2010.

Bennett, C. M., 1986, *Capacity of the Diversion Channel Below the Flood-Control Dam on the Big Lost River at the Idaho National Engineering Laboratory*, Report 86-4204, U.S. Geological Survey, Idaho Falls, ID, October 1986.

Berger, R. M., 1997, "Draft Plan of Study Big Lost River Diversion Dam and Facilities," U.S. Army Corps of Engineers Draft memo, Walla Walla District, June 17, 1997.

Census Bureau, 2011, State and County Quick Facts. http://quickfacts.census.gov/qfd/index.html, 2011.

Cieminski, K. L., 1993, *Wildlife Use of Wastewater Ponds at the Idaho National Engineering Laboratory*, South Dakota State University, Brookings, South Dakota, 1993.

Clark, W. H. and P. E. Blom, 1988, "Observations on the Relationship Between Ants (Hymenoptera: Formicidae: Myrmicinae, Dorylinae) and Araeoschizus (Coleoptera: Tenebrionidae)," *Journal of the Idaho Academy of Science*, 24 (1/2): 34–37.

Clark, W. H. and P. E. Blom, 1992, "Notes on Spider (Theridiidae, Salticidae) Predation of the Harvester Ant, *Pogonomyrmex salinus* Olsen (Hymenoptera: Formicidae: Myrmicinae), and a Possible Parasitoid Fly (Chloropidae)," *Great Basin Naturalist*, 52 (4): 385–386.

DOE, 1997, *Pronghorn Winter Range*, U.S. Department of Energy, Idaho Falls, Idaho.

DOE, 2009, "Facilities for the Future of Nuclear Energy Research: A Twenty-Year Outlook (Draft)," Department of Energy Office of Nuclear Energy, February 2009.

DOE, 2010a, *Nuclear Energy Research and Development Roadmap*, Report to Congress, U.S. Department of Energy, April 2010.

DOE, 2010b, *Environmental Assessment for the Multipurpose Haul Road Within the Idaho National Laboratory Site*, DOE/EA-1772, U.S. Department of Energy.

DOE-ID, 2004, *Idaho National Engineering and Environmental Laboratory Cultural Resource Management Plan*, DOE/ID-10997, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho, August 2004.

DOE-ID, 2009, "U.S. Department of Energy Idaho Operations Office, Cultural Resource Management Plan."

DOE-ID, 2010, *Idaho National Laboratory Site-Wide Institutional Controls, and Operations and Maintenance Plan for CERCLA Response Actions*, DOE-ID/11042, Revision 6, July 2010.

Graham, W. G. and L. J. Campbell, 1981, Groundwater Resources of Idaho: unpublished report by the Idaho Department of Water Resources.

Hackett, W. R. and R. P. Smith, 1992, "Quaternary volcanism tectonics, and sedimentation in the Idaho National Engineering Laboratory Area," *Field guide to geologic excursions in Utah and adjacent areas of Nevada, Idaho, and Wyoming*, J. R. Wilson, Salt Lake City, Utah, Utah Geological Survey, Miscellaneous Publication 92-3: 1–18.

Hampton, N. L., R. C. Rope, J. M. Glennon, and K. S. Moor, 1995, *A Preliminary Survey of National Wetland Inventory as Mapped for the Idaho National Engineering Laboratory*, INEL-95/0101, Lockheed Idaho Technologies Company, Idaho Falls, Idaho, March 1995.

Hortness, J. E. and J. P. Rousseau, 2002, *Estimating the Magnitude of the 100-Year Peak Flow in the Big Lost River at the Idaho National Engineering and Environmental Laboratory, Idaho*, Water Resources Investigations Report 02-4299, Idaho Falls, Idaho.

Houston, D. B., 1973, "Wildfires in Northern Yellowstone Park," *Ecology*, 54: 1111–1117.

ICP, 2015, "Idaho National Laboratory Institutional Control Sites Database," https://cleanup.icp.doe.gov/ics, accessed July 2015.

Idaho Department of Fish and Game, 2015, "Idaho Natural Heritage Program," http://fishandgame.idaho.gov/public/wildlife/nongame/?getPage=25.

IDWR, 2015, IDFG, State Historic Preservation Office, USDOT, BLM, USFS Region 1, www.history.idaho.gov.

INEEL, 2002, "INEEL Wildland Fire Management Guide," GDE-7063, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho, July 10, 2002.

INEEL, 2004, "Sagebrush Steppe Ecosystem Reserve Final Management Plan, " EA-ID-07402-067, Bureau of Land Management, Idaho Falls, Idaho, May 2004.

INL, 2010, *Idaho National Laboratory Cultural Resource Monitoring Report for FY 2010, INL Cultural Resource Management Office*, INL/EXT-10-20270, October 2010.

INL, 2011, "INL's 52 Nuclear Reactors," Idaho National Laboratory, http://nuclear.inl.gov, 2011.

INL, 2015, "INL's Seismic Monitoring," http://quakes.inl.gov/.

Kuntz, M. A., B. Skipp, M. A. Lanphere, W. E. Scott, K. L. Pierce, G. B. Dalrymple, D. E. Champion, G. F. Embree, W. R. Page, L. A. Morgan, R. P. Smith, W. R. Hackett, and D. W. Rodgers, 1994, *Geologic map of the INEL and adjoining areas, eastern Idaho*, U.S. Geological Survey, Miscellaneous Investigation Series Map I-2330.

Lamke, R. D., 1969, *Stage-Discharge Relations on the Big Lost River Within National Reactor Testing Station, Idaho*, Water Resources Division, IDO-22050, U.S. Geological Survey, Idaho Falls, Idaho.

Link, P. K. and E. C. Phoenix, 1994, *Rocks, Rails and Trails*, Idaho State University Press, Pocatello, Idaho.

NHPA, 1966, National Historic Preservation Act of 1966.

Olson, G. L., D. J. Jeppesen, and R. D. Lee, 1995, *The Status of Soil Mapping for the Idaho National Engineering Laboratory*, INEEL/EXT-95-00960, Lockheed Idaho Technologies Company, Idaho Falls, Idaho.

Ostenna, D. A., D. R. Levish, and R. E. Klinger, 1999, *Phase 2 Paleohydrologic and Geomorphic Studies for the Assessment of Flood Risk for the Idaho National Engineering and Environmental Laboratory, Idaho*, Report 99-7, Geophysics, Paleohydrology, and Seismotectonics Group, Technical Service Center, Bureau of Reclamation, Denver Colorado.

Pierce, K. L. and L. A. Morgan, 1992, 'The Track of the Yellowstone Hot Spot: Volcanism, Faulting, and Uplift," *Regional Geology of Eastern Idaho and Western Wyoming*, P. K. Link, M. A. Kuntz, and L. B. Platt. Boulder, Colorado, The Geological Society of America: 1–53.

Reynolds, T. D., J. W. Connelly, D. K. Halford, and W. J. Arthur, 1986, "Vertebrate Fauna of the Idaho National Environmental Research Park," *Great Basin Nature*, 46: 513–527.

Shumar, M. L. and J. E. Anderson, 1986, “Gradient Analysis of Vegetation Dominated by Two Subspecies of Big Sagebrush,” *Journal of Range Management*, 39: 156–160.

S.M. Stoller Corporation, 2005, *INL Environmental Surveillance, Education and Research Program*, S.M. Stoller Corporation, www.gsseser.com.

S.M. Stoller Corporation, 2011a, “Current and Past Research at the Idaho NERP,” http://www.gsseser.com/NERP/research.htm.

S.M. Stoller Corporation, 2011b, “Vertebrates of the INL, Summary,” http://www.gsseser.com/LandManagement/species_index.htm.

Stacy, S., 2000, *Proving the Principle—A History of the Idaho National Engineering and Environmental Laboratory 1949-1999*, DOE/ID-10799, Jason Associates Corporation, Idaho Falls, Idaho.

Stone, M. A. J., L. J. Mann, and L. C. Kjelstrom, 1992, *Statistical Summaries of Streamflow Data for Selected Gaging Stations on or Near the Idaho National Engineering Laboratory, Idaho, Through September 1990*, DOE/ID-22109, Water Resources Investigations Report 92-4196, U.S. Geological Survey, Idaho Falls, Idaho.

Tullis, J. A. and K. N. Koslow, 1983, *Characterization of Big Lost River Floods with Recurrence Intervals Greater Than 25 Years*, RE-PB-83-044, EG&G Idaho, Inc., Idaho Falls, Idaho.

U.S. Army Corps of Engineers, 1991, *Feasibility Report, Big Lost River Basin, Idaho*, Walla Walla, Washington.

U.S. Code, Title 33, Chapter 26, Subchapter 1251, Congressional Declaration of goals and policies, “Clean Water Act,” 2002.

U.S. Department of Agriculture, 2007, 2007 Census of Agriculture, County Profile, http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/County_Profiles/Idaho/cp16051.pdf.

U.S. Department of the Interior, 2005, *Big Lost River Flood Hazard Study Idaho National Laboratory*, prepared for the Idaho National Laboratory by the Bureau of Reclamation, Denver, Colorado.

U.S. Department of Justice, 1990, *Water Rights Agreement Between the State of Idaho and the United States, for the United States Department of Energy*, U.S. Department of Justice, Environmental and Natural Resources Division, Washington DC, July 1990.

USFWS, 2015, Idaho’s Endangered, Threatened, Proposed, and Candidate Species (With Associated Proposed and Critical Habitats) Under the Jurisdiction of the Fish and Wildlife Service (updated January 2015) http://www.fws.gov/idaho/species.htm.

Wright, H. A., L. F. Neuenschwander, and C. M. Britton, 1979, *The Role and Use of Fire in Sagebrush-grass and Pinyon-juniper Plant Communities: a State-of-the-Art Review*, USDA Forest Service, General Technical Report INT-58, Intermountain Forest and Range Experiment Station, Ogden, Utah.

Wright, H. A. and A. W. Bailey, 1982, *Fire Ecology: United States and southern Canada*, John Wiley and Sons, New York, New York.