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U.S. Department of Energy
Idaho Operations Office

Environmental Assessment for the Wildland Fire Management Program at Idaho National Laboratory

July 2025

Idaho National Laboratory

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Prepared for the
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CONTENTS

FIGURES

TABLES

ACRONYMS

ACHP	Advisory Council on Historic Preservation
APE	Area of Potential Effects
ATR	Advanced Test Reactor
BLM	Bureau of Land Management
BMP	Best Management Practice
BPP	Bat Protection Plan
CAA	Clean Air Act
CCA	Candidate Conservation Agreement
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CITRC	Critical Infrastructure Test Range Complex
CRMO	Cultural Resource Management Office
DOE	Department of Energy
EA	environmental assessment
EDG	emergency diesel generator
EPA	U.S. Environmental Protection Agency
ESRP	Eastern Snake River Plain
FEC	Facility Emissions Cap
GHG	Greenhouse Gas
HAP	Hazardous Air Pollutant
HeTO	Heritage Tribal Office
ICP	Idaho Cleanup Project
IDAPA	Idaho Administrative Procedures Act
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish and Game
INTEC	Idaho Nuclear Technology and Engineering Center
INL	Idaho National Laboratory
MFC	Materials and Fuels Complex
MIST	minimum impact suppression tactics
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NRHP	National Register of Historic Places

PM	Particulate Matter
PSD	Prevention of Significant Deterioration
PTC	Permit to Construct
RWMC	Radioactive Waste Management Complex
R&D	Research and Development
ROI	Region of Influence
SHPO	Idaho State Historic Preservation Office
SGCA	Sage-grouse Conservation Area
SMC	Specific Manufacturing Capability
SSER	Sagebrush Steppe Ecosystem Reserve
TAN	Test Area North
USFWS	U.S. Fish and Wildlife Service
VOC	Volatile Organic Compound
WLF	Wildland Fire
WLFMC	Wildland Fire Management Committee

Draft Environmental Assessment for the Wildland Fire Management Program at the Idaho National Laboratory

1. INTRODUCTION

The Idaho National Laboratory (INL) Site is federal research and development site managed by the U.S. Department of Energy (DOE) and is located on the upper Snake River Plain in southeastern Idaho, about 50 miles west of Idaho Falls, Idaho (Figure 1). The INL Site was established in 1949 as the National Reactor Testing Station. Today, INL is a science-based, applied engineering national laboratory dedicated to supporting DOE's nuclear and energy research, science, and national defense missions. Operations at the INL Site also include the Idaho Cleanup Project (ICP). ICP has been charged with the environmental cleanup of legacy wastes generated at the INL Site from World War II-era conventional weapons testing, government-owned reactors, and spent fuel reprocessing.

The INL Site encompasses about 890 square miles (mi^2) and consists of several primary facilities, which are typically less than a few square miles in size and separated by miles of undeveloped land. The major facilities at the INL Site are the Advanced Test Reactor (ATR) Complex, Central Facilities Area (CFA), Critical Infrastructure Test Range Complex (CITRC), Idaho Nuclear Technology and Engineering Center (INTEC), Materials and Fuels Complex (MFC), Naval Reactors Facility (NRF), Radioactive Waste Management Complex (RWMC), and Test Area North (TAN), which includes the Specific Manufacturing Capability (SMC). The Research and Education Campus is in Idaho Falls, Idaho. The locations of major INL Site facilities are shown in Figure 2.

Over 50% of the INL Site is in Butte County and the remainder is distributed across Bingham, Bonneville, Clark, and Jefferson counties. Federal lands surround much of the INL Site, including Bureau of Land Management (BLM) lands and Craters of the Moon National Monument and Preserve to the southwest, Challis National Forest to the west, and Targhee National Forest to the north. Mud Lake Wildlife Management Area, Camas National Wildlife Refuge, and Market Lake Wildlife Management Area are within 50 miles of the INL Site. The Fort Hall Indian Reservation is located about 37 miles to the southeast. Currently, the INL Site employs about 10,000 people. No permanent residents reside within the INL Site boundary.

The INL Site lies within a large, relatively undisturbed expanse of sagebrush steppe. About 94% of the land on the INL Site is open and undeveloped. The INL Site has an average elevation of 4,900 ft above sea level and is bordered on the north and west by mountain ranges and on the south by volcanic buttes and open plain. Lands immediately adjacent to the INL Site are open sagebrush steppe, foothills, or agricultural fields (INL 2024).

Fire rotation intervals for Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) have been estimated to range up to 350 years. Sagebrush is not particularly well-adapted to fire, as evidenced by its lack of fire resistance, inability to resprout, and poor long-distance seed dispersal capability. As a foundation species, sagebrush modulates the local ecosystem, and the loss of sagebrush from a plant community disproportionality affects co-occurring species and overall ecosystem function. When large regions of the sagebrush steppe shift from sagebrush-dominated shrublands to grasslands or communities dominated by resprouting shrubs, substantial changes in habitat availability and ecosystem function are expected. Because sagebrush has been lost from nearly 247,105 acres of the INL Site over the past 30 years (Figure 3), much of the landscape is already undergoing extensive ecological changes (Forman, Kramer, et al. 2024).

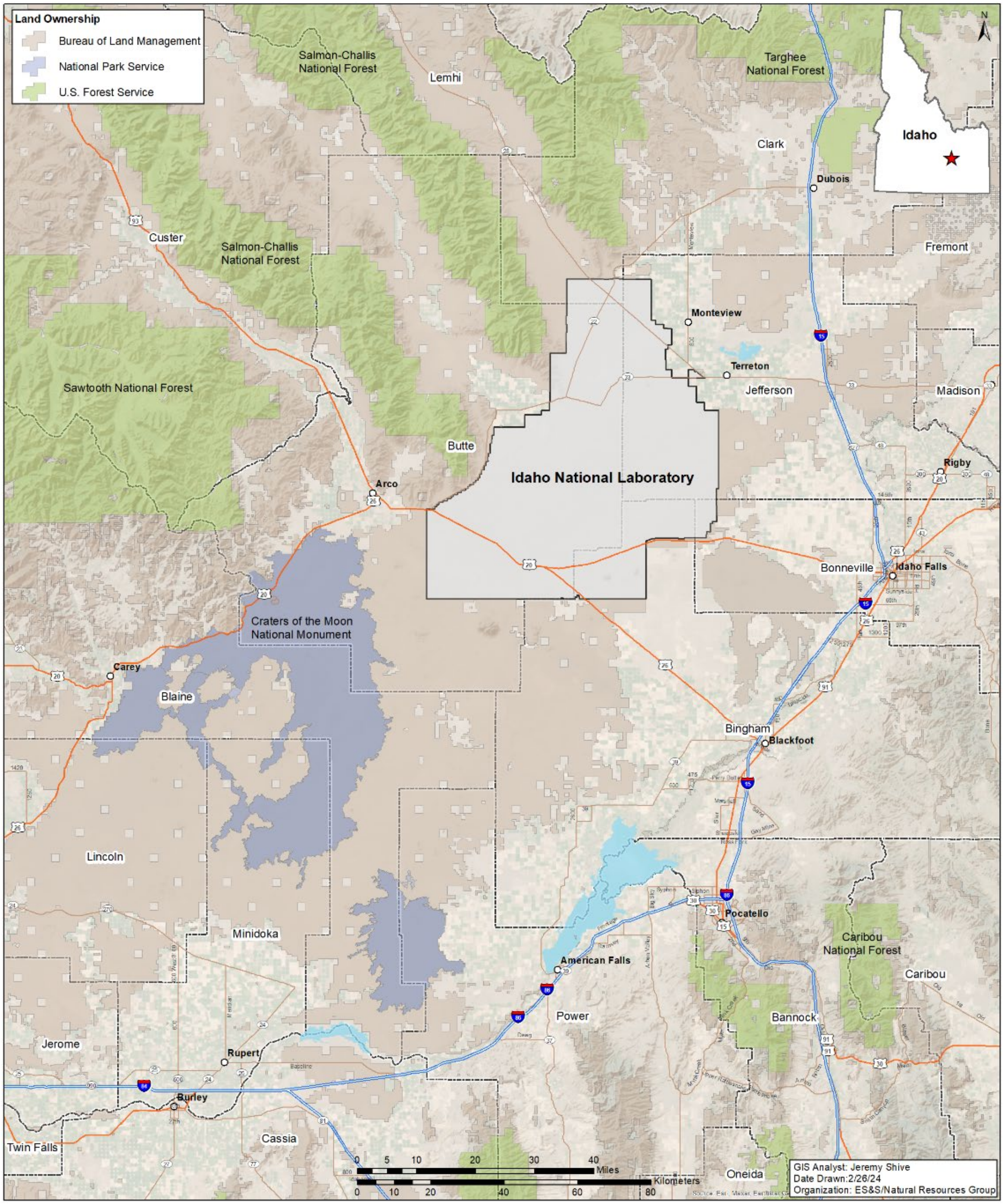

Figure 1. Site map of INL.

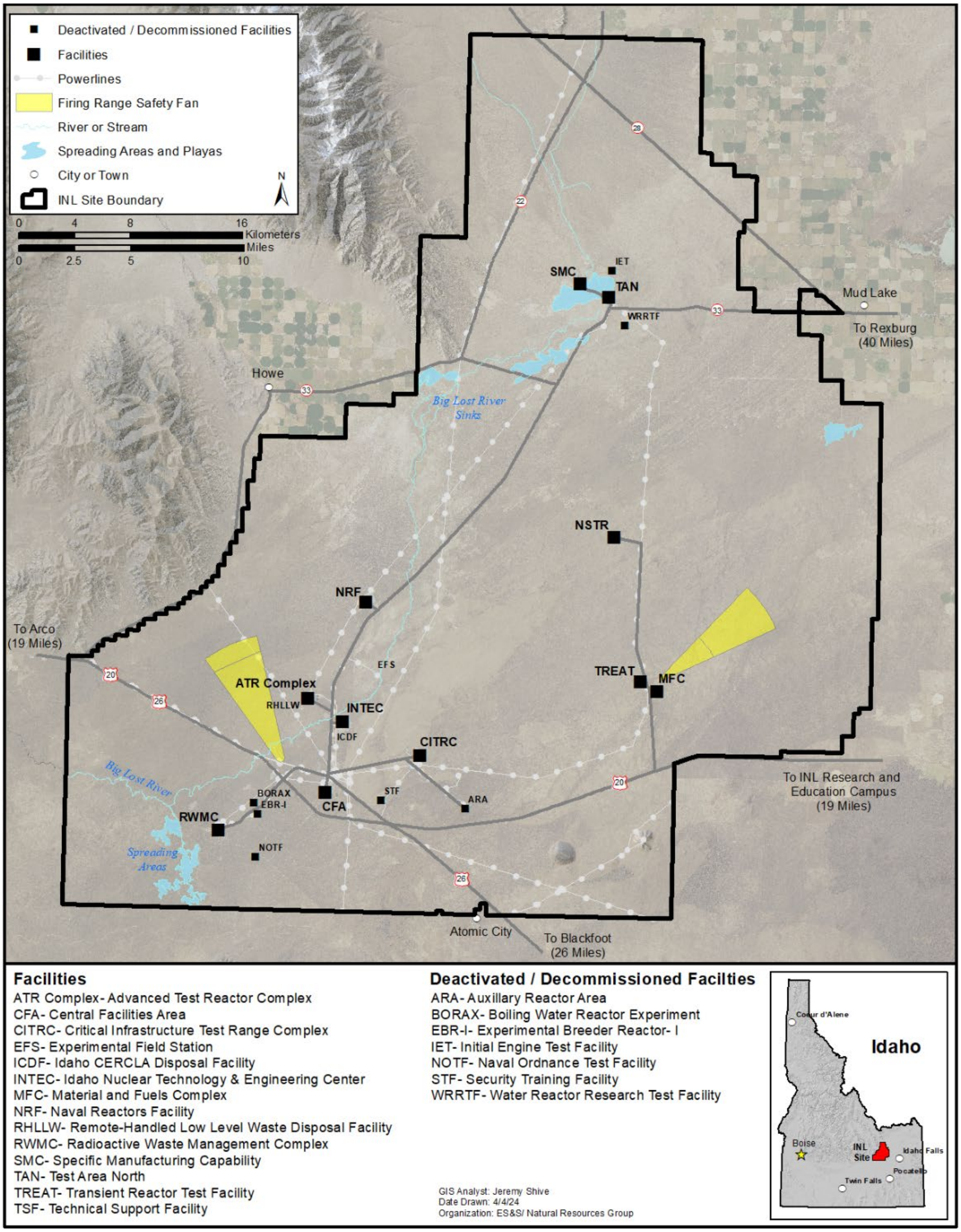

Figure 2. Location of INL Site facilities.

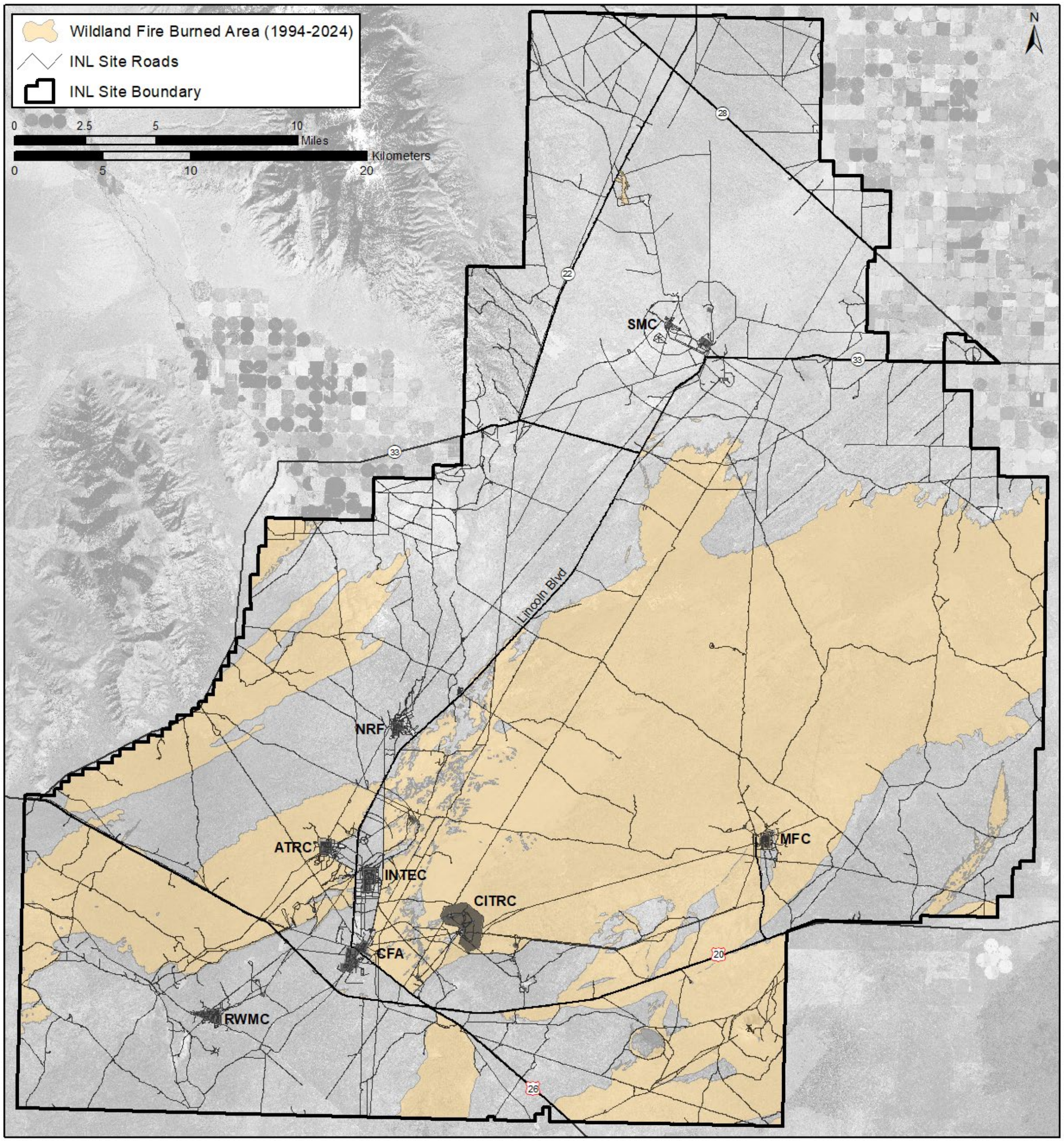

Figure 3. All areas burned from 1994–2022 on the INL Site.

INL's primary fire management priority is to ensure the safety of firefighters, workers, and the public. Infrastructure, cultural, and ecological resources are then protected based on the relative values of each resource. INL takes necessary suppression actions to minimize the threat of WLF on mission-important improved property, including protection of wildland urban interfaces and intermixes.

1.1 Background

In 2003, DOE issued the *Idaho National Engineering and Environmental Laboratory Wildland Fire Management Environmental Assessment and Finding of No Significant Impact* (DOE-ID 2003), hereafter referred to as the 2003 Wildland Fire Environmental Assessment (EA) and Finding of No Significant Impact (FONSI), to evaluate wildland fire management options for pre-fire, fire suppression, and post-fire activities due to the important role these activities play in minimizing the conversion of native sagebrush steppe to non-native species. In the 2003 FONSI, DOE decided to create a Wildland Fire Management Committee (WLFMC) to address pre-fire and post-fire activities and to implement the following actions:

Pre-Suppression Actions

1. Mow vegetation along the following highways and roads:
    - A minimum of 10 feet to a maximum of 300 feet on each side of State Highways 20, 26, and 20/26
    - A minimum of 10 feet to a maximum of 50 feet on each side of State Highways 22, 28, and 33
    - A minimum of 10 feet to a maximum of 50 feet along these locations:
        - Each side of Lincoln Boulevard and Adams Boulevard from Lincoln Boulevard to the RWMC
        - Approach roads to the CFA Gun Range Facility, Argonne National Laboratory-West (what is now MFC), INTEC, Test Reactor Area (now the ATR Complex), NRF, Waste Reduction Operations Complex, and the SMC Site areas
    - A minimum of 100 feet to a maximum of 300 feet around the CFA Gun Range
    - A 5-to-10-foot strip along facility perimeter roads.
2. Maintain the following strategic, unimproved roads as passable for 4×4 equipment: T-12, T-13, and Main Street from the intersection of T-13 to State Highway 20/26, T-16, T-4, T-3, T-5, T-20, T-9, and the existing power line roads.
3. Provide defensible space using the following methods (except that blading, with or without sterilization will not be used, and placing gravel over areas that may require long-term weed control will be minimized):
    - Maintain a 30-to-50- foot defensible area around all INL Site buildings, structures, and significant support equipment
    - Maintain a 30-foot defensible area around parking lots, storage pads, designated buildings, designated perimeters, designated propane and fuel tanks, substations, and along the rail system within the INL Site.

Fire Suppression Actions

1. Use a staged fire suppression response and incorporate minimum impact suppression tactics (MIST) when conditions allow, as determined by the on-scene commander. Tactics include minimizing width and depth of containment lines, avoiding waterways, using cold-trail tactics, and using existing roads as containment lines.

2. Use the following direct tactics:
    - Hose line application of water or foam suppressants on burning vegetation using off- road firefighting equipment
    - Aerial delivery of water or chemical retardant using helicopters and air tankers
    - Construction of containment lines (generally up to 24 feet unless the on-scene commander determines that larger containment lines are necessary) on the fire perimeter using dozers, graders, other mechanical equipment, and hand tools.
3. Use the following indirect tactics:
    - Construct containment lines ahead of advancing fires, which generally involves the construction of a single- or double-blade containment line (generally up to 24 feet unless the on-scene commander determines that larger containment lines are necessary) using dozers, graders, and discs or the widening of existing breaks
    - Burn vegetation from a containment line to the fire edge.
4. Use the following parallel tactics:
    - Construct containment lines parallel to but further from the fire edge than in direct attack
    - Burn the fuel between the containment line and the fire edge
    - Construct containment lines only as large as necessary to effectively check the fire.

Post-Fire Actions

1. Suppress and control dust:
    - Apply a soil tackifier or mulch
    - Install water cannons or snow fences upwind of affected facilities.
2. Implement site restoration activities, as identified in Section 2.1.3, as necessary to determine impacts to cultural resources and ensure the establishment of a native plant community in areas disturbed by suppression activities. Until such time as a native plant community is established, the Idaho National Engineering and Environmental Laboratory (INEEL) will control non-native weeds, including noxious weeds and invasive species, on those areas.

In the 2003 WLF FONSI (DOE-ID 2003), DOE also decided that no fuel management activities would occur along unimproved roads and upgrading unimproved roads would be restricted to necessary segments, limited to filling ruts with gravel or dirt, and then leveling the fill materials.

Following the 2019 Sheep Fire, DOE identified several actions for addressing changing conditions on the INL Site that the agency did not implement in the 2003 WLF EA and FONSI (DOE-ID 2003). These actions include (1) better access and egress for firefighter and equipment safety during WLF response and suppression and (2) review comprehensive strategies for WLF recovery on the INL Site that evaluates the tools available to facilitate natural resource recovery and minimize the risk of unfavorable outcomes, like weed invasions or loss of ecosystem function.

1.2 Purpose and Need

DOE needs to improve fire preparedness and recovery at the INL Site(DOE-ID 2003)DOE fire management and recovery options at the INL Site are currently limited to those that were analyzed in the 2003 WLF EA and FONSI (DOE-ID 2003). New strategies are necessary to allow WLF protection strategies and recovery efforts that can offer improved asset protection, firefighter safety, and recovery of natural resources following WLF events on the INL Site.

The purpose of the proposed action is to (1) improve WLF response capabilities and firefighter safety and (2) offer adaptive capacity in WLF recovery practices. The potential for WLF poses a risk to the operational capabilities that enable INL to meet its primary mission needs. INL's primary mission includes to discover, demonstrate, and secure innovative nuclear energy solutions, other clean energy options, and critical infrastructure essential to the nation's security. Furthermore, as pressures from invasive species and anthropogenic impacts increase across the landscape in the western U.S., managing WLF recovery to promote healthy sagebrush steppe becomes an increasingly important stewardship responsibility. Consequently, DOE needs to reduce the risk of damage and injury to property, human life and health, and ecological resources at INL from WLF to protect and maintain the operational capabilities of INL and ensure that the local ecosystem is resilient to WLF and can recover from its impact.
ALTERNATIVES

In accordance with ten Code of Federal Regulations (CFR) 1021.321(c), this section describes the proposed action and No Action Alternatives. DOE considered alternatives for meeting the purpose and need for improving asset protection, firefighter safety, and recovery of natural resources following WLF events on the INL Site. For the alternatives to be feasible, the alternatives must meet the following criteria:

1. Improve access and egress for firefighters and equipment during WLF events at the INL Site.
2. Reduce the risk of noxious and invasive species spread to the extent possible.
3. Maintain the diversity and resilience of the INL Site vegetation and wildlife communities.
4. Ensure the local ecosystem can continue to provide ecosystem services by maintaining functional processes like water balance, nutrient cycling, and carbon storage.
5. Mitigate potential changes to the historical fire disturbance regime with respect to fire frequency and the annual grass feedback cycle.

The proposed action as described in this EA is strategic in nature, and DOE anticipates that the activities described may not necessarily reflect what is implemented. This EA uses a bounding approach to analyze the environmental impacts of the proposed action. The bounding approach to the analysis of environmental impacts in this EA is designed to identify the maximum range of potential impacts. Because the specific combination of actions to be implemented is unknown, the analysis of impacts in this EA is based on conservative assumptions using maximum reasonably foreseeable disturbance and impact levels. DOE could choose from many options based on changing Site conditions and could implement the options individually or in combination. Therefore, DOE did not identify other alternatives beyond implementing the proposed fire management and recovery actions or DOE taking no action.

2. ALTERNATIVES

2.1. Proposed Action

Under the proposed action, pre-suppression actions and fire suppression actions would continue as evaluated in the 2003 WLF EA (DOE-ID 2003). The program would implement prevention activities, maintain fire management infrastructure, and enact recovery efforts following a WLF. Wildland fire-fighting activities and tactics would continue to be performed by the INL Fire Department and partnering agencies following existing DOE procedures and interagency agreements. However, DOE has identified the following actions to meet the purpose and need for improving access and egress for firefighters and equipment and offering new WLF protection strategies and recovery efforts during and following WLF events on the INL Site:

To ensure safe access and egress routes, road improvements along several two-track roads would be implemented. In addition, the action includes mowing up to, and not more than, 100 feet from each edge of these roads (200 ft total) to reduce flame height during a WLF event. Mowing at a height of 6 inches would be completed using large commercial mowers attached to, or towed behind, wheeled tractor equipment to mechanically lower vegetation along the identified roadways. Roads would be improved from non-graveled two-track roads to graveled roads that are spot-graded as needed. These roads would not be widened past their existing width, and no new roads are proposed. As shown in Figure 4 and Table 1, DOE proposes the following road improvements.

Table 1. Proposed road improvements and mowing.

Road improvements and mowing	**Road improvements only (no mowing)**
T-2 T-3 (From MFC to western INL Site border)	T-3 (From eastern INL border to MFC) T-4 (Between Highway 20 and Highway 26)
T-20	T-7
T-25 (From MFC to Highway 33)	T-8
	T-22
	T-28
	T-5

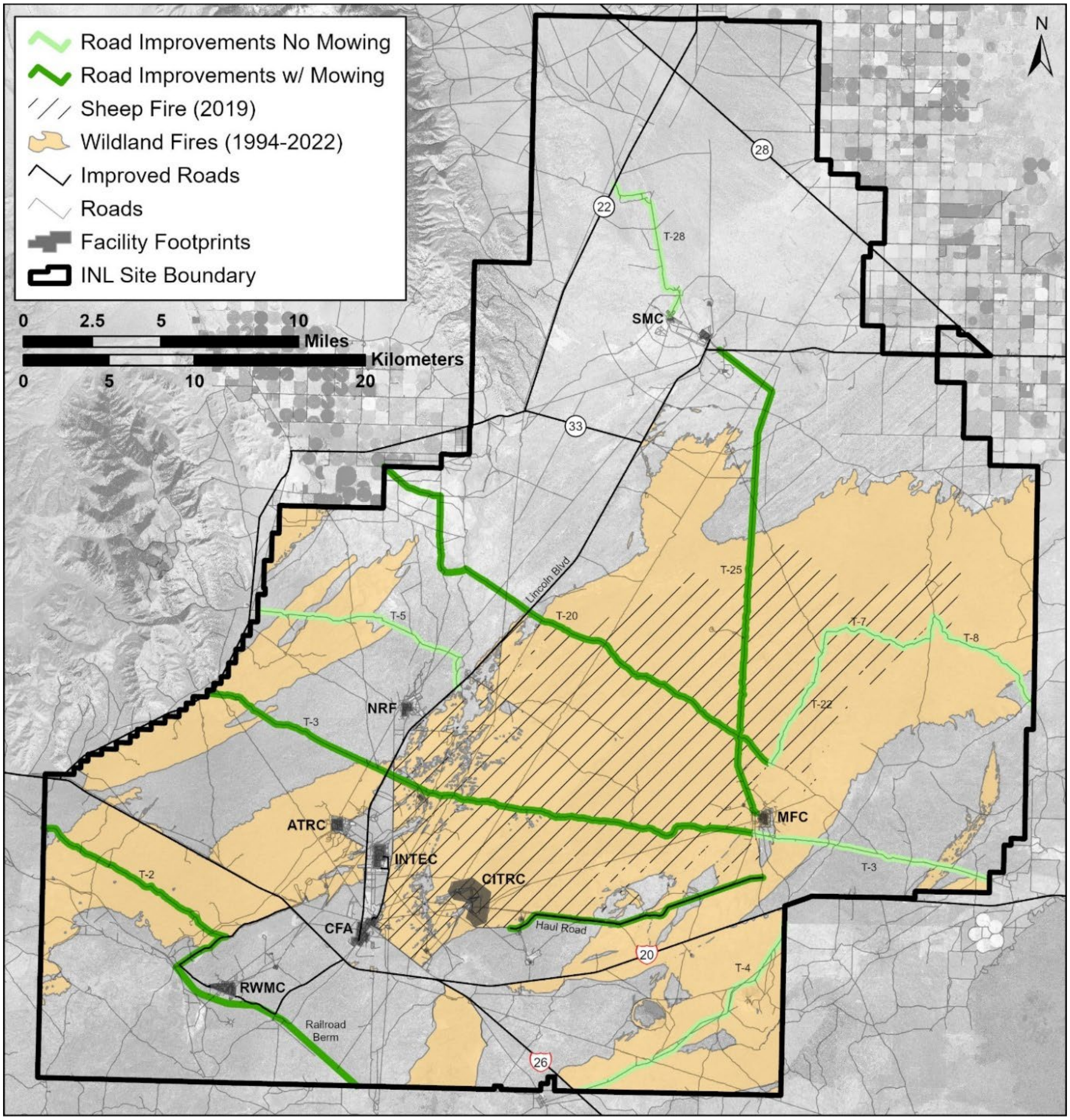

Figure 4. Proposed road improvements and mowing.

Future mowing or fuels management activities along roads identified for improvement in this EA, but not mowing are not covered by this analysis. Prior to implementing any such activities, additional NEPA analysis will be required to determine potential impacts and ensure regulatory compliance

In addition to the proposed road improvements, DOE proposes to implement a formal WLF recovery plan to facilitate the rehabilitation of burned areas following a WLF event. The *Idaho National Laboratory Site Natural Resources Wildland Fire Recovery Framewor*k (Forman, Kramer, et al. 2024) offers an adaptive management approach and gives recovery planners a toolbox of options to address post-fire conditions. This recovery framework is incorporated into this EA by reference and is included as Appendix A. The proposed comprehensive plan and guide is designed to address post-fire conditions quickly and effectively. DOE proposes the following treatment options for soil stabilization and erosion control, cheatgrass and noxious weed control, recovery of native herbaceous vegetation, and sagebrush habitat restoration that are outlined in the *Idaho National Laboratory Site Natural Resources Wildland Fire Recovery Framework* (Forman, Kramer, et al. 2024).

- Soil Stabilization and Erosion Control
    - Dust control for wind erosion (applying water, tackifier, mulch, etc.)
    - Sediment control for soil deposition (installing snow fence, silt fence, straw wattles, etc.)
    - Recontour and revegetate disturbed soils (restoring containment lines and staging areas)
    - Limit traffic to designated roads (installing signs, barriers, or other deterrents).
- Cheatgrass and Noxious Weed Control
    - Chemical control, including aerial application (using approved herbicides consistent with label instructions)
    - Control by native competition (planting native herbaceous species)
    - Environmental control (using inoculants or nutrients to ameliorate soil conditions)
    - Noxious weed inventory (completing comprehensive surveys to document weed abundance and distribution)
    - Mechanical treatment (hand pulling, mowing, digging, and tilling to remove weeds of concern)
- Native Herbaceous Recovery
    - Resting grazing allotments (collaborating with the BLM to ensure implementation of deferral)
    - Planting native species (using locally sourced or locally adapted plant materials)
    - Broadcast seeding (apply seed to the soil surface with a broadcast spreader)
    - Hydroseeding (applying seed mixed with water and hydro mulch to the surface)
    - Drill seeding (planting seed with a rangeland drill)
    - Planting containerized stock (planting greenhouse grown seedlings)
    - Utilizing soil or growth medium amendments (fertilizer, organic material, mycorrhizae, etc.)
    - Applying surface protection (mulch in the form of straw, gravel, woodchips, bonded fiber matrix, etc.)
    - Supplementing water availability (irrigating with a temporary sprinkler system)

- Sagebrush Habitat Restoration
  - Plant locally appropriate sagebrush material (collecting local seed or acquiring locally collected seed from a vendor)
  - Seeding (applying sagebrush through aerial or ground-based broadcasting or drill seeding) with option for imprinting (using an implement to improve seed/soil contact)
  - Planting seedlings (installing nursery grown seedlings with hand tools)

The WLF recovery planning process is outlined in Section 1.1.1 of Appendix A.

2.1.1 Operational Controls

If DOE selects the proposed action, they will adopt the following operational controls as an integral part of the proposed action to help reduce the impacts of the action and lower the potential for significant impacts:

- Pesticide application, within mowed and burned areas, would follow existing and established practices as defined by the INL *Sitewide Noxious Weed Management Plan* (INL 2022), in accordance with local weed control program monitoring protocol and consistent with manufacture label instructions to reduce the potential for the long-term establishment of noxious weeds.
- The proposed activities would adhere to established plans and procedures for managing ecological resources within the INL Site. These plans and procedures include seasonal and spatial restrictions to limit direct impacts on ecological resources.
- Perform Site surveys in the proposed areas for mowing, road improvements, or recovery activities prior to performing construction or maintenance activities to ensure that the presence of nesting birds, species of concern, or other ecological resources are not present or can be avoided.
- A biological observer may be present, depending on location, to monitor activities and verify direct impacts to ecological resources are avoided.
- Disturbed areas would be reseeded using a native species seed mix to restore native vegetation cover.
- Conservation measures and best management practices (BMPs) included in the *Candidate Conservation Agreement for Greater Sage-grouse (Centrocercus urophasianus) on the Idaho National Laboratory Site* (hereafter CCA) (DOE 2014)and Site Bat Protection Plan (BPP) (DOE 2018) would be followed while implementing the proposed activities throughout the life of the agreement. Conservation measures and BMPs outlined in the CCA include seasonal and daytime restrictions for certain activities, restricting activities within the Sage-grouse Conservation Area (SGCA), restricting activities within 1 km of active leks, and sagebrush compensatory mitigation. Sagebrush compensatory mitigation is carried out for the removal or disturbance of potential and existing sagebrush habitat (DOE 2014).
- Maintenance of graveled roads and roadside mowed areas would ideally be conducted during periods of low or moderate fire risk when soils are sufficiently dry to minimize soil compaction and disturbance, however, maintenance actives, including mowing, may be performed when fire danger is at higher levels when compensatory measures are in place and approved by the INL Fire Marshal.
- Conservation measures and BMPs included in the BPP would be followed while implementing the proposed activities. Conservation measures and BMPs outlined in the BPP include limiting activities and avoiding habitat modification within a certain proximity to hibernacula and important summer roosts (DOE 2018).

- Turn-around areas for equipment needed for road improvements and mowing would be located within the 100-foot mowed areas or at existing road intersections. Where turnarounds cannot be located within mowed areas or at existing road intersections, for example, on roads proposed for improvement but not for mowing, proposed turn-around areas would be identified prior to the commencement of road work, and cultural, ecological, and other required surveys (e.g., unexploded ordnance) would be required and other BMPs would be implemented to verify the impact to sensitive resources is reduced.
- A subset of historic properties identified within the project APE would be added to a map of sensitive areas that would be avoided during project implementation. "Sensitive areas" would include historic properties and areas of biological concern, ordnance areas, and other locations where off-road equipment use would threaten human safety or aspects of the human or physical environment.
- Individual historic properties may be excluded from the map of sensitive areas if road improvements and maintenance of mowed roadside strips are unlikely to diminish the integrity of the Site. Factors, such as distance from road, soil type, topographic position, and the character of surface cultural materials and features, would inform whether such exclusion is warranted.
- Boundaries of sensitive areas may be physically marked for avoidance with appropriate signage to alert equipment operators of the need for avoidance during road improvements or maintenance of mowed roadside strips. Appropriate signage for historic properties will be developed in consultation with representatives of the Shoshone-Bannock Heritage Tribal Office (HeTO).
- Maps of sensitive areas, those encouraged for avoidance whenever possible, would be provided to Facilities Sites and Services and incorporated into the processes within existing plans and procedures. The data could include hard copies, digital copies, and geospatial data. The distribution of such data would be limited, and all maps would be marked Official Use Only.
- In some locations where there is suspected or anticipated subsurface integrity of historic properties below the roadbed, geotextile barriers may be placed prior to gravel application.
- Monitoring by INL CRMO staff, and by HeTO staff when available, may also be implemented at individual historic properties during and post after project implementation pursuant to MCP-8008 Rev. 1 (*Section 106 Compliance*). The observations gathered during these monitoring events may also inform the necessity of future monitoring efforts at these locations.
- In the event of an inadvertent discovery, work would immediately halt, in keeping with INL's Stop Work Authority found in LWP-8000 (*Environmental Instructions for Facilities, Processes, Materials, and Equipment*). The discovery secured and flagged for avoidance, and the INL CRMO contacted to ensure that any potential disturbance is limited. CRMO will implement the *Post-Review Discoveries* procedure outlined in MCP-8013. In the event human remains are encountered, the same procedures discussed above would be followed, and CRMO would implement the [Native American Graves Protection and Repatriation Act] *NAGPRA Inadvertent Discoveries* procedure (MCP-8003).

2.2 No Action Alternative

The No Action Alternative serves as a baseline, enabling decision makers to compare the magnitude of environmental effects of the proposed action alternative to taking no action. No action does not necessarily mean doing nothing but involves maintaining or continuing the existing status or condition. In this document, no action means that WLF management options for pre-fire, fire suppression, and post-fire activities would continue in accordance with the 2003 WLF FONSI (DOE-ID 2003), and the proposed fire management and recovery actions described above would not be implemented.

3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 Regional Setting

INL is an 890-square-mile DOE facility located on the Eastern Snake River Plain (ESRP). It is primarily located within Butte County, Idaho, but portions of INL are also in Bingham, Jefferson, Bonneville, and Clark counties. All the land within the INL Site is controlled by DOE, and public access is restricted to highways, DOE-sponsored tours, special use permits (i.e., hunting and grazing), and the Experimental Breeder Reactor-I National Historic Landmark.

Public highways, U.S. 20 and 26 and Idaho 22, 28, and 33, pass through the INL Site, but off-highway travel within the INL Site and access to INL Site facilities are controlled. Currently, INL employs approximately 9,750 people (5,750 employees at BEA, 2,000 employees at Idaho Environmental Coalition, and 2,000 employees at the Naval Reactor Facility). No permanent Idaho resident resides within the INL Site boundary. Population centers in the region include large cities (more than 10,000 residents), such as Idaho Falls, Pocatello, and Blackfoot, which are located to the east and south of the INL Site, and several smaller cities (less than 10,000 residents), such as Arco, Howe, and Atomic City, which are located near the INL Site boundary (Figure 1).

Fire suppression activities have been evaluated in the 2003 WLF EA and are outside the scope of this analysis. The environmental impacts evaluated in this EA focus on the impacts from road improvements, mowing vegetation, and WLF recovery actions to protect natural resources.

Under the No Action Alternative, activities at the INL Site would continue under present-day operations and would be as analyzed in the 2003 WLF EA. The proposed road improvements, mowing, and WLF recovery options would not be implemented. The No Action Alternative would not result in impacts to resources at the INL Site beyond those captured in the discussion of the affected environment. The environmental impacts of future activities at the INL Site would be evaluated in project or program-specific analyses in compliance with NEPA. Therefore, impacts from the No Action Alternative are not discussed further in this EA.

3.2 Resource Areas Eliminated from Further Analysis

Scoping and preliminary analyses indicate the proposed capabilities would not likely impact the following resource areas; therefore, this EA does not analyze these areas further.

- **Land Use.** Land use is the term used to describe human development and use of land. It represents the economic and cultural activities (e.g., agriculture, residence, and industry) that are practiced at a given place. The proposed action would take place within the INL Site boundary and would be compatible with existing land uses. No changes in land use are expected. The proposed action would have no effect on land use.
- **Socioeconomics**. DOE would use contractor employees to implement the proposed action. The proposed action would not lead to an increase in employment. Potential impacts to local socioeconomics from the proposed activities would be indistinguishable from current INL Site operations. There would no socioeconomic impacts from implementing the proposed action.
- **Visual Resources**. It is anticipated that any WLF management activity would not be visually noticeable from any publicly accessible location on the INL Site. Post-fire recovery activities may be observed from any publicly accessible location because a fire may occur near it. However, there would be little-to-no substantial dominant visual change as observed from outside vantage points, no substantial change in visibility caused by predicted air pollutant emissions, no conflict with federal land management agency visual standards, and no long-term dominant visual interruption of existing or unique viewsheds.

- **Site Infrastructure**. INL Site infrastructure includes basic resources and services required to support the proposed activities and continued operations of existing facilities. For the purpose of this EA, infrastructure is defined as electricity, fuel (for equipment), water, and transportation infrastructure such as roads. The proposed activities would require fuel for equipment and water for recovery activities and dust suppression. The expected usage of these resources would be similar to existing demand at the INL Site. There would not be an increase in demand for these resources under the proposed action.
- **Waste Management**. Waste generated from the proposed activities would most likely be classified as construction or municipal waste. Construction waste would primarily be disposed of at the CFA Landfill Complex. Municipal waste is transported offsite to a commercial disposer. The CFA Landfill Complex is operated in accordance with State of Idaho regulations. The remaining capacity of the landfill is approximately 3.4 million cubic meters. The proposed action is not anticipated to generate waste in a quantity to noticeably affect the capacity of the CFA Landfill Complex. Nonhazardous solid waste items that cannot be disposed of at the landfill are sent off-Site to a commercial disposer. It is not anticipated that the proposed activities would generate radiological waste or other waste without an established disposition pathway.
- **Transportation**. The proposed action would not noticeably increase worker commuter traffic on the roadways that service INL beyond the current levels. Proposed activities would occur entirely on the INL Site and not affect publicly accessible roadways. Equipment or material delivery to the INL Site would be similar to shipments that currently are received on the INL Site and would follow existing plans and procedures. DOE estimates that the proposed action would require about 6,100 loads of fill material to be hauled from the T-28 and Monroe Borrow Sources to complete the proposed action. However, the majority of the transportation routes would occur on roads contained completely within the INL Site and on roads that only receive limited use. Traffic from the proposed action is not expected to cause a change in the existing level of service for on-Site roads.
- **Worker and Public Health and Safety.** Operations at the INL Site are required to comply with DOE requirements for worker health and safety. DOE environmental, safety, and health programs regulate the work environment and seek to minimize the likelihood of work-related exposures, illnesses, and injuries. These programs are controlled by the safety and health regulations for DOE contractor workers governed by 10 CFR 851, which establishes requirements for worker safety and health programs to ensure that DOE contractor workers have a safe work environment. Provisions are included to protect against occupational injuries and illnesses, accidents, and hazardous chemicals. Adherence to approved health and safety plans, use of personal protective equipment and engineered controls, and completion of appropriate hazards training would be expected to help prevent adverse acute or chronic health effects to workers. Activities planned under the proposed action would not be expected to have any adverse health effects on workers. The proposed action would not involve direct hazards to the public. The level of exposure to hazards, the regulatory requirements for managing those hazards, and existing exposures are not anticipated to change. Effects on human health would be negligible.

3.3 Air Quality and Greenhouse Gases

3.3.1 Affected Environment

The population over the region of influence (ROI) is exposed to air pollutants from a variety of sources, including agricultural and industrial activities, residential wood burning, wind-blown dust, and vehicle exhaust. Many of the activities at INL also emit air pollutants. Sources for criteria, toxic, greenhouse gases (GHGs), and both radiological and non-radiological Hazardous Air Pollutants (HAPs) at INL include fuel oil-fired boilers; diesel engines; emergency diesel generators (EDGs); miscellaneous small gasoline, diesel, and propane combustion sources; remediation; and research and development (R&D) activities. The boilers are used to generate steam for heating facilities and are the main source of non-radiological air emissions at INL. Diesel engines are used at the ATR Complex to generate electricity for reactor operations. EDGs are used at all INL facilities as emergency electrical power sources, and periodic testing contributes to criteria and toxic air pollutant emissions. The miscellaneous combustion sources include non-vehicle sources, such as small, portable generators, air compressors, and welders. Radiological emissions are primarily from the R&D activities as well as remediation.

Meteorology and Climatology

Meteorology and climatology at the INL Site, located along the western edge of ESRP, is characterized by a semi-arid steppe climate with low relative humidity, significant daily temperature variations, and variable annual precipitation due to its altitude, latitude, and inter-mountain setting. The area experiences intense solar heating during the day and rapid cooling at night, with most precipitation originating from Pacific Ocean air masses crossing the ESRP. Average midday relative humidity ranges from 18% in summer to 55% in winter, with extreme temperatures averaging 16.5°F in January and 69.0°F in July. The predominant wind flow is southwest-northeast, influenced by the ESRP's orientation and surrounding mountains, which channel west winds into a southwesterly pattern, promoting effective atmospheric dispersion during the day and limited dispersion at night. Average annual wind speeds are 7.5 miles per hour, with spring being the windiest season. Severe weather includes thunderstorms, strong winds, hail, tornadoes, snowstorms, and dust devils, with thunderstorms most commonly occurring from March to October and tornadoes being rare and typically weak. Dust devils are frequent in summer due to intense solar heating, creating localized dust clouds.

3.3.1.1 Air Quality Standards and Regulations

Federal and state agencies establish air quality regulations to protect public health and the environment from air pollution and prevent significant deterioration of air quality. These regulations set acceptable ambient pollution levels, limit radiation doses to the public, control emissions from vehicles and other human sources, and administer permits for stationary sources.

The Clean Air Act (CAA) and its amendments provide the framework to protect public health, particularly sensitive populations, and reduce pollution effects on visibility, animals, crops, vegetation, and buildings. The U.S. Environmental Protection Agency (EPA) delegates regulatory authority to the Idaho Department of Environmental Quality (IDEQ) through the State Implementation Plan, which enforces National Ambient Air Quality Standards (NAAQS) and other requirements.

Non-radiological emissions at INL are regulated under IDEQ's Air Permitting Program through a Site-wide permit with emission caps to stay below major source thresholds. Radionuclide emissions are regulated under EPA's National Emissions Standards for Hazardous Air Pollutants (NESHAP). INL ensures compliance by identifying pollutant sources, obtaining permits, controlling emissions, monitoring sources, operating within permit conditions, and obeying prohibitory rules.

NAAQS

The NAAQS are a critical component of the CAA designed to protect public health and the environment from the adverse effects of air pollution. The NAAQS set maximum allowable concentrations for six primary pollutants, known as criteria pollutants, which have been identified as posing significant risks to human health and the environment. These pollutants include sulfur dioxide (SO_2), nitrogen dioxide (NO_2), particulate matter in two size ranges (PM10 and PM2.5), carbon monoxide (CO), lead (Pb), and ozone (O_3).

Each pollutant has specific standards that address both primary and secondary health and welfare concerns. Primary standards are intended to protect human health, particularly of sensitive groups such as children, the elderly, and individuals with respiratory illnesses. Secondary standards are designed to safeguard public welfare by preventing decreased visibility and damage to animals, crops, vegetation, and buildings.

For instance, sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) are regulated due to their potential to cause respiratory problems and contribute to acid rain, which can harm ecosystems. Particulate matter (PM10 and PM2.5) is monitored because fine particles can penetrate deep into the lungs and even enter the bloodstream, causing cardiovascular and respiratory issues. Carbon monoxide (CO) is a colorless, odorless gas that can impair oxygen delivery to the body's organs and tissues, leading to serious health problems. Lead (Pb) exposure can result in neurological impairments, particularly in children. Ozone (O_3), a secondary pollutant formed by the reaction of sunlight with precursors, such as nitrogen oxides (NOx) and volatile organic compounds (VOCs), can cause respiratory issues and other health problems.

Idaho has incorporated the NAAQS into its state regulations by referencing the federal standards outlined in 40 CFR Part 50. The state monitors air quality to ensure compliance with these standards and to determine allowable emissions of criteria pollutants for new or modified sources. Areas meeting the NAAQS are designated as attainment, while those that do not meet these standards are labeled as nonattainment. If sufficient data are not available to determine the status, an area may be designated as unclassifiable.

INL is currently designated as attainment, better than national standards, or unclassifiable/attainment for the criteria pollutants, meaning the air quality in these areas meets or exceeds the NAAQS. Therefore, the CAA General Conformity Requirements do not apply to INL. The closest nonattainment area for particulate matter is in Pocatello, Idaho, approximately 50 miles southeast of INL. Figure 5 illustrates Idaho's NAAQS designations.

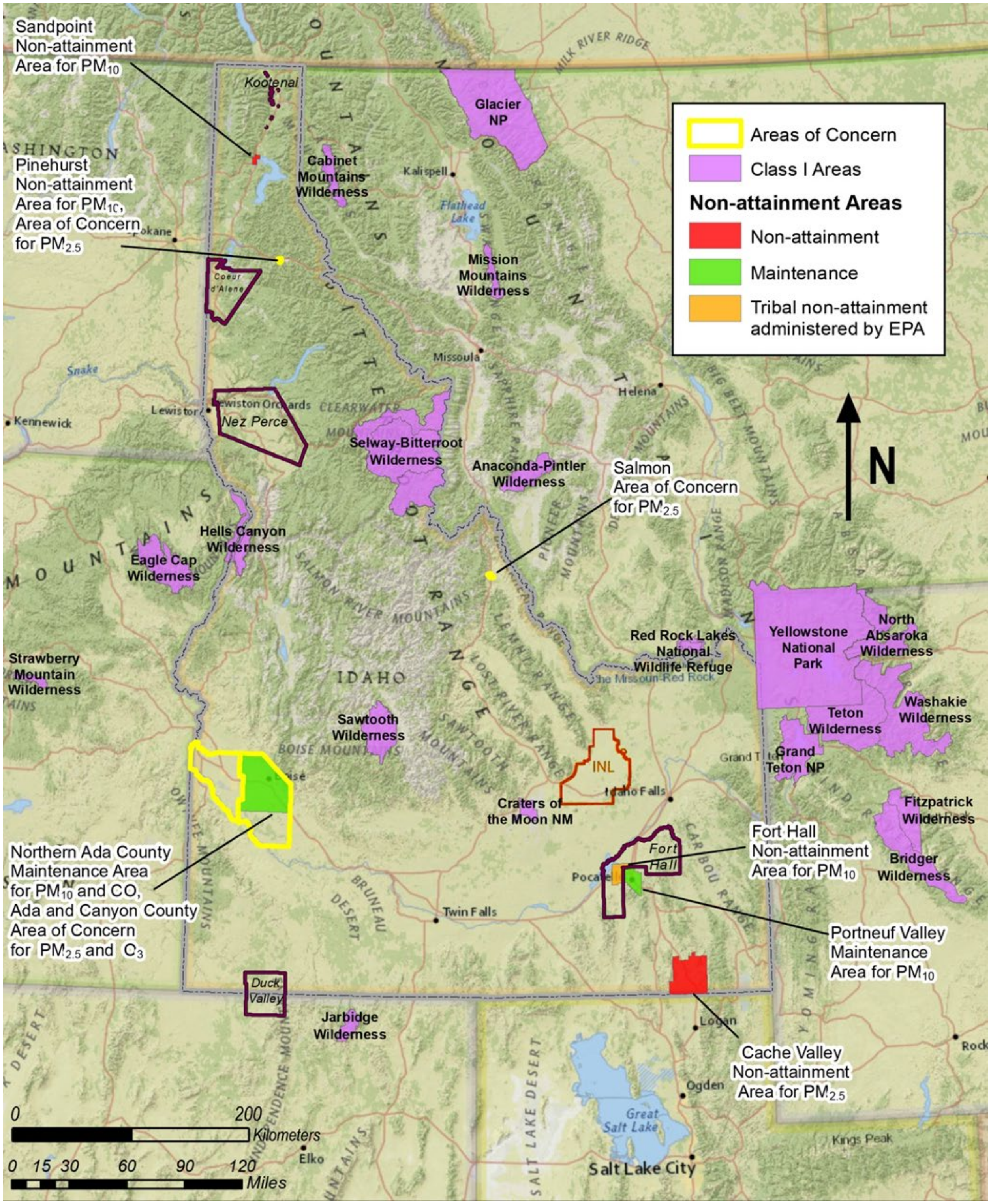

Figure 5. Idaho Prevention of Significant Deterioration and NAAQs classifications.

Prevention of Significant Deterioration

In areas with pollutant levels below the NAAQS, the Prevention of Significant Deterioration (PSD) Program (40 CFR § 52.21) places limits on the total allowable increases in ambient pollutant levels above the established baseline levels for SO_2, NO_2, and PM10. This prevents "polluting up to the standard." Maximum allowable PSD pollutant concentration increases or increments are specified for the nation (designated as Federal Class II areas), and more stringent increment limits (as well as ceilings) are prescribed for national resources such as national forests, parks, and monuments (designated as Federal Class I areas). Federal Class I areas in Idaho are identified in Figure 5.

Limits on increases in specific air pollutants for PSD areas are based on an existing or baseline year. Maximum allowable ambient pollutant concentration increases or increments are specified for the nation (designated Class II areas), and more stringent increments (as well as ceilings) are prescribed for designated national resources such as national forests and parks (designated Class I areas). PSD increments for PM10, PM2.5, SO_2, and NO_2 have been established for Class I and II areas in the state of Idaho (Table 2). No Class III areas have been established in Idaho.

Table 2. Maximum allowable PSD increments.

PSD Class Area	Pollutant[1]	Averaging Time	Maximum Allowable Increment (micrograms per cubic meter)
Class I	PM10	Annual arithmetic mean	4
		24-hour maximum	8
	PM2.5	Annual arithmetic mean	1
		24-hour maximum	2
	SO_2	Annual arithmetic mean	2
		24-hour maximum	5
		3-hour maximum	25
	NO_2	Annual arithmetic mean	2.5
Class II	PM10	Annual arithmetic mean	17
		24-hour maximum	3
	PM2.5	Annual arithmetic mean	4
		24-hour maximum	9
	SO_2	Annual arithmetic mean	20
		24-hour maximum	91
		3-hour maximum	210
	NO_2	Annual arithmetic mean	25

PSD Class Area	Pollutant[1]	Averaging Time	Maximum Allowable Increment (micrograms per cubic meter)
Source: 40 CFR § 51.166(c)(1): Table for Class I, II, and III areas [1] PM10 = particulate matter ≤10 micrometers; PM2.5 = particulate matter ≤2.5 micrometers; SO_2 = sulfur dioxide; and NO_2 = nitrogen dioxide			

Construction or modification of any stationary source, facility, major facility, or major modification, as defined in Idaho Administrative Procedures Act (IDAPA) 58.01.01, requires an evaluation to determine the expected level of emissions of all pollutants (e.g., criteria, toxic, hazardous) and an evaluation of whether a PTC or Permit to Operate is required (IDAPA 58.01.01). Unless the source is specifically exempt from permitting requirements, a PTC and a Permit to Operate must be obtained prior to construction and operation. INL must comply with a Site-wide PTC with a Facility Emissions Cap (FEC), which contains specific emission limits and conditions for operation. This formal permitting process allows the State to determine that emissions will be adequately controlled, the source will comply with all emission standards and regulations, and public health and safety will be adequately protected.

If the expected level of emissions for a new source or modification is significant for any air pollutants, additional ambient air quality and PSD analyses are required. Levels of significance are tabulated below in Table 3 and vary depending on the pollutant. Emission limits, monitoring requirements, and reporting requirements for a proposed new or modified source that is not exemptible under IDAPA 58.01.01.220-222 are established and regulated through Idaho's PTC process and managed under an area source or major source permit.

Table 3. Significance levels for non-radiological pollutants.

Pollutant[1]		Significance Level	
		Kilograms per year[2]	Tons per year
CO		9.1×10^4	100
NO_2		3.6×10^4	40
O_3		3.6×10^4	40
Pb		5.4×10^2	0.6
SO_2		3.6×10^4	40
Total PM		2.3×10^4	25
PM10		1.4×10^4	15
PM2.5[3] as:	Direct PM2.5	9.1×10^3	10
	SO_2	3.6×10^4	40
	NO_2	3.6×10^4	40

Pollutant[1]	Significance Level	
	Kilograms per year[2]	Tons per year
Fluorides	2.7×10^3	3.0
Sulfuric acid mist	6.4×10^3	7.0
H_2S	9.1×10^3	10
Total reduced sulfur (including H_2S)	9.1×10^3	10
Reduced sulfur compounds (including H_2S)	9.1×10^3	10
Source: IDAPA 58.01.01		

[1]CO=carbon monoxide; NO_2=nitrogen dioxide; O_3=ozone; Pb=lead; SO_2=sulfur dioxide; PM= particulate matter; PM10 = particulate matter ≤10 micrometers; PM2.5 = particulate matter ≤2.5 micrometers, and H_2S = hydrogen sulfide

[2] Significance levels from the regulations were converted from tons per year to kilograms per year and then rounded to two significant figures.

[3] SO_2 and NO_2 are precursors for the formation of $PM_{2.5}$.

IDEQ has established rules and methodologies to estimate and control the potential human health impacts of toxic air pollutants. Toxic air pollutants include cancer-causing agents, such as arsenic, benzene, carbon tetrachloride, and formaldehyde, as well as substances that pose non-cancerous health hazards such as fluorides, ammonia, and sulfuric acids (see IDAPA 58.01.01 for a list of toxic air pollutants). Rules and methodologies for the control of toxic air pollutant emissions are implemented through air quality permit programs (i.e., PTC and Permit to Operate). Threshold emission levels have been established for about 700 toxic air pollutants based on known or suspected toxicity of these substances. Acceptable ambient concentration levels have been defined for many toxic air pollutants by the state of Idaho. A project is eligible for a toxic air pollutant exemption if it can be shown that toxic air pollutant concentrations at the public receptor location most affected are less than the state threshold for those pollutants.

Greenhouse Gases

GHGs are a group of gases whose presences in the earth's atmosphere trap heat, effectively warming the earth's surface. These gases include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases. The natural greenhouse effect is essential for maintaining temperatures conducive to life. However, human activities, such as burning fossil fuels, deforestation, and industrial processes, have significantly increased the concentrations of these gases, enhancing the greenhouse effect. This leads to additional heat being trapped, causing global temperatures to rise, a phenomenon known as global warming. The resulting climate change manifests in altered weather patterns, more frequent and severe extreme weather events, sea level rise, and disruptions to ecosystems and biodiversity. Mitigating GHG emissions is critical to addressing these adverse environmental and health impacts.

The EPA established PSD and Title V applicability permitting thresholds for GHG-emitting sources (40 CFR § 51.166). IDAPA 58.01.01 incorporated the federal rule by reference with a major and minor source permitting program. Sources are not required to obtain a permit based solely on GHG emissions. INL currently operates under a PTC, but there are no GHG reporting or reduction requirements in the permit. Additionally, statewide reduction targets for GHG emissions are not identified in IDAPA 58.01.01.

INL emits roughly 90,000 metric tons (MT) carbon dioxide equivalent (CO_2e) each year from Scope 1, 2, and 3 emission sources, according to the 2024 Site Sustainability Plan (DOE 2023). Scope 1 is direct emissions from production of electricity, heat, cooling, or steam; mobile combustion sources (e.g., automobiles, ships, and aircraft); fugitive emissions within an agency's organizational boundary; and process emissions from laboratory activities. Scope 2 emissions are indirect or shared emissions associated with the consumption of purchased or acquired electricity, steam, heating, or cooling. Scope 3 emissions include all other indirect emissions not included in Scope 2 (e.g., business air/ground travel, employee commuting, contracted solid waste disposal, contracted wastewater treatment, subcontractor emissions, and transmission and distribution losses associated with purchased electricity).

3.3.2 Environmental Consequences

The ROI of the proposed action consists of public roads and receptors as defined for INL by IDEQ (IDEQ 2011), and federal Class I areas (Craters of the Moon National Monument, Grand Teton National Park, and Yellowstone National Park).

The proposed action as well as fire recovery activities have the potential to generate fugitive emissions from mobile equipment, both from the combustion of fossil fuels and the mechanical disturbance of soil. Emissions from fire recovery are not defined due to their unpredictable and unbounding nature but are expected to be similar to current INL operations. Fire recovery emissions will be far less than the alternative emissions of leaving fire-affected land unamended. For these reasons, only the impacts associated with road improvements and mowing portion of the proposed action are addressed.

Road Improvements and Mowing

The proposed action would improve about 130 miles and place about 152,550 cubic yards of pit run gravel. It includes mowing roughly 80 miles, or roughly 2100 acres, of roadway shoulder. Mowing operations are expected to equate to a total of about 1600 vehicle or mower miles traveled.

Using the AP-42 emission factors for heavy construction and unpaved roads, the proposed placing of soil and gravel, grading roadways, and mowing would result in combined emissions of fine particulate matter (PM2.5 and PM10) of 0.52 and 2.51 tons per year, respectively, which is below the PSD significant levels. These fugitive emissions will be emitted from locations across the INL Site over the course of the summer months. Utilizing the average dispersion factors across the site from ECAR-2078 (Sondrup, 2022), impacts to the ambient emissions would be less than the PSD increments for Class II areas. Table 4 shows a comparison of estimated PM concentration from the proposed action compared to the PSD significance levels.

Table 4. Proposed action impacts to ambient air.

PSD Class Area			PSD Significance Levels (ug/m^3)	Proposed Action Impact (ug/m^3)
Class II	PM_{10}	Annual	17	0.05
		24-hr	3	1.71
	$PM_{2.5}$	Annual	4	0.01
		24-hr	9	0.36

Combustion emissions of the mobile vehicles used were estimated based on EPA's *Emission Factors for Greenhouse Gas Inventories* (EPA 2014). Table 5 shows the estimated emissions from the proposed action. CO_2 emissions are well below the GHG emissions reference point of 25,000 MT CO_2e per year for reporting under 40 CFR Part 98.

Table 5. Proposed action emissions from mobile source combustion.

Total Emissions	Nox	PM	THC	CO_2
lbs	10.7	0.3	1.5	18,760
tons	0.0	0.0	0.0	9.4

Emissions from the proposed action are well within acceptable ranges and are not considered significant. Additionally, DOE anticipates that the minor increase in emissions would result in a negligible contribution to reasonably foreseeable impacts on air quality.

3.3.2.1 No Action Alternative

Under the No Action Alternative, activities at the INL Site would continue under present-day operations and as analyzed in the 2003 WLF EA. The proposed road improvements, mowing, and WLF recovery options would not be implemented. The No Action Alternative would not result in impacts to air resources at the INL Site beyond those captured in the discussion of the affected environment. The environmental impacts of future activities at the INL Site would be evaluated in project- or program-specific analyses in compliance with NEPA.

3.4 Water Resources

3.4.1 Affected Environment

The INL Site includes surface water from three primary streams—the Big Lost River, Birch Creek, and the Little Lost River—and from seasonal runoff from snowmelt. The Big Lost River is an intermittent ephemeral stream that begins in the pioneer mountains, dammed at Mackay Reservoir, and flows toward Arco into the INL Site. On the INL Site, the Big Lost River channel is either diverted to the south to the spreading areas or flows northward to a playa area or depression, known as the Big Lost Sinks or The Playas, where surface water infiltrates the Snake River Plain Aquifer (IDEQ 2004). Though periods of continuous flow above ground are infrequent on the INL Site, during high-water years, the river will run inside the INL Site boundary and be diverted toward the southern spreading area or to the Big Lost Sinks. The segment of the Big Lost River that traverses the INL Site is not identified as impaired waters in §303(d) under the Clean Water Act nor exceeds the Total Maximum Daily Load (TMDL) pollutant as this segment is usually a dry channel throughout the year (IDEQ 2004).

All three streams feed into the Snake River Plain Aquifer that underlies the INL Site (Figure 6). The Snake River Plain Aquifer is the major source of drinking water and crop irrigation for southeastern Idaho and has been designated a Sole Source Aquifer by the EPA. The U.S. Geological Survey estimates that the thickness of the active portion of the Snake River Plain Aquifer at the INL Site ranges from 250–820 feet. Depth to the water table ranges from about 200 feet below land surface in the northern part of the INL Site to about 1,000 feet in the southern part. The Snake River Plain Aquifer is the only source of water for INL facilities. The INL's Federal Reserved Water Right permits a maximum water consumption of 11.4 billion gallons per year from the Snake River Plain Aquifer. Each major facility is serviced by one or more production or potable water wells.

The U.S. Army Corp of Engineers has regulatory jurisdiction over waters of the United States, including those pursuant to Section 404 of the Clean Water Act, and has jurisdiction over Navigable Waters of the United States pursuant to Section 10 of the 1899 Rivers and Harbors Act. Any disturbance to vegetation or soils below the high-water mark of any surface water feature at INL may be considered a discharge of fill material that would require a permit from the Department of the Army pursuant to Section 404 of the Clean Water Act. Receipt of a Section 404 permit and adherence to the terms and conditions of the permit, including any associated compensatory mitigation and BMPs to reduce sedimentation and erosion control, would demonstrate compliance to the Clean Water Act.

INL has identified a storm water corridor where there is a reasonable potential to discharge storm water into waters of the United States (Figure 7). Projects that will disturb one or more acres and are located within the stormwater corridor, require coverage under an Idaho Pollutant Discharge Elimination System storm water construction general permit (CGP). A CGP requires BMPs to reduce the sediment and other pollutants discharged in stormwater. It also requires periodic inspection of construction projects by those who are knowledgeable about erosion, sediment control, and pollution prevention.

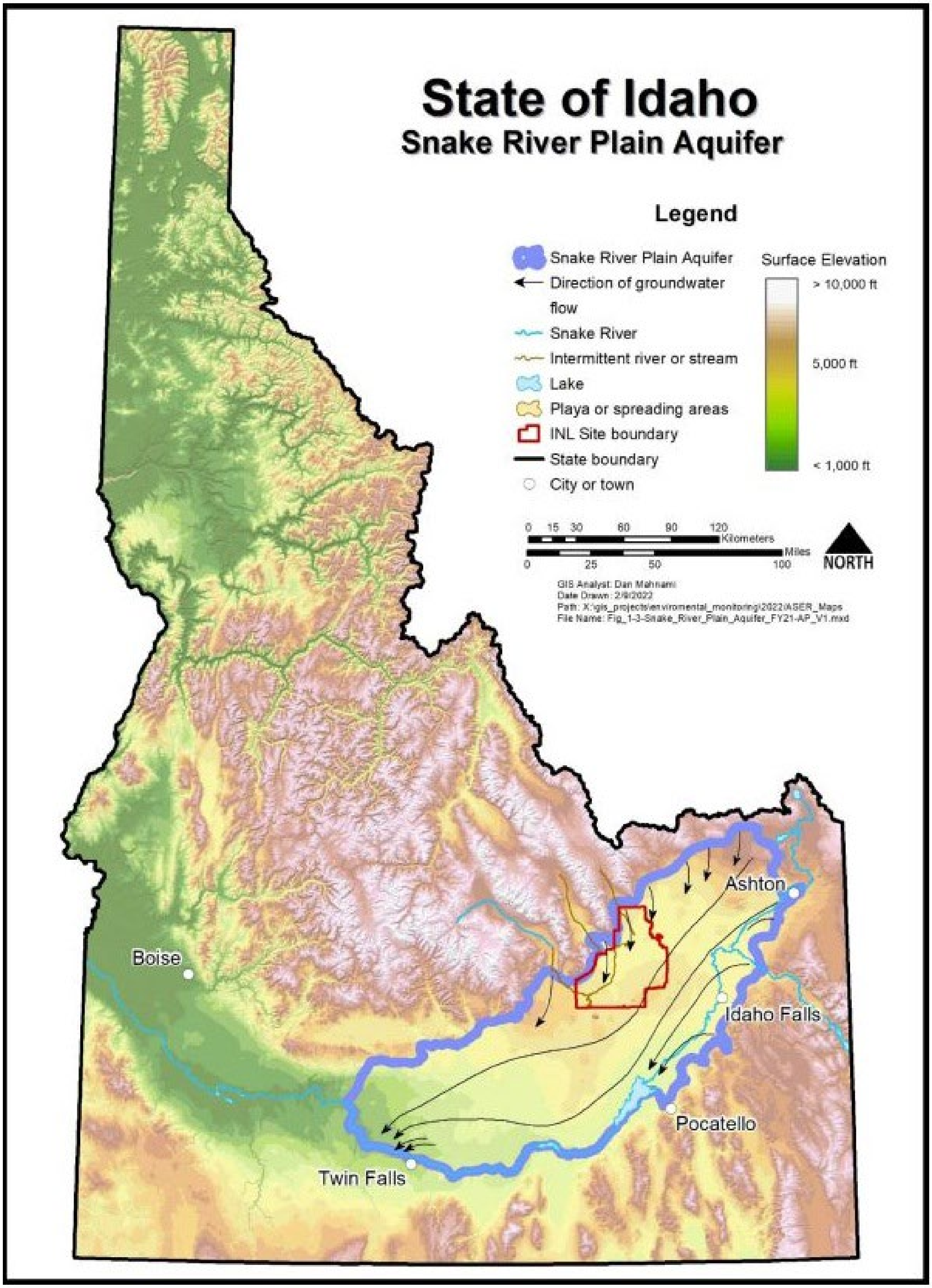

Figure 6. Snake River Plain Aquifer.

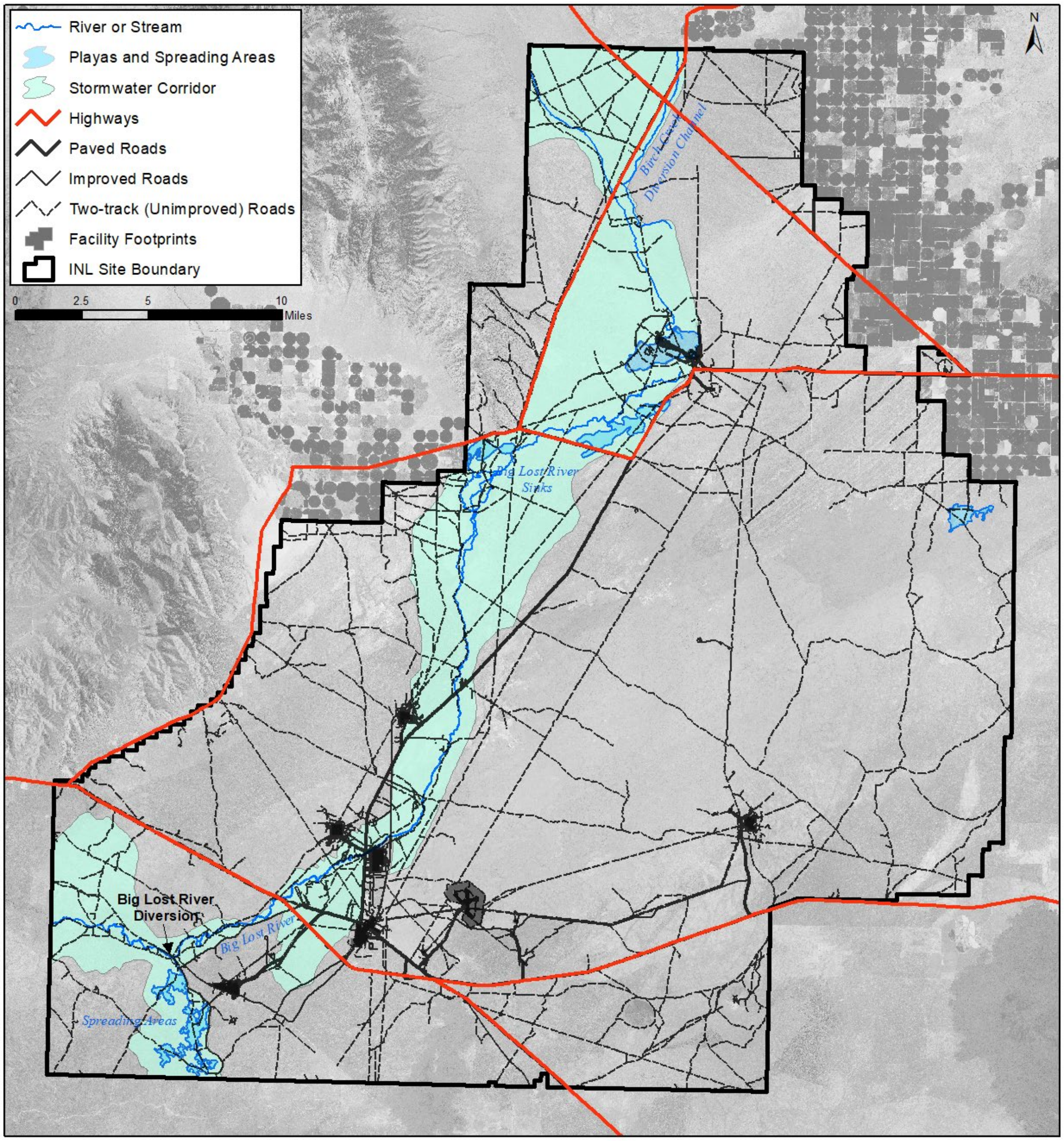

Figure 7. Surface water features at the INL Site.

3.4.2 Environmental Consequences

The proposed action would not require drilling wells, discharge into injection wells, or noticeable changes in groundwater consumption. Dust suppression activities associated with road improvements would use approximately 153,000 gallons of water. In 2023, total water use at the INL Site was 735 million gallons. The proposed action would increase INL water use by about 0.02%. This represents about 0.0013 percent of the INL Site's Federal Reserved Water right of 11.4 billion gallons per year. The proposed action would have a negligible increase on water use at the INL Site.

Mowing would reduce vegetation to 6-inches in height along about 130 miles of road but would not result in bare soil that would increase erosion and sediment to surface waters. Where roads would be improved and graded, soil compaction could affect infiltration and drainage. Roadway improvement and maintenance activities have the potential to alter local hydrology (e.g., removal/addition of material to roadway footprint), which may change the water flow along and adjacent to the roadways. However, most roads have already been compacted from vehicle travel, and impacts to infiltration and drainage would be negligible when compared to baseline conditions.

Any potential impact to surface water—direct, indirect, or reasonably foreseeable impacts—is considered low because surface water sources are not prevalent on the INL Site. Most years, the three streams mentioned above do not appear above the surface on the INL Site. If surface water is present, then effort will be taken to avoid surface water features. The proposed action would not violate any water quality standard or degrade water quality, expose any undue risk to existing structures or personnel, or substantially alter existing drainage patterns. Efforts will be taken to ensure the work is performed outside of the stormwater corridor and BMPs are used for controlling storm water runoff. If improved roadways or mowing are needed within the stormwater corridor or surface waters, then permit requirements will be incorporated into work control documents to ensure compliance with the Clean Water Act.

Post-fire recovery activities would not likely impact surface water resources considering that the likelihood of resources being present is low. The proposed action also includes the use of BMPs, such as silt fencing and other measures, to reduce erosion and the movement of surface soils from recently burned areas. Silt fencing and similar BMPs would also reduce stormwater runoff from impacting surface water if present. The application of herbicides may contaminate surface waters, but the application would be per the manufacturer's recommendations and avoid any standing surface water.

Any potential impacts to surface water from post-fire recovery activities would be considered low because surface water sources are not prevalent on the INL Site. If surface water is present, then efforts will be taken to avoid those features.

Reasonably foreseeable impacts to water resources from the proposed action would be negligible.

3.4.2.1 No Action Alternative

Under the No Action Alternative, activities at the INL Site would continue under present-day operations and as analyzed in the 2003 WLF EA. The proposed road improvements, mowing, and WLF recovery options would not be implemented. The No Action Alternative would not result in impacts to water resources at the INL Site beyond those captured in the discussion of the affected environment. The environmental impacts of future activities at the INL Site would be evaluated in project- or program-specific analyses in compliance with NEPA.

3.5 Soil and Geological Resources

3.5.1 Affected Environment

INL is found on the ESRP, which is part of the broader Snake River Plain. This physiographic region is characterized by low-relief topography and is covered by basaltic lava flows and sediments. The Snake River Plain is about 56-miles wide and 348-miles long and extends as a broad arc across southern Idaho from the Yellowstone Plateau in Wyoming in the east to the Idaho and Oregon border on the west (Figure 8). Surface elevations gradually decrease from 6,562 feet near Yellowstone to 2,132 feet near the western edge of the plain.

The ESRP represents the track of buried and extinct volcanic centers associated with the passage of the North American plate over the relatively stationary "Yellowstone" hotspot (Pierce and Morgan 1992) (Pierce and Morgan 2009) (Smith, et al. 2009). From about 6.3 to 8.4 million years ago, the crust beneath the ESRP at and near the INL Site's location was impacted by volcanism associated with the Yellowstone hotspot (McCurry, McLing, et al. 2016) (Anders, et al. 2014) (Schusler, et al. 2020). Volcanism within the last 2.1 million years associated with the Yellowstone hotspot is now beneath the Yellowstone Plateau (Christiansen, et al. 2007), 99–143 miles northeast of the INL Site. Since about 4 million to 2,100 years ago in the ESRP at and around the INL Site, basaltic magma has continued to periodically erupt producing volcanic vents and lava flows (Kunz, Skipp, et al. 1994) (Kunz, Anderson, et al. 2002) (Kuntz, et al. 2007). Surface basalt flows at the INL Site range in age from 13,000 to 1.2 million years ago (Kunz, Skipp, et al. 1994). During intervening eruptive periods, sediments have been deposited by wind and surface water. Along the southern INL Site border, basaltic magma stagnated in the crust and eventually evolved in composition to erupt from 300,000 years to 1.4 million years ago as rhyolitic domes, which formed five buttes with heights between 394 to 2,460 ft (McCurry, Hayden, et al. 2008).

Earthquakes occurring from 1850 to 2020 with magnitudes >2.0 compiled from INL's and other nearby seismic networks (Payne and Montaldo Falero 2022) show a parabolic distribution of epicenters in the mountainous region outside of the ESRP.

Mineral resources within the INL desert Site are confined to several quarries. The INL Site features six active gravel/borrow quarries, known as borrow sources, and provide sand, gravel, pumice, silt, clay, and aggregate for road construction and maintenance, new facility construction, waste burial activities, and on-Site landscaping (DOE-ID, 2019). Beyond the INL Site and within about 100 miles of its boundary, mineral resources include sand, gravel, pumice, phosphate, and both base and precious metals (NRC, 2004).

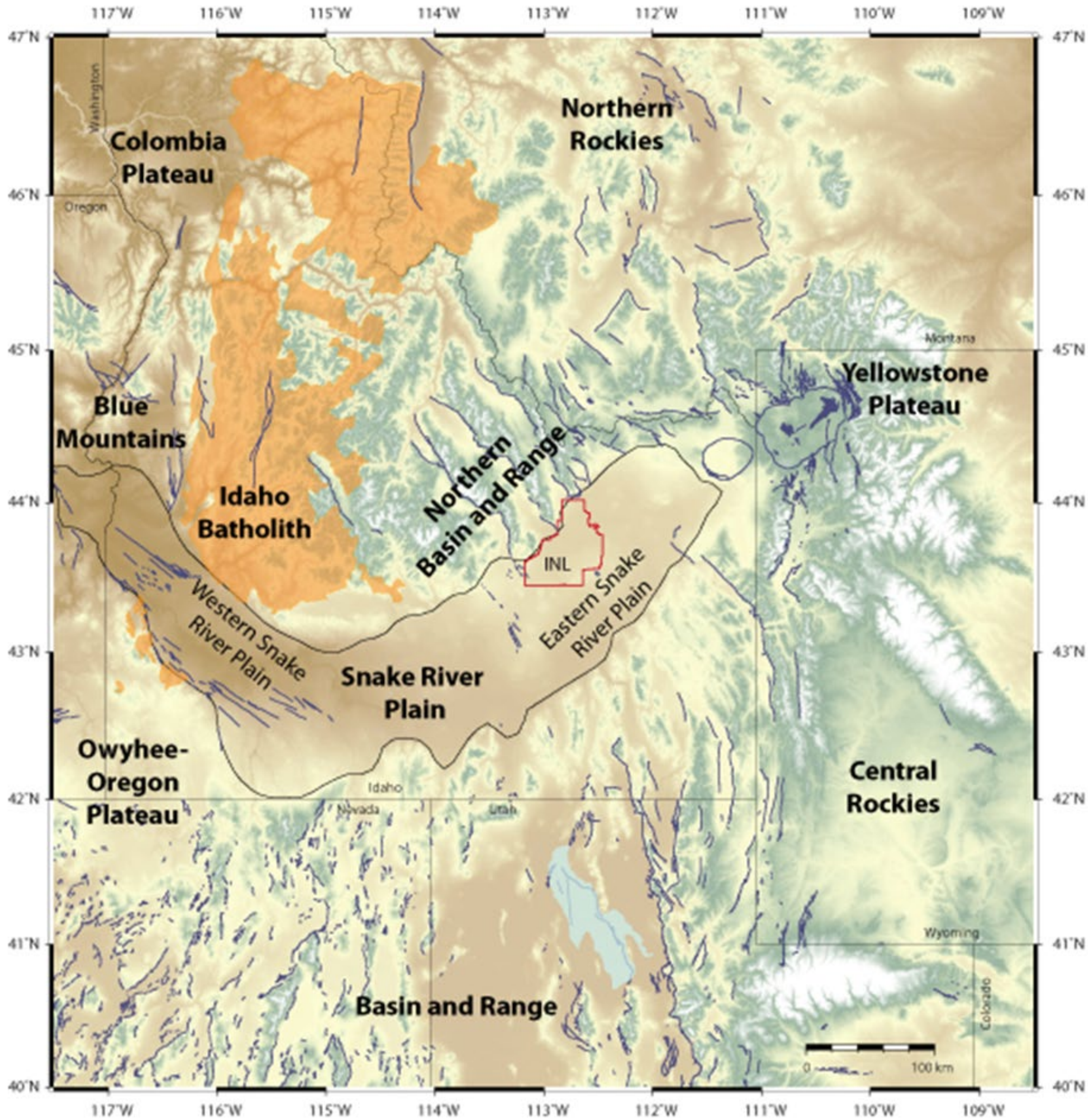

Figure 8. Location of the INL Site in relation to the Snake River Plain.

3.5.2 Environmental Consequences

The proposed action includes maintenance and soil disturbances of preexisting roads found on the INL Site, which would be associated with grading and shaping the preexisting roads. The proposed action would directly disturb 130 miles of previously disturbed roads. Although soil disturbed during the proposed work would be temporarily subject to wind and water erosion, adherence to standard BMPs for soil erosion and sediment control (e.g., use of silt fencing, staked hay bales, mulching and geotextile fabrics, and revegetation) during the proposed activity would serve to minimize soil erosion and loss.

The proposed action includes transitioning approximately 130 miles of non-graveled two-track roads to graveled roads and mowing 80 miles of roadway shoulder on the INL Site. Sources of materials would include gravel supplied by INL Site borrow sources (the Monroe and T-28 borrow sources). The proposed action would require about 152,550 cubic yards of fill material (about 6,100 loads at 25 cubic yards per load) from these INL Site borrow sources. However, this would not result in an expansion of the borrow pits. Therefore, the proposed action would have a small additional impact on geology and soils. In addition, the nature and location of the proposed work are not anticipated to have an impact as the result of potential future earthquakes. Additional discussion of soil impacts is included in Section 3.6.

3.5.2.1 No Action Alternative

Under the No Action Alternative, activities at the INL Site would continue under present-day operations and as analyzed in the 2003 WLF EA. The proposed road improvements, mowing, and WLF recovery options would not be implemented. The No Action Alternative would not result in impacts to geology and soil resources at the INL Site beyond those captured in the discussion of the affected environment and as further described in Section 3.6.2.1. The environmental impacts of future activities at the INL Site would be evaluated in project- or program-specific analyses in compliance with NEPA.

3.6 Ecological Resources

3.6.1 Affected Environment

General Ecological Description

The primary ecosystem of the INL Site is characterized as sagebrush steppe. Approximately 94% of the land on the INL Site is undeveloped (DOE 2014), with approximately 60% open to livestock grazing. Over the past two decades, WLF has affected ecological resources across a substantial portion of the INL Site. Since 2001, when individual fire size estimates were first available, several large WLFs have burned substantial portions of the INL Site. Of those that have occurred partially or entirely within the INL Site boundary, six fires have been over 2,741 acres. Vegetation maps of the INL Site prior to 1994 (McBride, et al. 1978) (Kramber, et al. 1992) indicate that plant communities across much of the landscape were dominated by big sagebrush (*Artemisia tridentata*). More recent vegetation maps reflect a transition to grassland and green rabbitbrush (*Chrysothamnus viscidiflorus*) dominated communities that are recovering from WLF (Shive, et al. 2019) (J. P. Shive 2024). Currently, approximately 43.1% of the INL Site remains as intact sagebrush plant communities, and 37.3% is recovering to a sagebrush climax.

Until the last few decades, vegetation across the INL Site was thought to be in generally good ecological condition (Anderson and Inouye 2001). Although ecological condition has declined in some plant communities on the INL Site over the past 10–20 years, native vegetation still dominates much of the area (Shive, et al. 2019). Studies of post-fire dynamics on the INL Site and across the region indicate that, except for sagebrush, post-fire species composition closely resembles pre-fire composition (Ratzlaff and Anderson 1995), (Blew and Forman 2010). Communities that were in good ecological condition prior to fire will generally recover to good-condition communities within a few years post-fire (Blew 2010). However, the recovery of sagebrush to pre-burn abundance can take more than a century (Forman 2024).

Wildlife

The INL Site is host to a variety of wildlife species, including large ungulates, (e.g., elk [*Cervus canadensis*] and pronghorn [*Antilocapra americana*]), 11 species of bats, sagebrush-obligates (e.g., sagebrush lizard [*Sceloprus graciosus*]), the greater sage-grouse (*Centrocercus urophasianus*), and the pygmy rabbit (*Brachylagus idahoensis*). Herpetofauna, such as the Great Basin rattlesnake (*Crotalus oreganus lutosus*) and the Great Basin spadefoot toad (*Spea intermontana*), use locally appropriate habitats, as do over 200 species of birds (e.g., raptor, waterfowl, passerine, and upland game species).

Vegetation

The vegetation of the INL Site consists predominantly of an overstory of shrubs and an understory of grasses and forbs. Nearly 500 vascular species have been documented occurring on and adjacent to the INL Site (Anderson, Ruppel, et al. 1996). Big sagebrush (*Artemisia tridentata*) and green rabbitbrush (*Chrysothamnus viscidiflorus*) are the most common shrubs (Forman, Blew and Hafla 2010). However, communities dominated or co-dominated by low sagebrush (*Artemisia arbuscula*), black sagebrush (*Artemisia nova*), and three-tip sagebrush (*Artemisia tripartita*) are frequently distributed around the periphery of the INL Site, and salt desert shrub communities are generally associated with playas and floodplains. Junipers (*Juniperus osteosperma*) are common at higher elevations associated with the buttes and foothills on the INL Site. Native grasslands may be dominated by rhizomatous species like streambank wheatgrass (*Elymus lanceolatus*) and western wheatgrass (*Pascopyrum smithii*) or by bunchgrasses like bluebunch wheatgrass (*Pseudoroegneria spicata*), needle and thread (*Hesperostipa comata*), or Indian ricegrass (*Achnatherum hymenoides*); they are most abundant in burned areas but are also understory components of most native shrublands.

Non-native species like crested wheatgrass (*Agropyron cristatum*), cheatgrass (*Bromus tectorum*), saltlover (*Halogeton glomeratus*), and annual mustards (*Sisymbrium* spp., *Descurainia* spp.) occasionally dominate INL Site plant communities, but typically occur as minor components of native communities. See Figure 9. INL vegetation community map for a map of the distribution of plant communities on the INL Site (Shive, et al. 2019). Noxious weed species that have been identified and treated on the INL Site include, but are not limited to, rush skeletonweed (*Chondrilla juncea*), scotch thistle (*Onopordum acanthium*), musk thistle (*Carduus nutans*), Russian knapweed (*Acroptilon repens*), spotted knapweed (*Centaurea stoebe*), black henbane (*Hyoscyamus niger*), leafy spurge (*Euphorbia esula*), houndstounge (*Cynnoglassum officinale*), sowthistle (*Sonchus arvensis*), and Canada thistle (*Cirsium arvense*).

Special Status Species and Communities

There are several plant and wildlife species designated as special status species and plant communities with elevated conservation rankings that occur within the INL Site boundary. Special status plant and wildlife species on the INL Site include species identified as threatened or endangered under the Endangered Species Act (16 USC 1531-1544), species protected by specific Federal Acts, Birds of Conservation Concern, sensitive species identified by the BLM, Idaho Department of Fish and Game (IDFG) sensitive species, and plant communities with elevated conservation rankings.

The United States Fish and Wildlife Service (USFWS) provides spatially explicit information regarding threatened and endangered wildlife and plant species, bald eagles (*Haliaeetus leucocephalus*) and golden eagles (A*quila chrysaetos*), and Birds of Conservation Concern. Based on the information provided by the USFWS, there is no critical habitat nor listed or proposed plant species identified within the INL Site boundary (USFWS 2025). The USFWS identifies the North American wolverine (*Gulo gulo luscus*; Threatened), the Suckley's Cuckoo Bumble Bee (*Bombus suckleyi*; Proposed Endangered), and the monarch butterfly (*Danaus plexippus;* Proposed Threatened) as potentially occurring within the INL Site. The USFWS also acknowledges the protection of bald and golden eagles under the Bald and Golden Eagle Protection Act of 1940 (16 USC 668-668d), both of which have been documented on the INL Site (DOE-ID 2024). There were 17 Birds of Conservation Concern identified by USFWS to have the potential to occur on the INL Site, of which 12 have been documented on the INL Site (Owens 2025).

Aside from the federally listed wildlife species identified by the USFWS, there are at least 35 wildlife species of conservation concern identified by the BLM as special status species (Type 2) that have been documented or are likely to occur on the INL Site (BLM 2022). Of these species, some of the most common on the INL Site include the greater sage-grouse (*Centrocercus urophasianus*), the sage thrasher (*Oreoscoptes montanus*), the sagebrush sparrow (*Artemisiospiza nevadensis*), the loggerhead shrike (*Lanius ludovicianus*), and the ferruginous hawk (*Buteo regalis*).

At least 61 wildlife species identified in the Statewide Wildlife Action Plan (IDFG 2024) by the IDFG as Species of Greatest Conservation Need (SGCN) or Species of Greatest Information Need have been documented to have occurred or are likely to occur on the INL Site. These include 11 species of bats, as well as commonly observed species, such as the greater sage-grouse, the burrowing owl (*Athene cunicularia*), the Brewer's sparrow (*Spizella breweri*), Hunt's bumble bee (*Bombus huntii*), pronghorn (*Antilocarpa americana*), and the short-eared owl (*Asio flammeus*).

Special status plant species on the INL Site are identified based on their designated conservation rank using NaureServe Explorer. On the INL Site, there are 48 wildflowers, 6 grasses, 3 shrubs, 1 cactus, 1 tree, 4 lichens, and 1 moss designated as special status plant species (NatureServe 2025). Included within these, there are 17 BLM-ranked plant species (BLM 2022) and 2 SGCN-ranked (IDFG 2024) plant species. Most of these species have very limited distribution and are restricted to areas with unique soils, topography, and associated plant communities. Many species that are recognized as likely to occur were identified as such due to nearby, documented occurrences or the presence of appropriate habitat on the INL Site.

The INL Site includes mapped plant communities with elevated conservation rankings (NatureServe 2025) (Shive, et al. 2019). There are 47 special status associations that either have been mapped or have the potential to occur on the INL Site. These associations include 20 grasslands, 22 shrublands, 2 meadows, 2 woodlands, and 1 prairie. The large-scale vegetation mapping and classification efforts prioritize characterizing representative plant communities across the INL Site, rather than focusing on unique species assemblages. This approach ensures efficient use of resources and avoids the unnecessary workload from fine-scale mapping. Consequently, highly localized and rare plant communities were not identified in these efforts.

Conservation Planning Areas

There are currently three conservation plans at INL that are related to the proposed actions. These conservation plans identify specific threats and tailor conservation measures to address threats. The operational controls listed in Section 2.1.1 identify specific mitigation measures, project-specific instructions, hold points, and BMPs that include seasonal time-of-day restrictions, buffers, altitude restrictions for aircraft, and pre-activity surveys. These measures are intended to minimize impacts to ecological resources and will be applied to the extent possible during and after the proposed actions.

The Candidate Conservation Agreement for the Greater Sage-grouse: The CCA identifies threats to greater sage-grouse and their habitat and defines conservation measures and objectives to avoid or minimize threats to the species. The CCA established the SGCA, which is designed to be deprioritized for future infrastructure development and employs additional conservation measures and BMPs to reduce human disturbance of breeding and nesting greater sage-grouse, including seasonal buffers and time-of-day restrictions (Figure 10). In conjunction with the CCA, PRD-407 requires sagebrush mitigation for any project in which related activities result in the loss of sagebrush habitat or recovering sagebrush habitat. Any activities taking place contrary to the conservation measures and BMPs listed in the CCA will require further consultation between DOE and USFWS (DOE 2014).

The INL Site Bat Protection Plan: Large undisturbed areas of shrub-steppe habitat, basalt outcrops, lava caves, juniper uplands, and ponds and landscape trees at industrial facilities provide complex and abundant foraging and roosting habitat for a variety of resident and transient bat species. The INL Site BPP (DOE 2018) provides a framework to reduce mission impacts on bat species, monitor the status of bat populations, and establish conservation measures and BMPs designed to reduce the threat to or destruction of bat habitat. To protect summer roosts and hibernacula from INL-related activities, the BPP established distances in which certain activities are limited, including vegetation removal, herbicide use, and noise.

The Sagebrush Steppe Ecosystem Reserve: On July 19, 2004, DOE signed a FONSI for an EA and Management Plan that outlined a framework to collaboratively manage the INEEL Sagebrush Steppe Ecosystem Reserve (SSER) with the BLM, USFWS, and IDFG. The SSER includes 74,000 acres of high desert land in the north central portion of the INL Site (Figure 10). Specific actions to guide the SSER management according to its mission and management goals were provided in the INEEL Sagebrush Steppe Ecosystem Reserve Final Management Plan (DOE-ID and BLM 2004). The primary actions included in the preferred alternative for managing the SSER were as follows: (1) established a Reserve Management Committee, (2) reduced road access and use, (3) implemented an integrated weed management plan, (4) limited restoration actions to locally collected plant materials, (5) no changes in livestock class or increase in stocking levels, (6) no construction of wells for livestock watering purposes, (7) minimized anthropogenic structures for raptor perching, and (8) responded to WLF suppression and post-fire restoration in a manner that is consistent with INL's WLF EA.

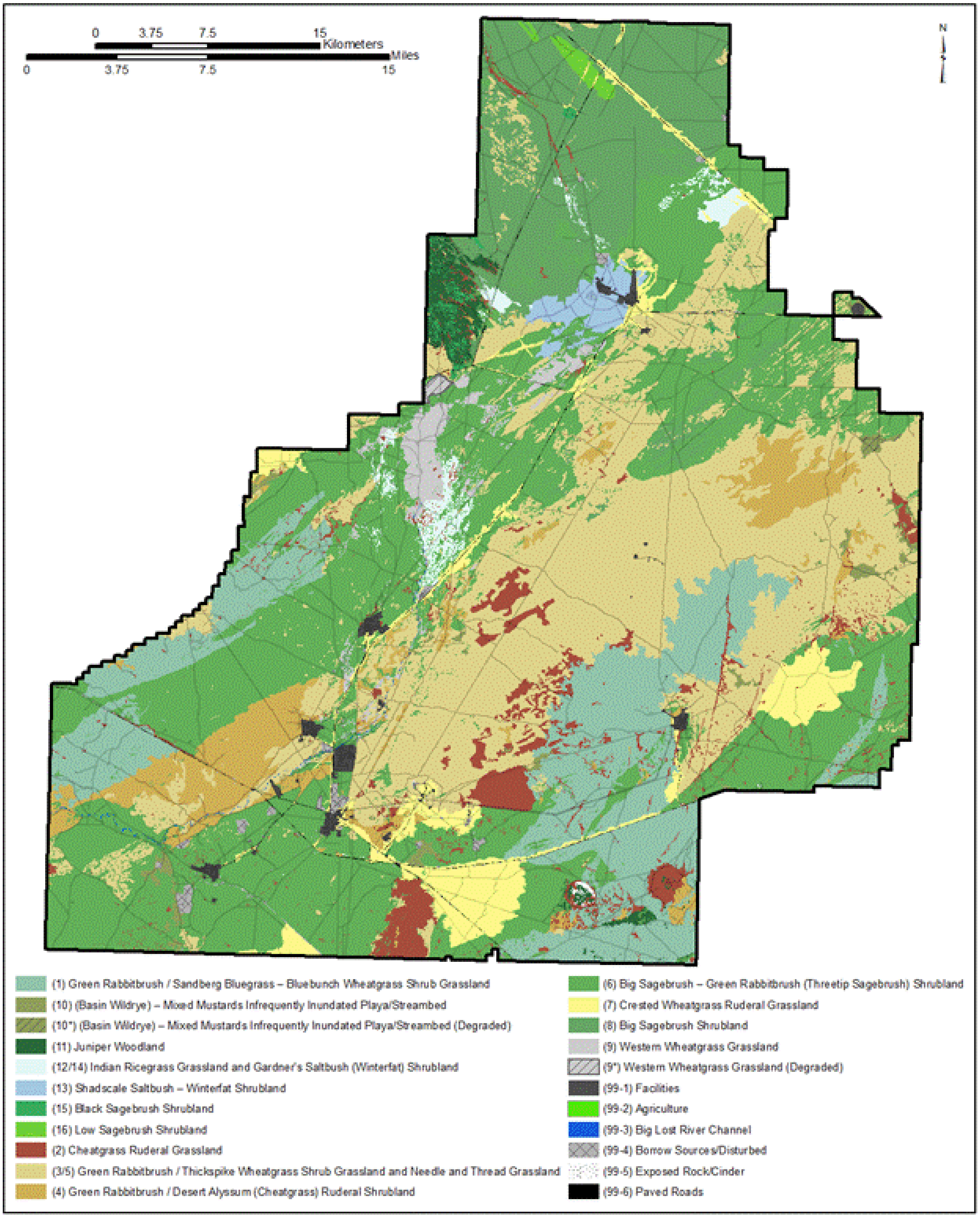

Figure 9. INL vegetation community map.

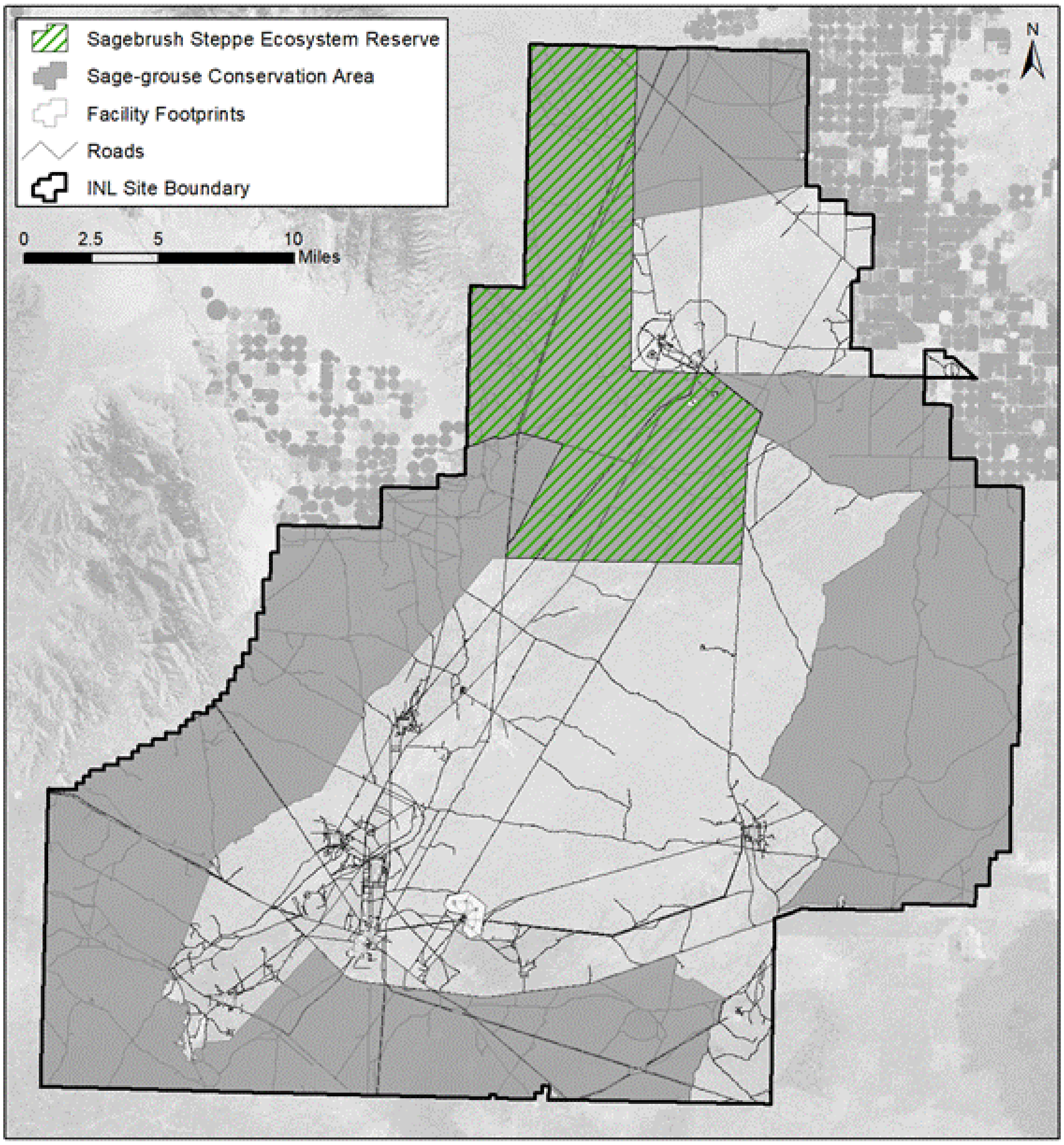

Figure 10. Sagebrush Steppe Ecosystem Reserve and SGCA on the INL Site.

3.6.2 Environmental Consequences

Wildland Fire Management Activities

Unlike fuels reduction treatments, which are intended to reduce the size and severity of WLF events and improve ecological resilience (Waltz, et al. 2014) (Chambers, et al. 2024), mowed roadside strips are linear strips that are treated to reduce hazardous fuels to provide safe, strategic anchor points for fire suppression activities (Moriarty, Okeson and Pellant 2015). Vegetation treatments for fuel breaks may include promoting plant growth that retains a high moisture content (green strips), mowing and applying herbicide to reduce the amount and structure of fuels, or removing all vegetation (brown strips). While this reduction in fuels may passively change fire behavior under the right weather, fire, and fuels conditions (Weise, et al. 2023), mowed roadside strips are intended to reduce the rate of spread and residence time of fires by disrupting fuel continuity and reducing flame lengths (Maestas, et al. 2016) (Ellsworth, et al. 2022) to support fire suppression efforts.

Mowed roadside strips are most effective when designed based on fuel loading, topography, local weather conditions, and predicted fire behavior (Syphard, Keeley and Brennan 2011) (Gannon, et al. 2023) and when used in conjunction with fire-fighting activities (Syphard, Keeley and Brennan 2011). Roads are often used as tools in the control and management of fires, providing efficient ingress and egress of firefighting personnel and equipment and may be enhanced by roadside vegetation treatments. However, while the areas adjacent to roads proposed for mowing and herbicide application actions within this EA may be used for a similar purpose, they were not explicitly selected based on fuel loads, topography, or weather conditions, but are intended to enhance firefighter safety and access to remote areas of the INL Site in the event of a WLF. Ecologically, potential consequences and benefits are similar to planned mowed roadside strips, but these proposed actions will be referred to as mowed roadside strips to indicate the difference in reasoning for site selection.

The primary purpose of road improvements is to reduce the response time to lightning ignitions of remote WLFs and to increase accessibility of backcountry locations to fight larger fires that exhibit extreme fire behavior. Over the past thirty years, about 25% of ignitions on the INL Site were caused by lightning, with the remaining ignitions resulting from roadside human behavior (summarized in (Forman, Kramer, et al. 2024). Although most fires that have burned on the INL Site did not exhibit extreme fire behavior, there have been six fires in the last three decades that quickly expanded to over 2,500 acres within the span of a few hours. The primary purpose of the mowed roadside strips is to enhance firefighter safety by reducing flame length. The INL FD has determined that 100-foot strips on either side of the road, mowed to a stubble height of 6 inches, with an annual frequency, will be sufficient to address safety requirements. Discussions of the environmental consequences of mowed roadside strips are based on these design specifications.

Vegetation

Road improvement and maintenance activities, including turnarounds, staging areas, and any other areas needed to support road work, will result in direct disturbance of vegetation and soil within and adjacent to current road footprints, which will increase the potential for the establishment of noxious weeds and undesirable annual grasses and forbs in those areas. If soils impacted by road improvements, including turnarounds and other support areas, are not sufficiently stabilized, they may increase the risk of the road becoming a vector for weed spread (Ferguson, Duncan and Snodgrass 2003) (Hansen and Clevenger 2005) (Lazaro-Lobo and Ervin 2019). Because road improvements often result in increased traffic volume (Hills 1996), the potential for weed establishment and movement along the vector corridor will increase proportionally to road use. Potential indirect impacts from roadway improvement and maintenance activities may include habitat degradation associated with alterations in hydrology (e.g., removal/addition of material to roadway footprint), which could change the flow of water along and adjacent to the roadways and into the surrounding native plant communities.

Under the proposed action, approximately 2,100 acres of established vegetation would be disturbed because of roadside mowing (Table 6). Sagebrush and other shrubs would be removed, and native perennial grasses and forbs would be damaged. Any populations of special status plant species that occur within the areas impacted by roadside mowing could be permanently lost. The removal of sagebrush and other native species through mechanical processes like mowing allows for encroachment of less desirable weedy species (Prevey, et al. 2010). Overall, mowing in sagebrush steppe has been shown to shift fuel composition, but does not result in long-term changes to fuel amount (Ellsworth, et al. 2022). Mowing in sagebrush steppe has also been shown to significantly increase cheatgrass abundance (Davies, Bates and Nafus, Mowing Wyoming Big Sagebrush Communities With Degraded Herbaceous Understories: Has a Threshold Been Crossed 2012) (Swanson, et al. 2016) even in stands that did not previously have degraded understories (Davies, Bates and Nafus, Comparing Burned and Mowed Treatments in Mountain Big Sagebrush Steppe 2012). Cheatgrass provides continuous fine fuels (Young, et al. 1987), and when cheatgrass monocultures occur along the roadside, they may increase the risk of fire spreading from a roadside into adjacent native vegetation (Harrison, et al. 2024). Because road improvements often result in increased traffic volume, any risk of human fire ignition and spread would increase proportionally with any increase in traffic. Additionally, fire ignitions may result from mowing activities due to equipment malfunctions, inattentive personnel, sparks created by mowing equipment contacting rocks or other surface features, etc.

Table 6. Estimated acreage disturbed during the establishment and maintenance of mowed roadside strips.

Proposed Areas of Disturbance	Total Disturbed Acres	Total Acres
All Roads Proposed for Mowing (100-ft buffer)	2,133.58	569,157
Sage-grouse Conservation Area	488.95	326,176
Sagebrush Steppe Ecosystem Reserve	98.69	74,171
Recovering Sagebrush Habitat	1,118.7	212,250
Existing Sagebrush Habitat	576.2	245,570

The increased risk of weed introduction, establishment, and spread due to road improvements and roadside mowing can be minimized through soil stabilization and by implementing a program-specific weed monitoring and treatment program. However, the potential impacts of herbicide treatment may potentially harm or destroy non-target vegetation, including special status species (BLM 2023). The effects of herbicides applied to treat vegetation vary by the type of chemical pathway employed (foliar vs. soil), the timing of application (growing season vs. dormant season), and plant community composition and soil types in the target area. Impacts of herbicide treatments may be minimized by using appropriate chemicals only under optimal conditions and applying the chemicals no more than necessary to address weed concerns.

The loss of sagebrush from mowing roadside strips can be mitigated as required under the CCA (DOE 2014). The CCA requires that the removal or loss of potential and existing greater sage-grouse habitat from the INL Site will be compensated or restored at another location (DOE 2014). Based on the projected sagebrush loss from the proposed action, it is anticipated that approximately 1,700 acres of sagebrush will need to be mitigated. Although many decades are required for mitigated areas to provide sagebrush habitat equivalent to those where sagebrush has been removed, if mitigation efforts are successful, they will eventually offset sagebrush losses from mowing roadside strips.

The impacts of road improvements and mowed roadside strips on local vegetation resources can be minimized to the extent possible by implementing project- and location-specific operational controls, as described in Section 2.1.1. These operational controls include hold points and project-specific instructions to ensure that BMPs for special status species and their associated conservation planning areas are effectively implemented.

If road improvements are effective in reducing response times and mowed roadside strips are effective in increasing safe access points for firefighters, then wildfire sizes may be reduced under certain conditions. For reference, when data about weather, fuels, topography, and ignition risk are analyzed and results are used to guide the placement of mowed roadside strips, then those strips can effectively function as fuel breaks. Based on data summarized over the past 30 years, mowed roadside strips are expected to be effective in the sagebrush biome about 58% of the time (Weise, et al. 2023). These estimates assume that the mowed roadside strips are used as anchor points for active suppression efforts. If those wildfires that are effectively managed would have otherwise burned an area that had not burned in the previous 30 years, then these proposed actions may be beneficial for preventing further sagebrush habitat loss. If the proposed actions prevent wildfire spread into areas that are recovering from previous wildfire, then any recovery from natural or assisted treatment actions would be preserved.

Wildlife

The construction and maintenance of roadway improvements and mowed roadside strips will have short-term direct effects on wildlife species. Wildlife occupying areas within proposed roadways and mowed strips will be disturbed by dust, noise, equipment, vehicles, and human presence. This can cause changes in behavior, including flight initiation, interruption of courtship and reproduction, non-optimal movement, and habitat avoidance. Wildlife with restricted mobility, such as small mammals, pollinators, reptiles, or ground-nesting birds, may be displaced, injured, or killed by the operation of mowers, vehicles, and heavy equipment. Some of these impacts can be minimized by following operation controls in Section 2.1.1 (e.g., seasonal and time-of-day restrictions, nesting bird surveys). The potential short-term effects to wildlife species from herbicide treatments implemented during the construction and maintenance of roadway improvements and mowed roadside strips to control noxious weeds and undesirable annual grasses and forbs includes direct spraying and ingestion of contaminated foliage (BLM 2023). These short-term effects will vary depending on the chemical, duration, and mechanism of exposure and can be minimized or eliminated by following the operational controls for herbicide application listed in Section 2.1.1.

Long-term direct effects of the construction and maintenance of roadway improvements and mowed roadside strips on wildlife species include soil compaction and altered hydrology, which may negatively impact burrows, nesting areas, and caves near project activities; habitat degradation or loss due to changes in vegetation amount and structure; edge effects that may increase the risk of predation by reducing available cover for prey species and lowering energy costs and detection time for some predators (Chalfoun, Thompson III and Ratnaswamy 2002) (DeGregorio, Weatherhead and Sperry 2014); and increased habitat fragmentation by creating visual barriers to movement (Edgel, et al. 2018) or by reducing habitat connectivity, particularly for less mobile species (Meinzen, Burkle and Debinski 2023). Another long-term direct effect of roadway improvements is a higher probability of vehicle-wildlife collisions due to increased driving speeds and roadbed usage by some wildlife species (e.g., snakes) (Jochimsen, et al. 2004). Additionally, indirect habitat loss may occur if species avoid high quality habitat due to adjacent human disturbance (Heinemeyer, et al. 2019) (Jones, et al. 2019).

Alteration or removal of sagebrush and recovering sagebrush habitat will have larger long-term impacts on pollinator, sagebrush-obligate, and sagebrush-associated species. Reduced shrub height from mowing will remove nesting habitat for sage thrashers, sagebrush sparrows, and loggerhead shrikes, which require sagebrush with structural complexity (Miller, et al. 2017) (Dinkins and Beck 2019) (Timmer, Aldridge and Fernandez-Gimenez 2019). Multiple studies have indicated that mechanical manipulation of sagebrush reduces nest and brood site selection for greater sage-grouse (Smith, et al. 2023) and does not increase the abundance or diversity of important nesting and brood-rearing habitat elements such as insects and forbs (Hess and Beck 2012), (Smith, et al. 2023). Pygmy rabbit habitat is characterized by areas of higher forb cover, shrub cover, and sagebrush density (Gabler, Heady and Laundre 2001), which will be reduced by the proposed action. Depending on the timing and blade height, mowing can reduce the availability of floral resources, increase habitat fragmentation, and limit population connectivity of pollinators (Meinzen, Burkle and Debinski 2023). Additionally, the potential for the spread of noxious weeds and invasive annual grasses from equipment and vehicles used for mowing and roadway improvements may reduce habitat quality for many of these species within the proposed action area.

Roadway improvements and mowed roadside strips will alter the habitat and produce noise disturbance for 26 greater sage-grouse leks within 0.62 miles of the proposed action area. Unoccupied leks have been associated with lower shrub heights compared to occupied leks (Smith, et al. 2006), and increasing variability in shrub height was found to be associated with lek abandonment (Hess and Beck 2012) at this distance. Chronic noise from road traffic and industrial machinery within 1,312 feet of a lek has been associated with lower lek attendance by both males and females (Blickley, Blackwood and Patricelli 2012). Conservation measures found in the CCA are designed to minimize disruptions to greater sage-grouse and are detailed in Section 2.1.1. These measures include restricting non-emergency activities from March 15 through May 15 between 6 p.m. to 9 a.m. within 0.62 miles of greater sage-grouse leks to avoid disrupting courtship behaviors. Additionally, disruptive non-emergency activities within the SGCA that may disturb nesting greater sage-grouse hens should be avoided between April 1 through June 30.

Habitat will be altered, and noise disturbance will impact nine known bat hibernacula and summer roost sites that are located within 1 mile of the proposed action area. Conservation measures found in the BPP are designed to minimize disruptions to bats and are detailed in Section 2.1.1. These measures include restricting activities generating continuous noise levels exceeding 75 decibels within 1 mile of a bat hibernacula or important summer roosts. Large-scale modification of native vegetation (>10 acres) in undisturbed areas within 1.5 miles of a hibernacula should be avoided. Prior to implementing activities involving pesticide application, fertilizer use, or mechanical vegetation removal within 150 feet of caves, a bat survey must be conducted to assess potential impacts.

Generalist predators, such as common ravens (*Corvus corax*) and coyotes (*Canis latrans*), will likely benefit from roadway improvements and mowed roadside strips as these species commonly use linear features and edge habitats (Crete and Lariviere 2003) (O'Neil, et al. 2018) to reduce energy costs and increase prey detection. If the proposed action decreases response times for initial attack and results in successful fire suppression, then it may reduce loss and fragmentation of native wildlife habitat on the INL Site from a WLF event.

Post-Fire Recovery Activities

The primary purpose of the proposed post-fire recovery activities is to rehabilitate and restore vegetation communities following a WLF. Active post-fire recovery treatments will be limited to areas where post-fire conditions may affect INL Site operations, where an area is at risk of poor natural recovery and where restoring habitat would yield high potential value for wildlife like seasonal-use areas or migration corridors. Treatments may also be prioritized in conservation areas like the SGCA or the SSER. When post-fire recovery activities are initiated in conservation areas, they will be conducted in accordance with the BMPs of that area. For example, locally collected seed will be used as directed by the SSER EA (DOE-ID and BLM 2004). The evaluation of effects of proposed post-fire recovery activities on the local ecosystem provided in this document includes the potential impacts and benefits associated with soil stabilization activities, noxious and invasive weed treatments, native herbaceous recovery activities, and sagebrush habitat restoration activities.

Vegetation

The goal of soil stabilization efforts on the INL Site are focused on (1) reducing erosion and weed vector potential of soils that were disturbed during fire suppression activities, (2) reducing human health impacts of blowing dust around facilities, and (3) minimizing damage to infrastructure from soil loss or deposition. Soil stabilization efforts, such as the installation of stormwater control features (e.g., silt or snow fencing, wattles), use of dust suppression techniques (e.g., water or chemical applications), and performance of recontouring or revegetating disturbed areas may impact existing vegetation not eliminated by the fire or fire-fighting activities. Physical structures may cause unintended soil redistribution. These activities may also temporarily increase fugitive dust or have the potential to introduce undesirable plant species where revegetation, and commercially procured plant materials, are used for stabilization. Weed seeds may also be spread via equipment used for stabilization activities.

The potential impacts of herbicide treatment implemented during WLF recovery activities to control noxious weeds and undesirable annual grasses and forbs include potentially harming or destroying non-target vegetation, including special status species (BLM 2023). The effects of herbicides applied to treat vegetation vary by the type of chemical pathway employed (foliar vs. soil), the timing of application (growing season vs. dormant season), and plant community composition and soil types in the target area. Additional potential risks of herbicide application include the spread of weed seed via equipment, destabilization of soils, and recurrence of weedy species where adequate native species are not available to recolonize after weeds have been removed (Monson 1994) (Elseroad and Rudd 2011). Herbicide application will only be considered when other means of weed control prove to be ineffective at controlling noxious and invasive species and when the overall impact of these effects would be low.

Herbaceous revegetation treatments are intended to increase the resilience and invasion resistance of plant communities and to decrease recovery time of important habitat. Revegetation efforts, including seedbed preparation, application of soil amendments, seedings, and seedling plantings could cause impacts to the soil and remaining vegetation (Forman, Kramer, et al. 2024). Mechanical seedbed preparation, application of soil amendments, and seed drilling would be more damaging to existing vegetation than hand planting because mechanical techniques have the potential to expose the soil surface to wind erosion and damage the root structures of surviving perennial species (Ratzlaff and Anderson 1995). Herbaceous revegetation treatments also have the potential to introduce undesirable genetic materials or weeds through seed contaminants and equipment.

Sagebrush restoration would be used to reduce recovery time for sagebrush habitats that are of high importance to obligate species. Post-fire recovery activities include sourcing appropriate plant materials, sagebrush seeding, and planting seedlings. Potential impacts of sagebrush planting include soil disturbance, creating weed vectors with equipment, introduction of genetic materials that impact local sagebrush populations, and introduction of sagebrush chemotypes that are not preferred forage for locally adapted wildlife populations (Rosentreter, Robb and Forbey 2021).

The impacts of the revegetation efforts on local ecological resources can be minimized to the extent possible by implementing project- and location-specific operational controls, as described in Section 2.1.1. Assuming the same level of efficacy as mechanical and hand-based revegetation efforts, any aerial seeding, soil amendments, or other activities completed using airplanes, helicopters, or drones would have no short-term impact on vegetation. Additional impacts may also be reduced using deferred livestock grazing or limiting access to recovering sites, in collaboration and accordance with BLM policies. This practice would protect restoration efforts until vegetation is established adequately to withstand regular use.

Restoration and revegetation in cold desert environments can be particularly challenging and any benefits from assisted recovery treatments would be proportional to the level of success achieved with those treatments. In the short-term, only weed control treatments will provide substantial benefit. If successful, longer term benefits to treatment would include enhanced site diversity and vigor of the restored vegetation communities. Anticipated long-term benefits from soil stabilization, weed control, and restoration also include (1) improving and restoring biodiversity of native vegetation, (2) restoring quality habitat for wildlife, (3) protecting habitat for species of concern, and (4) preventing extensive invasive annual grass dominance that could lead to an altered fire cycle. All these benefits would eventually translate to increases in available functional habitat for sagebrush-obligate species, improved ecosystem function, and increased ecological stability against stressors like shifts in precipitation amount and timing.

Wildlife

Near-term post-fire recovery actions, including creation of stormwater control features, dust suppression, recontouring, seedbed prep, mechanical seed drilling, weed control efforts, and associated human presence, will have short-term direct effects on wildlife species. Wildlife occupying areas within proposed post-fire recovery treatment areas will be disturbed by dust, noise, equipment, vehicles, and human presence. This can cause changes in behavior, including flight initiation, interruption of courtship and reproduction, non-optimal movement, and habitat avoidance. Wildlife with restricted mobility, such as small mammals, pollinators, reptiles, or ground-nesting birds, may be displaced, injured, or killed by the operation of vehicles and heavy equipment. Noise and visual disturbance from activities involving aerial operations may also induce short-term behavioral changes in some wildlife species. These disturbances can be minimized by following operation control listed in Section 2.1.1. Herbicide treatments may be used to control noxious weeds and undesirable annual grasses and forbs during WLF recovery activities. Short-term potential wildlife impacts from herbicide treatments include indirect contact with sprayed foliage and ingestion of contaminated food items (BLM 2023). These short-term effects will vary depending on the chemical, duration, and mechanism of exposure and can be minimized or eliminated by following the operational controls for herbicide application listed in Section 2.1.1.

Some wildlife species of conservation concern have exhibited positive responses to post-fire recovery actions. For example, pre-emergent herbicide application to reduce invasive annual grasses and aerial seeding of sagebrush, grasses, and forbs were associated with increased habitat use by greater sage-grouse in the first three years after the Soda Fire in Idaho and Oregon (Poessel, et al. 2022) (Germino, et al. 2023). However, longer term responses of greater sage-grouse to post-fire recovery actions are unknown. Sagebrush-associated species are negatively impacted by the conversion of sagebrush habitats to non-native grasslands (Rottler, et al. 2015), which can occur in low-resilience communities after a WLF event. Soil stabilization, application of pre-emergent herbicides, reseeding with native herbaceous species, and planting sagebrush can help reduce the establishment of non-native grasses and retain habitat elements for these species post-fire.

If WLF recovery efforts to stabilize soil and control the spread of noxious weeds and invasive annual grasses are successful, then wildlife species that are associated with early successional native plant communities will likely benefit in the near term. If suitable timing and duration of rainfall aids in the natural or assisted recovery of sagebrush, then use by sagebrush-obligate species will likely increase over the following decades.

3.6.2.1 No Action Alternative

Under the No Action Alternative, impacts on ecological resources from WLF, pre-fire suppression activities, and suppression activities will remain the same as they have been since the initial WLF EA was implemented in 2003. Risk of weed spread and the impacts of habitat loss and fragmentation associated with roads will remain unchanged. The tools available for post-WLF recovery will remain limited to those available under the current EA, and many proposed individual treatments will require environmental evaluation before they can be initiated. Treatment options related to the aerial application of herbicide to reduce cheatgrass dominance would not be feasible under the No Action Alternative. Cheatgrass-dominated plant communities currently occupy about 5% of the INL Site and have not increased in distribution substantially over the past 15 years (J. P. Shive 2024), so extreme shifts in fuels and fuels-related fire frequency are unlikely over the next decade under the No Action Alternative.

If road improvements and mowed roadside strips are effective in reducing response times and increasing access points for firefighting and increasing in capability results in smaller fire footprints, then the No Action Alternative may result in some loss of habitat that may not have occurred by adopting the proposed action. The amount of sagebrush habitat conserved by the proposed action would have to substantially offset the losses and fragmentation that will be incurred from the proposed action. Because nearly half of the INL Site has been impacted by wildfire over the past three decades, each new wildfire burns proportionally less sagebrush habitat than preceding fires, so the proposed action would need to be used to focus efforts on remaining sagebrush to yield effective protection for the remaining sagebrush habitat.

3.7 Noise

3.7.1 Affected Environment

The area surrounding the project site is characterized as being predominantly developed, surrounded by sagebrush steppe communities. Regionally, elevated noise levels mainly result from vehicular traffic on the highways. The closest manmade structures within the project area include numerous access roads and 25 INL facilities. Primary noise contributors at the INL Site are natural sounds (e.g., the wind and occasionally wildlife) and manmade sounds, including vehicular traffic and activities associated with INL operations. Within the INL Site boundary, the vegetation cover and regional topography quickly attenuate noise and vibrations with distance from the noise source.

3.7.2 Environmental Consequences

The proposed activities would occur within the INL Site boundary. The closest noise-sensitive receptors to INL are agricultural properties that surround the INL Site at certain locations. U.S. Highway 20 is typically considered the primary source of noise noticeable to the public on publicly accessible locations throughout the Site. It is expected that discernible sound would range from approximately 80–85 decibels (dBA). To give context, a whisper registers at approximately 30 dBA, normal conversation at approximately 50–60 dBA, a ringing phone at 80 dBA, and a power mower at 90 dBA (OSHA 2011). Any discernible noise from proposed activities would be from mechanical equipment used for mowing, broadcasting seeds or herbicides, or any aircraft that may be used. For reference, a typical tractor at idle speed produces about 85 decibels, while a tractor at work speed will produce up to 100 decibels. However, these noise levels would be consistent with other equipment used at the INL and, when in use, operators and nearby INL personnel are required to use appropriate PPE. The proposed action would not cause a change in the noise environment at the INL Site.

Given the distance to the nearest off-site receptors, reasonably foreseeable noise from the proposed action within the INL Site would be indistinguishable from background, and therefore, the impacts would be negligible.

3.8 Cultural Resources

3.8.1 Affected Environment

Section 106 of the National Historic Preservation Act (NHPA) and implementing regulations, 36 CFR Part 800, require federal agencies to consider potential effects to historic properties from undertakings funded or permitted by the U.S. federal government. *Historic properties* are historic districts, buildings, structures, sites, or objects that are eligible for inclusion or listing on the National Register of Historic Places (NRHP). The proposed actions are subject to Section 106 review.

In 2022 and 2023, the INL Cultural Resources Management Office (CRMO) conducted background research and intensive cultural resource inventories necessary to identify and characterize cultural resources within the project area of potential effects (APE). An undertaking's APE is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist." (36 CFR 800.16[d]). The APE for the proposed activities was designed to capture the geographic extent where road improvements and roadside mowing would take place. The APE includes the roads and their immediate margins for those roads proposed for improvements only, and includes 100 feet from each edge of the road, resulting in a total of 200 feet along the sections of road currently identified for road improvements and mowing." (Figure 4). The total APE equals 3,055.43 acres, encompasses over 140 linear miles of road, and crosses through three counties.

Activities proposed in the post-fire recovery portion of the EA are not included in the APE for the proposed action because the specific footprint of future WLF incidents cannot be anticipated. Current INL procedures establish a framework for Section 106 review of emergency incidents, including WLF methods for analyzing effects to historic properties during emergency response to wildfire and post-fire recovery efforts, are identified in Appendix F of the 2023 Programmatic Agreement (PA) between DOE, Idaho State Historic Preservation Office (SHPO), and the ACHP (DOE-ID 2023). Individual recovery plans will be reviewed by the INL CRMO on a case-by-case basis to evaluate effects on historic properties in accordance with the INL Section 106 Process for Emergency Actions (Management Control Procedure 8014).

The records review and Class III archaeological inventory of the APE identified 120 cultural resources within the APE (e.g., isolated finds, linear resources, and archaeological sites). Of these, 44 are historic properties (eligible or listed in the NRHP). The remaining cultural resources in the APE are recommended as not eligible for listing on the NRHP.

3.8.2 Environmental Consequences

Assumptions

- This analysis provides a broad overview of cultural resource types and potential effects based on the available information used to determine the APE. Additional consultation would be performed before the implementation of proposed activities to avoid, minimize, or mitigate adverse effects to historic properties, as defined by Section 106 of the NHPA.
- The avoidance of cultural resources during proposed activities may compromise the effectiveness or the intention of the activity, and it may be necessary to minimize effects to such sites through using manual treatments, cultural resource awareness training, or other appropriate measures.
- The effectiveness of the proposed activities would have long-term benefits on cultural resources by decreasing the acres burned and promoting fire resiliency of the landscape through soil stabilization and vegetation restoration.

Wildland Fire Management Activities

Road improvements have the potential to cause direct, indirect, and reasonably foreseeable effects to historic properties. Spot grading, applications of gravel, and incidental widening of routes resulting from these actions may damage or displace artifacts and features at archaeological sites adjacent to, and bisected by, roads. However, the proposed improvements will be limited to the existing envelope of disturbance associated with these roads, which may alter characteristics that qualify the historic property for the NRHP (e.g., artifacts, features, subsurface deposits) but not to the degree to diminish integrity. In certain locations, geotextile fabric can be placed and sites and site features can be avoided to further reduce impact to NRHP characteristics of historic properties. Road improvements along NRHP-eligible linear resources of historic roads, railways, and trails may affect route design but would not alter or diminish the other aspects of the Site integrity (e.g., location, feeling, setting, and association).

The action of roadside mowing may affect archaeological historic properties within the APE. Mechanical thinning and mowing may also affect some archaeological historic properties, such historic homesteads, where high-relief features and artifact scatters are susceptible to damage or displacement by mowing equipment. Effects to precontact archaeological historic properties, like lithic scatters and other sites where artifacts are well below the target fuel height of six inches, are less likely. Offroad use of heavy equipment during periods of high soil moisture or in areas with loose, sandy soils could result in disturbance to archaeological historic properties through soil disturbance, compaction, and erosion. Roadside mowing along NRHP-eligible historic roads, railways, and trails may affect aspects of integrity such as feeling and setting. Combined with potential effects to the integrity of design that would result from proposed road improvements, mowing may compromise the integrity of some route segments.

While the proposed road improvements have the potential to result in a disturbance to historic properties within the APE, they would also stabilize roadbeds, reduce erosion, discourage overland travel, and improve access during emergency events. If road improvements are effective in reducing response times and mowed roadside strips are effective in increasing safe access points for firefighters, then wildfire sizes may be reduced under certain conditions and more timely response to WLFs has the potential to facilitate more rapid containment. If successful, the proposed road improvements would reduce the impacts of WLF to archaeological historic properties in areas susceptible to post-fire soil loss due to wind erosion processes. Improved containment and suppression may also reduce the effects to historic properties from fire suppression efforts (i.e., containment lines and overland travel) and to post-fire erosion and deflation. Potential impacts to historic properties that would result from the proposed action could also be prevented through implementation of avoidance and minimization strategies described in Section 2.1.1.

In conjunction with the operational controls in Section 2.1.1, cultural resource awareness training and an annual environmental training refresher are provided for DOE contractor staff who conduct work at the INL Site. These trainings enrich the knowledge of cultural resources and how and why they are protected. Although Section 106 has been initiated, project-specific consultation has not been completed as of June 2025. Through consultation with the Idaho SHPO and the Shoshone-Bannock Tribes, DOE will establish the specifics of the avoidance and minimization recommendations necessary for each historic property and decide on the effect under Section 106. At this time, with the project controls in place (see Section 2.1.1), DOE anticipates there would be no adverse effects to historic properties as a result of the proposed action under Section 106, and there would be moderate impacts given the context and intensity under NEPA.

Post-Fire Recovery Activities

Proposed post-fire actions would expedite the development and implementation of recovery plans for individual WLF incidents. This would reduce the indirect effects of fire to historic properties by streamlining habitat recovery and restoration. Efforts to facilitate the timely recovery of native vegetation and combat the spread of invasive species are essential to stabilize soils and prevent further degradation of cultural resources impacted by fire. Timely restoration (i.e., before the next growing season) of disturbance caused by fire suppression activities (e.g., recontouring and reseeding of containment lines) would reduce the potential for repeated disturbance incurred due to delays in post-fire restoration efforts.

Post-fire recovery actions will likely vary depending on the fire suppression actions. The proposed activities would be tailored to the restoration needs that arise following a given incident or fire season. The scope of actions described in such plans will remain subject to Section 106 review on an individual basis under established INL plans and procedures.

3.8.2.1 No Action Alternative

Under the No Action Alternative, no road improvements or additional mowing beyond that which was already analyzed as part of the 2003 WLF EA would occur. Section 106 reviews would continue to be performed on a case-by-case basis for actions that occur under the 2003 EA. Additionally, consideration of impacts to cultural resources during emergency fire suppression methods and post-fire recovery are facilitated through the Wildland Fire Management Committee and Appendix F of the 2023 PA (DOE-ID 2023).

Routine maintenance of roadways has little potential to directly affect historic properties on the INL Site as actions for maintenance are limited to spot filling ruts with no grading. Current conditions on unimproved roads may have indirect or reasonably foreseeable effects to historic properties by incentivizing offroad vehicle use in rough conditions and emergency events. Slow travel over unimproved routes encourages WLF equipment operators to travel overland (authorized during emergencies) to reduce response times, and results in soil disturbance in areas that would otherwise be unaffected by vehicular travel. Slower emergency response times allow fires to grow larger, resulting in a potential need for more containment lines and greater degrees of vegetation loss in larger burn areas, which ultimately impacts cultural resources through damage and displacement of artifacts and features through dozer grading and erosion susceptibility.

Mowed roadside strips along U.S. Highways 20, 26, 20/26 and State Highways 22, 28, and 33 are established within right-of-way areas maintained by the Idaho Transportation Department. These actions performed by the Idaho Transportation Department are subject to Section 106 review. Mowed roadside strips along improved roads between INL facilities have been maintained by INL since the WLF EA was issued in 2003. Areas within existing mowed roadside strips are affected by continual ground disturbance from initial road construction and maintenance, utility corridors, and drainage infrastructure. Continued maintenance of these mowed roadside strips through mowing, mechanical thinning, and herbicides is unlikely to further affect the integrity of historic properties located adjacent to, and bisected by, roads.

Following WLF events, DOE would continue to develop stand-alone recovery plans outlining measures needed to facilitate habitat recovery and address disturbances resulting from emergency response. In the absence of a formal WLF recovery guide, development of such plans would continue to require considerable time and negotiation among stakeholders, slowing or impeding implementation of recovery measures. Failure to facilitate the timely recovery of native vegetation prior to the following growing season and combat the spread of invasive species can irreversibly compromise the biotic integrity and soil stability of burn areas, with consequences for cultural resources impacted by removal of vegetation through fire. Failure to address disturbance resulting from fire suppression efforts (such as recontouring and reseeding of containment lines) prior to the next growing season may further contribute to the spread of invasive species, such as cheatgrass, increasing susceptibility to repeated fire and exacerbating vegetation and soil loss in areas containing cultural resources. As a result of the No Action Alternative, impacts to cultural resources would be moderate to high.

3.9 Accidents and Emergency Planning

DOE Order 151.D, "Comprehensive Emergency Management System," describes detailed requirements for emergency management that DOE must implement (2016). Each DOE site, facility, and activity, including the INL Site, establishes and maintains a documented emergency management program that implements the requirements of applicable federal, state, and local laws, regulations, and ordinances for fundamental worker safety programs (e.g., fire, safety, and security). In addition, each DOE site, facility, and activity containing hazardous materials (e.g., radioactive materials or certain chemicals that do not fall under the purview of fundamental worker safety programs) establishes and maintains an Emergency Management Hazardous Material program.

The emergency management system at INL includes emergency response facilities and equipment, trained staff, and effective interface and integration with off-site emergency response authorities and organizations. INL maintains the necessary apparatus, equipment, and state-of-the-art Emergency Operations Center in Idaho Falls, Idaho, to respond to emergencies not only at INL but throughout the local communities.

The purpose of the proposed action is to reduce the risks WLF poses at the INL Site and recover after a WLF occurs. Risk reduction efforts, such as improving existing roadways and creating mowed roadside strips, reduces the possibility that a large WLF would impact an INL worker, a member of the public, or INL facility. Furthermore, in efforts to restore sagebrush habitat following a WLF, the existing landscape would become more robust and resilient to the effects of a WLF.

If a WLF was to occur, the Emergency Operations Center is activated and WLF response efforts are coordinated from that office. In preparation of an event, INL workers and support personnel are prepared through training and readiness assessments.

3.10 Intentional Destructive Acts

INL routinely uses a variety of measures to mitigate the likelihood and consequences of intentional destructive acts. DOE maintains a highly trained and equipped Protective Force intended to prevent attacks against and entry into facilities and to mitigate the potential for an act of sabotage to occur on-Site.

Whether an intentional destructive act were to occur—including its exact nature, location, and consequential magnitude—is inherently uncertain. However, an intentional destructive act would be highly unlikely related to the proposed action as described in this document. INL is a protected area and under a high level of security as compared to the surrounding lands managed by other entities. If an intentional destructive act occurred on the INL Site that started a human-caused WLF, it would be managed as appropriate, regardless of the actions implemented under the proposed action.

3.11 Conclusion

Table 7 reflects the discussion of potential impacts of the proposed action and the No Action Alternative outlined in this report.

Table 7. Summary of potential impacts.

Resource Area	Potential Impact Proposed Action	Potential Impact No Action Alternative
Air Quality and Greenhouse Gases	The proposed action is expected to generate some fugitive emissions from road improvements and mowing activities. However, these emissions, including fine particulate matter (PM2.5 and PM10), will be below the significant levels set by regulations. Overall, the increase in emissions is considered minor and will not significantly impact air quality.	Under the No Action Alternative, current activities at the INL Site will continue without the proposed road improvements or mowing. This means that there will be no new measures to control emissions, and air quality will likely remain the same as it currently is. Future activities will still be evaluated for their environmental impacts, but without improvements, the potential for increased emissions from uncontrolled wildfires remains.
Water Resources	The proposed action will not require drilling new wells or discharging into injection wells, and it will not cause noticeable changes in groundwater use. Dust suppression activities will use approximately 153,000 gallons of water, which is only about 0.02% of the total water used at INL in 2023. This means the increase in water use is negligible compared to the INL Site's annual water right of 11.4 billion gallons. The actions taken will not violate water quality standards or significantly alter existing drainage patterns. Potential impacts to surface water are also considered low, as these sources are not prevalent on the INL Site.	Under the No Action Alternative, current operations will continue as they are, with no new measures for managing water resources. This means there will be no additional water use or improvements to mitigate impacts. Water resources will remain managed under existing conditions, and future activities will still be evaluated. However, without the proposed enhancements, the risk of degradation from uncontrolled events may persist.

Resource Area	Potential Impact Proposed Action	Potential Impact No Action Alternative
Soil and Geology Resources	The proposed action will involve maintenance and soil disturbances along approximately 130 miles of existing roads. This will temporarily disturb soil and may expose it to wind and water erosion. However, the use of BMPs, such as silt fencing, hay bales, and revegetation efforts, will help minimize soil erosion and protect soil integrity. The transition of non-graveled roads to graveled surfaces will not expand existing borrow pits, resulting in only a small additional impact on geological resources. Furthermore, the proposed activities are not expected to be negatively impacted by potential future earthquakes.	Under the No Action Alternative, soil and geological conditions will remain unchanged, as current operations will continue without the proposed road improvements or mowing. This means no new protective measures will be implemented, leaving the area susceptible to ongoing risks of erosion from natural events. The existing conditions will persist, but without the potential benefits offered by the proposed action.
Ecological Resources	The proposed action aims to enhance fire management through the mowing of approximately 80 miles of roadside strips and the improvement of existing roads. These activities are designed to improve firefighter safety and increase access and egress to and from remote areas during wildfires. These activities may disturb approximately 2,100 acres of established vegetation. This disturbance is expected to include the removal of sagebrush and damage to native perennial grasses and forbs, which are critical components of the sagebrush steppe ecosystem. These activities may increase the potential for the establishment of noxious weeds and undesirable annual grasses, which could outcompete native species and alter habitat quality.	Under the No Action Alternative, ecological impacts will remain unchanged, and the current risk of habitat loss and fragmentation will continue without any new interventions. The tools available for post-WLF recovery will remain limited, and there will be no aerial application of herbicides to control invasive cheatgrass. Cheatgrass currently occupies about 5% of the INL Site, and without active management, the potential for further spread and associated changes in fire frequency remains. The absence of new fire management strategies may exacerbate ecological risks, particularly in the context of uncontrolled wildfires.

Resource Area	Potential Impact Proposed Action	Potential Impact No Action Alternative
	Additionally, road improvements may lead to changes in local hydrology, affecting water flow along and adjacent to roadways, which could impact surrounding native plant communities and wildlife. The proposed action includes roughly 1,700 acres of sagebrush mitigation measures as part of existing agreements that require replacing displaced sagebrush, which is essential for maintaining the ecological integrity of the area. Should BMPs and mitigation measures be diligently followed, any potential impacts are expected to be minimized, and potential benefits, maximized thereby helping to stabilize the ecosystem and support the recovery of impacted native vegetation and wildlife over time.	
Noise	The proposed action will generate noise from mechanical equipment used for mowing and other activities within the INL Site boundary, with sound levels expected to range from 80–100 decibels (dBA). This noise is consistent with existing levels from operations, such as traffic on U.S. Highway 20, and is not anticipated to significantly alter the overall noise environment. Operators will use appropriate personal protective equipment (PPE) to mitigate any impacts. Given the distance to the nearest offsite receptors, reasonably foreseeable noise from the proposed action is expected to be negligible.	Under the No Action Alternative, noise impacts will remain unchanged, as current operations will continue without new measures. Existing noise levels from traffic and INL activities will persist, and no significant alterations to noise disturbances for nearby agricultural properties are expected.

Resource Area	Potential Impact Proposed Action	Potential Impact No Action Alternative
Cultural Resources	The proposed action includes road improvements and mowing activities that will impact cultural resources within the APE. These activities could potentially disturb archaeological sites and historic properties, possibly damaging or displacing artifacts. However, measures will be taken to avoid significant impacts, such as using geotextile fabric to protect sensitive areas and conducting cultural resource awareness training for staff. The aim is to stabilize roadbeds and improve access for emergency response, which can ultimately reduce the risk of wildfires damaging cultural sites. If implemented effectively, these actions will lead to long-term benefits by preserving the integrity of cultural resources and facilitating quicker recovery efforts after a wildfire.	Under the No Action Alternative, current practices will continue without new road improvements or mowing. This means that cultural resources will remain at risk without enhanced protections. Although Section 106 reviews will still be performed on a case-by-case basis, the lack of proactive measures will lead to ongoing degradation of historic properties. Additionally, the existing conditions may encourage offroad vehicle use during emergencies, causing unintended damage to cultural sites. The reasonably foreseeable effects of this approach could result in moderate-to-high impacts on cultural resources, particularly if wildfires occur and are not managed effectively.

4. COORDINATION AND CONSULTATION

4.1 Shoshone-Bannock Tribes

DOE provided the Draft EA to the Shoshone-Bannock Tribes on June 9, 2025 for review and briefed the Shoshone-Bannock Tribes Tribal staff on June 17, 2025 on the Draft EA and proposed action.

4.2 State of Idaho

DOE provided the draft EA to the Idaho Governor's Office of Energy and Mineral Resources on June 9, 2025 for review.

5. REFERENCES

Anders, M. H., D. W. Rodgers, S. R. Hemming, J. Saltzman, V. J. Divenere, J. T. Hagstrum, G. F. Embree, and R. C. Walter. 2014. "A Fixed Sublithospheric Source for the Late Neogene Track of the Yellowstone Hot Spot: Implications of the Heise and Picabo Volcanic Fields." *Journal of Geophysical Research: Solid Earth, V. 119.* doe:10.1002/2013JB0483.

Anderson, J. E., and R. S. Inouye. 2001. "Landscape-Scale Changes in Plant Species Abundance and Biodiversity of a Sagebrush Steppe over 45 Years." Ecological Society of America.

Anderson, J. E., K. T. Ruppel, J. M. Glennon, K. E. Holte, and R. C. Rope. 1996. "Plant Communities, Ethnoecology, and Flora of the Idaho National Engineering Laboratory." Environmental Science and Research Foundation, June.

Blew, R. D. 2010. "Jefferson Fire Recovery: Options and Recommendations for Stabilizing the Burned Area and Addressing Habitat Conservation." S.M. Stoller Corporation, August 30.

Blew, R. D., and A. D. Forman. 2010. "Tin Cup Fire Recovery Report." S.M. Stoller Corporation, December.

Blickley, J. L., D. Blackwood, and G. L. Patricelli. 2012. "Experimental Evidence for the Effects of Chronic Anthropogenic Noise on Abundance of Greater Sage-Grouse at Leks." Conservation Biology.

BLM. 2022. *BLM - Idaho Special Status Species Animal List.* March 24. Accessed May 21, 2025. https://www.blm.gov/sites/blm.gov/files/docs/2022-04/Programs_FishandWildlife_BLMIdaho_Special_Status_Species_Animals_2022.pdf.

—. 2022. *Idaho Rare Plants.* Accessed March 15, 2025. https://www.blm.gov/programs/natural-resources/native-plant-communities/rare-and-cultural-plant-conservation/idaho.

—. 2023. "Programmatic Environmental Impact Statement Addressing Vegetation Treatments Using Herbicides." Bureau of Land Management, December.

Chalfoun, A. D., F. R. Thompson III, and M. J. Ratnaswamy. 2002. "Nest Predators and Fragmentation: a Review and Meta-Analysis." Conservation Biology, April.

Chambers, J. C., E. K. Strand, L. M. Ellsworth, C. M. Tortorelli, A. K. Urza, M. R. Crist, R. F. Miller, M. C. Reeves, K. C. Short, and C. L. Williams. 2024. "Review of fuel treatments effects on fuels, fire behavior and ecological reslilience in sagebrush (Artemisia spp.) ecosystems in the Western U.S." Association for Fire Ecology, March.

Christiansen, R. L., J. B. Lowenstern, R. B. Smith, H. Heasler, L. A. Morgan, M. Nathenson, L. G. Mastin, P. Muffler, and J. E. Robinson. 2007. "Preliminary Assessmentof Volcanic and Hydrothermal Hazards in Yellowstone National Park and Vicinity." *U.S. Geological Survey Open-file Report 2007-1071.*

Crete, M., and S. Lariviere. 2003. "Estimating the costs of locomotion in snow for coyotes." Jornal of Zoology.

Davies, K. W., J. D. Bates, and A. M. Nafus. 2012. "Comparing Burned and Mowed Treatments in Mountain Big Sagebrush Steppe." Environmental Management, June.

—. 2012. "Mowing Wyoming Big Sagebrush Communities With Degraded Herbaceous Understories: Has a Threshold Been Crossed." Rangeland Ecology and Management, September.

DeGregorio, B. A., P. J. Weatherhead, and J. H. Sperry. 2014. "Power lines, roads, and avian nest survival: Effects on predator identity and predation intensity." Ecology and Evolution, March.

Dinkins, J. B., and J. L. Beck. 2019. "Comparison of conservation policy benefits for an umbrella and related sagebrush-obligate species." Human-Wildlife Interactions, December.

DOE. 2014. "Candidate Conservation Agreement for Greater Sage-grouse (Centrocercus urophasianus) onthe Idaho National Laboratory Site." *DOE/ID-11514.* U.S. Department of Energy and U.S. Fish and Wildlife Service, September.

—. 2023. "FY 224 Idaho National Laboratory Site Sustainability Plan." *DOE/ID-11383.* Idaho Falls: U.S. Department of Energy Idaho Operations Office, December.

—. 2018. "Idaho National Laboratory Site Bat Protection Plan." *DOE/ID-12002.* Idaho Falls, ID: U.S. Department of Energy Idaho Operations Office, September.

DOE-ID. 2024. "2023 Idaho National Laboratory Annual Site Environmental Report." *DOE/ID-12082(23).* Department of Energy Idaho Operations Office, September.

DOE-ID and BLM. 2004. "Final Management Plan Finding of No Significant Impact: INEEL Sagebrush Steppe Ecosystem Reserve." *EA ID-074-02-067.* Department of Energy - Idaho Operations , May.

DOE-ID. 2003. "Idaho National Engineering and Environmental Laboratory Environmental Assessment and Finding of No Significant Impact." *DOE/EA-1372.* Idaho Falls : U.S. Department of Energy Idaho Operations Office, April.

—. 2023. "Programmatic Agreement Among the Department of Energy, Idaho Operations Office, the Idaho State Historic Preservation Office, and the Advisory Council on Historic Preservation." *NE700154.* Idaho Falls, ID: U.S. Department of Energy Idaho Operations Office.

Edgel, R. J., R. T. Larsen, J. C. Whiting, and B. R. McMillan. 2018. "Space Use, Movements, and Survival of Pygmy Rabbits in Response to Construction of a large Pipeline." Wildlife Society Bulletin, September.

Ellsworth, L. M., B. A. Newingham, S. E. Shaff, C. L. Williams, E. K. Strand, M. Reeves, D. A. Pyke, E. W. Schupp, and J. C. Chambers. 2022. "Fuel reduction treatments reduce modeled fire intensity in the sagebrush steppe." Ecosphere, January.

Elseroad, A. C., and N. T. Rudd. 2011. "Can Imazapic Increase Native Species Abundance in Cheatgrass (Bromus tectorum) Invaded Native Plant Communities." Rangeland Ecology and Management, November.

EPA. 2014. "Emission Factors for Greenhouse Gas Inventories." April 4. Accessed May 22, 2025. https://www.epa.gov/sites/default/files/2015-07/documents/emission-factors_2014.pdf.

Ferguson, L., C. L. Duncan, and K. Snodgrass. 2003. "Backcountry Road Maintenance and Weed Management." USDA - Forest Service, July.

Forman, A. D. 2024. "The Idaho National Laboratory Site Long-Term Vegetation Transects: Updates Through 2022." *INL/RPT-24-80913.* Idaho National Laboratory, September.

Forman, A. D., C. J. Kramer, J. P. Shive, S. R. Williams, K. N. Kaser, and B. F. Bybee. 2024. "Idaho National Laboratory Site Natural Resources Wildland Fire Recovery Framework ." *INL/RPT-24-76050.* Idaho Falls, ID: Idaho National Laboratory, Natural Resources Group.

Forman, A. D., R. D. Blew, and J. R. Hafla. 2010. "The Idaho National Laboratory Site Long-term Vegetation Transects: A Comprehensive Review." S.M. Stoller Corporation, April.

Gabler, K. I., L. T. Heady, and J. W. Laundre. 2001. "A Habitat Suitability Model for Pygmy Rabbits (Brachylagus idahoensis) in Southeastern Idaho." Western North American Naturalist.

Gannon, B., Y. Wie, E. Belval, J. Young, M. Thompson, C. O'Connor, D. Calkin, and C. Dunn. 2023. "A Quantitative Analysis of Fuel Break Effectiveness Drivers in Souther California National Forests." Fire, March.

Germino, M. J., C. R. Anthony, C. R. Kluender, E. Ellsworth, A. M. Moser, C. Applestein, and M. R. Fisk. 2023. "Relationship of greater sage-grouse to natural and assisted recovery of key vegetation types following wildfire: insights from scat." Restoration Ecology, March.

Hansen, M. J., and A. P. Clevenger. 2005. "The influence of disturbance and habitat on the presence of non-native plant species along transport corridors." Biological Conservation, March.

Harrison, G. R., L. C. Jones, L. M. Ellsworth, E. K. Strand, and T. S. Prather. 2024. "Cheatgrass alters flammability of native perennial grasses in laboratory combustion experiments." Fire Ecology, November.

Heinemeyer, K. , J. Squires, M. Hebblewhite, J. J. O'Keefe, J. D. Holbrook, and J. Copeland. 2019. "Wolverines in winter: indirect habitat loss and functional responses to backcountry recreation." Ecosphere, Feburary.

Hess, J. E., and J. L. Beck. 2012. "Disturbance Factors Influencing Greater Sage-Grouse Lek Abandonment in North-Central Wyoming." Journal of Wildlife Management, July .

Hills, P. J. 1996. "What is Induced Traffic." Transportation.

IDEQ. 2004. "Big Lost River Watershed Subbasin Assessment and TMDL." Idaho Falls, ID: Idaho Department of Environmental Quality, May 6.

—. 2011. "Memorandum: Default Ambient Air Receptors for Idaho National Laboratory." Idaho Department of Environmental Quality, May 23.

IDFG. 2024. "Idaho State Wildlife Action Plan 2023." Idaho Department of Fish and Game, January.

INL. 2024. "2023 Idaho National Laboratory Annual Site Environmental Report." *DOE/ID-12082 (23).* Idaho Falls: Idaho National Laboratory, September.

—. 2022. "Sitewide Noxious Weed Management." *PLN-611.* Idaho Falls: Idaho National Laboratory, June 29.

Jochimsen, D. M., C. R. Peterson, K. M. Andrews, and J. W. Gibbons. 2004. "A Literature Review of the Effects of Roads on Amphibians and Reptiles and the Measures Used to Minimize Those Effects." Idaho State University, November.

Jones, P. F., A. F. Jakes, A. C. Telander, H. Sawyer, B. H. Martin, and M. Hebblewhite. 2019. "Fences reduce habitat for a partially migratory ungulate in the Northern Sagebrush Steppe." Ecosphere, July.

Kramber, W. J., R. C. Rope, J. Anderson, J. Glennon, and A. Morse. 1992. "Producing a Vegetation Map of the Idaho National Engineering Lab Using Landsat Thematic Mapper Data." Idaho National Engineering Laboratory.

Kuntz, M. A., B. Skipp, D. E. Champion, P. B. Gans, and D. P. Van Sistine. 2007. "Geologic Map of the Craters of the Moon 30' x 60' Quadrangle, Idaho." *U.S. Geological Survey Scientific Investigations Map.*

Kunz, M. A., B. Skipp, M. A. Lanphere, W. E. Scott, K. L. Pierce, G. B. Dalrymple, D. E. Champion, et al. 1994. "Geologic Map of the Idaho National Engineering Laboratory and Adjoining Areas, Eastern Idaho." *U.S. Geological Survey Miscellaneous Investigation Map, I-2330, 1:100,000 scale.*

Kunz, M. A., S. R. Anderson, D. E. Champion, M. A. Lanphere, and D. J. Grunwald. 2002. "Tension Cracks, Eruptive fissures, Dike, and Faults Related to Late Pleistocene-Holocene Basaltic Volcanism and Implications for the Distribution of Hydraulic Conductivity in the Eastern Snake River Plain, Idaho." *Geology, Hydrogeology, and Environmental Remediation: Idaho National Engineering and Environmental Laboratory, Eastern Snake River Plain, Idaho.* Geological Society of America Special Paper, 353.

Lazaro-Lobo, A., and G. N. Ervin. 2019. "A global examination on the differential impacts of roadsides on native vs. exotic and weedy plant species." Global Ecology and Conservation, Feburary.

Maestas, J., M. Pellant, L. Okeson, D. Tilley, D. Havlina, T. Cracroft, B. Brazee, M. Williams, and D. Messmer. 2016. "Fuel Breaks to Reduce Large Wildfire Impacts in Sagebrush Ecosystems." USDA - Natural Resources Conservation Service, March.

McBride, R., N. R. French, A. H. Dahl, and J. E. Detmer. 1978. "Vegetation Types and Surface Soils of the Idaho National Engineering Laboratory Site." *IDO-12084.* U.S. Department of Energy Idaho Operations Office, April.

McCurry, M., K. P. Hayden, L. H. Morse, and S. Mertzman. 2008. "Genesis of Post-Hot Spot, Atype Rhyolite of the Eastern Snake River Plain Volcanic Filed by Extreme Fractional Crystallization of Olivine Tholeiite." *Bulletin of Volcanology, V. 70.*

McCurry, M., T. McLing, R. P. Smith, W. R. Hackett, R. Goldby, W. Lochridge, R. Podgorney, et al. 2016. "Geologic Setting of the Idaho National Laboratory Geothermal Resource Research Area." *Proceedings, 41st Workshop on Geothermal Reservoir Engineering.* Stanford, California: Stanford University, February 22-24.

Meinzen, T. C., L. A. Burkle, and D. M. Debinski. 2023. "Roadside habitat: Boon or bane for pollinating insects." BioScience, November.

Miller, R. A., L. Bond, P. N. Migas, J. D. Carlisle, and G. S. Kaltenecker. 2017. "Contrasting Habitat Assocaitions of Sagebrush-Steppe Songbirds in the Intermountatin West." Western Birds, March.

Monson, S. B. 1994. "he competitive influences of cheatgrass (Bromus tectorum) on site restoration. In Proceedings-ecology and management of annual rangelands." US Forest Service, Intermountain Research Station.

Moriarty, K., L. Okeson, and M. Pellant. 2015. "Fuel Breaks that Work." Great Basin Factshee Series .

NatureServe. 2025. *NatureServe Explorer.* Accessed March 15, 2025. https://explorer.natureserve.org/.

O'Neil, S. T., P. S. Coates, B. E. Brussee, P. J. Jackson, K. B. Howe, A. M. Moser, L. J. Foster, and D. J. Delehanty. 2018. "Broad-scale occurrence of a subsidized avian predator: Reducing impacts of ravens on sage-grouse and other sensative prey." Journal of Applied Ecology, May.

Owens, T. M. 2025. "2024 Breeding Bird Surveys on the Idaho National Laboratory Site." *INL/RPT-25-83402.* Idaho National Laboratory , March.

Payne, S. J., and V. Montaldo Falero. 2022. "1850-2022 regional earthquake catalog compiled for the INL SSHAC Level 3 probabilitist seismic hazard analysis; Battelle Energy Alliance report." *INL/RPT-22-66235.* Idaho National Laboratory, March.

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: Geological Society of America Memoir.*

Pierce, K. L., and L. A. Morgan. 2009. "Is the Track of the Yellowstone Hot Spot Driven by a Deep Mantle Plume? - Review of Volcanism, Faulting, and Uplift in Light of New Data." *Journal of Volcanology and Geothermal Research, V. 188.*

—. 2009. "Is the Track of the Yellowstone Hot Spot Driven by a Deep Mantle Plume? -Review of Volcanism, Faulting, and Uplift in Light of New Data." *Journal of Volcanology and Geothermal Research, V. 88.*

—. 1992. "The Track of the Yellowstone Hot Spot: Volcanism, Faulting, and Uplift." *Regional Geology of Eastern Idaho and Western Wyoming: Geological Society of America Memoir 179.*

Poessel, S. A., D. M. Barnard, C. Applestein, M. J. Germino, E. A. Ellsworth, D. Major, A. Moser, and T. E. Katzner. 2022. "Greater sage-grouse respond positively to intensive post-fire restoration treatments." Ecology and Evolution, Feburary.

Prevey, J. S., M. J. Germino, N. J. Huntly, and R. S. Inouye. 2010. "Exotic plants increase and native plants decrease with loss of foundation species in sagebrush steppe." Plant Ecology, August.

Ratzlaff, T. D., and J. E. Anderson. 1995. "Vegetal recovery following wildfire in seeded and unseeded sagebrush steppe." Journal of Range Management, September .

Rosentreter, R., B. C. Robb, and J. S. Forbey. 2021. "Using an ultraviolet light test to improve sagebrush identification and predict forage quality for wildlife." Western North American Naturalist.

Rottler, C. M., C. E. Noseworthy, B. Fowers, and J. L. Beck. 2015. "Effects of Consersion From Sagebrush to Non-Native Grasslands on Sagebrush-Associated Species." Rangelands, Feburary.

Schusler, K. L., D. M. Pearson, M. McCurry, R. C. Bartholomay, and M. H. Anders. 2020. "Regionally Continuous Miocene Rhyolites Beneath the Eastern Snake River Plain Reveal Localized Flexure at its Western Margin: Idaho National Laboratory and Vicinity." *Rocky Mountain Geologist, V. 57.*

Shive, J. P., A. D. Forman, A. Bayless-Edwards, K. Aho, K. N. Kaser, J. R. Hafla, and K. T. Edwards. 2019. "Vegetation Community Classification and Mapping of the Idaho National Laboratory Site 2019." Veolia Nuclear Solutions - Federal Services, June.

Shive, Jeremy P. 2024. "Idaho National Laboratory Site Vegetation Map Update 2024 ." *INL/RPT-24-80957.* Idaho National Laboratory , September.

Smith, J. T., L. D. Flake, K. F. Higgins, and G. D. Kobriger. 2006. "Microhabitat Characteristics Relative To Lek Abandonment by Greater Sage Grouse in the Dakotas." Intermountain Journal of Sciences.

Smith, K. T., J. R. Levan, A. D. Chalfoun, T. J. Christiansen, S. R. Harter, S. Oberlie, and J. L. Beck. 2023. "Response of greater sage-grouse to sagebrush reduction treatments in Wyoming big sagebrush." Wildlife Monographs, March.

Smith, R. B., M. Jordan, B. Steinberger, C. M. Puskas, J. Farrell, G. P. Waite, S. Husen, W. L. Chang, and R. O'Connell. 2009. "Geodynamics of the Yellowstone Hot Spot and Mantle Plume: Seismic and GPS Imaging, Kinematics, Mantle Flow." *Journal of Volcanology and Geothermal Research, V. 88.*

Swanson, S. R., J. C. Swanson, P. J. Murphy, J. K. McAdoo, and B. Schultz. 2016. "Mowing Wyoming Big Sagebrush (Artemisia tridentata ssp. wyomingensis) Cover Effects Across Northern and Central Nevada." Rangland Ecology and Management, April.

Syphard, A. D., J. E. Keeley, and T. J. Brennan. 2011. "Comparing the role of fuel breaks across southern California national forests." Forest Ecology and Management, Feburary.

Timmer, J. M., C. L. Aldridge, and M. E. Fernandez-Gimenez. 2019. "Managing for Multiple Species: Greater Sage-Grouse and Sagebrush Songbirds." The Journal of Wildlife Management.

USFWS. 2025. *IPaC Information for Planning and Consultation.* May. Accessed May 21, 2025. https://ipac.ecosphere.fws.gov/.

Waltz, A. E.M., M. T. Stoddard, E. L. Kalies, J. D. Springer, D. W. Huffman, and A. S. Meador. 2014. "Effectiveness of fuel reduction treatments: Assessing metrics of forest resiliency and wildfire severity after the Wallow Fire, AZ." Forest Ecology and Management, September.

Weise, C. L., B. E. Brussee, P. S. Coates, D. J. Shinneman, M. R. Crist, C. L. Aldridge, J. A. Heinrichs, and M. A. Ricca. 2023. "A retrospective assessment of fuel break effectiveness for containing rangeland wildfires in the sagebrush biome." Journal of Environmental Management, April.

Young, J. A., R. A. Evans, R. E. Eckert, and B. L. Kay. 1987. "Cheatgrass." Society for Range Management, December.