STOLLER-ESER-87

Survey and Review of Potential Impacts to Ecological Resources on the INL Due to Construction of a Road as Described in the Draft Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems DOE/EIS-0373D

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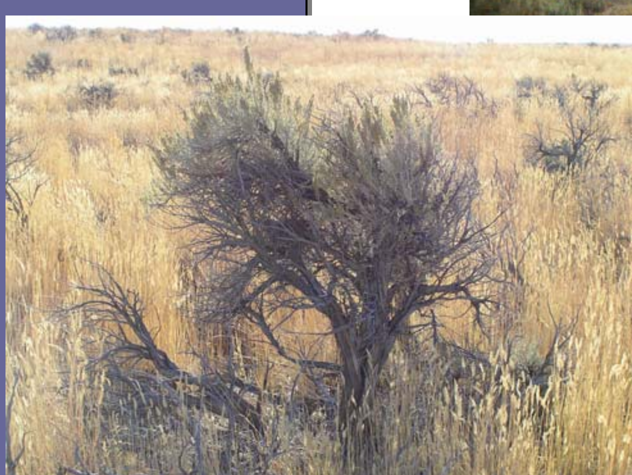

Environmental Surveillance, Education and Research Program

ESER

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November 22, 2005

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1.0 Introduction

1.1 Purpose of this Report

Using public roads for material transfers between MFC (Material Fuels Complex) and ATR (Advanced Test Reactor) at the INL is not practical due to the nature of the materials to be transferred. Therefore, a new, internal road will be required. The proposed new road at INL would be constructed between the Plutonium-238 Facility at MFC and ATR at the RTC. The road would be paved with asphalt over a compacted granular base. Width of the asphalt pavement would be approximately 6.7 m (22 ft) with 2.7 m (9 ft) of granular shoulders on either side. The width of the construction corridor would be 18 m (60 ft). Due to security requirements, the new road would be a Government road, with access restricted to INL contractor material transfers only and other official DOE projects. The entire length of this restricted access road would be on DOE property. Each end would have swing-type closure gates, which would be padlocked shut when not in use. Additionally, warning signs would be located on either side of each gate advising the use of this road is for official DOE business only (DOE 2005).

The purpose of this report is to assess the potential impacts to ecological resources including threatened, endangered and sensitive species due to construction and operation of a road in support of the proposed consolidation of nuclear operations related to production of radioisotopes power systems. DOE/EIS-0373D (DOE 2005) describes three possible routes for this road. This report covers surveys for two of those possible routes and one additional route identified during the survey. Figure 1 shows these routings.

1.1.1 Alternative I: T-24

The T-24 Road is located south of the T-3 Road. Approximately 16 km (10 mi) would need to be paved from the MFC until the road reaches the Critical Infrastructure Test Range Complex (CITRC) (formerly the Power Burst Facility) and connects to approximately 19 km (12 mi) of INL internal roads leading to the RTC. Although less direct than following the T-3, this route would use an existing bridge crossing (DOE 2005).

1.1.2 Alternative II: East Powerline Road

The East Powerline Road is located south of both the T-3 and T-24 Roads. An advantage is that this road is currently maintained at a higher level than the T-3 and T-24 routes because of ongoing power line maintenance. Approximately 19 km (12 mi) would need to be paved from the MFC before the new road connects to internal INL paved roads at CITRC. This route would use an existing bridge crossing (DOE 2005).

1.1.3 Alternative III: East Powerline Road with Shortcut

While conducting surveys for these two routes, we identified a possible third alternative by connecting the East Powerline Road with ARA. This routing reduces the amount of new road construction for East Powerline Road by approximately 3.2 km (2 mi).

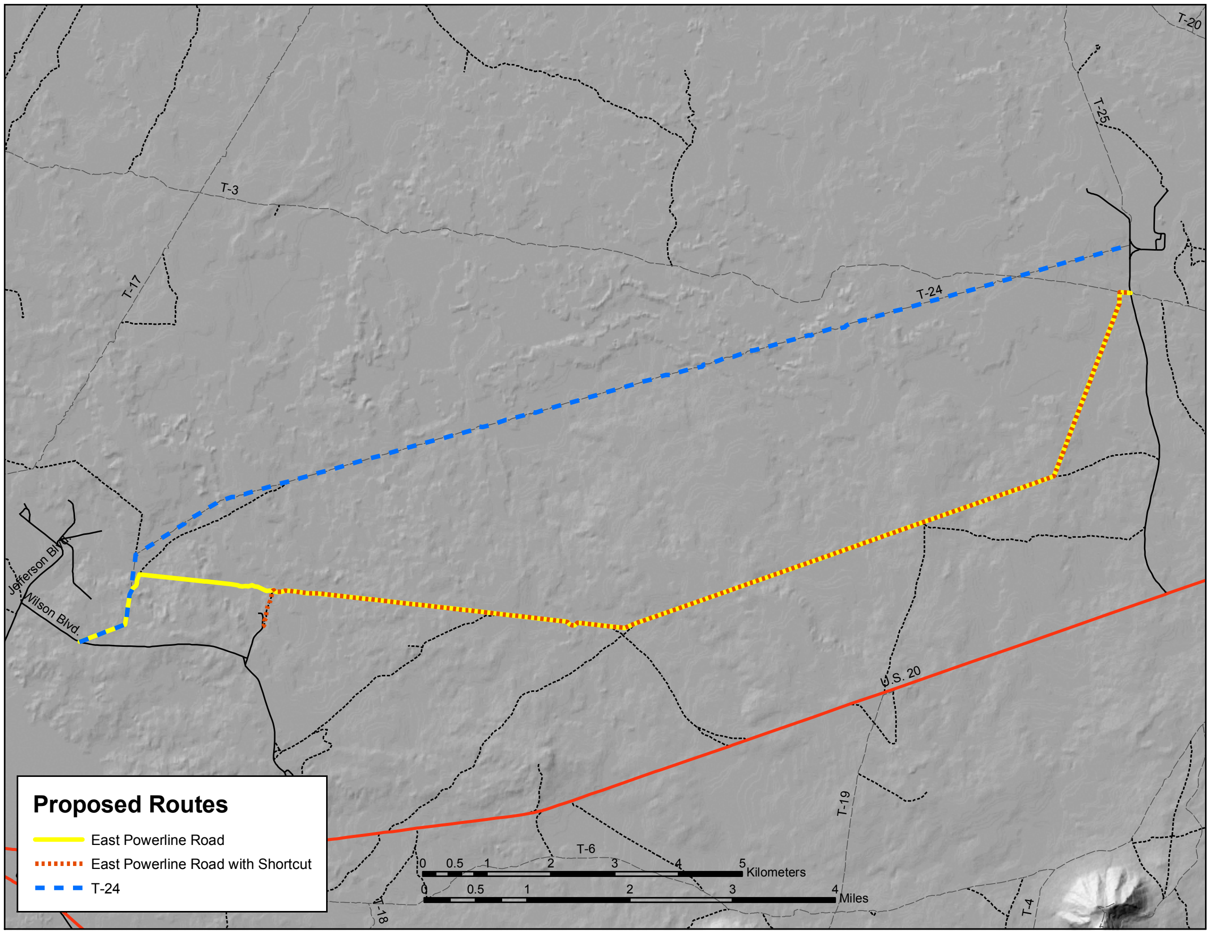

Figure 1. Potential routes for new road.

1.2 INL Natural Resource Management Objectives

Under DOE Policy 430.1 (Facility and Land Use Panning, July 1996), "it is Department of Energy policy to manage all of its land and facilities as valuable national resources. Stewardship is based on the principles of ecosystem management and sustainable development. DOE integrates mission, economic, ecologic, social, and cultural factors in a comprehensive plan for each site that will guide land and facility use decisions. Each comprehensive plan for each site will consider the site's larger regional context and be developed with stakeholder participation. This policy will result in land and facility uses which support the Department's critical missions, stimulate the economy, and protect the environment."

Further, DOE along with thirteen other Federal agencies signed a Memorandum of Understanding (MOU) to Foster the Ecosystem Approach (December 15, 1995). As stated in the MOU, “An ecosystem is an interconnected community of living things, including humans, and the physical environment within which they interact. The ecosystem approach is a method for sustaining or restoring ecological systems and their functions and values. It is goal driven, and it is based on a collaboratively developed vision of desired future conditions that integrates ecological, economic, and social factors. It is applied within a geographic framework defined primarily by ecological boundaries. The goal of the ecosystem approach is to restore and sustain the health, productivity, and biological diversity of ecosystems and the overall quality of life through a natural resource management approach that is fully integrated with social and economic goals. These goals and approaches are reflected in the Natural Resource Objectives established for this Environmental Assessment.”

The INL represents the largest remnant of undeveloped, ungrazed sagebrush steppe ecosystem in the Intermountain West (DOE 1997). This ecosystem has been listed as critically endangered with less than two percent remaining (Noss et al. 1995, Saab and Rich 1997). The INL is also home to the Idaho National Environmental Research Park (NERP). The NERP is an outdoor laboratory for evaluating the environmental consequences of energy use and development as well as strategies to mitigate these effects. A portion of the INL has been designated as the Sagebrush Steppe Ecosystem Reserve that has a mission of conducting research on and preserving sagebrush steppe.

The goal of ecological resource management on the INL is to perpetuate and protect a large, unfragmented native sagebrush steppe ecosystem, respond to existing Executive Orders, federal, state, and DOE mandates for protecting biological resources, and support NERP objectives (DOE 2003). Recognizing that there are requirements for road construction or improvement on the INL to meet DOE objectives, certain measures can be implemented to reduce or eliminate impacts to natural resources from these activities. Specific natural resource management objectives which fulfill DOE policy and Federal regulatory requirements include:

- **Reduce the need for rehabilitation following road construction**. The goal of this objective is to reduce or eliminate the need to rehabilitate areas after road construction. Reducing or eliminating the need for rehabilitation maintains the established adjacent ecosystem in its current state.
- **Protect threatened, endangered and sensitive species (this includes State of Idaho designated species) and their habitat.** The Endangered Species Act (ESA) requires that Federal agencies “shall seek to conserve endangered and threatened species.” The goal of this objective is to ensure that ESA listed and Idaho designated species are not adversely impacted by the proposed action.
- **Protect sage grouse and other sagebrush-obligate species and their habitat.** Because a number of the risk of being listed under ESA, the goal of this objective is not to adversely impact INL populations of sage grouse and other sagebrush-obligate species and their required habitat through the proposed action.

- **Prevent habitat loss and fragmentation.** Habitat loss and fragmentation can adversely impact plant, and animal species, biodiversity, and ecosystem stability. The goal of this objective is to minimize or prevent habitat loss and fragmentation.
- **Protect culturally significant flora and fauna.** This goal of this objective is to prevent impacts on culturally significant (to regional Native Americans) plants and animals from the proposed action and associated auxiliary actions.
- **Maintain a large undeveloped, sagebrush steppe ecosystem.** The goal of this objective is to conserve large tracts of sagebrush which eliminate impacts to flora, fauna, biodiversity and threatened and endangered species depending on this ecosystem.
- **Maintain plant genetic diversity.** The goal of this objective is to prevent non-regional genotypes from being established as a result of lack of revegetation planning.
- **Protect unique ecological research opportunities.** The goal of this objective is to preserve research opportunities unique to the sagebrush steppe ecosystem on the INL. The most significant "unique ecological research opportunities" are related to the large, undeveloped, unfragmented sagebrush steppe found on the INL. These sagebrush attributes should be protected from adverse impacts thus preserving these opportunities.
- **Prevent invasion of non-native species including noxious weeds**. Ground disturbing activities, particularly in close proximity to or adjacent to seed sources exacerbate the invasion of noxious species. The goal of this objective is to prevent invasion of non-native and noxious biota due to the proposed action.
- **Prevent animal/vehicle conflicts.** With new roads, the probability of animal/vehicle collisions will increase and cause, not only damage to the natural resource, but human health and safety as well. The goal of this objective is to minimize or eliminate these conflicts.
- **Protect biodiversity.** The goal of this objective is to protect the biodiversity on the INL. Biodiversity refers to the variety and variability among living organisms and the ecological complexes in which they occur. Biodiversity is important to the health of the environment and is a basic concept to the goal of ecosystem approach.

1.3 Background

The impacts of roads on terrestrial ecosystems, such as the sagebrush steppe on the INL, include direct habitat loss; facilitated invasion of weeds, pests, and pathogens, many of which are exotic (alien); and a variety of edge effects. Roads themselves essentially preempt wildlife habitat. Road construction also kills animals and plants directly, and may limit long-term site productivity of roadsides by exposing low nutrient subsoils, reducing soil water holding capacity, and compacting surface materials. It also makes slopes more vulnerable to landslides and erosion, which in turn remove additional terrestrial wildlife habitat and degrade aquatic habitats (Noss 1996).

Some species thrive on roadsides, but most of these are weedy species. In the Great Basin, rabbitbrush is usually more abundant and vigorous along hard-surfaced roads than anywhere else, because it takes advantage of the runoff water channeled to the shoulders. Many of the weedy plants that dominate and disperse along roadsides are non-native. In some cases, these species spread from roadsides into adjacent native communities. In much of the west, spotted knapweed has become a serious agricultural pest. This Eurasian weed invades native communities from roadsides (Noss 1996).

1.3.1 General effects of roads

Trombulak and Frisell (2000) identified seven general effects of roads. Some of these include modified animal behavior, such as altered reproductive rates and displacement, changes in physical geography, such as changes in surface runoff, erosion and sedimentation which effect aquatic and terrestrial animals, changes in populations due to direct kills, the spread of exotic species and increases in human ecological impacts.

Effects of roads can be immediate and localized or long-term and geographically widespread. Roads negatively impact a wide-variety of species but these impacts may not be noticed for eight to thirty years after the road has been built (Findlay and Bourdages 2000, Findlay and Houlahan 1997). In the long-term, roads tend to favor some species and discourage others, which can lead to a changes in species composition of ecosystems (Forman and Alexander 1998). Intricately connected to roads are the vehicles that travel them. Noise from vehicles has been shown to disturb wildlife, leading to relocation of wildlife populations (U.S. EPA 1971).

Roads often facilitate the dispersal of exotic species. Forcella and Harvey (1983) surveyed exotic species in Montana and related their abundance to frequency of road use. Parendes and Jones (2000) describe similar results, showing a higher abundance of exotic species along high and low use roads than abandoned roads. Many species such as spotted knapweed not only take advantage of the disturbed ground found alongside roadways, but are also dispersed by tires, mud and crevices in the undercarriage of vehicles (Marcus et al. 1998). Roads also affect the distribution and occurrence of insect species such as gypsy moths and tent caterpillars (Bellinger et al. 1989, Roland 1993).

Roads impact wildlife in a variety of ways. Animals die in collisions with vehicles, change behavior to avoid disturbance, possibly abandoning preferred habitats. Roads spread noxious weeds, which displace native forage. Roads consume land so there is less range for animals to use. Roads also fragment habitat by breaking it up into smaller and smaller units of secure habitat (Thomson et al 2005).

To summarize from Trombulak and Frissell (2000), roads cause the following impacts:

Mortality from road construction. The actual construction of a road, from clearing to paving, will often result in the death of any sessile or slow-moving organisms in the path of the road. Obviously, vegetation will be removed, as well as any organisms living in that vegetation.

Mortality from collisions with vehicles. Road kill is the greatest directly human-caused source of wildlife mortality throughout the U.S. More than a million vertebrates are killed on our roadways every day.

Modification of animal behavior. The presence of a road may cause wildlife to shift home ranges, and alter their movement pattern, reproductive behavior, escape response and physiological state. When roads act as barriers to movement, they also bar gene flow where individuals are reluctant to cross for breeding.

Alteration of the physical environment. A road transforms the physical conditions on and adjacent to it, creating edge effects with consequences that extend beyond the white lines. Roads alter the following physical characteristics of the environment:

- Soil density - Soil becomes compacted and remains so long after a road is in use.
- Temperature - Dark pavement absorbs radiant heat and releases it at night, creating a "heat island" around roads. This can attract heat-seeking species such as birds and snakes to roads, increasing their mortality by vehicle collision.
- Soil water content - Porosity of soil is reduced, allowing for less absorption of water.
- Dust - Passing cars will stir up dust from the road. Dust will settle on nearby plants, blocking photosynthesis. Amphibians are also affected by traffic dust.
- Pattern of run-off - Roads are often built with parallel ditching, which diverts rainwater run-off along roadways, rather than the natural flow pattern.

Alteration of the chemical environment. Maintenance and use of roads contribute at least five different general classes of chemicals to the environment:

- Heavy metals - gasoline additives.
- Salt - de-icing.
- Organic molecules - dioxins, hydrocarbons.
- Ozone - produced by vehicles.
- Nutrients – nitrogen.

Spread of exotics. Roads provide opportunities for invasive species by:

- providing habitat by altering conditions;
- stressing or removing native species; and
- allowing easier movement by wild or human vectors.

Increased use of areas by humans. Roads facilitate increased human access to formerly remote areas. In addition to the disturbance and pollution often associated with roads, roads increase the likelihood of additional, unplanned activities in the area.

Increased potential for additional development. Building and improving roads on the INL can provide a conduit for additional development along this new corridor increasing the impacts associated with habitat fragmentation, transportation, and facility development. Increased development also amplifies all aspects of human activity providing an additional source of adverse impacts to habitat, plants and wildlife.

1.3.2 Effects of roads on individual species

While the effects of roads and vehicles are wide-ranging, many of the scientific studies conducted have dealt with their effects on single populations. The effects of roads on wildlife range from extremely detrimental to neutral to beneficial.

Ungulates have varying levels of tolerance to roads. While elk and deer can adapt fairly well to busy highways, roads with continuous, slow moving traffic caused displacement and changes in range use (Burbridge and Neff 1976, Gruell et al. 1976, Edge and Marcum 1991). While larger animals tend to be displaced by roads, smaller animals tend to suffer different effects. Because smaller animals are less noticeable and slower-moving, direct kills from motorized vehicles are extremely common. For example, kills of desert tortoises and rattlesnakes by motorized vehicles are significant (Bury 1978, Berish 1998). In addition, even small roads block movement of small animals and populations are more easily cut off from each other (herpetofauna- DeMaynadier and Hunter 2000, DeMaynadier and Hunter 1995; small rodents- Oxley, et al. 1974, Wilkins 1982).

Birds are often used as indicators of ecological health due to the prominence of population records. Many studies have linked declines in bird populations to habitat fragmentation caused by roads (Keyser et al, 1997, Jones, et al. 2000, Boren 1999). Roads displace certain species of birds while attracting others (Kuitunen et al. 1998). For example, raptors may benefit from roads as they provide good hunting habitat (Dijak and Thompson 2000).

Some effects of roads such as soil compaction, changes in composition due to imported road surfaces, disturbed ground, and exhaust emissions and dustings greatly affect soil organisms. Haskell (2000) examined the occurrence of macroinvertebrates essential to soil nutrition processes and found them to decrease in areas adjacent to roads.

Mychorrhizae and other soil organisms eliminated through soil compaction are essential for protection against pathogens, and nutrient and water uptake (Amaranthus and Perry 1994). Changes at the soil community level are extremely important because they cause changes in essential processes that can propagate throughout an ecosystem, eventually altering other animal and plant communities. For example, changes in soil compaction, composition and soil flora and fauna have been shown to contribute to the alteration of plant communities alongside roads (Angold 1997, Sharifi et al. 1999, Adams et al. 1982).

1.3.3 Effects of roads on abiotic functioning of ecosystems

As noted above, roads can significantly affect abiotic processes in ecosystems. Roads can cause changes to soil structure, aridity, erosion, and hydrology. Road construction often results in an increase in surface water flows that can lead to erosion of soil surfaces (Harr et al. 1975, Jones et al. 2000, Jones and Grant 1996).

1.4 Survey Methods

The two proposed alternative routes were surveyed for ecological resources from September 26 through October 4, 2005. For purposes of the survey, each route was divided into segments 400 m (0.25 miles) in length. The surveys covered a band approximately 35 m (120 ft) wide centered on the existing unimproved roadways. Surveys were conducted by five people spread evenly across the band. Vegetation community classes were determined in plots separated by 400 m (0.24 mi). More details on this sampling are given below.

2.0 Affected Environment

2.1 Vegetation Communities

Plant community descriptions for this ecological review were derived primarily from three sources that describe distinct community types encompassed within the larger, more general sagebrush steppe ecosystem on the INL. The references used to describe vegetation classes within the affected environment include the *INEEL Sagebrush Steppe Ecosystem Reserve Management Plan* (BLM 2003), *Plant Communities, Ethnoecology, and Flora of the Idaho National Engineering Laboratory* by Anderson et al. (1996), and *Vegetation Types and Surface Soils of the Idaho National Engineering Laboratory Site* by McBride et al. (1978). Plant community descriptions from the sources listed above were tailored to the vegetation communities that may be affected by the alternatives proposed in this EIS using vegetation data collected in September and October 2005.

Vegetation plots were sampled approximately every 400 m along East Powerline road and T-24. Plots were located on the south side of the road, with the closest edge of the plot about 10m from the road. One thousand square meters were surveyed in each circular plot for a complete species list and a rank of each species' importance within the plant community. The species ranking system used for this survey is shown in Table 1.

Table 1. Ranking system used for vegetation plot surveys.

Rank	Description
1	Dominant or co-dominant.
2	Abundant; comprising a substantial portion of live plant cover, but not dominant.
3	Common; easily found but not contributing a large portion of plant cover.
4	Rare, only a few individuals found within the plot.

A complete list of the species encountered within the plots surveyed can be found in Appendix A. Species nomenclature follows the National PLANTS Database (USDA – NRCS 2005).

Between both proposed routes, eight vegetation classes were described. Vegetation classes were based primarily on dominant and co-dominant species within each plot. Each of the eight vegetation classes is described below.

2.1.1 Vegetation Class Descriptions

Sagebrush Steppe. Sagebrush steppe communities in the surveyed area are generally dominated by Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*); however, they are occasionally dominated by Basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*), and may even be co-dominated by both subspecies. Communities dominated by Basin big sagebrush often occur as patches within extensive stands of Wyoming big sagebrush. The distribution and abundance of these two subspecies is related to soil depth and texture. Basin big sagebrush tends to dominate on deep, well drained, sandy soils, such as soils found on the lee side of lava ridges where sand accumulates. Conversely, Wyoming big sagebrush tends to dominate on fine-textured shallow soils. Native perennial grasses are typically more abundant in the understory of communities dominated by Wyoming big sagebrush than they are in the understory of communities dominated by Basin big sagebrush. Cheatgrass (*Bromus tectorum*) may be common in the understory of Basin big sagebrush stands, but tends to be quite rare in the understory of Wyoming big sagebrush stands. Aside from differences in grass abundance, communities dominated by either subspecies of big sagebrush can have similar understory species compositions. Common understory grasses include bottlebrush squirreltail (*Elymus elymoides*), Sandberg bluegrass (*Poa secunda*), thick-spiked wheatgrass (*Elymus lanceolatus*), and Indian ricegrass (*Achnatherum hymenoides*). Bluebunch wheatgrass (*Pascopyrum spicata*) is abundant in the undestrory of relatively higher elevation plots, especially along East Powerline road, and needle-and-thread grass (*Hesperostipa comata*)is abundant in lower elevation plots with sandy soils, especially along T-24. Green rabbitbrush (*Chrysothamnus viscidiflorus*), prickly phlox (*Leptodactylon pungens*), spineless horsebrush (*Tetradymia canescens*), and spiny hopsage (*Grayia spinosa*) are frequently occurring shrubs within the sagebrush steppe community type. Broom snakeweed (*Gutierrezia sarothrae*) and dwarf goldenbush (*Ericameria nana*) are locally abundant on basalt outcroppings. Shadscale (*Atriplex confertifolia*) may also occur occasionally in low densities. Pricklypear (*Opuntia polyacantha*) may be locally abundant, and common forbs include Hood's phlox (*Phlox hoodii*), Douglas' dustymaiden (*Chaenactis douglasii*), tapertip hawksbeard (*Crepis acuminata*), freckled milkvetch (*Astragalus lentiginosus*), fernleaf biscuitroot (*Lomatium dissectum*), and hoary aster (*Machaeranthera canescens*).

Sagebrush/Rabbitbrush. Co-dominated by green rabbitbrush and Wyoming big sagebrush, these communities can have a species rich understory of perennial grasses and forbs. Winterfat (*Krascheninnikovia lanata*) occurs occasionally within this vegetation type, and spineless horsebrush occasionally becomes locally abundant. Common grasses in this community type include needle-and-thread grass, thick-spiked wheatgrass and bottlebrush squirreltail. Great Basin wildrye (*Leymus cinerus*) may be locally abundant, and Indian ricegrass occurs regularly, but usually in low densities. Forbs that frequently occur in sagebrush/rabbitbrush communities include Hood's phlox, ballhead gilia (*Ipomopsis congesta*), Wilcox's woollystar (*Eriastrum wilcoxii*), hoary aster, and Douglas' dustymaiden.

Sagebrush/Saltbush. This vegetation class represents communities in which sagebrush species dominate and salt desert shrub species are ubiquitous. This community differs from the sagebrush steppe vegetation class because of the relatively high abundance of salt desert shrub species. Shadscale is the most common salt desert shrub species in this vegetation class. Rabbitbrush is also quite abundant within this community type. Bottlebrush squirreltail is the most abundant understory grass, Indian ricegrass is nearly always present within this community, and needle-and-thread grass and may be locally abundant. Common forbs include tapertip hawksbeard, Hood's phlox, and Douglas' dustymaiden.

Rabbitbrush. Communities within this vegetation class are dominated by rabbitbrush and contain little, if any, sagebrush. Nearly all of the plots within this vegetation class have burned within the last ten years. Other resprouting shrubs such as winterfat and spineless horsebrush occur occasionally in this vegetation type. Along East Powerline road, these communities are often co-dominated by bluebunch wheatgrass. Bottlebrush squirreltail, Sandberg bluegrass, basin wildrye, needle-and-thread grass, and western wheatgrass (*Pascopyrum smithii*) occasionally co-dominated plots within this vegetation type along both roads. Forbs common to these communities include Hood's phlox, hoary aster, shaggy fleabane (*Erigeron pumilus*), Douglas' dustymaiden, tapertip hawksbeard, and ballhead gilia.

Rabbitbrush/Saltbush. Rabbitbrush/Saltbush communities are co-dominated by green rabbitbrush and shadscale saltbush. Only one survey plot occurred within this vegetation class and it had burned within the previous ten years. Native grasses are very abundant within this community and included bottlebrush squirreltail, bluebunch wheatgrass, and Sandberg bluegrass. Tapertip hawksbeard, shaggy fleabane, western tansymustard (*Descurainia pinnata*), and Hood's phlox are forbs common to this vegetation class. Sagebrush occurred in the survey plot within this community type, but at very low densities.

Native Grasslands. Communities within this vegetation class may vary considerably by species composition; however, they are all dominated by perennial grasses. Native grassland communities may be dominated by rhizomatous species, bunchgrasses, or a combination of both. Thick-spiked wheatgrass and western wheatgrass are common dominant rhizomatous species. Bunchgrass species that may dominant or co-dominate grasslands include Great Basin wildrye and bluebunch wheatgrass. Additional grass species such as, bottlebrush squirreltail, Sandberg bluegrass, needle-and-thread grass, and Indian ricegrass are also abundant, but not dominant, in native grassland communities within the affected area. All of the grassland communities within the affected environment of the road alternatives proposed in this EIS had burned within the last ten years.

Shrubs often occur within grassland communities; however, shrub cover is generally sparse. Shrub species that frequently occur within this vegetation class include Wyoming big sagebrush, Basin big sagebrush, green rabbitbrush, and prickly phlox. Spineless horsebrush and shrubby buckwheat (*Eriogonum microthecum*) may also occur sporadically within grassland communities. Pricklypear is often locally abundant. Forbs that typically occur in grasslands include white-stemmed globe-mallow (S*phaeralcea munroana*), whitestem blazingstar (*Mentzelia albicaulis*), western tansymustard, and western stickseed (*Lappula occidentalis*).

Crested Wheatgrass. Crested wheatgrass (*Agropyron cristatum*) communities are strongly dominated by crested wheatgrass. Some of the plots within crested wheatgrass vegetation class were planted and others are the result of crested wheatgrass invasion into other community types. Low species richness is a characteristic very typical of these communities. Green rabbitbrush and sagebrush may be locally abundant, but the presence of native grass species is rare. Forbs are generally restricted to weedy annuals such as, flatspine stickseed and desert cryptantha (*Cryptantha scoparia*). Native, perennial forbs that occasionally occur in low densities within this vegetation class include Hood's phlox and tapertip hawksbeard.

Annual/Playas/Disturbed Areas. These areas have experienced a great deal of past hydrologic disturbance due to flooding, or soil disturbance associated with wildland fire control measures. Communities within this vegetation type are dominated by annual species including introduced annuals such as tall tumblemustard (*Sisymbrium altissimum*), herb sophia (*Descurainia sophia*), cheatgrass, or native annuals such as western tansymustard. As with crested wheatgrass communities, this vegetation type is characterized by a lack of native grasses. However, these communities do tend to have a relatively diverse compliment of native forbs. Common native forbs in these communities include Douglas' dustymaiden, tapertip hawksbeard, and hoary aster. Low stature shrubs like prickly phlox and broom snakeweed may also be locally abundant in communities within this vegetation class.

2.1.2 Summary Statistics for Vegetation Classes

The distribution of plots within each of the vegetation classes along the proposed routes is shown in Figure 2. The distribution of community type among the plots is more homogenous along East Powerline road than along T-24. The relative heterogeneity of plot distribution along T-24 is likely due to greater fine scale variation in abiotic factors such as slope and aspect. The number of plots within each vegetation class is similar between roads with the exception of the Annuals/Playas/Disturbed Areas vegetation class (Table 2). Plots in this vegetation class were relatively more abundant along T-24 due to the presence of numerous low-lying basins, playas, and channels that periodically fill with water.

The average percentage of plots along each route in which any single species dominated or co-dominated was substantially different for several species between the routes. For example, green rabbitbrush was dominant or co-dominant on 55 percent of the plots on East Powerline road and was dominant or co-dominant on only 40 percent of the plots on T-24. Similarly, needle-and-thread grass was a co-dominant in 20 percent of the plots along T-24, but was not a dominant or co-dominant in any of the plots along East

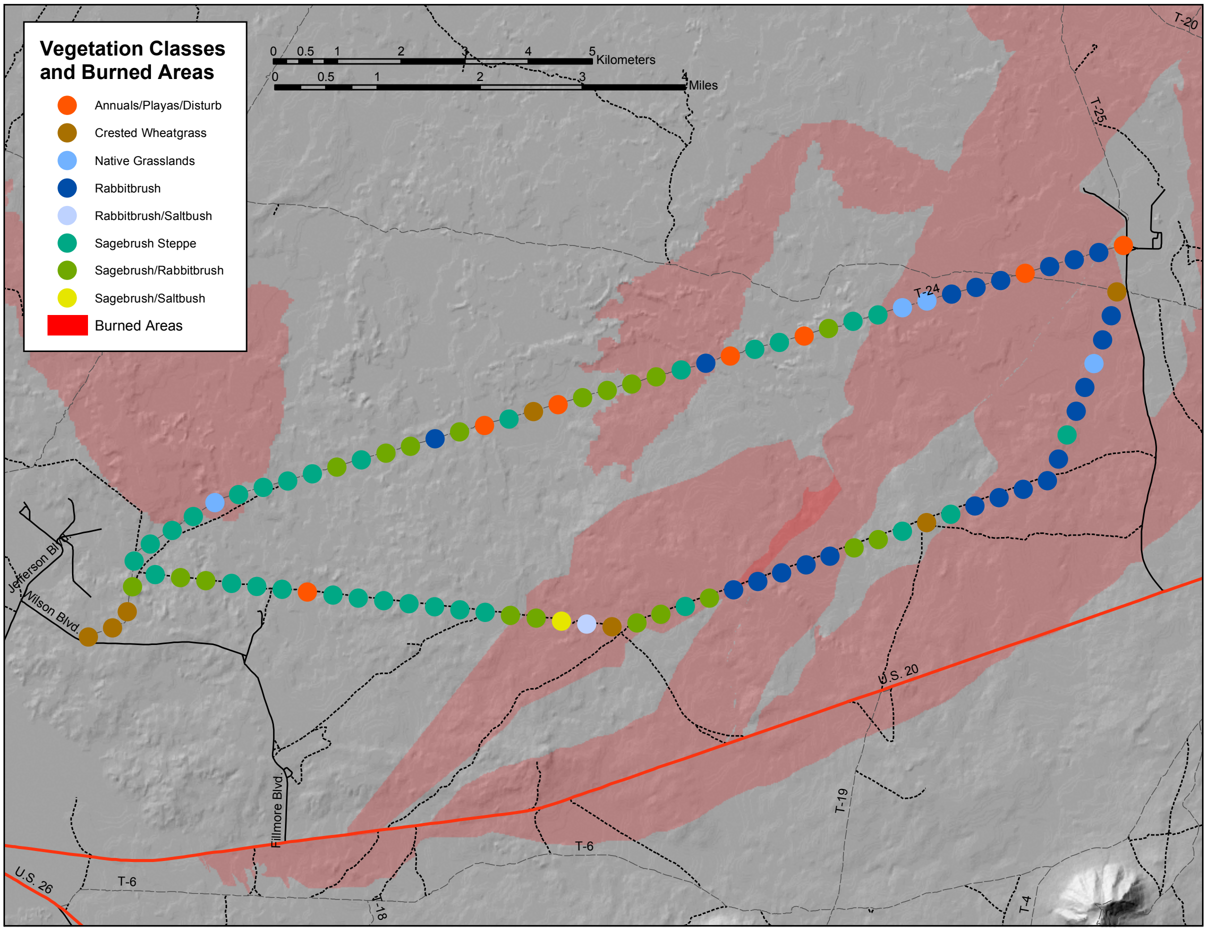

Figure 2. Vegetation classes for each of the plots surveyed.

Table 2. The number of plots in each vegetation class.

Plant Communities	East Powerline	T-24
Sagebrush Steppe	15	15
Sagebrush/Rabbitbrush	9	9
Sagebrush/Saltbush	1	0
Rabbitbrush	14	8
Rabbitbrush/Saltbush	1	0
Native Grasslands	1	3
Crested Wheatgrass	3	1
Annuals/Playas/Disturbed Areas	1	6
Total	45	42

Powerline road; instead, bluebunch wheatgrass was a key species in over 20 percent of the plots along that route. However, some species such as sagebrush dominated or co-dominated nearly the same proportion of plots along each route (Figure 3).

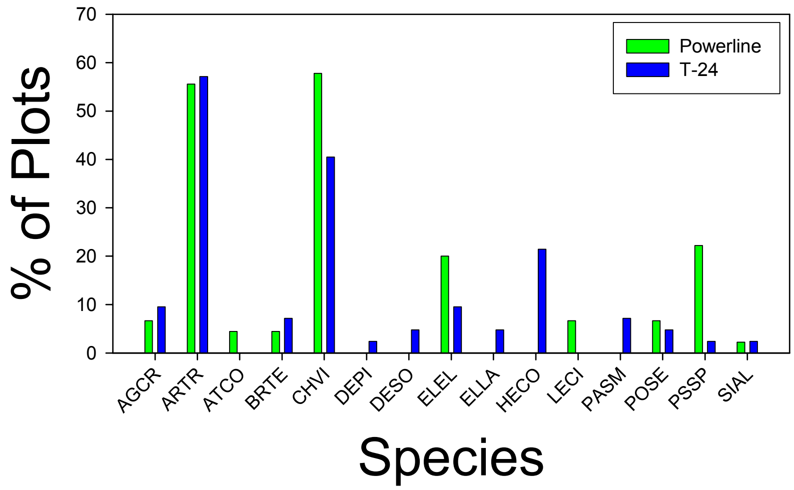

Figure 3. Percentage of plots in which each species was a dominant or co-dominant (see Appendix A for key to species codes).

Species richness was, on average, five species per plot greater on T-24 than on East Powerline road. The difference is statistically significant (Students T test, $P < 0.001$). Higher species richness in plots along T-24 was largely due to greater native perennial forb diversity, indicating that the ecological condition of communities along T-24 is better than ecological condition of plant communities along East Powerline road. Species richness of introduced annual species in plots along T-24 was similar to introduced annual species richness in plots along East Powerline road, and thus, doesn't contribute greatly to differences in total species richness between the routes. The average number of noxious weeds species per plot was also higher on T-24 than along East Powerline road; however, that number is quite low overall, and didn't contribute substantially to total species richness in any of the plots (Table 3). In general greater species richness in plots along T-24 is likely to due greater heterogeneity among plots along that route, as discussed above.

Table 3. Average species richness, number of native perennial forb species, number of introduced annual species, and number of noxious weed species per plot along each proposed route.

	East Powerline	T-24
Species Richness	19.04	24.21
# of Native Perennial Forbs	4.47	6.93
# of Introduced Annuals	2.36	2.81
# of Noxious Weeds	0.02	0.07

Because the survey was conducted in September and October, the detectibility of several species was likely quite low. When compared to similar surveys in similar plant communities conducted in June (Blew et al. 2004), we estimated that about 90 percent of the perennial plant species were detected and about 75 percent of the annual species were detected in the surveys conducted for this report. Perennial species that were difficult to detect included, but were not limited to, desert biscuitroot (*Lomatium foeniculaceum*), shaggy fleabane (*Erigeron pumilus*), woollypod milkvetch (*Astragalus purshii*), and white-stemmed globe-mallow. Annual plants that were difficult to detect included, but were not limited to, sticky phacelia (*Phacelia glandulifera*), sand gilia (*Gilia leptomeria*), narrowleaf goosefoot (*Chenopodium leptophyllum*), spreading groundsmoke (*Gayophytum diffusum*), and Wilcox's woollystar. Therefore species richness, especially of native annuals, was likely greatly underestimated in these surveys.

Vegetation plots were sampled upwind of existing roads in order to determine the abundance and distribution of potentially affected plant communities without bias to the effects of the current road. Additionally, vegetation community classes within any given plot cannot by extrapolated to surrounding areas because of the inherent spatial heterogeneity of plant communities on the INL.

2.2 Soils

The soils along the proposed routes include three general soil groups (Figure 4). These three groups are generally described as Sands, Sands Over Basalt and Loess (Olson et al 1995). In the areas that include the proposed alternative routes, Olson et al (1995) mapped the Sands as the Grassy Butte series, Sands Over Basalt as the Malm-Bondfarm-Matheson Complex (M-B-M) and the Loess soils as the Coffee-Nargon-Atom Complex (C-N-A).

Thirty-one percent of the T-24 route is in C-N-A, 64 percent in M-B-M and 4 percent in Grassy Butte. East Powerline road is 82 percent in C-N-A, 15 percent in M-B-M and 3 percent in Grassy Butte. East Powerline road with Shortcut to ARA is all within C-N-A.

The C-N-A mapping units include 30 percent Coffee, 30 percent Nargon, 15 percent Atom and 25 percent contrasting inclusions. These soils are primarily loams and silt loams, and are deep to very deep to bedrock. The contrasting inclusions are likely basalt outcrops. Olson et al (1995) lists potential natural vegetation for these soils as dominated by Wyoming big sagebrush. Rangeland improvement is limited by available water holding capacity. Hazard of wind erosion is slight.

Characteristics of the Grassy Butte soils include: 1) very deep, well drained to somewhat excessively drained sands, 2) sands are wind deposited, 3) the soils are calcareous throughout their depth and have a lime accumulation beginning at 10 to 19 inches deep, and 4) the hazard of soil blowing (wind erosion) is very high.

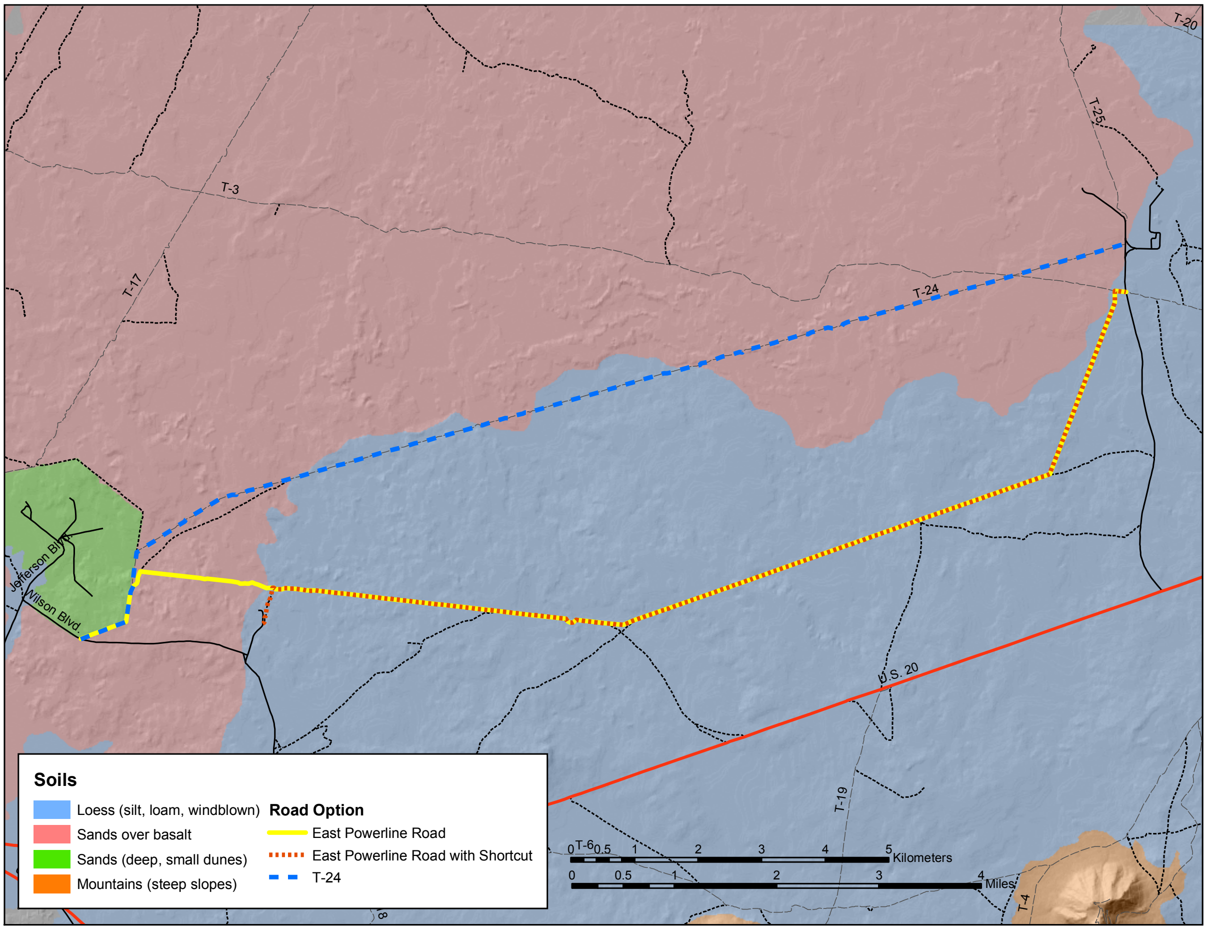

Figure 4. Soils map for the area surrounding the proposed routes for new road.

The very high hazard of soil blowing imparts certain limitations to use of these soils (Olson et al, 1995). They are not suited to mechanical rangeland management treatments including seeding. These soils are classified as Capability Class VIIe (Very severe limitations that make them unsuitable for cultivation or range improvement [revegetation] due to erosion). Crop seedings require replanting of close grown crops every other year on the Grassy Butte soil. This suggests poor suitability for rangeland drill seeding.

The M-B-M mapping units include about 60 percent Malm, 20 percent Bondfarm, 15 percent Matheson and 5 percent contrasting inclusions (Olson et al 1995). The contrasting inclusions are rock outcrops. The soils that make up the M-B-M complex are primarily sandy loams. Olson et al (1995) lists potential dominant vegetation for the Malm and Bondfarm soils as Wyoming big sagebrush and bluebunch wheatgrass, and for the Matheson soil as basin big sagebrush and bluebunch wheatgrass. Olsen et al (1995) does allow for Indian ricegrass as a potential co-dominant with basin big sagebrush on the Matheson soils.

Our observations in the field survey suggest that the portions of T-24 that are in the areas mapped as M-B-M have as their dominant grass needle-and-thread rather than bluebunch. This suggests that these areas may be more like the Grassy Butte or Matheson-Grassy Butte Complex (Olson et al 1995). Olson et al (1995) describes the range site for Matheson in the Matheson-Grassy Butte complex as basin big sagebrush, Indian ricegrass and needle-and-thread. Note that the “Sands” soil group (Figure 4) is mapped coincident with the fence at PBF. The mapping inside the fence was done at a finer scale than outside the fence (Olson et al 1995), but similar to the scale of the vegetation surveys conducted for this study. Much of the same sort of landscape position (slope and aspect) found at PBF also occurs along the T-24 route giving further support for the consideration that much of the soil in the M-B-M complex along T-24 may actually include conditions more like Grassy Butte or Matheson-Grassy Butte complex. Those conditions include high to severe risk of wind erosion and poor suitability for rangeland drill seeding. Our observations at the INL suggest that these sand soils are quite susceptible to invasion by cheatgrass and other non-native annual plants.

The interpretation of soils as they relate to the proposed road alternatives is limited because of the scale at which the soil survey and mapping were conducted. To better understand the role of soil in addressing the ecological impacts of the proposed road alternatives, more detailed mapping of these areas is required.

2.3 Invasive and Non-Native Species

A total of eleven Idaho Noxious Weeds have been identified on the INL. Of those, only musk thistle (*Carduus nutans*) and Canada thistle (*Cirsium arvense*) presently occur in the projected road corridors. In a literature survey, Pyke (1999) identified 46 exotic species that are weeds capable of invading sagebrush steppe ecosystems, with as many as 20 of these classed as highly invasive and competitive. Other significant non-native and/or invasive plants found on or near the proposed road corridors include cheatgrass (*Bromus tectorum*), Russian thistle (*Salsola kali*), halogeton (*Halogeton glomeratus*), tumble mustard (*Sysimbrium altissimum*) and crested wheatgrass (*Agropyron cristatum*, *A. desertorum*, *A. sibericum*).

Musk thistle and Canada thistle are both very common noxious weeds on the INL. Canada thistle appeared only once in the survey, along the East Powerline road. Canada thistle is extremely difficult to control in that it reproduces from both seed and rootstock (Sheley and Petroff 1999). Musk thistle is more readily controlled, but requires persistent management. Musk thistle is present on 33 percent of East Powerline road segments. It occurs on 62 percent of T-24 road segments.

Non-native species also present a challenge in disturbed areas. They establish very quickly and successfully compete with the native species. Cheatgrass is present on 98 percent of both the East Powerline road segments and T-24 segments. Halogeton is present on 98 percent of East Powerline road segments, but on only 64 percent of T-24 segments. These non-native annual species are very quick to colonize any new disturbance and are very difficult to eradicate once they are present. Most non-native annuals produce large amounts of seed every year and the seeds remain viable for long periods of time.

Although only two noxious weed species were found in this survey, it is possible that others were present in the survey corridor. Due to the time frame of the survey, many plants had already senesced. For example, it would be very easy to miss the knapweeds. Dry, dead knapweeds could easily resemble native asters. Because the surveys were conducted so late in the year, it is not possible to guarantee other noxious weed species are not present in the project area.

2.4 Sensitive Plant Species

A list of the sensitive plant species that have the potential to occur within the area affected by an upgrade of either the East Powerline road or T-24 was compiled using data from the Idaho CDC (2005). All sensitive species known to occur in Butte, Custer, Jefferson, Bonneville and Bingham counties were considered. Species with habitat requirements similar to the conditions occurring around the affected area were included in the list. Sensitive species that were not included in the list were discounted because the habitat around the affected area was not suitable due to topography, soils, or climate. Both vegetation plots (see Section 2.1) and road survey segments (see Section 1.3) were surveyed for the six species in the potentially occurring sensitive species list. Table 4 lists sensitive plant species for which suitable habitat is present on or around the affected area.

None of the species considered to potentially occur in the area affected by an upgrade of either road were confirmed to be present.

Table 4. Sensitive species potentially occurring in the area affected by an upgrade of either the East Powerline road or T-24 and appropriate State of Idaho, U.S. Forest Service Region 4, and/or Bureau of Land Management Ranking.

Scientific Name	Common Name	State	USFS Reg. 4	BLM
Astragalus aquilonius	Lemhi milkvetch	GP3	S	TYPE 2
Astragalus diversifolius	meadow milkvetch	GP2	S	TYPE 3
Camissonia pterosperma	wing-seeded evening-primrose	S		TYPE 4
Catapyrenium congestum	earth lichen			S
Eriogonum capistratum Rev. var. *welshii* Rev.	Welsh's buckwheat	GP2	S	TYPE 3
Ipomopsis polycladon	spreading gilia	2		TYPE 3

The surveys for sensitive plants were conducted after the growing season; therefore, it would have been difficult to identify some of the species that senesce by early summer such as wing-seeded evening primrose (*Camissonia pterosperma*) and spreading gilia (*Ipomopsis polycladon*). We assumed that all of the potentially occurring sensitive species were contained in the sensitive species list for at least one of the counties listed above.

2.5 Ethnobotany

Vegetation plot data collected along the east powerline road and T-24 (see Section 2.1) were analyzed for the frequency of occurrence of several species of ethnobotanical concern. A list of species thought to be of historical importance to local tribes was compiled from Plant Communities, Ethnoecology, and Flora of the Idaho National Engineering Laboratory by Anderson et al. (1996). The list included those species documented to have been used by "indigenous groups of the eastern Snake River Plain," (Anderson et al. 1996). Table 5 lists those species of ethnobotanical concern observed in the vegetation survey plots.

Table 5. List of species of ethnobotanical concern occurring on vegetation plots surveyed in the affected area of the proposed road upgrades.

Current Scientific Name	Common Name	Uses
Achnatherum hymenoides	Indian ricegrass	food
Allium acuminatum	tapertip onion	food, medicine, flavoring, dye
Allium textile	textile onion	food, medicine, flavoring, dye
Artemisia tripartita	threetip sagebrush	food, medicine, cordage, clothing, shelter, fuel, dye
Artemisia tridentata	big sagebrush	food, medicine, cordage, clothing, shelter, fuel, dye
Calochortus bruneaunis	Bruneau mariposa lily	food
Chenopodium leptophyllum	narrowleaf goosefoot	food
Chrysothamnus viscidiflorus	green rabbitbrush	medicine, gum
Cirsium arvense	Canada thistle	food
Delphinium andersonii	Anderson's larkspur	medicine, dye
Descurainia pinnata	western tansymustard	food, medicine
Descurainia sophia	herb sophia	food, medicine
Ericameria nauseosus	rubber rabbitbrush	medicine, gum
Lappula occidentalis	flatspine stickseed	food
Leymus cinerus	basin wildrye	food, manufacture
Lomatium dissectum	fernleaf biscuitroot	food, medicine
Lomatium foeniculaceum	desert biscuitroot	food, medicine
Opuntia polyacantha	pricklypear	food
Poa secunda	Sandberg bluegrass	food, medicine
Salsola kali	Russian thistle	food

The frequency of species occurrence in plots along either the East Powerline road or T-24 was similar for many of the most common species such as Indian ricegrass, big sagebrush, green rabbitbrush, and flatspine stickseed. One commonly occurring species, basin wildrye, occurred much more frequently in plots along the East Powerline road than along T-24. Substantial differences in frequency of occurrence between roads were apparent for less common species such as textile onion, fernleaf biscuitroot, and narrowleaf goosefoot (Table 6).

Because the surveys were conducted late in the growing season the detectability of several of the species of ethnobotanical concern was quite low. For example, both of the onion species are highly desirable forage for small mammals and were likely heavily grazed in June and July, making them difficult to survey in October. From vegetation sampling conducted in June and July in similar plant communities elsewhere on the INL (Blew et al. 2004), we know that desert biscuitroot occurs much more frequently than we detected it on this survey, leading us to conclude that it senesces early in the season and doesn't leave a distinct skeleton, making it difficult to detect. Other species of ethnobotanical concern which are difficult to detect late in the growing season include Bruneau mariposa lily and Anderson's larkspur. Also, we assumed that the list we compiled contained all species of ethnobotanical significance.

Table 6. Frequency of occurrence (as a percentage) of species of ethnobotanical interest in vegetation survey plot along the East Powerline road and T-24.

Current Scientific Name	Powerline	T-24
Achnatherum hymenoides	82.22	78.57
Allium acuminatum	0.00	2.38
Allium textile	0.00	14.29
Artemisia tripartita	6.67	0.00
Artemisia tridentata	84.44	78.57
Calochortus bruneaunis	2.22	0.00
Chenopodium leptophyllum	33.33	16.67
Chrysothamnus viscidiflorus	97.78	97.62
Cirsium arvense	2.22	0.00
Delphinium andersonii	8.89	4.76
Descurainia pinnata	82.22	69.05
Descurainia sophia	37.78	47.62
Ericameria nauseosus	11.11	16.67
Lappula occidentalis	57.78	59.52
Leymus cinerus	62.22	23.81
Lomatium dissectum	6.67	19.05
Lomatium foeniculaceum	2.22	0.00
Opuntia polyacantha	64.44	57.14
Poa secunda	82.22	71.43
Salsola kali	11.11	4.76

2.6 *Hydrography*

Several ephemeral streams intersect the proposed routes. None of these have any riparian habitat associated with them. Most of them likely carry water in only the wettest of years and probably only associated with spring run-off, a rain-on-snow event, or a significant rainstorm. Nearly all of these streams are small in size. However, T-24 crosses one ephemeral stream that is substantial and will likely require a bridge or substantial culvert. None of these streams are gauged and no information about discharge rates is known to be available.

The proposed routes also cross several basins that likely hold substantial run-off associated with the type of events listed above for ephemeral streams. These basins may contain sagebrush steppe, Great Basin wildrye or by annual species depending on the periodicity and duration of flooding. Large basins are intersected by all proposed routes.

2.7 Wildlife Use

Scientists on the INL have been collecting wildlife data for more than 30 years and have recorded a total of 219 vertebrate species (Reynolds et al. 1986) occurring on the INL, many of which are directly associated with sagebrush steppe habitat. Species that permanently reside within the alternative areas (i.e., East Powerline road, T-24) include small and medium sized mammals [bushy-tailed woodrat (*Neotoma cinerea*), Ord's kangaroo rat (*Dipodomys ordii*), pygmy rabbit (*Brachylagus idahoensis*), black-tail jackrabbit (*Lepus californicus*), long-tailed weasel (*Mustela frenata*), badger (*Taxidea taxus*)], and reptiles [sage brush lizard (*Sceloporus graciosus*) and gopher snake (*Pituophis catenifer*)]. Such species have small home ranges, limited mobility, or a social structure that restricts movements. With the exception of pygmy rabbit, each of these species can be found in both sagebrush and grassland habitats. Birds [horned lark (*Eremophila alpestris*), sage sparrow (*Amphispiza bilineata*), rough-legged hawk (*Buteo lagopus*), and red-tailed hawk (*Buteo jamaicensis*)] and large mammals [elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), and pronghorn antelope (*Antilocapra Americana*)] use the area in a seasonal transitory manner.

Wildlife species of concern addressed in this report include all migratory birds (including sage grouse and raptors), pygmy rabbits, Great Basin rattlesnakes, and all large mammal species.

Birds. Most avian species occupying the INL use both sagebrush and grassland habitats from a few days for feeding and resting during migration to several months for breeding and raising young. Many bird species utilize specific habitats for foraging and reproduction. Species that primarily use sagebrush include the greater sage grouse (*Centrocercus urophasianus*), sage sparrow, Brewer's sparrow (*Spizella breweri*), sage thrasher (*Oreoscoptes montanus*), and loggerhead shrike (*Lanius ludovicianus*). Species that occur mainly in grassland habitats include horned lark, western meadowlark (*Sturnella neglecta*), vesper sparrow (*Pooecetes gramineus*), and grasshopper sparrow (*Ammodramus bairdii*). Although most raptors use the site indiscriminately for foraging, nesting structures are a limiting factor in population abundance and species diversity.

T-24 and the East Powerline Road were searched for nests to determine which species might be present during the breeding season. Due to low detectability (cryptic nests and multiple search images), observer bias and the season the survey was conducted, it is likely that not all nests in the areas were located. Nests most commonly observed in both alternative areas were Brewer's sparrow, sage sparrow, and sage thrasher. Ninety-eight percent of all nests located were in sagebrush. Due to the season in which the survey was conducted, no ground nesting bird nests were located. If a more accurate assessment of birds that nest in both sagebrush and grassland habitats is desired, surveys should be conducted during June when peak nesting activities occur.

Breeding and wintering habitats for sage grouse occur within the proposed alternative areas. Although both are important to the survival of sage grouse, breeding habitats have become a focal point for managing this species. Lyon (2000) estimated the average nest distances to the nearest lek varies from 1.1 to 6.2 km (3.9-0.6 mi) but may be as great as 20 km (12.5 mi). The current sage grouse guidelines indicate that all sagebrush habitats within 3.2 km (2 mi) of occupied leks be protected (Connelly et al. 2000).

East Powerline. Bird species observed during the survey were western meadowlark, white-crowned sparrow (*Zonotrichia albicollis*), sage thrasher, horned lark, sage sparrow and mourning dove (*Zenaida macroura*). Due to the season (autumn) that these surveys were conducted, no active nests were found. It is likely the birds observed were migrating through to wintering areas farther south. Twenty-nine bird nests were located on the power line road (Table 7). Nests were identified as sage sparrow or Brewer's sparrow, sage thrasher, and loggerhead shrike. Although few signs of sage grouse using the area were located, historical records show that approximately 8.3 kilometers (5.1 miles) of the East Powerline Road are within 3.2 km (2 mi) of sage grouse leks (Figure 5).

Power poles provide artificial habitat for species such as raptors. Raptors rely on perching structures for nesting, hunting and resting. Although no raptor nests were observed on power poles that run adjacent to the road, several species were observed using the poles for resting and hunting. Raptors observed during this survey include Swainson's hawk (*Buteo swainsoni*), red-tailed hawk, ferruginous hawk (*Buteo regalis*), northern harrier (*Circus cyaneus*), prairie falcon (*Falco mexicanus*), and American kestrel (*Falco sparverius*)(Table 7).

T-24. Bird species observed on T-24 included western meadowlark, white-crowned sparrow, rock wren (*Salpinctes obsoletus*), and mourning dove. Due to the time of year that the survey was conducted, it is doubtful that any were actively nesting. It is likely they were migrating through to wintering areas farther south. However, these birds could potentially nest on the proposed areas during nesting season. Fifty-four bird nests were located on T-24. Nests were identified as sage sparrow or Brewer's sparrow, sage thrasher, and loggerhead shrike (Table 7).

Recent and historic sage grouse lek surveys show almost 12.5 km (7.75 mi) of T-24 occurring within 3.2 km (2 mi) of a lek (Figure 5). An area with an abundance of sage grouse droppings was also located within the surveyed area that indicates a potential lek location which has not been recorded in the past. This location should be surveyed for sage grouse attendance during the spring of 2006 to determine use of this area. Other sign (sage grouse droppings) located outside the critical breeding

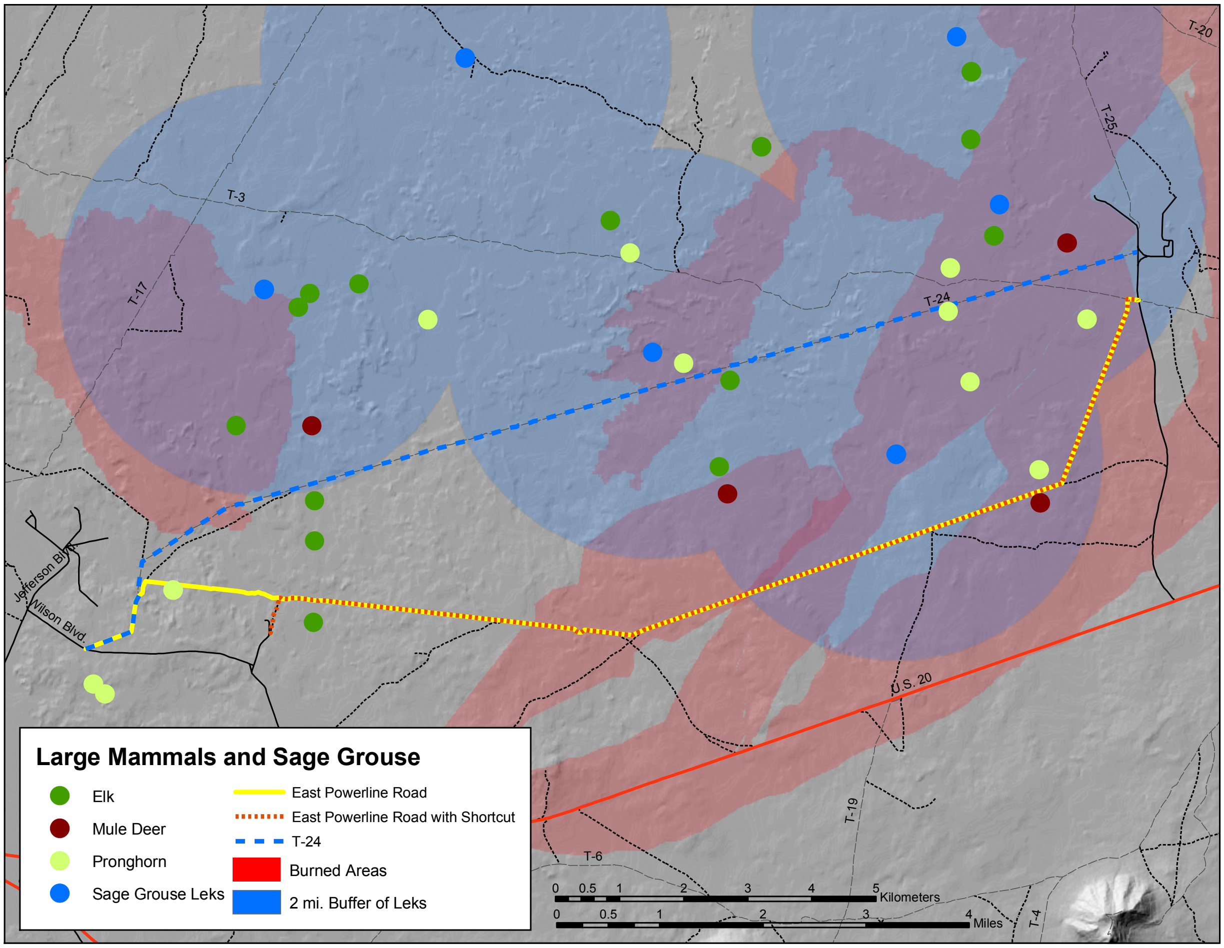

Figure 5. Locations of large mammals sighted in recent annual surveys of the INL and sage grouse lek locations with 2-mile breeding range buffer.

range and the presence of sagebrush (a critical forage species) indicate that this area is also used by sage grouse during non-breeding seasons such as brood rearing and wintering. Overall, it is predicted that sage grouse utilize at least 95 percent of the T-24 area.

The only raptor observed on T-24 was a northern harrier. This is probably due to the limited amount of perching structures available to raptors along T-24.

Table 7. Species occurrences associated with two road corridors, September - October, 2005.

Species	Road Powerline	Road T-24
Brewer's or Sage Sparrow nests	8	26
Sage Thrasher nests	19	24
Loggerhead Shrike nests	2	4
Sage Grouse Lek	1	4
Raptor observation	14	2
Pygmy Rabbit sign	2	4
Garter Snakes	2	10
Gopher Snakes	0	1
Big Game (locations from annual surveys)		
Elk (groups)	4	7
Mule Deer (groups)	2	2
Pronghorn (groups)	7	8

Pygmy Rabbits. Pygmy rabbits are sagebrush steppe obligate species and have recently been petitioned for protection under the Endangered Species Act. Pygmy rabbits depend on sagebrush for cover and forage. Once sagebrush is removed from an area pygmy rabbits disappear (Green and Flinders 1980, Katzner et al 1997). Populations of pygmy rabbits on the INL may be relatively stable because much of the site remains undisturbed; however, little is currently known about the status of pygmy rabbit populations on the INL. Pygmy rabbit occurrence on East Powerline Road and T-24 were assessed based on the presence of pygmy rabbit sign (i.e., sightings of rabbits, burrows, and/or scat) and the presence of suitable sagebrush habitats. Suitable sagebrush habitats were identified by the presence or absence of sagebrush. Unfortunately, our surveys were not conducted under conditions conducive to observing pygmy rabbit sign. If a more accurate assessment of pygmy rabbit occurrence along the alternative roads is desired, surveys should be conducted during the winter when there is adequate snow cover to allow for the identification of tracks.

East Powerline. Pygmy rabbit sign was identified in two locations along the East Powerline Road (Figure 6). Both locations were in dense patches of basin big sagebrush but one was within contiguous sagebrush habitat and the other was isolated in the middle of a large burn. Fifty-six percent of vegetation plots along the East Powerline Road were potentially suitable (i.e., had sagebrush cover) for pygmy rabbits.

T-24. Pygmy rabbit sign was identified in four locations along T-24 (Figure 6). All locations were in contiguous undisturbed sagebrush habitats. Fifty-seven percent of the vegetation plots along T-24 were potentially suitable for pygmy rabbits.

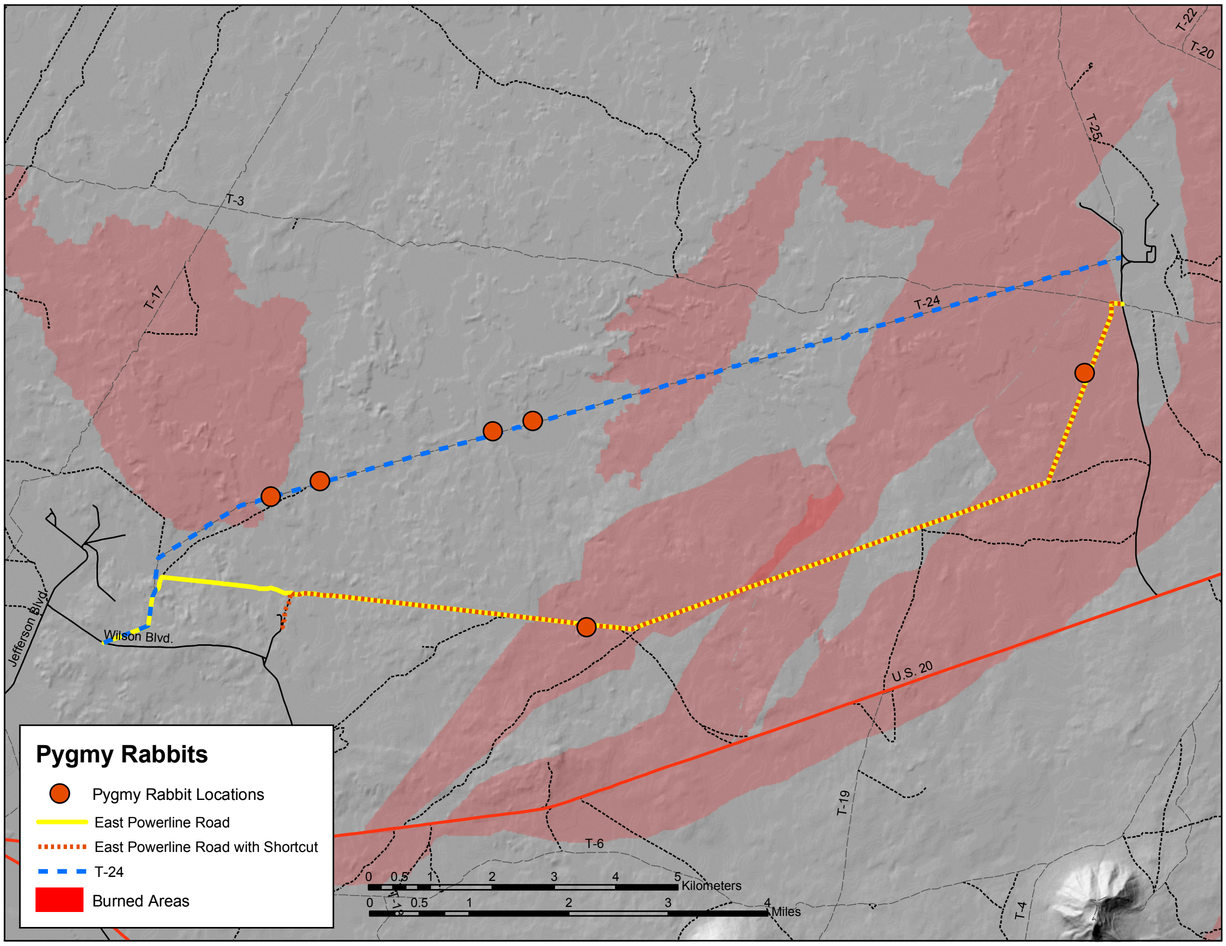

Figure 6. Locations of pygmy rabbit sightings, burrows and sign found during the survey.

Rattlesnakes. Great Basin rattlesnakes are listed as protected non-game wildlife by the State of Idaho (Idaho CDC 2005). In addition, they also provide information (e.g. long-term rattlesnake monitoring program conducted by ISU) on ecosystem health on the INL. Great Basin rattlesnakes require winter habitats that allow them to go underground to depths below the frost line. On the INL these habitats are typically associated with volcanic features such as craters, cones, and lava tubes. Differences in the availability of rattlesnake winter habitat were assessed by the number of hibernacula observed and the amount of potential hibernacula based on the presence of volcanic features. Great Basin rattlesnakes on the INL select summer habitats with higher prey availability which are relatively undisturbed (Jenkins and Peterson in press). Summer habitat quality was assessed based on the amount of disturbed and undisturbed habitat and the number of prey items (i.e., small mammals) observed during wildlife surveys. To characterize habitats in terms of rattlesnake preference, plant community classifications were collapsed to burned and unburned types. Specifically, sagebrush steppe, sagebrush/rabbitbrush, sagebrush/saltbrush, and rabbitbrush/saltbrush communities were collapsed into an unburned category (i.e., preferred) and rabbitbrush, native grasslands, crested wheatgrass, and annuals/playas/disturbed areas were collapsed into a burned category (i.e., not preferred).

Surveys were conducted in late October when the majority of rattlesnakes are already underground in winter hibernacula (C. Peterson unpublished data). Thus our estimates of rattlesnake occurrence were based on the presence of other snake species that occur sympatrically, but remain active later in the season and on the presence of suitable habitat. The presence of garter snakes or gopher snakes suggests that rattlesnakes may also occur because snakes often over-winter in the same locations on the INL (Cooper-Doering 2005). Rattlesnakes prefer and have higher reproductive output in undisturbed sagebrush habitats with abundant prey resources (Jenkins and Peterson in press). If more accurate estimates of rattlesnake occurrence and abundance are desired, conducting additional surveys when rattlesnakes are leaving hibernacula in May is necessary.

East Powerline. No winter snake hibernacula were observed on the East Powerline Road (Table 8). In addition, little potential rattlesnake winter habitat was observed on the East Powerline Road relative to T-24. One garter snake was located along East Poweline road which suggests that there is at least one potential rattlesnake hibernaculum in the area (in October snakes would not be far from a hibernaculum). Fifty-eight percent of the vegetation along the East Powerline Road was characteristic of preferred rattlesnake summer habitat (Table 8). However, few prey items (i.e., small mammals) were observed along the East Powerline Road relative to T-24. One rattlesnake shed was found along the East Powerline Road indicating that snakes use this area as summer habitat.

T-24. Five garter snake and/or gopher snake hibernacula (i.e., potential rattlesnake hibernacula) were found on T-24 (Table 8) (Figure 7). In addition, a great deal of potential rattlesnake habitat was observed on T-24 relative to the East Powerline Road. Fifty-seven percent of the vegetation along the T-24 was characteristic of preferred rattlesnake habitat (Table 8). We found many prey items (i.e., small mammals) along T-24 relative to the East Powerline Road.

Table 8. Predictors of rattlesnake occurrence associated with two road corridors, September - October, 2005.

Occurrence Predictors	Road	
	Powerline	T-24
Winter		
Snake Hibernacula	0	5
Potential Snake Hibernacula	Low	High
Individual Snakes	2	11
Summer		
Vegetation (i.e., proportion of plots in preferred habitats)	0.58	0.57
Prey (i.e., number of small mammals)	6	18

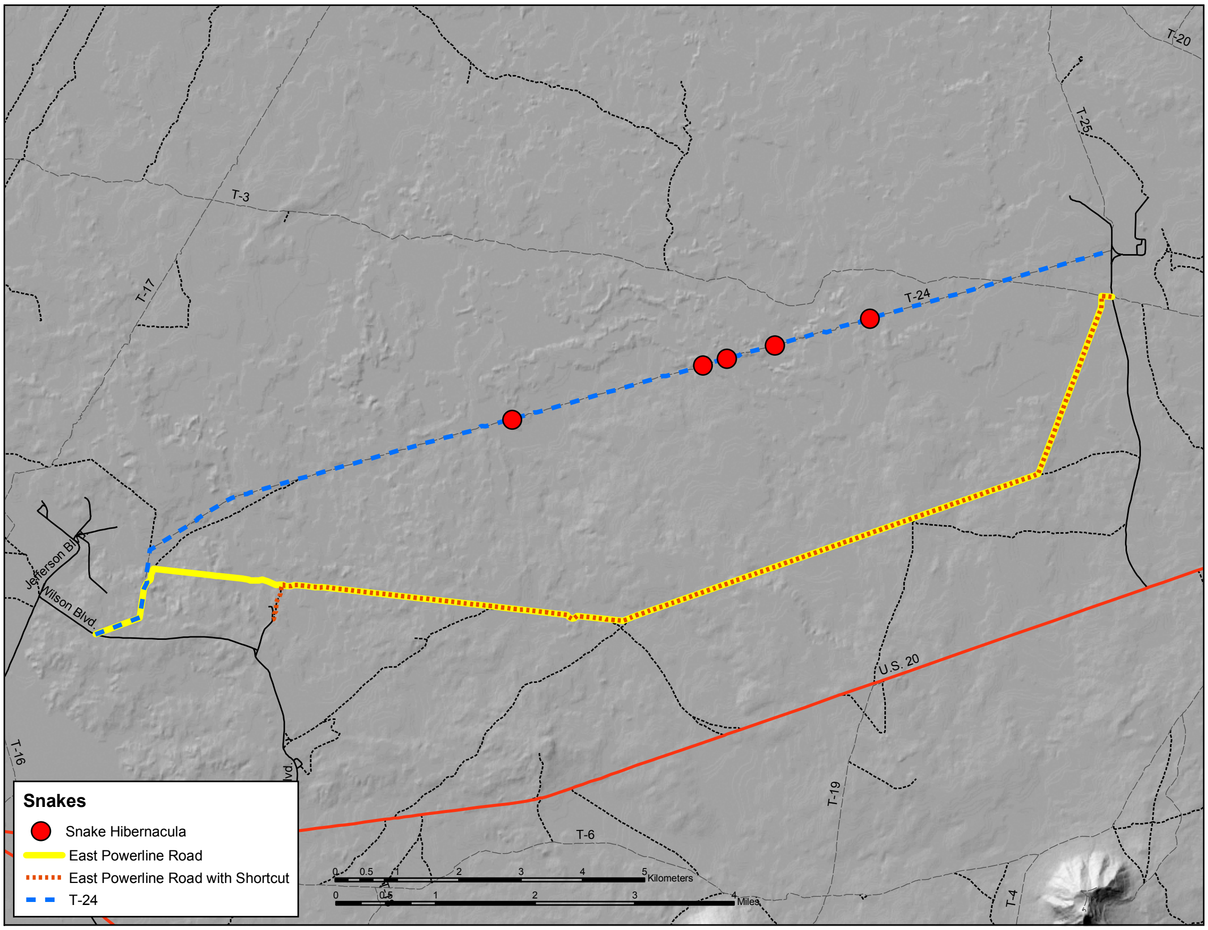

Figure 7. Locations of snake hibernacula found during survey.

Large Mammals. Elk, mule deer and pronghorn have been observed during semi-annual surveys using the general areas of both alternative routes throughout the year. Comer (2000) found that elk tend to utilize sagebrush on lava habitat more frequently than any other habitat type on the INL. The majority of this habitat type on the INL occurs within the non-grazed areas. Pronghorn and mule deer are more randomly scattered throughout the INL, with concentrations being greater near the Big Lost River Sinks and juniper woodlands respectively.

East Powerline. Signs of elk, mule deer, and pronghorn antelope use of the area were observed during the survey. Annual large mammal survey data shows that over the past five years herds of elk, mule deer and pronghorn have been documented within 1.6 km (1 mi) of this route during the summer and winter months (Figure 5). Elk appear to only use this area during the winter. Herds of elk ranged in size from 4 to 19 individuals.

T-24. During this survey an abundance of large mammal sign and herds of large mammals were observed on T-24. Annual large mammal survey data show that over the past five years herds of mule deer, pronghorn, and elk reside within 1.6 km (1 mi) of this route (Figure 5). These herds range in size from 1 individual to more than 60.

2.8 National Environmental Research Park

The INL is also the site of the Idaho National Environmental Research Park (NERP). The NERP program was established by Congress in the early 1970s. The Idaho NERP was chartered in 1975. The National Environmental Research Parks are field laboratories set aside for ecological research, for study of the environmental impacts of energy developments, and for informing the public of the environmental and land-use options open to them. According to the NERP Charter, those goals have been articulated in the National Environmental Policy Act, the Energy Reorganization Act, the Department of Energy Organization Act, and the Non-nuclear Energy Research and Development Act. The public's concern about environmental quality was translated through NEPA into environmental goals and the NERPs provide a land resource for the research needed to achieve those goals. The NERP Charter allows that while execution of the program missions of DOE sites must be ensured, ongoing environmental research projects and protected natural areas must be given careful consideration in any site-use decisions.

The primary objectives for research on the NERPs are to develop methods for assessing the environmental impact of energy development activities, to develop methods for predicting and mitigating those impacts. The NERP achieves these objectives by facilitating use of this outdoor laboratory by university and government researchers. Several research and monitoring projects have study sites in the vicinity of the proposed road alternatives (Figure 8).

The Long-Term Vegetation Transects (LTV) were established in 1950 and have been read on a regular basis since then. The data from these transects represents one of the longest rangeland vegetation databases in the western U.S. The plots are scheduled to be surveyed in 2006. Several LTV plots are in the vicinity of the proposed road alternatives.

A recent research project studying vegetation recovery following wildland fire established plots near the proposed road corridors. The plots were established with the expectation of being used as a long-term monitoring plot for assessing vegetation recovery following fire.

In addition to the NERP activities described above, additional DOE-sponsored ecological monitoring is conducted near the proposed test site (Figure 8). Two of the facility Breeding Bird Survey routes on the INL are in the vicinity of the proposed road alternatives. One route follows the fence line around PBF and the other is around MFC. These routes are surveyed during June each year.

Surveys for large mammals, primarily elk, pronghorn and mule deer are conducted in January and July each year. These surveys are conducted using fixed-wing aircraft flying 500 feet above the ground. The surveys are conducted on north-south transects one-half mile apart and cover the area crossed by the potential road corridors.

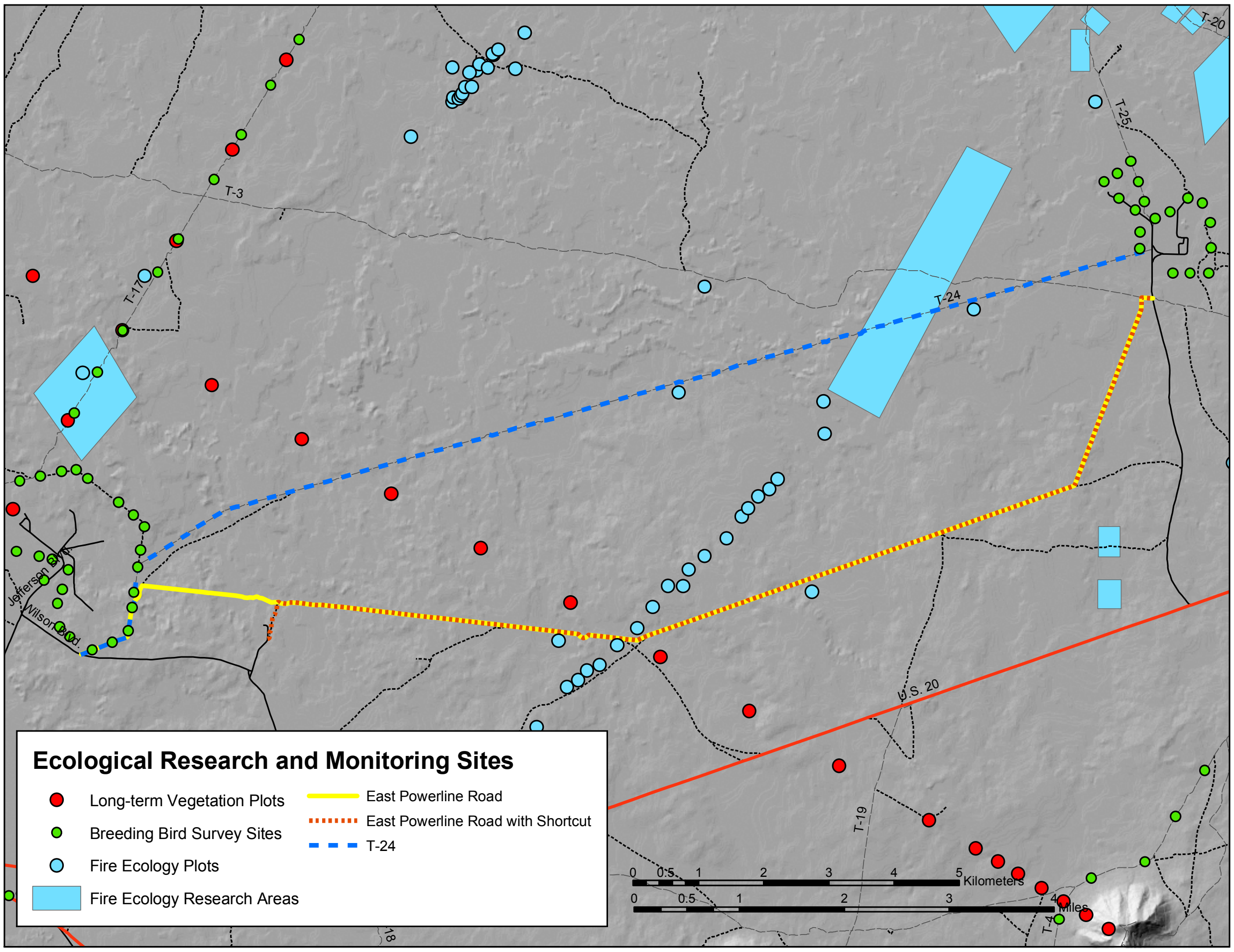

Figure 8. Ecological research and monitoring sites in the vicinity of the proposed routes for the new road.

3.0 Environmental Consequences and Mitigative Measures

3.1 Vegetation Communities

Road improvement along either route will increase soil disturbance and vegetation community fragmentation. An increase in soil disturbance will likely lead to an associated increase in weedy non-native species and the potential to displace natives in the communities adjacent to the upgraded road. The prevalence of needle-and-thread grass as a community dominant or co-dominant in plots along T-24 is indicative of sandy soils along that route. Because sandy soils tend to have less structure and, therefore, are more easily displaced, the invasibility of those soils can be quite high. The high risk of invasibility combined with the high frequency (0.93) of cheatgrass in plots along T-24, make the potential risk of cheatgrass invasion much higher on T-24 than on East Powerline road. It should be noted that although the frequency of cheatgrass in plots along T-24 is high, abundance of cheatgrass was quite low. Thus, the potential of cheatgrass invasion is high because a ubiquitous seed source exists, not because the community has already been impacted by the species.

In addition to the impacts of upgrading a road as they relate to invasibility, the initial ecological condition of the plant communities prior to disturbance relates to the potential impacts to the plant community. For example, the plots along the T-24 road tend to have higher total species richness and higher species richness of native forbs and thus, are in better ecological condition. Therefore potential impacts would be greater to the plant communities along T-24 because the initial ecological condition of those communities is higher than that of the plant communities along East Powerline road. Likewise the relative heterogeneity of plots within each vegetation class along T-24, indicates more diverse plant communities than those found along East Powerline road. In brief, East Powerline road has already experienced some level of disturbance, therefore; the overall impact to the plant communities adjacent to East Powerline road would be much less than it would be to the plant communities adjacent to the relatively undisturbed T-24.

Potential impacts to the vegetation communities along either potential route can be mitigated to some extent by minimizing the footprint of the soil disturbance and revegetating the areas that have been disturbed. Revegetating with a diverse native species mix, similar in composition to the affected plant communities may help maintain the diversity of those communities. Weed control may also be necessary, as even the slightest amount of soil disturbance may lead to non-native species invasions.

3.2 Soils

Soil disturbance for road construction will result in a direct loss of native vegetation and will provide opportunities for invasive and other non-native plants to become established. In the proposed project, soil would be disturbed to a width of approximately 36 meters (120 feet) along the length of the new road. No information about construction laydown areas or other potential for soil disturbance were made available for this review, but any such areas will likely have similar impacts to those described for the road itself.

Soil degradation may occur as a result of soil compaction. Soil compaction may have a serious negative impact on soil structure and vegetation recovery, which in turn, may impact the ecosystem as a whole. Environmental disruption by soil compaction is a long-term event; as the recovery of compacted sandy soils (sandy soils are more susceptible, and recover more slowly than clay or wetter soils) is extremely slow and can take longer than 50 years (Caling and Adams 1999). Sandy soils are present on both alternative routes, but dominate the T-24 route (Figure 4) (Olson et al. 1995) and thus may exhibit this extended recovery period. Weed invasion of disturbed areas has been linked to changes in soil properties (Zink et al. 1995).

Planning and site preparation that minimizes soil disturbance will limit the impacts to soil and vegetation, and greatly reduce the efforts required for revegetation and weed management. Management practices that should be used include:

- Designation of roadways, parking and laydown areas and restricting traffic to those designated areas.

- Limiting the amount of traffic allowed access to, and on, the project site.

If the M-B-M soils are actually more like Grassy Butte or Matheson-Grassy Butte complex, then 69 percent of the T-24 route and 18 percent of the East Powerline road may be in areas with sandy soils that are not suitable for rangeland plantings, are susceptible to wind erosion and are at substantial risk to invasion by cheatgrass and other non-native annual plants following disturbance. Soil disturbing activities in these areas should be kept to an absolute minimum.

3.3 Invasive and Non-Native Species

Soil disturbance is a primary contributor to the spread of invasive plants. Invasive and non-native plants are present on the much of the East Powerline and T-24 roadways and could be spread by mowing, blading, and any other means used to remove the vegetation in order to build a road. Seed dispersal may be limited in a number of ways. First seed dispersal may be limited by disturbing as little area as possible along the road corridors whether that disturbance is mowing, blading, etc. Second, the timing is critical to seed dispersion. Most invasive and non-native species produce large numbers of seed. If the disturbance does not occur during peek seed dispersal, it will help reduce the number of viable seed on the ground. This will limit spread of weeds into areas presently not infested. Failure to limit seed dispersal from these areas will likely increase the level of effort necessary for revegetation and weed management.

The data collected on the presence of invasive and non-native plants shows equal distribution of cheatgrass between roads. However, there is more halogeton on the East Powerline road than on T-24 and more musk thistle on T-24 than on the East Powerline road. While disturbing weeds often creates a larger problem, the distribution of the weeds is equally important. In the case of halogeton, most of the infestations occur in the existing roadway or in disturbed areas immediately adjacent to the road. The East Powerline road has halogeton present along nearly its entire length. This area would be paved in the event that the East Powerline road was selected for this project. If construction and revegetation were conducted properly, they may actually reduce the amount of halogeton in that area. Musk thistle is distributed differently in that most of the infestations are located some distance from the road, but close enough to provide seed to any newly disturbed soil. The road shoulder and borrow ditch will be susceptible to invasion for several years following construction.

3.4 Revegetation and Weed Management Plan

Revegetation of all areas with soil disturbance and loss of native vegetation should be accomplished based on the guidelines of Anderson and Shumar (1989) and Twitchell (2001). The revegetation target for this project should be to achieve 70 percent of the cover and using species present in the surrounding undisturbed native plant community.

Revegetation and weed management are both greatly influenced by the type of soils present. Please refer to the Soil section (Section 2.2) for more information on the soil characteristics present along the proposed routes and how those characteristics affect revegetation and weed management.

Topsoil management is also important for successful revegetation on the INL. As part of construction, the top 20 - 25 cm (8 – 10 in) should be removed first and stockpiled along the margins of the disturbed corridor. These topsoil stockpiles should be no more than about 1 m (36 in) deep. This topsoil should be used to recover the road shoulder, borrow ditches and any other areas with soil disturbance. If the topsoil stockpiles are to remain for more than one growing season (i.e. the area will not be planted the first autumn following disturbance), the stockpiles should be planted with an appropriate native grass. This will provide some protection from weedy species becoming established on the stockpile and contaminating it with weed seeds and the activity associated with grass roots will maintain the viability of the soil microbiota necessary for maintenance of soil fertility in the stockpile.

Normally at the INL, a Truax or similar drill is recommended for planting. Seeds of native plants must be planted very shallow, generally one-quarter inch deep. Once the seeds are drilled into the soil, they must be covered with some type of protection. Wood chips have been used with moderate success for revegetation if they are applied at the correct rate and time. Wind can be very detrimental to reseeding and may blow seeds away before they have had a chance to germinate without some type of protection. Broadcast and hydroseeding place seed directly on the soil surface and would provide even less protection for seed. Broadcast and hydroseeding are not recommended for any revegetation projects on the INL.

The only other possible method for revegetation provided by Anderson and Shumar (1989) is by transplanting. This could be done using container-grown stock, bare-root stock or wildings. Transplanted mature plants are hardier and may produce seed in the first growing season if they receive enough water and are not heavily grazed. Many local growers who are specialized in native plants will produce them in any form desired if the seed is market available or collectable around the affected area. Transplanting wildlings that are already established and mature may yield a better chance of restoration for the test area and may be the most economical (Shumar and Anderson 1987). Another advantage of planting wildlings is that the vertical structure of the mature plant acts as a wind break, reducing the risk of wind erosion and increasing the soil stability of the site. The best source for wildings would be the surrounding, undisturbed native plant community. Shumar and Anderson (1987) indicate that, with care, this can be done without causing undue damage to the source community. Transplanted wildlings could include bunch grasses, forbs and shrubs. However, Shumar and Anderson (1987) did not conduct their studies in sandy soils and therefore, the potential for success in sandier soils, such as T-24, is unknown. A combination of drilling and containerized wildlings may present the greatest potential for successful revegetation.

Any area of soil and/or vegetation disturbance must be replanted before the first growing season following the disturbance or a weed management program must be initiated.

Building roads requires a large disturbed area and it must be understood by the project management, that the project will not be complete until all of these areas have been successfully revegetated. Both of the road options for this project cross many different vegetation classes. Each vegetation class change will require a planting a different combination of species. Native seed can be provided by various local growers. Some areas will not have suitable soil conditions for using a drill and will have to be replanted using transplants. The number one limiting factor and key to revegetation success is sufficient moisture during the first growing season. The use of a water truck may be very beneficial to the establishment of vegetation during that period.

It is recommended that an experienced revegetation contractor be used for this work. It is possible that an experienced revegetation contractor may have additional methods available other than those described here that may increase the effectiveness of the revegetation effort. It is highly recommended that contract performance goals be for successful revegetation rather than just planting.

A vital component for long term success in revegetation is monitoring, maintenance and weed management. Areas that are devoid of vegetation often times become a safe harbor for weeds. Most weeds are opportunistic and will colonize a disturbed area much faster than will native species. If these plants are not detected and managed, they can threaten revegetation success. Long-term monitoring and maintenance is important because no revegetated area will in reach the 70 percent surrounding cover goal following the first planting or even in the first growing season. The project area should be visited each spring in order to perform maintenance as necessary and should continue until revegetation goals have been met. Monitoring and maintenance should also continue as long as noxious weeds are present on the project area.

3.5 Ethnobotany

The impacts of upgrading either road will likely be greater on less common species than they would be on abundant species. Frequently occurring species are generally quite abundant; thus, removing several individuals will not greatly affect the larger population. Populations of species with more isolated distributions, however, are much more sensitive to the loss of several individuals. Since narrowleaf goosefoot has a relatively low frequency of occurrence overall, but is more common along the East Powerline road, that species would most likely experience a greater impact from disturbances associated a road upgrade along that route. Conversely, textile onion and fernleaf biscuitroot will experience greater impact from an upgrade to T-24, as individuals from those relatively limited populations are found more frequently along that route. Since textile onion and fernleaf biscuitroot are considerably more difficult to reestablish than narrowleaf goosefoot, species of ethnobotanical concern that occur in low frequencies would experience greater impact along T-24 that they would along the East Powerline road.

Because the soil disturbance and risk of non-native species invasion will impact populations of species of ethnobotanical concern along either route, the most effective mitigative measure to protect those populations is to minimize the amount of soil disturbed. Potential impacts to populations of plant species of ethnobotanical concern may also be mitigated through revegetation of areas impacted by soil disturbance. Seed or seedlings are commercially available for about one third of the species listed in Table 2, so those species may be directly replanted; so long as care is taken to choose appropriate subspecies and cultivars. The use of a diverse mix of native species in revegetation efforts will be important if species of concern, for which seed or stock is not available, are to re-establish voluntarily. Finally, weed control will be critical to facilitate reestablishment of native communities, including species of ethnobotanical concern.

3.6 Hydrography

Ecological impacts by altered hydrography are likely to occur in the basins bisected by the proposed road. Because the vegetation class present in these basins is the result of the periodicity and duration of flooding, any alteration in the flooding regime will likely alter those plant communities. It is expected that the road constructed through these basins will be elevated to limit damage to the road due to flooding in the basin. These elevated roadways will act as dams preventing water from evenly flooding the basin. Consideration for placement of adequate culverts under roads in these basins will be essential to prevent alteration of the natural patterns of flooding disturbance and subsequent alteration of the native vegetation communities in the basins.

3.7 Wildlife Impacts and Mitigation

Each alternative will have common unavoidable impacts such as: 1) unavoidable loss of ground-dwelling wildlife species and associated habitat, 2) displacement of certain wildlife species due to increased habitat fragmentation, and 3) an increase in the potential for collisions between wildlife and motor vehicles. Although there is little difference in the type of impact, differences vary between alternatives in the severity of the impact to some species. Mitigation measures will result in lessening the impact of roads on wildlife. Mitigation techniques include, but are not limited to, seasonal timing of activities, lower speed limits, fencing, warning signs, reflectors, ultrasonic warning whistles, habitat alteration, hazing animals from the road, and awareness programs.

Timing of Project Activities - Both alternative areas provide important breeding habitat to many species during the spring, thus seasonal restrictions should be imposed in order to prevent any detrimental effects to breeding populations. The following are times when specific animals are breeding, nesting, or birthing.

- Sage grouse February 15 - June 30
- Passerine birds April 15 - June 30 (a few nest until Sept 1)
- Raptors February 1 - July 1
- Pygmy rabbits February - July
- Snakes August - September

Speed Limits. Wildlife strikes by vehicles are a frequent occurrence on many roads. Mortality can be greatly reduced by reducing speeds (<24 kph [15 mph]) and awareness of the presence of any animal that might frequent the area. If a wild animal is observed in the road, vehicles should stop and wait until the animal leaves the road, encourage it to move on by driving forward SLOWLY, or stop and take measures to safely move the animal from the road.

Birds. Bird-vehicle collisions not only result in the death of individual birds, but also in preventing birds from successfully breeding. Destruction of roosting places, hunting perches, and nest sites will influence local populations more than the actual loss of individual birds to automobiles (Forman et al. 2003). Some species are more vulnerable to habitat loss than others. Sagebrush obligate species such as Brewer's sparrow, sage sparrow, sage thrasher and sage grouse rely on sagebrush for nesting and brood rearing. Project activities will impact birds by removing sagebrush thus reducing opportunities for successful breeding. Survey results showed fewer species of concern located on the East Powerline Road than on T-24. Disturbances associated with activities on and near the proposed road have the potential to permanently displace sage grouse and other birds during winter and spring. Winter and spring are critical survival and reproductive periods for all birds. Potential impacts of the proposed action on birds that use the area can be minimized by maintaining vehicular speeds of less than 24 kph (15 mph) and restricting access to only authorized vehicles. Construction activities such as vegetation removal should not occur without a nesting bird survey for compliance with the Migratory Bird Treaty Act.

Pygmy Rabbits. Road construction will impact pygmy rabbits by removing sagebrush directly through construction activities and indirectly by disturbing soils and promoting the invasion of weeds that may alter fire regimes. In addition, roads fragment suitable habitats and create barriers to rabbit movements. Many portions T-24 contain native vegetation within the middle of the tire tracks of the road. This vegetation reduces the impacts of fragmentation and supports continuity of habitat. Vegetation within the East Powerline Road tracks is sparse and often limited to non-native vegetation. Roads with little to no vegetation growing between the tracks are barriers to movement and dispersal, since pygmy rabbits are unlikely to cross open areas. To reduce impacts to pygmy rabbits and their habitats, soil disturbance should be minimized and invasion of weeds and direct disturbance of known rabbit locations should be avoided. Road construction should be planned to minimize impact to the pygmy rabbit locations identified in this survey. Specifically, the route of the road should be shifted away from rabbit locations by 100 meters (300 feet) to prevent direct impacts. Soil disturbance and the removal of sagebrush should be minimized and disturbed areas should be replanted with native vegetation to prevent indirect impacts.

Rattlesnakes. Great Basin rattlesnakes are listed as protected non-game wildlife by the State of Idaho (Idaho CDC 2005). Overall, T-24 provides significantly more winter and summer habitat for Great Basin rattlesnakes. More potential hibernacula and higher prey availability were found along T-24. However, vegetation along the East Powerline Road suggests that it may also have suitable summer rattlesnake habitat. If T-24 is selected as the route, the hibernacula would be destroyed during road construction due to their close proximity to the road (3 are within 5 meters). In addition, if construction occurs when snakes occur in high densities at hibernacula (May-early June and September-early October) there could be significant mortality of snakes and safety concerns for workers.

If T-24 is selected, a 100-m (300-ft) buffer should be placed around each hibernacula and the road should be rerouted around these buffers to prevent the destruction of hibernacula, snake mortality, and safety issues for workers. Construction should also be avoided from May through June and September through October. T-24 has high quality rattlesnake summer habitat. Building the road along this route would disturb soil, promote invasion of invasive plants, and result in lower prey availability. If T-24 is the route selected, minimum disturbance should occur along undisturbed portions of the route and disturbed soils should be replanted with native vegetation. Rattlesnake habitats may also become fragmented and road mortality of snakes will increase (D. Jochimsen unpublished data). To mitigate these effects, a series of crossing tunnels should be placed along the portions of the road that go around the buffered hibernacula. In addition, fences to guide snakes into the tunnels should be installed and maintained. If the East Powerline Road is selected as the route, minimum disturbance should occur along the road in nonburned areas and disturbed soils should be replanted with native vegetation to prevent the degradation of rattlesnake summer habitats.

Large Mammal Species. Vehicle collisions with large mammals involves vehicle damage, human casualties, and lost economic opportunities. Survey data indicate that more large mammals can be found occupying areas closer to T-24 than the East Powerline Road. Impacts to large mammals can be minimized by choosing the alternative that increases the distance of the project to preferable habitat cover and wildlife movement corridors. Other mitigation measures include fencing, warning signs, maintaining vehicular speeds to less than 24 kph (15 mph), using ultrasonic warning whistles on vehicles and restricting access to authorized vehicles only.

3.8 Habitat Fragmentation

Habitat Fragmentation will result from the proposed road construction action and cause some negative impacts no matter which alternative is selected. Infrastructure affects natural systems in both direct and indirect ways. The physical presence of roads in the landscape creates new habitat edges, alters hydrological dynamics, and disrupts other ecosystem processes and habitats. Road maintenance and traffic contaminate the surrounding environment with a variety of chemical pollutants and noise. In addition, infrastructure and traffic impose dispersal barriers to most non-flying terrestrial animals, and vehicle traffic causes the death of millions of individual animals per year. The various biotic and abiotic factors operate in a synergetic way across several scales, and cause not only an overall loss and isolation of wildlife habitat, but also splits up the landscape in a literal sense (Seiler 2001).

Roads fragment plant and animal populations (Noss 1996). Habitat fragmentation is the process whereby a large, continuous area of habitat is both reduced in area and divided into two or more fragments (Wilcove et al. 1996; Schonewald-Cox and Buechner 1992; Reed et al. 1996; Theobald 1998). Fragmentation can occur when area is reduced to only a minor degree if the original habitat is divided by roads, canals, fire lanes, or other barriers to free movement of species (Primack 1998).

Habitat fragmentation leads to increasing edge effects, loss of species diversity, alterations in natural disturbance regimes, and alterations in ecosystem functioning (Caling and Adams 1999). Habitat fragments differ from original habitat in two important ways: 1) fragments have a greater amount of edge for the area of habitat, and 2) the center of each fragment is closer to the edge (Primack 1998).

Changes in the microenvironment at the fragment edge can result from habitat fragmentation. Some of the more important edge effects include microclimate changes in light, temperature, wind, humidity, decreased soil moisture, and incidence of fire (Shelhas and Greenberg 1996; Laurance and Bierregaard 1997; Reed et al. 1996). Each of these edge effects can have a significant impact upon the vitality and composition of species in the fragment and increased wind, lower humidity, and higher temperatures make fires more likely (Primack 1998). Edges produced by roads can also increase nest parasitism by brown-headed cowbirds (*Molothrus ater*). Brown-headed cowbirds, the only obligate brood parasite in North America, feed primarily in open areas, but use perches to watch for nest building activities. Edge habitats are perfect for their needs (Brittingham and Temple 1983) and it has been demonstrated on the INL that brood parasitism increases on edges and in fragmented habitats (Belthoff and Rideout 2000).

Fragmentation affects animal populations in a variety of ways, including decreased species diversity and lower densities of some species in the resulting smaller patches (Reed et al. 1996). Some species of animals refuse to cross barriers as wide as a road. For these species, a road or fire line effectively cuts the population in half. A network of roads or firelines fragments the population even further (Noss 1996). In addition to direct loss of shrub habitats, responses of shrub-obligate species of wildlife will be related to dispersal capabilities and populations may not persist in landscapes of increasingly fragmented patches of sagebrush after disturbance (Braun et al. 1976; Knick and Rotenberry 1995; Knick and Dyer 1997).

For example, fragmentation of sagebrush communities poses a threat to populations of pygmy rabbits (*Brachylagus idahoensis*) because dispersal potential is limited (Weiss and Verts 1984). Sage grouse (*Centrocercus urophasianus*), sagebrush obligates, are totally dependent on sagebrush habitat (Benson et al. 1991) and removal of sagebrush has a negative impact on the value for winter habitat (Gates 1983). Good winter range provides sage grouse with access to sagebrush under all snow conditions. Sage grouse only eat sagebrush during the winter and often use relatively open habitats with 10-25 percent sagebrush canopy cover and an average height of 25-35 cm above the snow.

The quality and quantity of breeding and winter habitat have declined during the 1980's and 1990's because of prolonged drought, fires and agricultural development. Vast areas that were once sagebrush/bunchgrass habitats are now dominated by cheatgrass (*Bromus tectorum*), with little or no sagebrush overstory making population recovery difficult.

Many sage grouse populations are migratory and birds may move 100 kilometers or more between seasonal ranges. Sage grouse have a relatively low reproductive rate compared to other game bird species so populations do not recover very fast following optimal conditions (Schroeder 1999).

Roads fragment plant populations and facilitate the spread of invasive animals, insects and plants. Many of the weedy plants that dominate and disperse along roadsides are exotics. In some cases, these species, such as cheatgrass, spread from roadsides into adjacent native communities (Noss 1996). Exotic species disrupt natural ecosystem processes and the species that depend on them. Exotic plants have been shown to replace native under story vegetation, inhibit seed regeneration, and change soil nutrient cycling. Some weeds can cause higher erosion rates or change fire regimes.

In shrub-steppe ecosystems, invading weeds, which were usually non-mycorrhizal, disrupted succession of native species, 99 percent of which were mycorrhizal–dependent. Also, fires have become more common and extensive in sagebrush ecosystems invaded by cheatgrass (Billings 1994). Presence of cheatgrass along edges (roads) may allow it to invade adjacent habitats, increasing the likelihood of fire spread into nearby sagebrush patches, further fragmenting the ecosystem (Knick and Rotenberry 1997).

Disturbance from roads can increase the distance between remaining shrub patches that provide seed sources (Knick and Rotenberry 1997). The dominant shrub on the INL, big sagebrush (*A. tridentata*), does not resprout from crown or roots following fire (Young and Evans 1978). Thus, natural regeneration of these shrublands could be severely limited by availability and dispersion of seed sources. Dispersal of sagebrush is primarily wind driven and occurs largely within 30 m of the seed source (Young and Evans 1989).

Studies concerning roads and their influence on habitat fragmentation offer sufficient reason for adopting a precautionary stance toward road issues (Brittingham and Temple 1983). Roads precipitate fragmentation by dissecting previously large habitats into smaller ones. As the density of roads in landscapes increases, these effects increase as well. Even though roads occupy a small fraction of the landscape in terms of land area, their influence extends far beyond their immediate boundaries (Reed et al. 1996).

3.9 Radiological Impacts

The assessment for radiological impacts to biota would be the same for each alternative. No radiological impacts to biota would occur during road construction. Due to the containment and shielding of shipment processes, the only way for Pu-238 to occur in the environment and be integrated into biota tissues would be for an accident that breached the container allowing release into the surrounding environment. The primary radiations from Pu-238 are 5.50 and 5.46 Mega Electron Volts (MeV) alpha making them hazardous only if taken internally or integrated into tissue (USDHEW 1970).

If such an event were to occur, concentrations of 350 and 3500 pCi/g of Pu-238 would need to be released and the total amount incorporated into biota tissues to obtain dose limits of 0.1 rad/day for animals and 1.0 rad/day for vegetation, respectively specified as protective for biota (Amiro 1997; IAEA 1992). This is not a realistic scenario due to the protective containment used for radioactive material shipment. Therefore, radiological impacts to biota for this project are insignificant or nonexistent.

3.10 Ecological Monitoring and NERP Research Activities

There is the potential for impact to ecological research and monitoring activities in the vicinity of the proposed road alternatives. This includes ongoing ecological monitoring and research conducted by the ESER Program and academic researchers. The potential for impact may be in the form of direct damage to plots, alteration of natural animal behaviors being investigated, and/or potential loss of access to the area for data collection.

Most of these potential impacts can be avoided by implementing a few administrative controls. Travel should be strictly limited to that deemed necessary to achieve project goals. Project managers should coordinate their activities with ESER personnel to avoid conflicts with long-term scheduled monitoring activities such as the Breeding Bird Survey, Long-Term Vegetation Survey, Rabbit Survey, Big Game Surveys, Sage Grouse Surveys and other data collection activities. It is essential for the continuation of these research and monitoring programs that ESER personnel not be restricted from accessing these areas on T-24 and the East Powerline roads.

The Breeding Bird Survey sites around PBF will be disrupted if either the T-24 or East Powerline routes are chosen. Selecting the East Powerline road with Shortcut to ARA would eliminate that impact.

3.11 Effects on INL Natural Resource Management Objectives

To summarize the evaluation of consequences of the proposed road on ecological resources, we have analyzed the impact of the alternatives on each of the INL natural resource management objectives. To do this, we prepared a narrative synthesis of the data collected in the field surveys related to each of the resources as described above and of information regarding the status of those resources on the INL collected as part of other research or monitoring programs as they relate to the natural resource management objectives. That narrative synthesis follows below. Also, that synthesis is summarized in Table 9.

- **Reduce the need for rehabilitation following road construction**. Assuming that the width of the disturbance is the same no matter which route is selected, the main differences between routes on the need for rehabilitation is due the length. The T-24 and East Powerline road options are nearly the same length and would have the same impact. Selecting either of these two routes means that this resource objective cannot be met. The East Powerline Shortcut route reduces the total distance by 3.2 km (2 mi), and therefore, would meet the management objective to reduce rehabilitation needs, but there would still be other impacts.

- **Protect threatened, endangered and sensitive species (this includes State of Idaho designated species) and their habitat.** During our survey, we recorded more sightings of sensitive species on T-24 than on the Powerline road. This was in part due to finding new snake hibernacula on T-24. No snake hibernacula are known along the East Powerline route. None of the sensitive species were found on the portion of the Powerline road that would not be disturbed if the Shortcut were selected, so those two routes would have similar impact on sensitive species.

- **Protect sage grouse and other sagebrush-obligate species and their habitat.** The presence the powerline itself on East Powerline road has already altered habitat such that it is less suitable for sage grouse because it provides artificial perches for raptors. The sage grouse habitat on T-24 presently has no such artificial alteration. We also recorded more pygmy rabbit sightings on T-24 than on the East Powerline road. Selecting T-24 means that this resource objective cannot be met. The segment of East Powerline road bypassed by the shortcut contains much good condition sagebrush habitat that would not be disturbed if the East Powerline road with Shortcut is selected.

- **Prevent habitat loss and fragmentation.** Because T-24 crosses through a very large area of otherwise undisturbed area of sagebrush steppe, upgrading this road from a two-track road to a modern two-lane highway would cause both direct habitat loss and fragmentation. Implementing the recommended mitigation can alleviate some of the effects of fragmentation. However, for certain species, this fragmentation cannot be mitigated and this resource management objective cannot be met. For both East Powerline routes, the presence of the powerline and because East Powerline road has been bladed recently, significant habitat loss and fragmentation has already occurred on these routes. Selecting either of these routes means that this resource objective might be met, but other impacts to the resource would still result.

- **Protect culturally significant flora and fauna.** Selecting T-24 and the East Powerline road would both have direct impacts to ethnobotanical species and would not meet the goal of this objective. Selecting the East Powerline with Shortcut would mitigate this loss because the segment of East Powerline road bypassed by the shortcut contains much good condition sagebrush habitat that would not be disturbed.

- **Maintain a large undeveloped, sagebrush steppe ecosystem.** As described above, T-24 crosses a very large, mostly undisturbed area of sagebrush steppe. Selecting this route would not meet this resource objective. Selecting either of the East Powerline routes would not directly affect the maintenance of a large undeveloped sagebrush steppe ecosystem because the existing powerline and road have already caused disturbance in that area.

- **Maintain plant genetic diversity.** Construction of this road will require substantial revegetation effort no matter which route is selected. It is possible to meet the objective of preserving plant genetic diversity by using only locally collected plant materials for use in the revegetation effort. This would include locally collected seed or use of transplanted "wildings."

- **Protect unique ecological research opportunities.** Because the unique ecological research opportunities provided by the INL is the large, undeveloped, unfragmented sagebrush steppe ecosystem, any of the alternatives that change those characteristics will not meet this resource objective. Because developing the T-24 route fragments and brings other potential impact to this otherwise undeveloped area, selecting this alternative will not meet the requirements of this resource objective. Selecting either of the East Powerline routes may meet the objectives, but other impacts to natural resources will occur.

- **Prevent invasion of non-native species including noxious weeds**. All of the proposed routes will cause disturbance to soils and vegetation communities that will open the door to invasive species. The most cost effective way to prevent invasive species following a disturbance such as is proposed, is to successfully revegetate those disturbed areas with desirable vegetation. However, because of the sand soils encountered on the T-24 route that are known to be difficult to revegetate, it is unlikely that the mitigation will be successful in those areas. This statement should not be taken to mean that the soils on East Powerline road will be substantially easier to revegetate. Revegetation in any desert environment should not be considered as trivial.

- **Prevent animal/vehicle conflicts.** We encountered more large mammal sign on T-24, more snake dens, and T-24 has more use by sage grouse than the East Powerline routes. Because of the greater use of T-24 by wildlife, it will likely have greater potential for animal/vehicle conflicts. However, it is our opinion that implementation of the mitigation methods described earlier in this report will reduce animal/vehicle conflicts on the East Powerline routes.

- **Protect biodiversity.** The data collected in this survey indicates that T-24 has greater species richness of both plants and wildlife. Constructing an upgraded road on this route will not meet this resource objective. Selecting either of the East Powerline routes will provide some measure of protection to biodiversity because of the disturbances already affecting that route.

The summary shown in Table 9 indicates the that more of the natural resource management objectives are met by selecting Alternative 3 (East Powerline road with Shortcut) than the other proposed routes. The T-24 route would have the greatest impact to ecological resources and meet fewer of the natural resource management goals.

Table 9. Evaluation Matrix for Natural Resources Management Objectives[a].

Natural Resources Objectives Alternatives	Alternative 1 T-24 Road	Alternative 2 East Powerline Road	Alternative 3 East Powerline Road with Shortcut	Alternative 4 No Action
Reduce the need for rehabilitation following construction	0	0	1	3
Protect threatened, endangered, and sensitive species and their habitat	1	2	2	3
Protect sage grouse and other sagebrush-obligate species and their habitat	0	1	2	3
Prevent habitat loss and habitat fragmentation	0	1	1	3
Protect culturally significant flora and fauna	1	1	2	3
Maintain a large undeveloped sagebrush steppe ecosystem	0	1	1	3
Maintain plant genetic diversity	2	2	2	3
Protect unique ecological research opportunities	0	1	1	3
Prevent invasion of non-native species including noxious weeds	1	2	2	3
Prevent animal/vehicle conflicts	1	2	2	3
Protect Biodiversity	0	1	1	3
Total	***6***	***14***	***17***	***33***

[a]3 Meets the natural resources management objective.
2 May meet natural resource management objective with implementation of resource specific mitigation.
1 May meet natural resources management objects, but may cause other impacts regardless of mitigation.
0 Does not meet the natural resources management objectives.

3.12 Cumulative Impacts

Historically, cumulative impacts have not been addressed in INL NEPA documents. However, NEPA indicates these impacts should be considered and there is extensive literature discussing the potential short-term and long-term impacts of road building. In addition to the direct impacts from the road, the existence of a new road would likely increase the need for infrastructure and will encourage future development, thus creating additional cumulative impacts.

While NEPA does not explicitly mention indirect and cumulative impacts, NEPA makes it the responsibility of the Federal government to "include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on the environmental impact of the proposed action [and] adverse environmental effects which cannot be avoided should the proposal be implemented." [42 U.S.C. 4332(C)].

The Council of Environmental Quality's (CEQ) Regulations for Implementing the Procedural Provisions of NEPA [40 CFR 1500-1508] clarify the requirements by defining direct effects, indirect effects, and cumulative effects.

- **Direct Effects.** Those effects caused by the action and occurring at the same time and place. [40 CFR 1508.8].
- **Indirect Effects.** Those effects caused by the action and occurring later in time or farther removed in distance, but still reasonably foreseeable. Indirect effects may include effects related to induced changes in the pattern of land use and related effects on air and water and other natural systems, including ecosystems. [40 CFR 1508.8].
- **Cumulative Impacts.** Those impacts on the environment, which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. [40 CFR 1508.7].

Even though we cannot quantify the potential cumulative impacts to ecological resources, it is possible to do a qualitative assessment of what those impacts might be. This new road will re-set the southern boundary for what remains of the large, undisturbed central core area of the INL. That boundary is now, arguably, set by Highway 20, with some interruption by the east powerline. The boundary on the west is generally marked by Lincoln Boulevard, INTEC, CFA and PBF. Recent activities associated with the development of the CITRC have strengthened the effectiveness of the boundary in that area. The proposed development of a new reactor facility in that general area would move that boundary in still further. The proposed explosives test area on T-23 will also cause a significant reduction in the size of that undisturbed core area.

Because the proposed routes are in or near the planned development corridor, it is reasonable to expect that a new paved road between CITRC and MFC will result in additional future development along that corridor (DOE 1997). Development of new facility areas in this corridor will also require utility development such as electricity and fiber optic cable. Developing these utilities will bring new disturbance along the road, strengthening the impacts of that road on habitat fragmentation and loss. It is also reasonable to expect more habitat loss and fragmentation by construction of new facilties along the new road. Among the proposed routes, these impacts would be greatest along T-24 and least along the East Powerline routes.

As stated previously, the resources to develop a quantitative assessment of cumulative impacts to ecological resources are not yet available. However, as new developments occur on the INL, as good condition sagebrush steppe habitat and populations of sagebrush obligate species continues to decline all across the West and as the risk of being required to manage for those species continues to increase, it will become increasingly more important that cumulative impacts on the INL be quantified. Being able to quantify cumulative impacts and plan INL developments to minimize those impacts will reduce the likelihood of impacts to the INL mission due to requirements for conservation management of ecological resources.

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Glossary Terms

Detectability: The ability to discover the existence or presence of something.

Ethnobotany: The study of plants as they pertain to an indigenous culture.

Ethnoecology: The study of the natural environment as it pertains to an indigenous culture.

Habitat fragmentation: A splitting of contiguous areas into smaller and increasingly dispersed fragments.

Hibernacula: A protective structure in which an organism remains dormant for the winter.

Home range: The geographic area to which an organism normally confines its activity.

Lek: An area where male grouse congregate for breeding purposes.

Non-game species: Animals which are not normally hunted, fished, or trapped.

Roost: A place on which birds rest or sleep.

Sagebrush obligate species: A species that is only able to exist or survive in sagebrush habitat.

Senesce: The dormancy of plants due to dry or cold conditions.

Sympatric: Species or other taxa with ranges that overlap.

Transitory: Existing or lasting only a short time; short-lived or temporary.

Wilding: Individual plants that are removed from nearby natural communities and immediately transplanted onto a disturbed site.

Appendix A: Plant Species List

Table A-1. Plant Species List

Species Code	Current Scientific Name	Common Name	Family	Nativity	Duration	Growth Habit
achy	*Achnatherum hymenoides*	Indian ricegrass	Poaceae	Native	Perennial	Graminoid
agcr	*Agropyron cristatum*	crested wheatgrass	Poaceae	Introduced	Perennial	Graminoid
alac	*Allium acuminatum*	tapertip onion	Liliaceae	Native	Perennial	Forb
alde	*Alyssum desertorum*	desert alyssum	Brassicaceae	Introduced	Annual	Forb
alte	*Allium textile*	textile onion	Liliaceae	Native	Perennial	Forb
ambl	*Amaranthus blitoides*	mat amaranth	Amaranthaceae	Introduced	Annual	Forb
arfr	*Arenaria franklinii*	Franklin's sandwort	Caryophyllaceae	Native	Perennial	Forb
arho	*Arabis holboellii*	Holboell's rockcress	Brassicaceae	Native	Perennial	Forb
arli	*Arabis lignifera*	desert rockcress	Brassicaceae	Native	Perennial	Forb
artp	*Artemisia tripartita*	threetip sagebrush	Asteraceae	Native	Perennial	Shrub
artr	*Artemisia tridentata*	big sagebrush	Asteraceae	Native	Perennial	Shrub
artrt	*Artemisia tridentata* ssp. *tridentata*	basin big sagebrush	Asteraceae	Native	Perennial	Shrub
artrw	*Artemisia tridentata* ssp. *wyomingensis*	Wyoming big sagebrush	Asteraceae	Native	Perennial	Shrub
asfi	*Astragalus filipes*	basalt milkvetch	Fabaceae	Native	Perennial	Forb
asle	*Astragalus lentiginosus*	freckled milkvetch	Fabaceae	Native	Perennial	Forb
aspu	*Astragalus purshii*	woollypod milkvetch	Fabaceae	Native	Perennial	Forb
atco	*Atriplex confertifolia*	shadscale saltbush	Chenopodiaceae	Native	Perennial	Shrub
atnu	Atriplex nuttallii	Nuttall's saltbush	Chenopodiaceae	Native	Perennial	Shrub
brte	*Bromus tectorum*	cheatgrass	Poaceae	Introduced	Annual	Graminoid
caan	*Castilleja angustifolia*	northwestern Indian paintbrush	Scrophulariaceae	Native	Perennial	Forb
cabr	*Calochortus bruneaunis*	Bruneau mariposa lily	Liliaceae	Native	Perennial	Forb
canu	*Carduus nutans*	musk thistle	Asteraceae	Introduced	Perennial	Forb
chdo	*Chaenactis douglasii*	Douglas' dustymaiden	Asteraceae	Native	Biennial	Forb
chle	*Chenopodium leptophyllum*	narrowleaf goosefoot	Chenopodiaceae	Native	Annual	Forb
chvi	*Chrysothamnus viscidiflorus*	green rabbitbrush	Asteraceae	Native	Perennial	Shrub
ciar	*Cirsium arvense*	Canada thistle	Asteraceae	Introduced	Perennial	Forb
cora	*Cordylanthus ramosus*	bushy bird's beak	Scrophulariaceae	Native	Annual	Forb
crac	*Crepis acuminata*	tapertip hawksbeard	Asteraceae	Native	Perennial	Forb
crci	*Cryptantha circumscissa*	cushion cryptantha	Boraginaceae	Native	Annual	Forb
crin	*Cryptantha interrupta*	Elko cryptantha	Boraginaceae	Native	Perennial	Forb
crsc	*Cryptantha scoparia*	desert cryptantha	Boraginaceae	Native	Annual	Forb
dean	*Delphinium andersonii*	Anderson's larkspur	Ranunculaceae	Native	Perennial	Forb
depi	*Descurainia pinnata*	western tansymustard	Brassicaceae	Native	Annual	Forb
deso	*Descurainia sophia*	herb sophia	Brassicaceae	Introduced	Annual	Forb
elel	*Elymus elymoides*	bottlebrush squirreltail	Poaceae	Native	Perennial	Graminoid
ella	*Elymus lanceolatus*	streambank wheatgrass	Poaceae	Native	Perennial	Graminoid
erce	*Eriogonum cernuum*	nodding buckwheat	Polygonaceae	Native	Annual	Forb
erfi	*Erigeron filifolius*	threadleaf fleabane	Asteraceae	Native	Perennial	Forb
ermi	*Eriogonum microthecum*	slender buckwheat	Polygonaceae	Native	Perennial	Shrub
erna	*Ericameria nauseosus*	rubber rabbitbrush	Asteraceae	Native	Perennial	Shrub
erna2	*Ericameria nana*	dwarf goldenbush	Asteraceae	Native	Perennial	Shrub
erov	*Eriogonum ovalifolium*	cushion buckwheat	Polygonaceae	Native	Perennial	Forb
erpu	*Erigeron pumilus*	shaggy fleabane	Asteraceae	Native	Perennial	Forb
erwi	*Eriastrum wilcoxii*	Wilcox's woollystar	Polemoniaceae	Native	Annual	Forb

Table A-1. Plant Species List (continued)

Species Code	Current Scientific Name	Common Name	Family	Nativity	Duration	Growth Habit
gadi	*Gayophytum diffusum*	spreading groundsmoke	Onagraceae	Native	Annual	Forb
gara	*Gayophytum ramosissimum*	hairstem gayophytum	Onagraceae	Native	Annual	Forb
gile	*Gilia leptomeria*	sand gilia	Polemoniaceae	Native	Annual	Forb
gitw	*Gilia tweedyi*	Tweedy's gila	Polemoniaceae	Native	Annual	Forb
grsp	*Grayia spinosa*	spiny hopsage	Chenopodiaceae	Native	Perennial	Shrub
gusa	*Gutierrezia sarothrae*	broom snakeweed	Asteraceae	Native	Perennial	Shrub
hagl	*Halogeton glomeratus*	saltover	Chenopodiaceae	Introduced	Annual	Forb
heco	*Hesperostipa comata*	needle and thread grass	Poaceae	Native	Perennial	Graminoid
ipco	*Ipomopsis congesta*	ballhead ipomopsis	Polemoniaceae	Native	Perennial	Forb
krla	*Krascheninnikovia lanata*	winterfat	Chenopodiaceae	Native	Perennial	Shrub
laoc	*Lappula occidentalis*	flatspine stickseed	Boraginaceae	Native	Annual	Forb
leci	*Leymus cinerus*	basin wildrye	Poaceae	Native	Perennial	Graminoid
lepe	*Lepidium perfoliatum*	clasping pepperweed	Brassicaceae	Introduced	Annual	Forb
lepu	*Leptodactylon pungens*	prickly phlox	Polemoniaceae	Native	Perennial	Shrub
lodi	*Lomatium dissectum*	fernleaf biscuitroot	Apiaceae	Native	Perennial	Forb
lofo	*Lomatium foeniculaceum*	desert biscuitroot	Apiaceae	Native	Perennial	Forb
lygr	*Lygodesmia grandiflora*	largeflower skeletonplant	Asteraceae	Native	Perennial	Forb
maca	*Machaeranthera canescens*	hoary aster	Asteraceae	Native	Perennial	Forb
meal	*Mentzelia albicaulis*	whitestem blazingstar	Loasaceae	Native	Annual	Forb
oeca	*Oenothera caespitosa*	tufted evening-primrose	Onagraceae	Native	Perennial	Forb
oepa	*Oenothera pallida*	pale evening-primrose	Onagraceae	Native	Perennial	Forb
oppo	*Opuntia polyacantha*	pricklypear	Cactaceae	Native	Perennial	Shrub
paca	*Packera cana*	wooly groundsel	Asteraceae	Native	Perennial	Forb
pasm	*Pascopyrum smithii*	western wheatgrass	Poaceae	Native	Perennial	Graminoid
pecy	*Penstemon cyaneus*	blue penstemon	Scrophulariaceae	Native	Perennial	Forb
phha	*Phacelia hastata*	silverleaf phacelia	Hydrophyllaceae	Native	Perennial	Forb
phho	*Phlox hoodii*	Hood's phlox	Polemoniaceae	Native	Perennial	Forb
phlo	*Phlox longifolia*	longleaf phlox	Polemoniaceae	Native	Perennial	Forb
pose	*Poa secunda*	Sandberg bluegrass	Poaceae	Native	Perennial	Graminoid
pssp	*Pseudoroegneria spicata*	bluebunch wheatgrass	Poaceae	Native	Perennial	Graminoid
ptte	*Pteryxia terebinthina*	turpentine wavewing	Apiaceae	Native	Perennial	Forb
saka	*Salsola kali*	Russian thistle	Chenopodiaceae	Introduced	Annual	Forb
sial	*Sisymbrium altissimum*	tall tumblemustard	Brassicaceae	Introduced	Annual	Forb
spmu	*Sphaeralcea munroana*	white-stemmed globe-mallow	Malvaceae	Native	Perennial	Forb
stvi	*Stanleya viridiflora*	green princesplume	Brassicaceae	Native	Perennial	Forb
teca	*Tetradymia canescens*	spineless horsebrush	Asteraceae	Native	Perennial	Shrub
thar	*Thlaspi arvense*	field pennycress	Brassicaceae	Introduced	Annual	Forb
thla	*Thelypodium laciniatum*	cutleaf thelypody	Brassicaceae	Native	Biennial	Forb
tofl	*Townsendia florifer*	showy Townsend daisy	Asteraceae	Native	Annual	Forb
trdu	*Tragopogon dubius*	yellow salsify	Asteraceae	Introduced	Biennial	Forb