DOE/EA-1728D

Environmental Assessment

Integrated Vegetation Management on the Hanford Site, Richland, Washington

U.S. Department of Energy
Richland Operations Office
Richland, Washington 99352

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ACRONYMS AND ABBREVIATIONS

ADT	Average daily traffic
ALE	Fitzner/Eberhardt Arid Land Ecology Reserve
ACGIH	American Conference of Governmental Industrial Hygienists
ALARA	As low as reasonably achievable
ARRA	*American Recovery and Reinvestment Act*
BCAA	Benton Clean Air Agency
BRMaP	Biological Resources Management Plan
BRMiS	Biological Resources Mitigation Strategy
CAA	*Clean Air Act*
CEQ	Council on Environmental Quality
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	Code of Federal Regulations
CLUP	*Comprehensive Land-Use Plan Environmental Impact Statement*
CO	Carbon monoxide
CO_2e	Equivalent carbon dioxide
CWA	*Clean Water Act*
DART	Days away from work or restricted work activity
dBA	Decibels A-weighted
DART	Days of Restricted Work Activity
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
DOH	Washington State Department of Health
EA	Environmental Assessment
ECAMP	Ecological Compliance Assessment Management Plan
Ecology	Washington State Department of Ecology
ECR	Ecological Compliance Review
EDNA	Environmental designation for noise abatement
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPCRA	*Emergency Planning and Community Right-to-Know Act of 1986*
ERDF	Environmental Restoration Disposal Facility
ESA	*Endangered Species Act*
FFTF	Fast Flux Test Facility
FONSI	Finding of No Significant Impact
HEIS	Hanford Environmental Information System
HFC	Hydrofluorocarbon
HMS	Hanford Meteorological Station
IVM	Integrated Vegetation Management
IRIS	Integrated Risk Information System

LERF	Liquid Effluent Retention Facility
LIGO	Laser Interferometer Gravitational Wave Observatory
LOSC	Level of service capacity
MBTA	*Migratory Bird Treaty Act*
MEI	Maximally exposed individual
mrem	millirem
MSA	Mission Support Alliance, LLC
MSDS	Material Safety Data Sheet
NEPA	*National Environmental Policy Act of 1969*
NFEMP	Near-Facility Environmental Monitoring Project
NIOSH	National Institute of Occupational Safety and Health
NMOG	Non-methane organic gases
NO_x	Oxides of Nitrogen
NPDES	National Pollutant Discharge Elimination System
OEL	Occupational exposure limit
OSHA	Occupational Safety and Health Administration
PAN	Pesticide Action Network
PEL	Permissible exposure limit
PM	Particulate Matter
PNNL	Pacific Northwest National Laboratory
RCRA	*Resource Conservation and Recovery Act of 1976*
RCW	Revised Code of Washington
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SEPA	*State Environmental Policy Act of 1971*
SESP	Surface Environmental surveillance Project
SO_x	Oxides of sulfur
TCP	Traditional Cultural Property
TEDF	Treated Effluent Disposal Facility
TLV	Threshold limit value
TRC	Total recordable cases
TSD	Treatment, storage, and disposal
TWA	Time weighted average
USC	United States Code
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
VOC	Volatile organic compounds
WAC	Washington Administrative Code
WDFW	Washington State Department of Fish and Wildlife
WSDA	Washington State Department of Agriculture
WSDOT	Washington State Department of Transportation

Unit Conversion Chart

Into metric units			Out of metric units		
If you know	Multiply by	To get	If you know	Multiply by	To get
Length			**Length**		
inches	25.40	Millimeters	Millimeters	0.03937	inches
inches	2.54	Centimeters	Centimeters	0.393701	inches
feet	0.3048	Meters	Meters	3.28084	feet
yards	0.9144	Meters	Meters	1.0936	yards
miles (statute)	1.60934	Kilometers	Kilometers	0.62137	miles (statute)
Area			**Area**		
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.09290304	square meters	square meters	10.7639	square feet
square yards	0.8361274	square meters	square meters	1.19599	square yards
square miles	2.59	square kilometers	square kilometers	0.386102	square miles
acres	0.404687	Hectares	Hectares	2.47104	acres
Mass (weight)			**Mass (weight)**		
ounces (avoir.)	28.34952	Grams	Grams	0.035274	ounces (avoir.)
pounds (avoir.)	0.45359237	Kilograms	Kilograms	2.204623	pounds (avoir.)
tons (short)	0.9071847	tons (metric)	tons (metric)	1.1023	tons (short)
Volume			**Volume**		
ounces (U.S., liquid)	29.57353	Milliliters	Milliliters	0.033814	ounces (U.S., liquid)
quarts (U.S., liquid)	0.9463529	Liters	Liters	1.0567	quarts (U.S., liquid)
gallons (U.S., liquid)	3.7854	Liters	Liters	0.26417	gallons (U.S., liquid)
cubic feet	0.02831685	cubic meters	cubic meters	35.3147	cubic feet
cubic yards	0.7645549	cubic meters	cubic meters	1.308	cubic yards
Temperature			**Temperature**		
Fahrenheit	subtract 32 then multiply by 5/9ths	Celsius	Celsius	multiply by 9/5ths, then add 32	Fahrenheit
Energy			**Energy**		
kilowatt hour	3,412	British thermal unit	British thermal unit	0.000293	kilowatt hour
kilowatt	0.94782	British thermal unit per second	British thermal unit per second	1.055	kilowatt
Force/Pressure			**Force/Pressure**		
pounds (force) per square inch	6.894757	Kilopascals	Kilopascals	0.14504	pounds per square inch
torr	133.32	Pascals	Pascals	0.0075	torr

06/2001

Source: *Engineering Unit Conversions*, M. R. Lindeburg, PE, Third Ed., 1993, Professional Publications, Inc., Belmont, California.

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1.0 INTRODUCTION

1.1 NATIONAL ENVIRONMENTAL POLICY ACT DETERMINATION RECOMMENDATION

This *Environmental Assessment for Vegetation Management on the Hanford Site, Richland, Washington* (DOE/EA-1728) (Draft Environmental Assessment [EA]) has been prepared by the U.S. Department of Energy (DOE) pursuant to the *National Environmental Policy Act of 1969* (NEPA); the Council on Environmental Quality's *Regulations for Implementing the Procedural Provisions of NEPA* (Title 40, Code of Federal Regulations [CFR], Parts 1500−1508); and DOE's "National Environmental Policy Act Implementing Procedures" (10 CFR 1021). The EA evaluates the potential environmental impacts from managing vegetation on the Hanford Site under a No Action Alternative and Proposed Action.

The EA will be used by DOE to determine if the Proposed Action is a major federal action significantly affecting the quality of the human environment. If so, DOE must then prepare an Environmental Impact Statement (EIS) and issue a Record of Decision (ROD) before the action could proceed. In contrast, if the Proposed Action is determined not to have significant environmental effects, then a Finding of No Significant Impact (FONSI) will be issued and the action may then be implemented.

Historically, DOE determined that vegetation management at the Hanford Site did not require preparation of an EA or EIS, and, therefore, was categorically excluded from preparation of either document. Vegetation management activities have been excluded pursuant to Categorical Exclusion B1.3, "Routine maintenance/custodial services for buildings, structures, infrastructures, equipment" (Title 10, CFR Part 1021, Subpart D, Appendix B) wherein provisions are made for "localized vegetation and pest control…Erosion control and soil stabilization measures (such as reseeding and revegetation)..."

Now, however, DOE believes it appropriate to evaluate the overall scope of most vegetation management activities conducted at the Hanford Site. This EA provides an evaluation of the potential direct, indirect, and cumulative environmental impacts from such management.

1.2 PURPOSE AND NEED FOR AGENCY ACTION

DOE needs to manage vegetation on the Hanford Site to:

- Reduce or eradicate invasive plants and noxious weeds
- Minimize biological uptake and transport of contaminants
- Reduce or eliminate wildfire hazards
- Restore and preserve desirable plant communities and wildlife habitat
- Protect natural, cultural, and ecological resources.

Vegetation management on the Hanford Site occurs at various locations each requiring different management strategies. These locations include radioactive and chemical waste management areas, infrastructure areas, open rangelands, and landscaped areas around buildings.[1, 2]

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[1] Vegetation management in landscaped areas, which is directed towards visual aesthetics, is not subject to DOE's purpose and need for action; such activities are not within the scope of this EA and are categorically excluded.

[2] Radioactive and chemical waste management and operation areas remediated by Hanford Site cleanup contractors may be treated in the future to promote desirable plant species while excluding invasive plants and noxious weeds.

In the past, DOE has managed vegetation at these locations in an individual, project-specific, or localized manner. The failure to conduct vegetation management from a more comprehensive perspective, however, has increased the density and distribution of invasive plants and noxious weeds, which in turn could spread into radioactive and chemical waste management areas increasing biological uptake and transport of contaminants. In addition, the diversity and abundance of ecologically desirable plants and associated wildlife habitat would continue to degrade as invasive plants and noxious weeds spread.

Furthermore, wildfire hazards would increase as invasive plants and noxious weeds proliferate providing additional supplies of wildfire fuel. Natural, cultural, and ecological resources would be in greater jeopardy of damage by more frequent, higher intensity wildfires and from associated fire suppression activities. Wind erosion and resulting fugitive dust would increase while wildfire disturbed areas recover.

Invasive Plants and Noxious Weeds

Invasive plants are introduced species that can thrive in areas beyond their natural range of dispersal. These plants are characteristically adaptable, aggressive, and have a high reproductive capacity. Their vigor combined with a lack of natural enemies often leads to outbreak populations. Russian thistle and cheatgrass are two invasive plants of chief concern on the Hanford Site due to wildfire hazards.

A **noxious weed** is an invasive plant. Federal and/or State law designates plants as "noxious" if they are overly aggressive, difficult to manage, parasitic, poisonous, and carriers or hosts of insects or serious diseases. The State of Washington has identified certain plants as noxious weeds – several of which are of high-priority for control on the Hanford Site, including Yellow Starthistle, Rush Skeletonweed, Medusahead, Babysbreath, Dalmatian Toadflax, Spotted Knapweed, Diffuse Knapweed, Russian Knapweed, Saltcedar, and Purple Loosestrife.

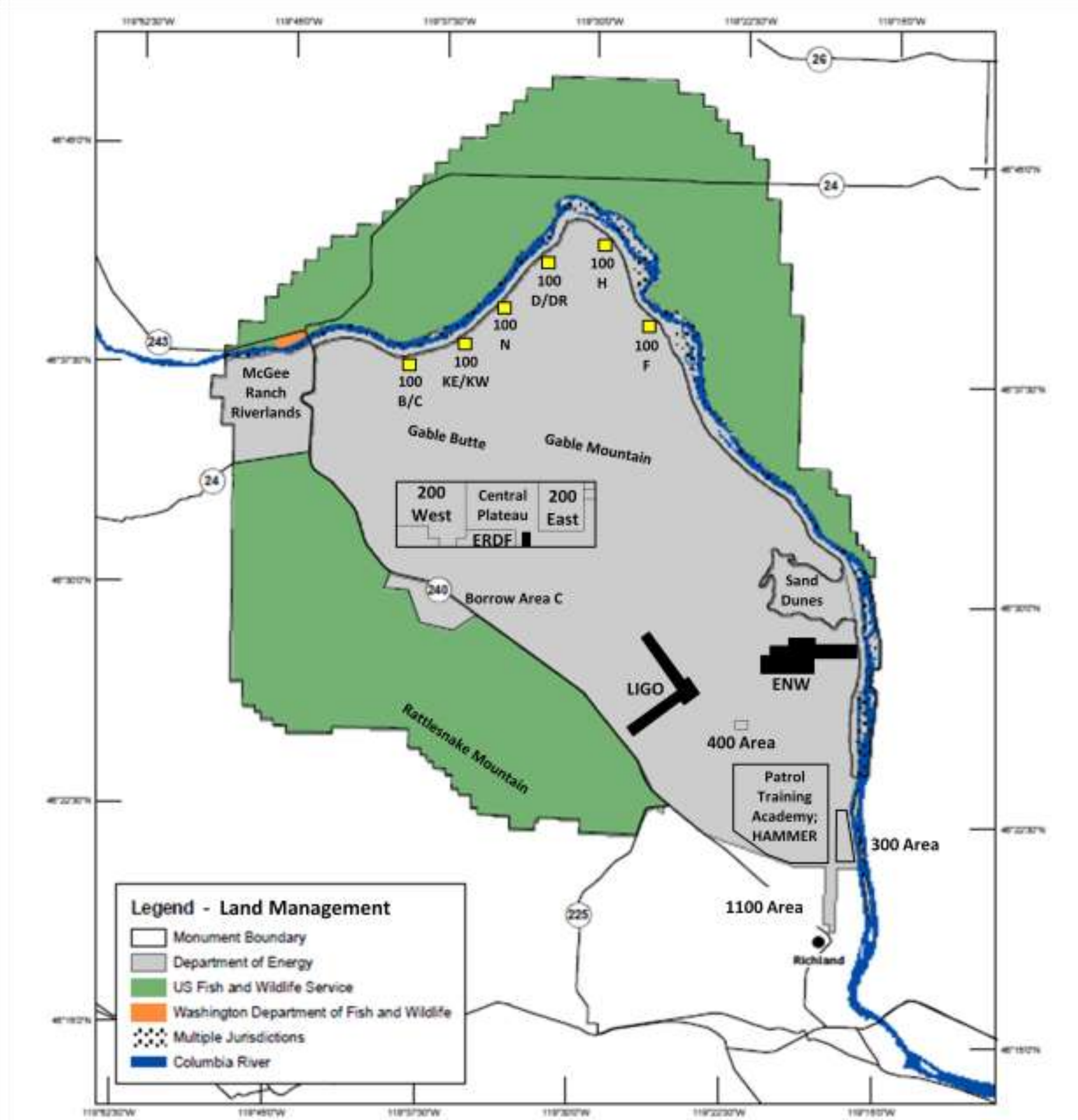
For these reasons, DOE needs to comprehensively manage vegetation onsite in a manner that would reduce or eradicate invasive plants and noxious weeds in favor of maintaining or enhancing the variety, distribution, and abundance of desirable plant communities.

1.3 BACKGROUND

The Hanford Site covers approximately 151,774 hectares (375,040 acres). Of this, 78,914 hectares (195,000 acres) are set aside for the Hanford Reach National Monument. The U.S. Fish and Wildlife Service (USFWS) manage 66,773 hectares (165,000 acres) of the monument through a permit with the DOE. The DOE directly manages 11,736 hectares (29,000 acres; i.e., McGee Ranch/Riverlands, Borrow Area C, and Sand Dunes). The Washington State Department of Fish and Wildlife (WDFW) manage the remaining 405 hectares (1,000 acres) under a DOE permit. The balance of the Hanford Site, 72,860 hectares (180,040 acres), is managed by DOE. For the purposes of this EA, all lands managed by the DOE are referred to as the “project area” of the Hanford Site (Figure 1-1). The project area totals approximately 84,596 hectares (209,040 acres) and is subject to vegetation management activities discussed in this EA.

Within the area of DOE’s responsibility, there are more than 3,000 waste sites grouped into operable units or waste management areas that total approximately 3,581 hectares (8,850 acres) of surface contamination (DOE/RL-88-30, *Hanford Site Waste Management Units Report*). In addition, there are approximately 578 hectares (1,430 acres) of underground contamination. Waste sites include single-shell tanks, double-shell tanks, inactive solid waste burial grounds and landfills, and inactive liquid waste ponds, ditches, cribs, and unplanned release sites. From 2006 through 2009, approximately 2,023 hectares (5,000 acres) to 3,197 hectares (7,900 acres) were treated annually with physical and chemical methods, and prescribed burning to control vegetation in radioactive and chemical waste management areas and maintain existing fire breaks nearby existing infrastructure (e.g., roads, transmission lines). A total of about 8,660 hectares

Figure 1-1. Project Area of the Hanford Site Managed by the U.S. Department of Energy.



(21,400 acres) were treated by these methods. During the same time frame, approximately 6,520 hectares (16,111 acres) of radioactive and chemical waste management areas were reseeded with bunchgrass; many areas were reseeded multiple times (PNNL-16623, PNNL-17603, PNNL-18427, PNNL-19455, *Hanford Site Environmental Report for Calendar Year*).

A variety of methods have been employed to manage vegetation, specifically invasive plants and noxious weeds, at various locations on the Hanford Site. Methods used to manage these invasive plants and noxious weeds have been selected in an individual, project-specific, or localized manner. The tank farms, for example, are kept vegetation-free by using physical or chemical methods. Stabilized solid and liquid waste sites are revegetated with shallow-rooted grasses and then treated (i.e., physical and chemical methods) to prevent the growth of deep-rooted invasive plants and noxious weeds. Finally, existing infrastructure and adjacent areas are kept vegetation-free by physical or chemical methods and prescribed burning to maintain existing firebreaks and reduce dried tumbleweed accumulations.

DOE is now considering whether to employ a more comprehensive approach, referred to as *Integrated Vegetation Management* (IVM), to manage vegetation, including invasive plants and noxious weeds on the Hanford Site. IVM is a decision-making and management process that uses knowledge from a broad base of expertise, a combination of treatment methods, and a monitoring and evaluation system to achieve long-term reduction and eradication of invasive plants and noxious weeds. The overall goals of IVM are to keep undesirable invasive plant and noxious weed populations low enough to prevent unacceptable spread, damage, or annoyance, and encourage the establishment of desirable shrubs, grasses, and forbs typically found in the Hanford Site's shrub-steppe ecosystem.

IVM promotes the integrated use of physical, chemical, and biological methods, prescribed burning, and revegetation, as appropriate, to manage vegetation. Physical methods include manual and mechanical techniques like hand pulling, mowing, and plowing vegetation. Selective application of physical methods is desirable at sites having higher cultural, ecological, or other values because these methods tend to minimize environmental impacts.

Chemical methods include ground-based and aerial application of selective or non-selective herbicides, including herbicide impregnated biological barriers; selective herbicides can target invasive plants and noxious weeds. Herbicides typically do not remove vegetation, but either kill existing vegetation leaving dead plant biomass, or inhibit vegetative growth.

Biological methods include the introduction of plant-specific parasites, parasitoids, pathogens, predators, and competitors to control invasive plants and noxious weeds when other methods are not technically or economically desirable. Biological methods reunite invasive plants and noxious weeds with their natural enemies to restore control and reduce dominance of target plants within a plant community.

Key Terms

A **selective** herbicide kills specific plant species while leaving desired plant species relatively unharmed. A **non-selective** herbicide kills all plants.

A **parasite** is an organism living with, in or on a plant. It derives all of its sustenance from the host plant.

A **parasitoid** is an organism that spends a significant portion of its life history attached to or within a single host organism in a relationship that is in effect parasitic, but in which it ultimately sterilizes or kills, and often consumes, the host.

A **pathogen** is a disease-causing organism that attacks plants.

Biological Barriers establish a barrier zone where plant roots cannot grow using a fabric impregnated with herbicide.

Prescribed burns are the intentional setting of fires under controlled conditions to achieve specific vegetation and wildfire fuels management objectives. Typically, fires are set to reduce or eradicate vegetation in a given area.

In newly disturbed areas or areas in which invasive plants and noxious weeds have been reduced or eradicated, revegetation is employed to encourage development of desirable plant communities and discourage infestations of invasive plants and noxious weeds. Three types of revegetation are often used: outplanting, transplanting, and broadcast seeding. Outplanting involves planting containerized or bare-root plants. Transplanting involves moving plants living in the wild from one site to another. Directly broadcasting seed over an unprepared or prepared (e.g., by ripping or contouring soils) surface is the most common type of seeding. Broadcast seeding can also be combined with mechanical means that push seeds into the soil (e.g., seed drill, cultipacker), hydro-mulching (combining seeds with a slurry of water and other materials), and pelleting (encasing seeds with soil or other particles).

As a practical matter, an appropriate combination of methods, including prescribed burning where applicable, is selected and then integrated into a treatment program, based on the vegetative attributes of a particular location and the desired outcome. Following treatment, the area may be revegetated with desirable plant species to minimize or prevent future invasive plant and noxious weed infestations. The area is then monitored to determine the extent to which vegetative goals are being met. If goals are not achieved as desired, the treatment program is adjusted to achieve optimum vegetation management (i.e., Adaptive Management).

When applied appropriately, IVM results in improved vegetation management, greater ease of maintenance, and lower environmental impacts. In essence, IVM will result in a gradual reduction in the use of chemical methods as undesirable invasive plants and noxious weeds are replaced by desirable shrubs, grasses, and forbs thereby minimizing vegetative fuels and associated wildfires.

This EA evaluates a No Action Alternative and the Proposed Action. Under the No Action Alternative, DOE would continue its current practices of managing vegetation in an individual, project-specific, or localized manner. Vegetation management would continue to use physical and chemical methods and limited revegetation and prescribed burning in radioactive and chemical waste management areas and near infrastructure to maintain existing firebreaks, as appropriate. Small, localized infestations of invasive plants and noxious weeds would be treated with limited use of physical, chemical, and biological methods. Dried tumbleweed accumulations along firebreaks would be piled and burned, or may be burned in-place if conditions warrant. Areas impacted by wildfires would be revegetated.

Under the Proposed Action, DOE would implement an IVM approach to manage vegetation, targeting invasive plants and noxious weeds, in the same areas as under the No Action Alternative, but also would manage vegetation over large areas in open rangelands using physical and chemical methods (including aerial application of herbicides). In addition, DOE would place greater reliance on prescribed burning, revegetation of treated areas, and targeted introduction of biological methods to control invasive plants and noxious weeds in open rangelands and replace them with desirable shrubs, grasses, and forbs.

The balance of this EA amplifies the discussion of the No Action Alternative and Proposed Action (Section 2.0), Affected Environment (Section 3.0), Environmental Consequences (Section 4.0), and Statutory and Regulatory Requirements (Section 5.0). Distribution of this EA is discussed in Section 6.0, and References are provided in Section 7.0. Several appendixes provide more detailed information in support of the sections.

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2.0 NO ACTION ALTERNATIVE AND PROPOSED ACTION

This section describes the No Action Alternative, which serves as a baseline for comparison with the Proposed Action; and the Proposed Action. It also discusses other alternatives considered, but not analyzed in detail.

> **Firebreak**
>
> Firebreaks are gaps in vegetation that act as a barrier to slow or stop the progress of wildfires; they occur typically along site infrastructure (e.g., paved and unpaved roadways, railroads, and utility right of ways).

2.1 NO ACTION ALTERNATIVE

The No Action Alternative represents a continuation of the current approach to vegetation management on the Hanford Site. As such, DOE would continue its practice of independent, project-specific, or localized vegetation management. To illustrate, DOE would identify a vegetation management concern, for example, an unacceptable increase in vegetative growth and/or accumulation of tumbleweeds in a firebreak. In response then, DOE would identify management goals (e.g., maintaining a vegetation-free firebreak) and select and implement a treatment method or methods, such as using truck-mounted or hand-operated equipment to spray herbicides intended to kill the vegetation in the firebreak. Tumbleweed accumulations would be removed, piled, and burned. The goal of this approach is to minimize undesirable vegetation, principally invasive plants and noxious weeds, and reduce tumbleweed accumulations and the potential for wildfires.

> **Herbicides**
>
> Herbicides would be applied by licensed chemical operators under supervision of a commercial pesticide applicator licensed in the State of Washington. Herbicides would be applied in accordance with manufacturer's recommendations, label requirements, and applicable DOE policies and procedures.

Under the No Action Alternative, DOE would continue to manage vegetation at three primary locations within the project area of the Hanford Site. One such location is the radiological and chemical waste management areas, which include tank farms, inactive solid waste burial grounds and landfills, and inactive liquid waste ponds, ditches, cribs, and unplanned release sites. Vegetation is managed in these locations to minimize biological uptake and transport of contaminants. DOE also would continue to manage vegetation to maintain firebreaks within and adjacent to infrastructure, such as roads and rail lines, and in relatively small areas of open rangelands to prevent the establishment and spread of invasive plants and noxious weeds.

In general, under the No Action Alternative, DOE would continue to remove vegetation by physical methods (i.e., manual, mechanical) and kill vegetation by chemical methods (i.e., herbicides) in certain radioactive and chemical waste management areas. Other such areas that have been stabilized (i.e., revegetated) with bunchgrasses would continue to be monitored, treated, and revegetated as needed to promote established bunchgrasses while excluding invasive plants and noxious weeds. Physical and chemical methods and limited prescribed burning would continue to be used to maintain firebreaks in and adjacent to infrastructure. Infestations of invasive plants and noxious weeds also would be reduced or eradicated in localized (limited) areas in open rangelands nearby infrastructure, and in other small disturbed areas. Open rangelands affected by wildfires would be revegetated. Table 2-1 provides the salient features of the No Action Alternative (and the Proposed Action).

Table 2-1. Description of the No Action Alternative and Proposed Action. (4 sheets)

Descriptive Element	No Action Alternative	Proposed Action
Approach to vegetation management	Continues current approach of managing vegetation in an individual, project-specific, or localized manner. Typically involves: • Problem identification (e.g., infestation of invasive plants) • Project-specific identification of management goals (e.g., maintain existing firebreaks vegetation-free) • Select individual treatment method to address problem and achieve goal (e.g., chemical herbicides) • Implement individual treatment method (e.g., application of non-selective herbicide) to address problems and achieve goals in localized areas.	Enhances current approach by managing vegetation in a comprehensive, holistic manner (referred to as IVM). IVM is a systematic, step-wise approach comprising: • Evaluation of vegetative attributes (i.e., types, distribution, variety, abundance) • Identification of management goals (e.g., elimination of invasive plants and noxious weeds; establishment and preservation of enduring shrubs, grasses, and forbs) at the landscape level to achieve desired ecosystem responses • Identification, integration, and application of multiple treatment methods (e.g., mowing, chemical herbicide, biological parasites, prescribed burning, and revegetation with desirable shrubs, grasses, and forbs) • Monitoring of results of treatment (i.e., management outcome, non-target effects, biodiversity, habitat connectivity, overall ecosystem response) • Reapplication of treatment regime, modified as needed, to meet vegetation management goals and achieve desired outcomes (i.e., Adaptive Management).
Locations in which vegetation is managed	1. Radiological and chemical waste management areas: • Tank farms • Solid waste burial grounds and landfills • Liquid waste ponds, ditches, cribs, and unplanned release sites.	1. Same as No Action Alternative.

Table 2-1. Description of the No Action Alternative and Proposed Action. (4 sheets)

Descriptive Element	No Action Alternative	Proposed Action
	2. Infrastructure, including, but not limited to: • Roadways • Railroads • Power lines • Rights-of-way • Fence lines. 3. Rangelands: • Localized and limited to areas damaged by wildfire, small infestations of invasive plants and noxious weeds, and existing firebreaks provided by site infrastructure.	2. Same as No Action Alternative. 3. Rangelands: • Unlimited, includes areas damaged by wildfire and existing firebreaks, but focuses on invasive plants and noxious weeds at the landscape or ecosystem scale • Targets agricultural "old fields" and other large disturbed areas dominated by wildfire fuel (primarily cheatgrass); followed by revegetation with desirable shrubs, grasses, and forbs.
Methods used by location	1. Radiological and chemical waste management areas: *Tank farms*: • Chemical methods (ground-based application of non-selective herbicides) used to inhibit vegetation growth (devoid of vegetation) • Physical methods (hand pulling) used to remove all vegetative growth, including manual removal and burial of windblown tumbleweeds as potentially contaminated solid waste. *Inactive solid waste areas (not stabilized)*: • Chemical methods (ground-based and aerial application of non-selective herbicides, and/or	1. Same as No Action Alternative.

Table 2-1. Description of the No Action Alternative and Proposed Action. (4 sheets)

Descriptive Element	No Action Alternative	Proposed Action
	herbicide impregnated biological barriers) used to inhibit growth of invasive plants and noxious weeds • Physical methods (hand pulling) to remove all vegetative growth, including manual removal and burial of windblown tumbleweeds as potentially contaminated solid waste. *Inactive solid waste areas (stabilized with grasses)*: • Chemical methods (ground-based and aerial application of selective herbicides and/or herbicide impregnated biological barriers) to prevent growth of invasive plants and noxious weeds • Physical methods (hand pulling) to remove invasive plants and noxious weeds, including manual removal and burial of windblown tumbleweeds as potentially contaminated solid waste • Revegetation (reseeding) with bunchgrasses, as needed. *Inactive liquid waste areas (stabilized with grasses)*: • Chemical methods (ground-based and aerial application of selective herbicides and/or herbicide impregnated biological barriers) to prevent growth of invasive plants and noxious weeds • Physical methods (hand pulling) to remove invasive plants and noxious weeds, including manual removal and burial of windblown tumbleweeds as potentially contaminated solid waste	

Table 2-1. Description of the No Action Alternative and Proposed Action. (4 sheets)

Descriptive Element	No Action Alternative	Proposed Action
	• Revegetation (reseeding) with bunchgrasses, as needed.	
	2. Infrastructure: • Physical methods (hand pulling, mowing, tilling) to remove vegetative fuels, primarily invasive plants and noxious weeds • Chemical methods (ground-based application of selective or non-selective herbicides) to remove vegetative fuels, primarily invasive plants and noxious weeds • Prescribed burning to remove vegetative fuels, primarily tumbleweed accumulations.	2. Same as No Action Alternative.
	3. Rangelands: • Revegetation (outplanting, transplanting, and broadcast/cultipacker or drill seeding) of areas damaged by wildfires • Chemical methods (ground-based application of selective or non-selective herbicides) to reduce or eradicate small infestations of invasive plants and noxious weeds and maintain existing firebreaks • Physical methods (hand pulling, mowing, tilling) to eradicate invasive plants and noxious weeds along existing firebreaks • Biological methods (parasites, parasitoids, pathogens) to reduce small infestations of invasive plants and noxious weeds.	3. Rangelands, same as No Action Alternative, except: • Chemical methods include aerial application of selective or non-selective herbicides on larger areas (i.e., landscape or ecosystem scale) • Prescribed burning to reduce or eradicate invasive plants and noxious weeds, including large agricultural "old fields" and other disturbed areas dominated by wildfire fuel (primarily cheatgrass) • Treated areas revegetated (outplanting, transplanting, and broadcast/cultipacker or drill seeding) with desirable shrubs, grasses, and forbs following treatment.

2.1.1 Radiological and Chemical Waste Management Areas

Under the No Action Alternative, DOE would continue to apply vegetation management strategies specific to tank farms, inactive solid waste burial grounds and landfills, and inactive liquid waste ponds, ditches, cribs, and unplanned release sites. In general, the goal of vegetation management at unstabilized (vegetation free) radiological and chemical waste management areas is to maintain these areas free of primarily deep-rooted vegetation and thereby minimize the potential for biological uptake and transport of contaminants while facilitating operations activities (e.g., tank waste or solid waste retrieval operations). The goal at stabilized (vegetated) radiological and chemical waste manage areas is to reduce or eradicate infestations of invasive plants and noxious weeds, and maintain viable bunchgrass communities, thereby minimizing biological uptake and transport of contaminants and soil erosion.

At the single-shell and double-shell tank farms, DOE would continue to use ground-based equipment (broadcast [for granular herbicides], truck-mounted and hand-operated sprayers) to apply non-selective herbicides, and manual methods (hand pulling) to remove vegetation, as needed, to ensure the farms remain devoid of vegetation. Wind-blown tumbleweed accumulations would be collected manually. All vegetation collected within radiologically posted areas would be compacted and disposed of as low-level radioactive waste in the onsite Environmental Restoration Disposal Facility (ERDF); all vegetation adjacent to (but not within) radiologically posted areas would be burned in accordance with protocols established with the Washington State Department of Health (DOH).

At inactive solid waste burial grounds and landfills that have not been revegetated, DOE would continue to apply non-selective herbicides using ground-based equipment or small aircraft (fixed wing or helicopter) to inhibit the growth of invasive plants and noxious weeds. Aerial applications of herbicides would occur when determined to be more cost effective than ground-based techniques considering the size of the treatment area, potential non-target impacts (e.g., overspray), and safety concerns (e.g., no walk/drive zones susceptible to subsidence/collapse). DOE also would apply herbicide impregnated biological barriers using ground-based equipment to inhibit invasive plant and noxious weed root penetration, although biological barriers would be limited to relatively small areas (93 square meters [1,000 square feet]). In addition, vegetation would be removed using physical methods such as hand pulling, and wind-blown tumbleweed accumulations would be collected manually. All vegetation collected within radiologically posted areas would be compacted and disposed of as low-level radioactive waste in the onsite ERDF; all vegetation adjacent to (but not within) radiologically posted areas would be burned in accordance with protocols established with the DOH.

At revegetated solid waste burial grounds and landfills, and inactive liquid waste ponds, ditches, cribs, and unplanned release sites, DOE would continue to monitor the viability of established shallow-rooted bunchgrasses and the extent to which invasive plants and noxious weeds develop. If needed, DOE would reseed these areas with shallow-rooted bunchgrasses (by seed spreaders, see drills, or broadcasting), and apply selective herbicides using ground-based and aerial methods and/or apply herbicide impregnated biological barriers using ground-based equipment to inhibit the growth of, or eradicate invasive plants and noxious weeds.

The radiological and chemical waste management areas comprise an estimated 4,160 hectares (10,278 acres [8,849 acres of surface contamination and 1,429 acres of underground contamination]) of the 72,860 hectares (180,040 acres) managed by DOE on the Hanford Site. Of this, DOE estimates that about 70 percent or 2,914 hectares (7,200 acres) would be treated annually using chemical and physical methods. In addition, under typical conditions about 202 hectares (500 acres) would be revegetated annually by reseeding previously stabilized areas. Table 2-2 provides a summary of the size of areas that would be treated under the No Action Alternative (and the Proposed Action).

Table 2-2. Size of Areas Treated under the No Action Alternative and Proposed Action

Resource	No Action Alternative		Proposed Action	
	Amount (miles)	Area Available for Treatment Annually (acres)	Amount (miles)	Additional Area Available for Treatment Annually (acres)
Radioactive and Chemical Waste Management Areas (Physical and Chemical Methods)				
Surface contamination		8,849		Same as No Action
Underground contamination		1,429		Same as No Action
SUBTOTAL		10,278		Same as No Action
Infrastructure – Firebreaks (Physical, Chemical, and Prescribed Burning Methods)				
Major Roads (paved/unpaved)	377	1,828[a]	Same as No Action	Same as No Action
Railroads	114	276[b]	Same as No Action	Same as No Action
Power Lines[d]	185	448[b]	Same as No Action	Same as No Action
Other (cultural sites, groundwater monitoring well sites, fence lines, and emergency siren sites)[c]	50	121[b]	Same as No Action	Same as No Action
SUBTOTAL	726	2,673	Same as No Action	Same as No Action
Open Rangelands (Physical, Chemical, Biological, and Prescribed Burning Methods)				
Physical methods		100		500
Chemical methods		500		5,000 – 10,000
Biological methods		100		500
Prescribed burning		None[h]		3,000 – 5,000
SUBTOTAL		700		9,000 – 16,000
Revegetation (Shrubs, Grasses, and/or Forbs)				
Repair of stabilized radioactive and chemical waste management areas		500		Same as No Action
Wildfire areas (rangelands)		7,500		No Additional Areas[g]
New treated areas (rangelands)		Not Applicable		3,000 – 5,000[e]
SUBTOTAL		8,000		3,500 – 5,500
TOTALS	726	21,651	Same as No Action	25,451 – 34,451[f]

NOTE: Convert miles to kilometers by multiplying by 1.609 and acres to hectares by multiplying by 0.405.

[a] Assumes 20 feet on either side of the roadways.
[b] Assumes 10 feet on either side of the railroad.
[c] Cultural sites included in roads. Groundwater monitoring well sites and emergency siren sites are small localized areas.
[d] Main 230-kilovolt and 13.8 kilovolt transmission lines from Bonneville Power Administration.
[e] Revegetation would occur on areas treated with prescribed burning. Areas treated with chemical methods may require multiple treatments before revegetation occurs.
[f] Total acreage treated annually is expected to decline over time as invasive plants and noxious weeds are replaced by desirable shrubs, grasses, and forbs and wildfires decrease.
[g] 7,500 acres under the No Action includes initial seeding and reseeding of burned areas. Proposed Action expected to control fuel and wildfires with no new areas; see note (e).
[h] Tumbleweed accumulations only; prescribed burning not used as a vegetation management treatment method.

2.1.2 Infrastructure Areas

> **Infrastructure**
>
> For purposes of this EA, infrastructure includes power line rights-of-way, rail line rights-of-way, roadways, certain cultural resources sites, groundwater monitoring well sites, fence lines, and emergency siren sites.

Under the No Action Alternative, DOE would continue to maintain firebreaks by reducing or eliminating vegetation in particular invasive plants, noxious weeds, and tumbleweed accumulations, within and along infrastructure in the project area of the Hanford Site. Paved and unpaved roads serve as the principal infrastructure firebreaks in the project area of the Hanford Site. DOE also maintains firebreaks in the project area to protect rail lines, power lines, certain cultural resources (e.g., Gable Mountain and Gable Butte traditional cultural properties), groundwater monitoring well sites, fence lines, and emergency siren sites. The goal of managing vegetation in these areas is to minimize the buildup of vegetation that could provide fuel for wildfires and minimize potential impacts to site infrastructure; and natural, cultural, and ecological resources on the Hanford Site.

DOE would use physical and chemical methods, as well as prescribed burning to manage invasive plants and noxious weeds. Physical methods would include the use of hand pulling (manual), or mechanical means such as mowing and tilling. Chemical methods would include the use of ground-based equipment to apply selective or non-selective herbicides. DOE also would use controlled burns (prescribed burning) to eliminate accumulations of tumbleweeds.

The total firebreak area is estimated at 1,082 hectares (2,673 acres). Firebreaks along major Hanford Site roadways occupy an area estimated at 740 hectares (1,828 acres). The combined total of other areas where firebreaks are established is estimated at 342 hectares (845 acres). Of this, DOE estimates that about 70 percent, or 518 hectares (1,280 acres) along Hanford Site roadways and 240 hectares (592 acres) of other areas, would be treated annually using physical and chemical methods and prescribed burning. Figure 2-1 depicts firebreaks provided by major roadways on the Hanford Site.

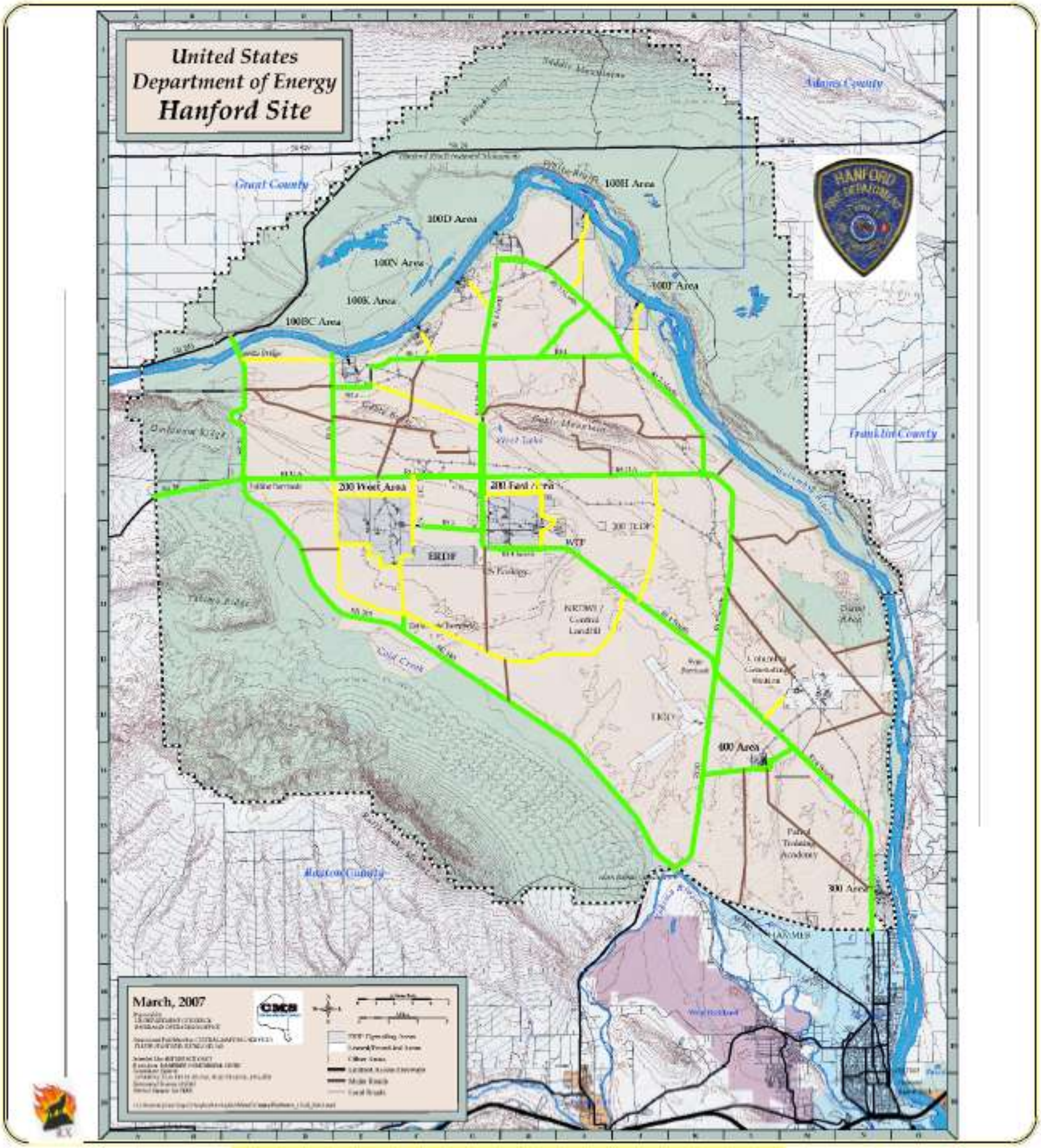
2.1.3 Open Rangelands Areas

Under the No Action Alternative, DOE would continue to reduce or eradicate small, local infestations of invasive plants and noxious weeds in relatively small areas of accessible open rangelands. DOE would also revegetate some areas affected by wildfire where it is desirable to augment natural recovery of desirable plant species while excluding invasive plants and noxious weeds. The principal goal is to minimize undesirable vegetation, principally invasive plants and noxious weeds that serve as fuels for wildfires, and thereby reduce wildfire hazards.

DOE would use physical, chemical, and biological methods to reduce or eradicate invasive plants and noxious weeds. Physical methods would include the use of hand pulling (manual), or mechanical means such as mowing and tilling. Chemical methods would include the use of ground-based equipment to apply selective or non-selective herbicides. Biological methods would include the use of parasites, parasitoids, or pathogens to weaken target plants.

DOE also would continue to revegetate open rangelands that have been disturbed by wildfire where determined appropriate (i.e., augment natural recovery). Revegetation with shrubs, grasses, and forbs would be achieved through various methods including outplanting, transplanting, and broadcast/cultipacker or seed drilling.

Figure 2-1. Major Roadway Firebreaks on the Hanford Site.



2011 Fire Containment Lines

Class Description

Class 1--Divided highway, or 2 lane highway with both sides treated. Typical width 100'.

Class 2--2 lane road, asphalt or dirt. Typical width of 50'.

Class 3--1 lane dirt road, or 2 wide disk line. Typical width of 30'.

Fire Line Class
Designated Fire Break
Class
1
2
3

DOE estimates that about 243 hectares (600 acres) per year would be treated using chemical and physical methods to reduce or eradicate invasive plants and noxious weeds. The use of biological methods would be limited to about 41 hectares (100 acres) annually. In addition, DOE estimates for purposes of analysis, that approximately 3,035 hectares (7,500 acres) would be revegetated yearly in response to damage by wildfires or reseeded as a result of past wildfires.

2.2 PROPOSED ACTION

The Proposed Action represents an enhancement of the previous approach to vegetation management within the project area of the Hanford Site (see Table 2-1). As such, DOE would initiate a more comprehensive approach, referred to as IVM, to managing vegetation in open rangelands at the landscape or ecosystem scale (i.e., broaden from localized project-specific basis to overall land health and ecosystem restoration). IVM is a systematic approach comprising several steps in which DOE would:

1. Evaluate vegetative attributes such as the types of vegetation and their distribution, variety, and abundance in broad, open areas of rangelands.
2. Identify management goals to be achieved. Goals would include, for example, the elimination of invasive plants and noxious weeds coupled with the establishment and maintenance of enduring shrubs, grasses, and forbs to enhance biodiversity, reconnect fragmented wildlife habitat, and reduce wildfires.
3. Identify, integrate, and apply multiple treatment methods. Treatment methods would include a variety of specific physical, chemical, and biological methods; prescribed burning; and revegetation.
4. Monitor treatment results to determine the extent to which vegetation management goals have been achieved.
5. Reapply treatment methods, modified as needed, to achieve vegetation management goals (i.e., Adaptive Management).

The goal of this approach under the Proposed Action is to minimize undesirable vegetation, principally invasive plants and noxious weeds; minimize biological uptake and transport of contaminants; reduce wildfire hazards; restore and preserve desirable plant communities and wildlife habitat; and protect natural, cultural, and ecological resources.

Under the Proposed Action, DOE would continue to manage vegetation at three primary locations on the Hanford Site: the radioactive and chemical waste management areas, within and adjacent to infrastructure areas, and in open rangelands. The methods used to manage vegetation in the radioactive and chemical waste management areas and within/near infrastructure would be the same as under the No Action Alternative (described in Sections 2.1.1 and 2.1.2).

In open rangelands, however, DOE would apply the IVM approach to manage relatively large areas of vegetation, including areas damaged by wildfires and agricultural “old fields” and other larger disturbed areas dominated by cheatgrass (a key fuel for wildfires). The methods used to manage vegetation in open rangelands would be the same as described under the No Action Alternative, except that DOE would more aggressively apply chemical methods, prescribed burning, and revegetation with desirable shrubs, grasses, and forbs; physical and biological control methods would be limited to relatively small areas where other methods are not feasible or cost effective. In addition, DOE would use small fixed-wing aircraft or helicopters to apply selective or non-selective herbicides on large areas dominated by invasive plants and noxious weeds, although herbicide use would decrease over time as invasive plants and noxious weeds are controlled and more desirable plant communities are established.

Under the Proposed Action, DOE estimates that up to 4,249 hectares (10,500 acres) of open rangelands per year would be treated by chemical and physical methods. Biological methods would be used to manage approximately 202 hectares (500 acres) per year. Prescribed burning and revegetation would occur on up to 2,023 hectares (5,000 acres) annually. Figure 2-2 depicts 9,581 hectares (23,675 acres) of cheatgrass in open rangelands targeted for prescribed burning followed by revegetation with desirable shrubs, grasses, and forbs.

2.3 IMPLEMENTING THE NO ACTION ALTERNATIVE AND PROPOSED ACTION

2.3.1 Guidance

DOE/EIS-0222, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (CLUP) and associated Record of Decision was prepared to evaluate the potential environmental impacts associated with implementing a comprehensive land-use plan for the Hanford Site for at least the next 50 years. Implementation of the CLUP would begin a more detailed planning process for land-use and facility-use decisions at the Hanford Site including preparation of land-use maps, definitions, policies, and implementing procedures. New or revised “area” or “resource” management plans would be prepared to align and coordinate with land-use maps, policies, and implementing procedures adopted by the CLUP (i.e., Biological Resources Management Plan, Cultural Resources Management Plan, etc.).

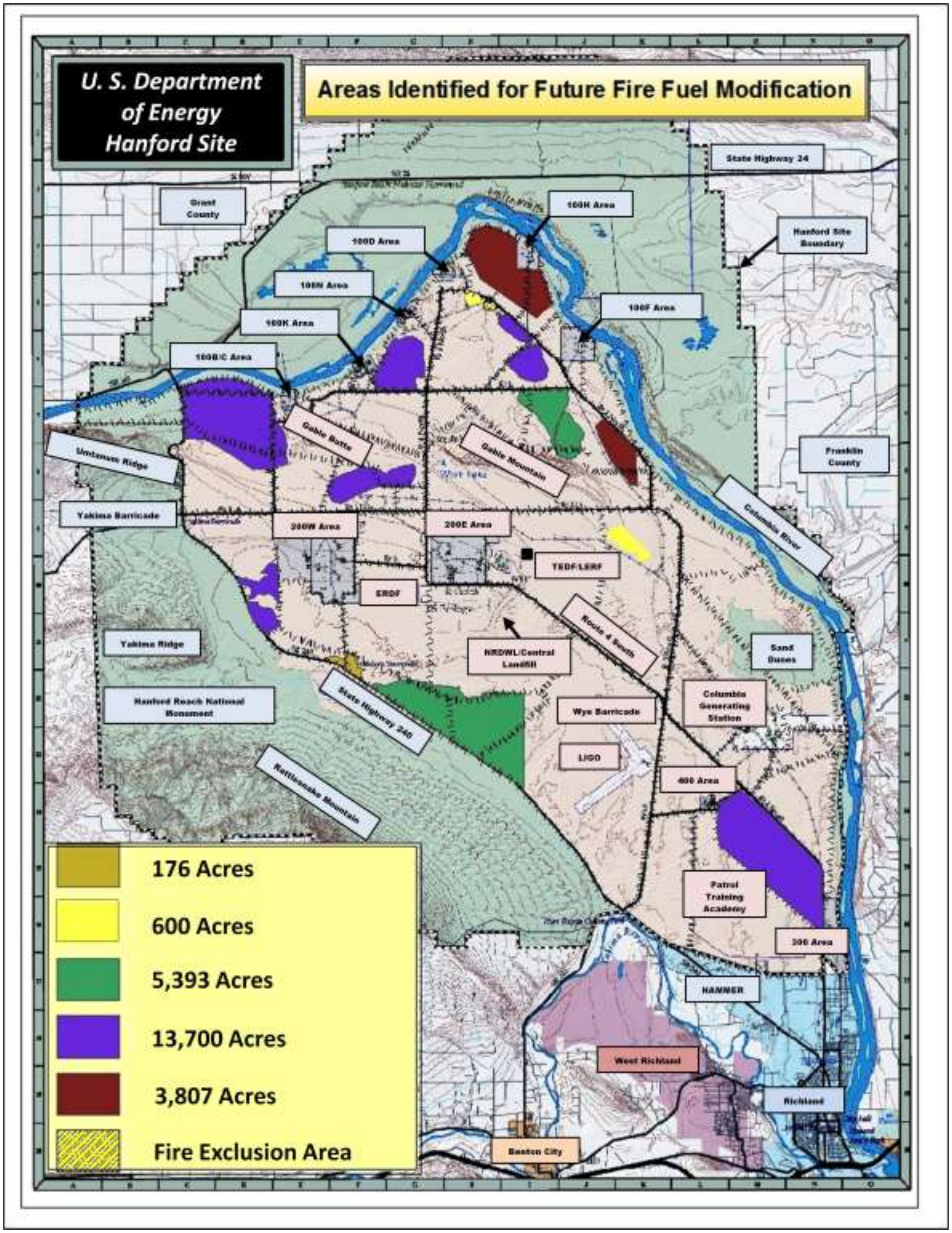
DOE/RL-96-32, *Hanford Site Biological Resources Management Plan* (BRMaP) was developed to assist DOE Richland Operations Office (DOE-RL) in managing potential impacts to threatened and endangered plant and animal species considering the overall health of the entire Hanford Site ecosystem. The biological resource management policies, goals, and objectives discussed in the BRMaP are implemented through two sub-tier documents: DOE/RL-95-11, *Ecological Compliance Assessment Management Plan* (ECAMP) and DOE/RL-96-88, *Hanford Site Biological Resources Mitigation Strategy* (BRMiS).

DOE/RL 96-88 describes the process followed to ensure that proposed actions on the Hanford Site are accomplished without significant impacts to important biological resources. Mitigation is a series of prioritized actions that reduce or eliminate potentially adverse impacts to biological resources by (1) avoiding the impact, (2) minimizing the impact, (3) rectifying impacts onsite, and (4) compensating for the impact away from the site.

DOE/RL 95-11 describes the procedures by which DOE-RL implements the Ecological Compliance Review (ECR) process. The ECR process ensures that the potential ecological impacts of Hanford Site projects and programs are understood and documented, including compliance with applicable laws.

Cultural and historic resources monitoring on DOE managed portions of the Hanford Site is conducted under the auspices of the DOE-RL *Hanford Cultural and Historic Resources Program* to ensure site compliance with federal laws and regulations. The manner in which cultural and historic resources monitoring is conducted on the Hanford Site is documented in DOE/RL-98-10, *Hanford Cultural Resources Management Plan.*

Figure 2-2. Areas of Cheatgrass Proposed for Prescribed Burning.



Vegetation management activities on the Hanford Site under the No Action Alternative and Proposed Action would not be conducted until the ecological and cultural resources review process described in DOE/RL- 95-11 and DOE/RL-98-10, respectively, has been completed. The ecological compliance review process serves, in part, to integrate biological resource management objectives into early planning phases of activities on the Hanford Site, and identify mitigation measures to reduce or eliminate potentially adverse impacts to biological resources. The DOE Manager retains the authority to declare an emergency and bypass the ecological compliance review process if delay would result in widespread habitat loss.

Similarly, the cultural resource review process and other applicable programmatic agreements, memoranda of understanding/agreement, and treatment plans serve, in part, to integrate cultural resource management objectives into early planning phases of activities on the Hanford Site, and identify mitigation measures to reduce or eliminate potentially adverse impacts to cultural resources.

Under the No Action Alternative and Proposed Action, once a treatment method(s) has been identified to address a vegetation management concern in a particular area, DOE would initiate the cultural and ecological compliance review processes (barring an emergency declaration by the DOE Manger). These processes are intended to identify potential impacts to cultural and ecological resources from implementing treatment method(s) and ascertain whether application of the method(s) would comply with applicable laws, regulations, and DOE directives/policies. If potentially adverse impacts to cultural or ecological resources appear likely, then mitigation measures that would not conflict with vegetation management goals would be identified and implemented.

In addition to the cultural and ecological compliance review processes, the implementation of certain vegetation management methods would be subject to provisions of other guidance documents, for example, the *Hanford Site Revegetation Manual*, currently under development, and protocols established by the Hanford Fire Department for prescribed burning. Under the No Action Alternative and Proposed Action, revegetation would be undertaken in consideration of the guidance established in the BRMaP and any applicable lower tier documents that provide guidance relevant to the design; and the timing, scheduling and implementing of the types of revegetation actions that would be conducted within the project area of the Hanford Site. Such guidance would be intended to ensure that proposed activities, including vegetation management activities, would be:

- Appropriate given the nature of concern for which revegetation is the selected method of treatment
- In compliance with applicable requirements
- Planned and scheduled in the most cost-efficient manner.

Prescribed burning under the No Action Alternative or the Proposed Action would be undertaken in accordance with Hanford Fire Department protocols. These protocols are an operational guide for managing prescribed burning (and wildfires) on the Hanford Site. They define the level of protection needed to ensure human health and safety; protect facilities; and minimize potential damage to natural, cultural, and ecological resources as a result of the fire and associated fire suppression activities. The protocols also identify the environmental conditions under which prescribed burning would be conducted (see Table 2-3). Prescribed burning would not be initiated or would be terminated when the 1-hour fuel moisture drops below 2 percent, sustained wind speeds exceed 15 miles per hour, or the area has a “red flag” warning (i.e., temperature at or near 100 degrees Fahrenheit and humidity below 10 percent).

Although not subject to specific guidance documents, DOE would only apply herbicides in conformance with their label requirements as required by law. Label requirements include, for example, application recommendations to avoid potentially adverse consequences on non-target plants and animals and protect human health. As an example, Tordon 22K (see Appendix A), U.S. Environmental Protection Agency

(EPA) Category II, moderately toxic, non-selective herbicide for the control of deep-rooted perennial and biennial weeds, would not be applied by air or under conditions that would result in spray drift, consistent with the manufacturer's label requirements. As a general matter, DOE would apply herbicides only after evaluating meteorological conditions and determining that herbicides could be applied without resulting in unintended consequences and non-target impacts. Tordon 22K, for instance, would not be applied during temperature inversions as the potential for herbicide drift from target areas is high, but may be applied when predominately unidirectional winds range between 2 and 15 miles per hour. In addition, herbicides would be applied at times when the onsite work force is reduced (e.g., weekends, Fridays off, etc.) to minimize potential human health effects.

Table 2-3. Conditions Relevant to Prescribed Burning.

Timing	Low	High	Desired
Time of Year			Year Around
Time of Day			9:00 am-6:00 pm
Environment			
Temperature, degrees F	Low 30s	Mid 90s	High 60s
Relative Humidity	60%	12%	20%
Wind Direction	Any	S, SW	SW
Wind Speed at 10 feet, miles per hour (mph)	5	15	5-10
Mid-Flame Wind Speed, mph	5	15	5-10
Fuel Moisture			
1 Hour	10%	2%	5%

2.3.2 Attributes

For purposes of analysis in this EA, DOE has identified the equipment and workforce needed to implement the No Action Alternative and the Proposed Action. The type of equipment required to undertake vegetation management activities would be the same under the No Action Alternative and Proposed Action, although additional equipment and workforce would be required under the Proposed Action. Table 2-4 describes the annual equipment needs and workforce for the No Action Alternative and Proposed Action.

Relative to the No Action Alternative, the Proposed Action would manage up to an additional 5,180 hectares (12,800 acres) annually (about a 59 percent increase), primarily by chemical methods and/or prescribed burning followed by revegetation. However, the increase in equipment and workforce would be small (i.e., one truck-mounted sprayer, one boom sprayer, and two equipment/chemical operators), because most of the additional open rangelands would be treated by subcontracted aerial application of herbicides in accordance with label requirements.

Although there would be an increase in prescribed burning, the Hanford Fire Department is on duty 24-hours per day, 7-days per week. For the most part, equipment and workforce are "on-call" awaiting the need to respond to wildfires and other fire fighting situations. Prescribed burning activities make use of existing equipment and workforce to treat vegetative fuel and reduce wildfire hazards.

Table 2-4. Equipment and Workforce Required Annually.

No Action Alternative	Proposed Action
Physical, Chemical and Biological Methods	
3 truck mounted sprayers 1 boom sprayer 5 equipment/chemical operators 2 commercial pesticide applicator operators	4 truck mounted sprayers 2 boom sprayers 7 equipment/chemical operators 2 commercial pesticide applicator operators Subcontracted aerial herbicide application services
Prescribed Burning	
2 engines (brush/grass trucks) 1 water tender 3 equipment operators 1 prescribed burn supervisor 1 safety officer 1 firing supervisor 1 firefighter 1 engine supervisor	Same as No Action Alternative
Revegetation	
3 tractors with seed spreaders/drills and rollers 3 equipment operators 1 field work supervisor	Same as the No Action Alternative

2.4 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL

The Council on Environmental Quality *Forty Most Asked Questions Concerning CEQ's NEPA Regulations* (CEQ, 1981) states that reasonable alternatives include those that are practical or feasible from a common sense, technical, and economic standpoint. Accordingly, a potential alternative may be eliminated from detailed consideration if it would result in stated objectives not being met within a reasonable timeframe, such that the underlying purpose and need would not be achieved. A potential alternative also may be eliminated from detailed consideration if it would take too long to implement or would be prohibitively expensive or highly speculative in nature.

DOE considered two alternatives in addition to the No Action Alternative and the Proposed Action. Under one alternative, referred to as *Terminate Vegetation Management*, all vegetation management activities would cease within the project area of the Hanford Site. DOE considers this alternative not to be reasonable. Failure to perform vegetation management would result in uncontrolled introduction of invasive plants and noxious weeds, such that the underlying purpose and need for action would not be achieved. For example, there would be increased potential for biological uptake and transport of contaminants. Furthermore, wildfire hazards would increase with potential impacts to desirable plant communities and wildlife habitat; including increased impacts to natural, cultural, and ecological resources.

DOE also considered another alternative, referred to as *Single Method Vegetation Management*, in which the approach to management would be the same as described under the No Action Alternative in Section 2.1, but only a single treatment method would be applied. Under this alternative, DOE would continue its practice of independent, project-specific, or localized vegetation management (i.e., identify a vegetation concern, identify management goals, and select and implement a single treatment method). DOE considers this alternative not to be reasonable because the use of a single method per area of concern likely would not be effective in long-term control of invasive plants and noxious weeds thereby increasing wildfire hazards and potential impacts to natural, cultural, and ecological resources; and is not likely to protect, preserve, and restore desirable plant communities and wildlife habitat (purpose and need) within the project area of the Hanford Site in a reasonable amount of time.

3.0 AFFECTED ENVIRONMENT

The following is a description of the Hanford Site environment that may be affected by the No Action Alternative and the Proposed Action analyzed in this EA. Affected environment descriptions provide the context for understanding the environmental impacts described in Section 4.0. As such, the descriptions serve as a baseline of existing conditions from which any environmental changes that may be brought about by implementing either the No Action Alternative or Proposed Action can be identified and evaluated.

In accordance with DOE's "sliding scale" guidance (i.e., *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements)*, the descriptions of the affected environment emphasize the resource areas most likely to be affected by or have an effect upon vegetation management activities discussed in this EA. More detailed descriptions of the various aspects of the affected environment may be found in PNNL-6415, Revision 18, *Hanford Site National Environmental Policy Act (NEPA) Characterization*.

3.1 LAND USE AND VISUAL RESOURCES

Land resources include the various areas of the Hanford Site, land uses, and visual resources. The Hanford Site is divided into major operations areas based on past missions. Land use is defined in terms of activities (e.g., agriculture, residential, industrial, etc.) for which land is developed. Visual resources are natural and manmade features that give a particular landscape its character and aesthetic quality.

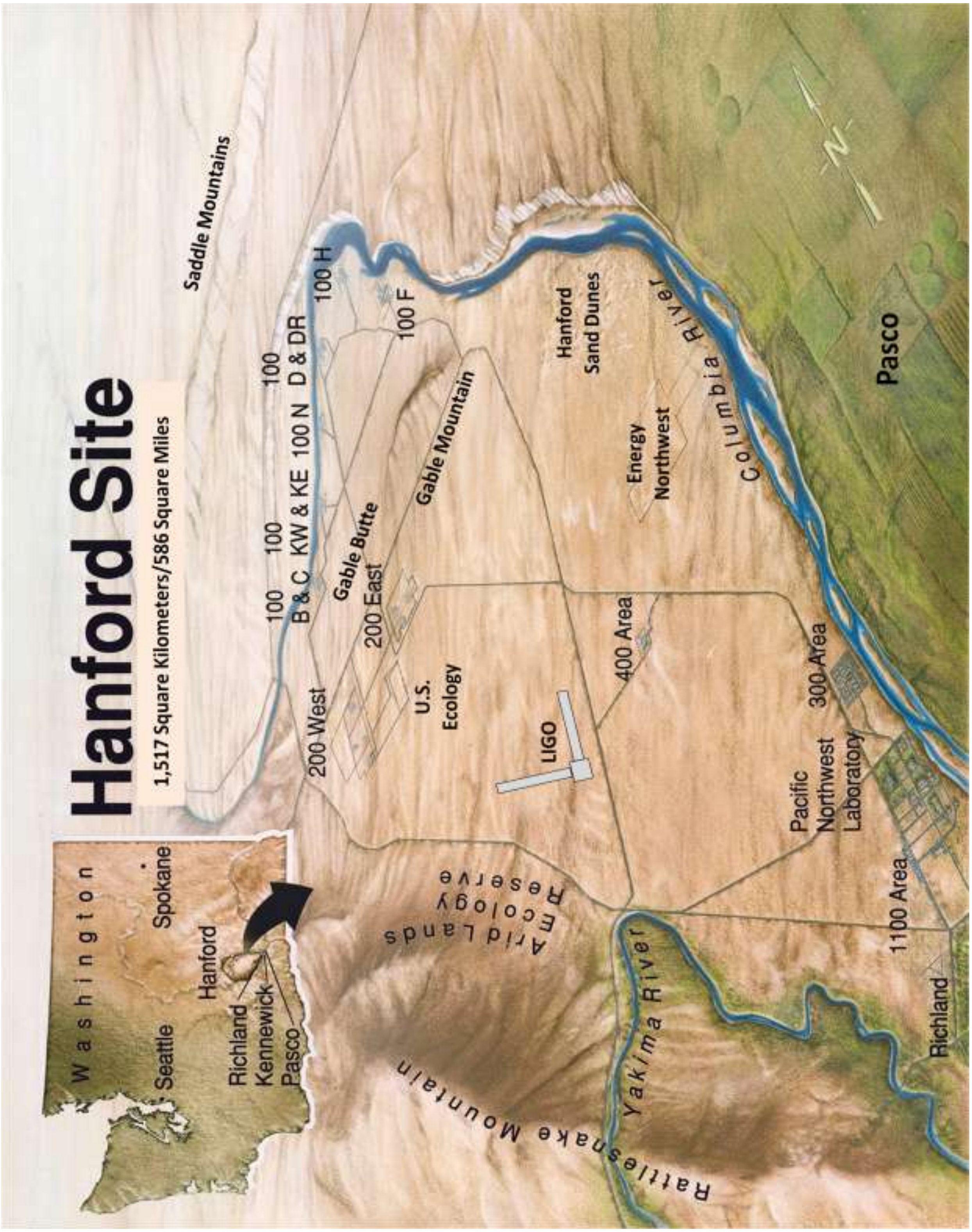
3.1.1 Hanford Site

The Hanford Site lies within the Pasco Basin of the Columbia Plateau in south-central Washington State and occupies an area of about 1,517 square kilometers (586 square miles or 375,040 acres). As discussed in Section 1.3, the Hanford Reach National Monument (78,914 hectares [195,000 acres]) is managed by the USFWS, WDFW, and the DOE. Lands managed by the USFWS and WDFW are not within the scope of this EA. This EA addresses the remaining 84,596 hectares (209,040 acres) representing the "project area" of the Hanford Site.

Public access to the Hanford Site is restricted and controlled providing a buffer for areas used for the treatment, storage, and disposal of radioactive and chemical wastes and ongoing waste site characterization, remediation, and closure activities. This buffer provides public protection from activities on the Hanford Site, including vegetation management conducted within the project area.

The Hanford Site is divided into operational areas. The vegetation management activities addressed by this EA would be conducted in the 100 Area, 200 Area, 300 Area, 400 Area, and 600 Area of the Hanford Site. The 100 Area, which covers about 1,100 hectares (2,720 acres), is in the northern part of the site along the southern shore of the Columbia River; it is the location of nine decommissioned reactors. The 200 Area, which includes 200 East and 200 West Areas, is in the center of the Hanford Site and covers about 5,100 hectares (12,602 acres); it is the location of waste management facilities. The 300 Area is in the southern part of the site, just north of the City of Richland, and covers 150 hectares (370 acres); it is the location of former research and development facilities, some of which are being dismantled. The 400 Area, located 8 kilometers (5 miles) northwest of the 300 Area, covers 61 hectares (150 acres); it is the location of the shutdown Fast Flux Test Facility (FFTF) and the Fuels and Materials Examination Facility. The 600 Area is the designation for Hanford lands that are not part of any other designation. Thus, it includes the remainder of the Hanford Site not occupied by the 100, 200, 300, and 400 Areas; and areas of the monument managed by DOE. It covers 78,185 hectares (193,198 acres) of rangelands. Figure 3-1 depicts the major areas of the Hanford Site.

Figure 3-1. Hanford Site Map.



3.1.2 Land Use

Land use designations are based on DOE/EIS-0222, *Final Hanford Comprehensive Land Use Plan Environmental Impact Statement*, and in the project area of the Hanford Site include Preservation, Conservation (Mining), Industrial, Industrial-Exclusive, and Research and Development (Figure 3-2). Land use designations for the project area of the Hanford Site are predominantly Industrial and Conservation (Mining). Land uses include:

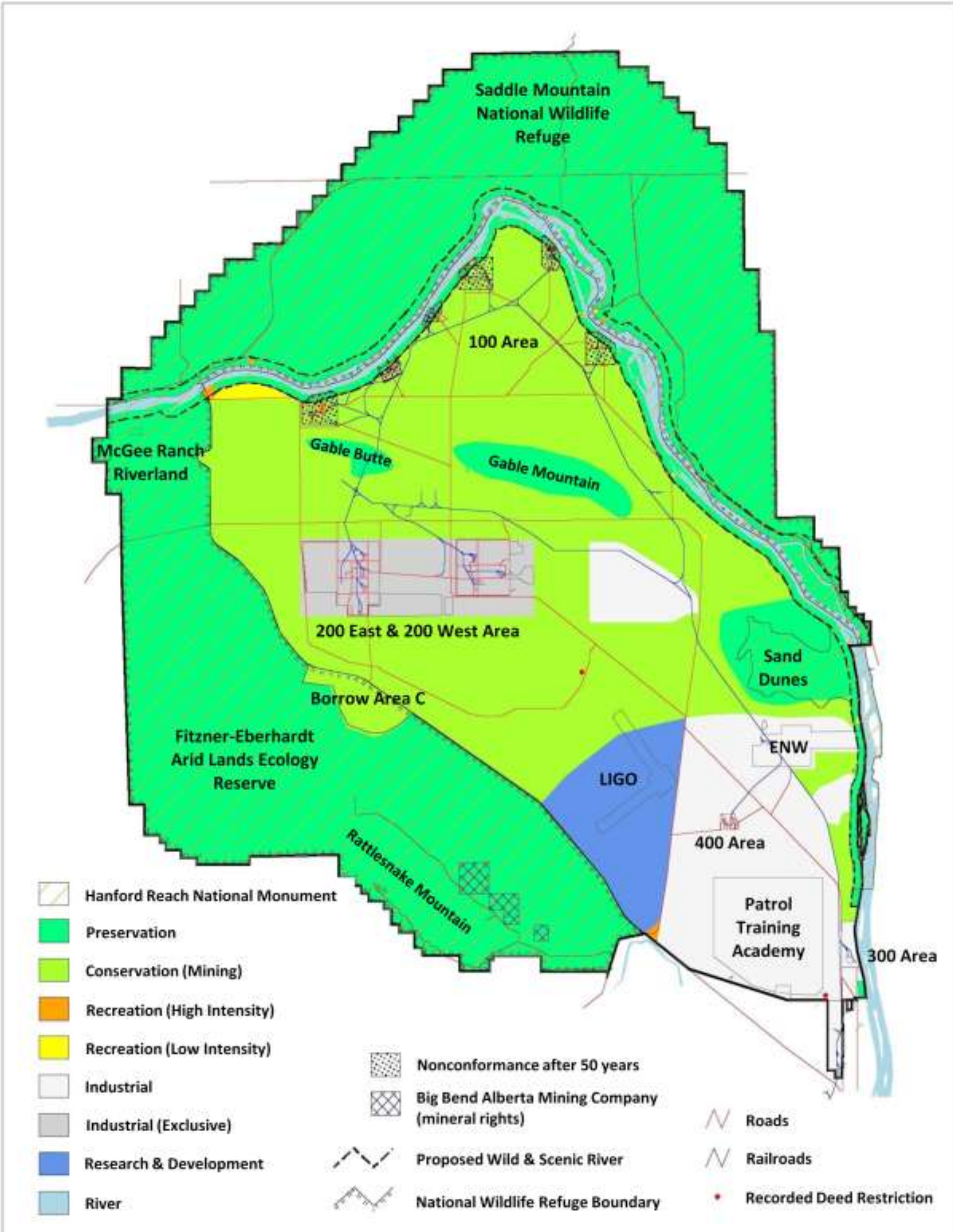
- ***Preservation*** - An area managed for preservation of cultural, ecological, and natural resources. For example, lands designated for preservation include American Indian traditional cultural properties (i.e., Gable Mountain and Gable Butte). No new consumptive uses (i.e., mining or extraction of nonrenewable resources) are permitted in this area, although activities related to wildfire, cultural resource, and ecological resource management are allowed.
- ***Conservation (Mining)*** - An area reserved for the management and protection of cultural, ecological, and natural resources. Limited and managed mining (e.g., quarrying for sand, gravel, basalt, and topsoil for governmental purposes only) can occur as a special use in appropriate areas. Limited public access consistent with resource conservation is allowed.
- ***Industrial*** - An area suitable and desirable to locate and operate facilities such as nuclear power reactors, solar energy parks, railroads, barge transport facilities, mines, electronics manufacturing, food processing, and commercial warehousing. This designation includes related activities such as those required for economic growth and development using existing infrastructure such as transportation corridors, utilities, and buildings.
- ***Industrial-Exclusive*** - An area suitable and desirable for treatment, storage, and disposal of hazardous, radioactive, mixed, and nonradioactive wastes. This designation includes related activities such as providing radioactive materials for food irradiation and medical purposes such as cancer treatment.
- ***Research and Development*** - An area designated for conducting basic or applied research that requires the use of a large-scale or isolated facility, or smaller scale time-limited research conducted in the field or in facilities that consume limited resources. This designation includes related activities such as the research and development of innovative waste site characterization, remediation, and closure technologies; molecular science studies; and investigation of gravitational waves of cosmic origin using laser interferometer technology (e.g., neutron stars, black holes, supernovas, etc.).

Table 3-1 provides a summary of estimated sizes of the various land use designations within the project area of the Hanford Site and the percentage of the total area.

3.1.3 Visual Resources

Typical of the regional shrub-steppe ecosystem, the Hanford Site is dominated by widely spaced, low-brush grasslands. A large area of stabilized sand dunes extends along the east boundary (near the Columbia Generating Station nuclear reactors), and non-vegetated blowouts (i.e., areas where wind erosion has eliminated or inhibited vegetation) are scattered throughout the site. These grassland areas of the regional shrub-steppe ecosystem comprise the 600 Area. The 100, 200, 300, and 400 Areas of the Hanford Site are industrial areas previously described in Section 3.1.1. Existing firebreaks maintained along site infrastructure (i.e., roadways, railways, power lines, fence lines, etc.) create a mosaic pattern within the shrub-steppe habitat of desirable native vegetation and undesirable invasive plants and noxious weeds that infest disturbed areas (i.e., construction areas, wildfire areas, etc.). This mosaic pattern is defined by the fire containment lines established to protect the visual resources.

1 **Figure 3-2. Land Use Designations on the Hanford Site.**



2

Table 3-1. Estimated Acreage by Land Use in the Project Area of the Hanford Site.[(a)]

Land Use Designation	Project Area Location	Acres (Hectares)	Percent of Total Area
Preservation (not in monument)	Gable Mountain and Gable Butte	3,000 (1,214)	1.4
Preservation (on Monument land; managed by DOE)	McGee Ranch and Riverlands	18,324 (7,415)	8.8
Preservation (on Monument land; managed by DOE)	Sand Dunes	10,531(4,262)	5.0
Conservation/Mining	100 Area	2,720 (1,101)	1.3
	Remainder of 600 Area	132,310 (53,544)	63.3
Conservation/Mining (on Monument land; managed by DOE)	Borrow Area C	145 (59)	0.1
Industrial	300 Area	370 (150)	0.2
	400 Area	150 (61)	0.1
	600 Area South of Energy Northwest and North of Patrol Training Academy	19,265 (7,796)	9.2
Industrial-Exclusive	200 East and West Area	12,602 (5,100)	6.0
Research and Development	Part of 600 Area Around LIGO Facility	9,623 (3,894)	4.6
TOTALS		209,040 (84,596)	100

[(a)] Based on information contained in DOE/EIS-0222.

Hanford Site facilities can be seen from elevated locations in the project area such as Gable Mountain and Gable Butte. Hanford Site facilities also are visible from State Highways 240 and 24 and the Columbia River. Due to terrain features, distances involved, the size of the Hanford Site, and the size of individual structures, not all facilities in the project area are visible from the highways or the Columbia River.

The 24 Command Fire burned 68,027 hectares (168,099 acres) of Federal, state, and private lands in FY 2000. The fire and suppression activities resulted in changes to the visual character of affected portions of the Hanford Site. Visual resources were also affected by dust storms from exposed soil. The most recent large fire was the Wautoma Wildfire that occurred in FY 2007 and burned 34,193 hectares (84,492 acres) within the footprint of the 24 Command Fire (due to cheatgrass fuel that invaded following the 24 Command Fire). Approximately 50 percent of the total area burned is within the boundaries of the project area of the Hanford Site. Both wildfires left large areas blackened across the southwestern portion of the Hanford Site, including the slope of Rattlesnake Mountain (a Traditional Cultural Property [TCP] and part of the Hanford Reach National Monument), which is visible from Richland and other areas in the region.

3.2 METEOROLOGY AND AIR QUALITY

Climatological data for the Hanford Site have been compiled at the Hanford Meteorology Station (HMS) since 1944. Before the HMS was established, local meteorological observations were made at the old Hanford town site (1912 through late 1943) and in the City of Richland (1943-1944). Regional climatological and meteorological information is also provided by the National Weather Service in Pendleton, Oregon.

The size of the Hanford Site and its topography give rise to substantial spatial variations in wind, precipitation, temperature, and other meteorological characteristics. To characterize meteorological differences accurately across the Hanford Site, the HMS has operated a network of onsite and offsite monitoring stations since the early 1980's (Figure 3-3).

3.2.1 Wind

Prevailing winds on the Hanford Site are from the northwest and occur most frequently during the winter and summer. During the spring and fall, there is an increase in wind frequency from the southwest and a corresponding decrease in winds from the northwest.

Monthly average wind speeds are lower during the winter months, averaging 2.7 to 3.1 meters per second (m/s; 6 to 7 miles per hour [mph]) and faster during the spring and summer months, averaging 3.6 to 4.0 m/s (8 to 9 mph). The highest winds are from the southwest. The HMS averages 156 days per year with peak wind gusts greater than or equal to 11 m/s (25 mph) and 57 days with peak gusts greater than or equal to 16 m/s (35 mph).

Conditions likely to increase atmospheric dispersion are most common in the summer when unstable stratification exists about 56 percent of the time. Conditions less likely to promote atmospheric dispersion are most common during the winter when moderately to extremely stable stratification exists about 66 percent of the time. The probability of an inversion, once established, persisting more than 12 hours varies from a low of about 10 percent in May and June to a high of about 64 percent in September and October.

3.2.2 Temperature and Humidity

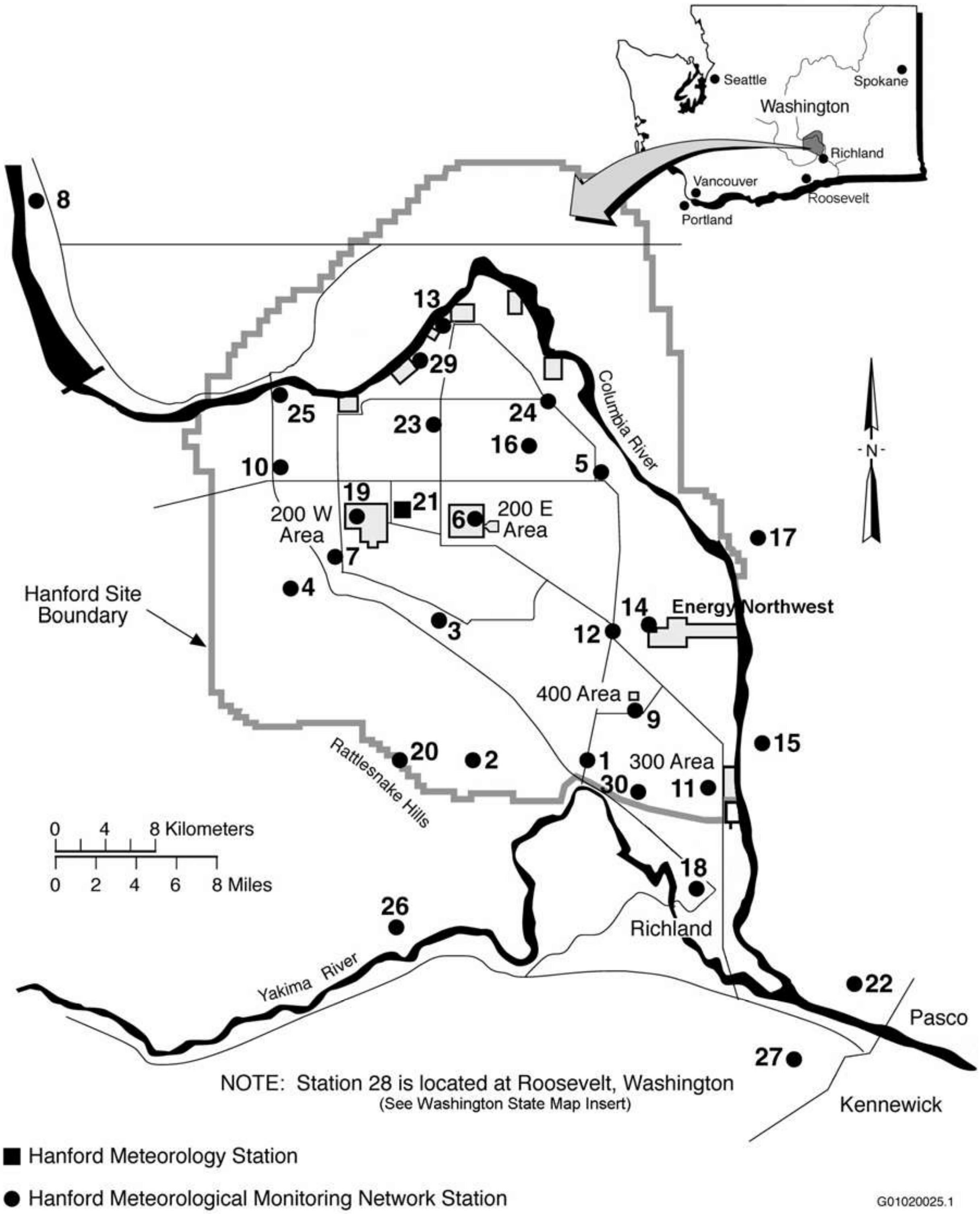
The average monthly temperatures at the HMS range from a low of -0.7°C (31°F) in January to a high of 24.7°C (76°F) in July. Daily maximum temperatures at the HMS vary from an average of 2°C (35°F) in late December and early January to 36°C (96°F) in late July. There are an average of 52 days during the summer months with maximum temperatures greater than or equal to 32°C (90°F) and 12 days with maximum temperatures greater than or equal to 38°C (100°F).

The annual average relative humidity at the HMS is 55 percent. It is highest during the winter months, averaging about 76 percent, and lowest during the summer, averaging about 36 percent. The annual average dew point temperature at the HMS is 1°C (34°F). In the winter, the dew point temperature averages about -3°C (27°F), and in the summer it averages about 6°C (43°F).

3.2.3 Precipitation

Average annual precipitation at the HMS is 17 cm (6.8 in.). Most precipitation occurs during the late fall and winter months, with more than half of the annual amount occurring from November through February. Days with greater than 1.3 cm (0.50 in.) precipitation occur on average less than one time each year. Average snowfall ranges from 0.25 cm (0.1 in.) during October to a maximum of 13.2 cm (5.2 in.) during December and decreases to 1.3 cm (0.5 in.) during March. Snowfall accounts for about 38 percent of all precipitation from December through February.

Figure 3-3. Hanford Site Meteorological Monitoring Network Locations.



3.2.4 Severe Weather

Concerns about severe weather usually focus on tornadoes and thunderstorms. There have been 28 tornadoes recorded at the Hanford Site. Of these, 21 had maximum wind speeds estimated to range from 18 to 32 m/s (40 to 72 mph), four had maximum wind speeds that ranged from 33 to 50 m/s (73 to 112 mph), and three had maximum wind speeds that ranged from 51 to 71 m/s (113 to 157 mph). The average occurrence of thunderstorms in the vicinity of the HMS is ten per year. They are most frequent during the summer and can generate high-speed winds and hail.

3.2.5 Air Quality

Radiological emissions are monitored by DOE's Surface Environmental Surveillance Project (SESP) and the Near-Facility Environmental Monitoring Project (NFEMP). The SESP conducts monitoring at locations across the Hanford Site, and at upwind and downwind locations offsite. The NFEMP collects samples near onsite sources of radiological emissions.

Standards for emissions of radionuclides to air from DOE facilities have been established by EPA (40 CFR 61, "National Emission Standards for Hazardous Air Pollutants"), Washington State (Washington Administrative Code [WAC] 173-480, "Ambient Air Quality Standards and Emission Limits for Radionuclides" and WAC 246-247, "Radiation Protection – Air Emissions"), and DOE (DOE Order 5400.5, Chg 2, *Radiation Protections of the Public and the Environment*). Under EPA and Washington State standards, airborne emissions may not exceed quantities that would result in a dose of 10 millirem (mrem) in a year to a maximally exposed individual (MEI) of the public. The DOE standard is set at 100 mrem in a year to a MEI of the public for all pathways (including airborne).

Based on the results of several years of monitoring, the amount of radiological materials in air is so small that there is no discernable difference between upwind and downwind samples from offsite locations. Atmospheric dispersion further reduces emissions to below background levels before leaving the Hanford Site boundaries. The Hanford Site dose from all pathways during 2009 was 0.12 mrem (0.032 mrem from the airborne pathway alone). Section 3.7.1, Table 3-6, provides a comparison of 2009 doses to the public from Hanford Site emissions versus federal standards and natural background levels.

Pursuant to the Clean Air Act (CAA), the EPA has issued regulations setting national ambient air quality standards (40 CFR 50, "National Primary and Secondary Ambient Air Quality Standards") for criteria pollutants. These include standards for sulfur oxides (measured as sulfur dioxide), nitrogen oxides, carbon monoxide, lead, ozone, PM-10 (small particles with an aerodynamic diameter less than or equal to 10 micrometers), and PM-2.5 (small particles with an aerodynamic diameter less than or equal to 2.5 micrometers). The standards specify the maximum pollutant concentrations and frequencies of occurrence that are allowed for specific averaging periods. The averaging periods vary from 1 hour to 1 year, depending on the pollutant. Areas that meet ambient air quality standards are said to be "in attainment" by the EPA. Areas that fail to meet one or more of the ambient air standards are designated as "nonattainment areas" and require controls to limit emissions of criteria pollutants.

Washington State also has established standards for criteria pollutants. In addition, Washington State has established standards for total suspended particulates (WAC 173-470, "Ambient Air Quality Standards for Particulate Matter") and fluorides (WAC 173-481, "Ambient Air Quality and Environmental Standards for Fluorides). The Washington State standards for carbon monoxide, nitrogen dioxide, ozone, and PM-10 (including total suspended particulates) are identical to the national standards; the sulfur dioxide standard is lower than the national standard. Although federal standards exist, Washington State has not established standards for lead or PM-2.5. Ozone is not directly emitted or monitored at the Hanford Site and is formed when nitrogen oxides and volatile organic compounds (VOCs), which are monitored, react in the presence of sunlight and elevated temperatures. Ammonia is monitored because some air pollutants (i.e., sulfur dioxide, nitrous oxides, VOCs, and ammonia) react in the atmosphere to form fine particles (i.e., PM-2.5). Washington State's fluoride standards are not relevant to the Hanford Site. They apply to forage protection for livestock grazing (prohibited in the project area) and protection of vegetation for commercial purposes and in public use areas (no commercial use of vegetation in the project area and public access is restricted and controlled). Benton County and the Hanford Site are "in attainment" for all federal and state ambient air quality standards. Table 3-2 depicts air concentrations for criteria and other pollutants from Hanford Site emissions during calendar year 2005, the latest year for which such information is available, based on dispersion modeling using calendar year 2005 emissions data in Table 3-3 (DOE/EIS-0391, *Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*). For all criteria and other regulated pollutants, the maximum Hanford Site concentrations were well below the standard or guideline for ambient air quality.

Table 3-3 provides a comparison between the calendar year 2005 and 2009 emissions for the Hanford Site. For all criteria and other regulated pollutants, the non-radiological pollutant emissions to the atmosphere are lower in 2009 than they were in 2005; with the exception of nitrogen oxides, which were about 17 percent higher (but still two orders of magnitude below standards). Since the modeled concentrations from Hanford sources in 2005 represent a small percentage of the ambient air quality standards, modeled concentrations based on 2009 emissions would also be small and well below ambient air quality standards.

Executive Order (E.O.) 13423, "Strengthening Federal Environmental, Energy, and Transportation Management" calls for Federal agencies to improve energy efficiency and reduce greenhouse gas emissions of the agency, through reduction of energy intensity by (1) three percent annually through the end of FY 2015, or (2) 30 percent by the end of FY 2015, relative to the baseline of the agency's energy use in FY 2003. On October 5, 2009, E.O. 13514, "Federal Leadership in Environmental, Energy, and Economic Performance," was signed, establishing an integrated strategy towards sustainability in the Federal government and making reduction of greenhouse gas emissions a priority for agencies.

Greenhouse Gases

Greenhouse gases are gaseous constituents of the atmosphere, both natural and anthropogenic (resulting from or produced by human beings), that absorb and emit thermal infrared radiation (heat) emitted by the Earth's surface, the atmosphere itself, and clouds. Water vapor, carbon dioxide, nitrous oxide, methane, and ozone are the primary greenhouse gases in the Earth's atmosphere. Greenhouse gases trap heat between the Earth's surface and the lower part of the atmosphere; this phenomenon is called the greenhouse effect.

DOE, pursuant to its sustainability plan for the Hanford Site, plans to reduce its greenhouse gas Scope 1 & 2 emissions by 28 percent by FY 2020 from a FY 2008 baseline. Scope 1 consists of direct emissions such as onsite combustion of fossil fuels or fugitive greenhouse gas emissions. Scope 2 consists of indirect emissions associated with the consumption of electricity, heat, or steam. The sustainability plan also commits DOE to reduce its Scope 3 greenhouse gas emissions by 13 percent; Scope 3 emissions are all indirect emissions other than those covered by Scope 2, for example, greenhouse gas emissions from employee commutation. The sustainability plan also commits DOE to develop incentive programs to encourage car sharing for employees attending out of town meetings.

Table 3-2. Modeled Non-Radiological Ambient Air Pollutant Concentrations from Hanford Site Sources and Ambient Air Quality Standards, 2005.

Pollutant	Averaging Period	Most Stringent Standard or Guideline[(a)]	Maximum Hanford Concentration[(b)]
		(micrograms per cubic meter, μg/m³)	
Criteria Pollutants			
Carbon Monoxide	8 Hours	10,000[(c)]	39.5
	1 Hour	40,000[(c)]	162
Nitrogen Dioxide	Annual	100[(c)]	0.263
Ozone	8 Hours	147[(d)]	[(e)]
	1 Hour	235[(f)]	[(e)]
PM_{10}	Annual	50[(f,g)]	0.134
	24 Hours	150[(c)]	0.884
$PM_{2.5}$	Annual	15[(d)]	0.134[(h)]
	24 Hours	35[(d,g)]	0.884[(h)]
Sulfur dioxide	Annual	50[(f)]	0.00621
	24 Hours	260[(f)]	0.52
	3 Hours	1,300[(c)]	2.01
	1 Hour	1,000[(f)]	4.56
	1 Hour	660[(e,i)]	4.56
Other Regulated Pollutants			
Total suspended particulates	Annual	60[(f)]	0.134[(h)]
	24 Hours	150[(f)]	0.884[(h)]
Ammonia	24 Hours	100[(j)]	1.91

[(a)] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (NAAQS, 40 CFR 50), other than those for ozone, particulate matter, lead, and standards based on annual averages, are not to be exceeded more than once per year. The annual arithmetic mean $PM_{2.5}$ standard is attained when the expected annual arithmetic mean concentration (3-year average) is less than or equal to the standard. The 24-hour $PM_{2.5}$ standard is met when the 98th percentile over 3 years of 24-hour average concentrations is less than or equal to the standard value. The 24-hour PM_{10} standard is met when the 99th percentile over 3 years of 24-hour concentrations is less than or equal to the standard value.

[(b)] Site contributions based on a 2005 emissions inventory, including emissions from the 200 Areas.

[(c)] Federal and state standard.

[(d)] Federal standard.

[(e)] Not directly emitted or monitored by the site.

[(f)] State standard.

[(g)] The EPA recently revoked the annual PM_{10} standard and changed the 24-hour $PM_{2.5}$ standard from 65 to 35 micrograms per cubic meter.

[(h)] Assumed the same as the concentration of PM_{10} because there are no specific data for total suspended particulates or $PM_{2.5}$.

[(i)] Not to be exceeded more than twice in any 7 consecutive days.

[(j)] State acceptable source impact level.

Note: The NAAQS include standards for lead. Lead emissions identified at the site are small (less than 1 kilogram [2.2 pounds] per year) and were not modeled. The State of Washington also has ambient standards for fluorides. No emissions of fluorides have been reported at Hanford.

Key: PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers.

Source: DOE/EIS-0391 (Draft).

Table 3-3. Non-Radiological Air Pollutant Mass Discharged to the Atmosphere on the Hanford Site, 2005 and 2009.

Constituent	Release (kilograms)	
	Calendar Year 2005	Calendar Year 2009
Particulate matter – total	6,500	1,800
Particulate matter – 10	2,800	900
Particulate matter – 2.5	1,000	0[e]
Nitrogen oxides	12,000	14,000
Sulfur oxides	3,000	0[e]
Carbon monoxide	14,000	12,000
Lead	0.47	0.45
Volatile organic compounds[a,b]	14,000	11,000
Ammonia[c]	12,000	5,500
Other toxic air pollutants[d]	6,600	4,300
Total criteria and toxic pollutants	71,900	49,500

[a] The estimate of volatile organic compounds does not include emissions from certain laboratory operations.
[b] From burning petroleum to produce steam and to power electrical generators; release value also includes calculated estimates from the 200 East and 200 West Areas tank farms, evaporation losses from fuel dispensing, 200 Area Effluent Treatment Facility, Central Waste Complex, T Plant Complex, and Waste Receiving and Processing Facility.
[c] Ammonia releases are calculated estimates from the 200 East and 200 West Areas tank farms and the 200 Area Effluent Treatment Facility; the release value also includes ammonia from burning petroleum to produce steam and to power electrical generators.
[d] Releases are a composite of calculated estimates of toxic air pollutants, excluding ammonia from the 200 East and 200 West Areas tank farms, 200 Area Effluent Treatment Facility, Central Waste Complex, T Plant Complex, and Waste Receiving and Processing Facility.
[e] Emissions less than 0.5 ton (500 kilograms) are rounded down to zero due to the insignificance of the release.
Sources: PNNL-15892, *Hanford Site Environmental Report for Calendar Year 2005*; PNNL-19455.

The primary contributor of Scope 1 greenhouse gas emissions is mobile sources (primarily fleet vehicles). Overall Scope 1 greenhouse gas emissions for FY 2010 were 46,105 metric tons equivalent carbon dioxide (CO_2e), compared with 35,591 metric tons CO_2e from the FY 2008 baseline. The Hanford Site expects to achieve an overall reduction of 28 percent for Scope 1 greenhouse gas emissions by FY 2020. Although the Scope 1 greenhouse gas emissions increased from FY 2008 to FY 2010, this was due in part to the increased size of the work force as a result of *American Recovery and Reinvestment Act* (ARRA) work scope. Achievement of the FY 2020 reduction in Scope 1 greenhouse gas emissions will be aided by anticipated reductions in the size of the Hanford Site work force as ARRA-funded activities phase out and the Hanford Site footprint is reduced to meet DOE's future vision for the site.

The overall FY 2010 Hanford Site greenhouse gas emissions profile is broken down by major category in Table 3-4 along with the associated FY 2008 baseline numbers. Priority areas for future reductions will include overall energy usage, fleet vehicle emissions, and employee commuting.

Table 3-4. Hanford Site Comprehensive Greenhouse Gas Emissions Inventory.

Greenhouse Gas Type	FY 2010 Emissions *(Metric Tons CO_2e)*	FY 2008 Baseline Inventory *(Metric Tons CO_2e)*
Scope 1		
Stationary Source Combustion	4,164	10,589
Mobile Sources (primarily fleet vehicles)	33,015	15,255
Fugitive Emissions	8,926	9,747
Scope 1 Subtotal	46,105	35,591
Scope 2		
Purchased Energy Usage	69,799	66,228
Scope 3		
Business Air Travel (no Federal employees)	1,137	762
Business Ground Travel (no Federal employees)	314	225
Commuting	37,912	51,194
Off-Site Waste Disposal	TBD	TBD
Off-Site Waste Water Treatment	53	84
Transmission and Distribution (T&D) Losses	6,343	6,145
Scope 3 Subtotal	45,759	58,410
Total Hanford Site Greenhouse Gas Emissions	**161,663**	**160,229**

The Hanford Site operates a diverse fleet of vehicles including pickups, sport utility vehicles, sedans (less than 5 percent), and medium/heavy duty trucks or special purpose vehicles. At the end of 2010, the Hanford Site fleet consisted of 1,794 vehicles plus an additional 1,500 pieces of other types of equipment for a total of 3,294. The vegetation management program utilizes ten vehicles from the Hanford Site fleet to accomplish activities addressed in this EA (two brush/grass trucks, one water tender, three tractors, three truck-mounted sprayers, and one boom-type sprayer). This represents less than 1 percent of the Hanford Site vehicle fleet. Greenhouse gas emissions from vegetation management vehicles and equipment would be small in comparison to the rest of the Hanford Site fleet.

The emission rates of gas-phase airborne toxic compounds (e.g., formaldehyde, acetaldehyde, benzene, and 1,3-butaidene) from vehicles have steadily been reduced during the past decade as a result of the introduction of reformulated gasoline (e.g., E-85) and low-sulfur diesel fuel, advances in engine design and fuel metering systems, and the implementation of highly efficient exhaust after-treatment control devices. Gas-phase airborne toxic compounds are formed by the incomplete oxidation of hydrocarbons during combustion and can be associated with adverse air quality and health effects. Of all the engine and vehicle technologies, the catalytic converter provides the greatest emission reductions. For gas-phase airborne toxic compounds, the reductions are about 50 to 80 percent for oxidation catalysts and 80 to 99 percent for three-way catalyst vehicles compared to non-catalyst vehicles; with conversion efficiencies for today's modern vehicle reducing gas-phase airborne toxic compounds greater than 98 percent. For diesel vehicles, a decrease of 69 to 85 percent in gas-phase airborne toxic compounds has been observed for diesel vehicles equipped with oxidation catalysts compared to uncontrolled diesel vehicles ("Internal Combustion Engine (ICE) Air Toxic Emissions – Final Report," Maldonado, 2004).

3.3 SOILS

The Hanford Site lies in the Columbia Basin, which comprises the northern part of the Columbia Plateau physiographic province and Columbia River flood-basalt geologic province. Within this region, the Hanford Site lies in the Pasco Basin, a structural and topographic depression of generally lower-relief plains and anticlinal ridges. The Pasco Basin is bounded on the north by the Saddle Mountains; on the west by Naneum Ridge and the eastern extension of Umtanum and Yakima Ridges; on the south by Rattlesnake Mountain and Rattlesnake Hills; and on the east by the Palouse Slope. Two east-west trending ridges, Gable Butte and Gable Mountain, lie in the central part of the Hanford Site, north of the 200 Areas.

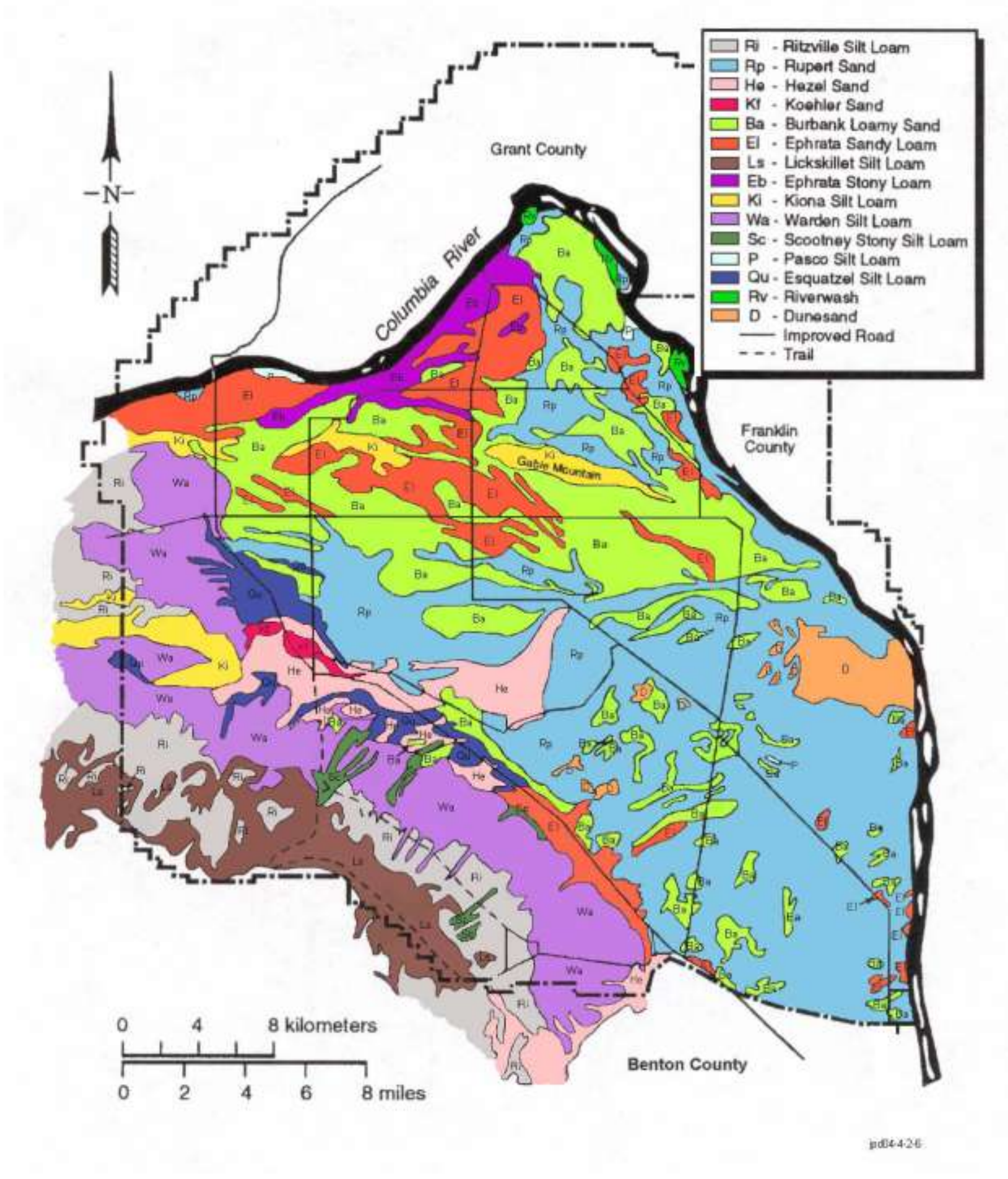
Fifteen soil types have been described on the Hanford Site. These soil types vary from sand to silty and sandy loam. The dominant soil types in the project area of the Hanford Site are Rupert Sand, Burbank Loamy Sand, Ephrata Sandy Loam, and Warden Silt Loam. Figure 3-4 provides a soil map for the Hanford Site. The dominant soil types are generally described as follows:

- **Rupert Sand -** Rupert Sand is a brown to grayish-brown coarse sand grading to dark grayish-brown at a depth of 90 cm (35 in.). It is one of the most extensive soil types on the Hanford Site. Rupert sand developed in coarse sandy alluvial deposits that were mantled by wind-blown sand and formed hummocky terraces and dune-like ridges.
- **Burbank Loamy Sand -** Burbank Loamy Sand is a dark-colored, coarse-textured soil underlain by gravel. Its surface soil is usually about 40 cm (16 in.) thick, but may be as much as 75 cm (30 in.) thick. The gravel content of its subsoil ranges from 20 percent to 80 percent.
- **Ephrata Sandy Loam -** Ephrata Sandy Loam is found on level topography on the Hanford Site. Its surface is darkly colored and its subsoil is dark grayish-brown medium-textured soil underlain by gravelly material that may continue for many feet.
- **Warden Silt Loam -** Warden Silt Loam is dark grayish-brown soil with a surface layer usually 23 cm (9 in.) thick. Its silt loam subsoil becomes strongly calcareous at about 50 cm (20 in.) and becomes lighter in color. Granitic boulders are found in many areas. Warden silt loam is usually greater than 150 cm (60 in.) deep.

3.4 WATER RESOURCES

Characterization of hydrology at the Hanford Site includes surface water, vadose zone, and groundwater. The vadose zone is the unsaturated region between the ground surface and the saturated zone (i.e., groundwater). Water in the vadose zone is called soil moisture. The area in the vadose zone just above the groundwater is called the capillary fringe. Groundwater refers to water within the saturated zone. Permeable saturated units in the subsurface are called aquifers, or perched water in the vadose zone.

1 **Figure 3-4. Soil Types on the Hanford Site.**



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3.4.1 Surface Water and Wetland Habitat

Surface water at the Hanford Site includes the Columbia River, springs, and ponds. In addition, the Yakima River flows along a short section of the southern boundary of the Hanford Site. Intermittent surface streams (i.e., Cold Creek, Dry Creek, Rattlesnake and Snively springs) and surface water associated with irrigation exist on the Hanford Reach National Monument. There are springs along the banks of the Columbia River that vary with river stage. These areas are also part of the Hanford Reach National Monument.

The Columbia River is the dominant surface water body on the Hanford Site. Several communities along the Columbia River rely on the river as their source of drinking water. The Columbia River is also used as a source of both drinking water and industrial water for several Hanford Site facilities. In addition, the Columbia River is used extensively for recreation including fishing, hunting, boating, sailing, water-skiing, diving, and swimming. Areas along the banks of the Columbia River comprise the Hanford Reach River Corridor and are managed in a multi-jurisdictional manner involving the DOE, USFWS, WDFW, and other state and county agencies. The corridor comprises the Columbia River and the near-shore environment extending approximately 0.25 mile inland from the river between the Vernita Bridge and the Ringold Fish Hatchery (approximately 40 miles).

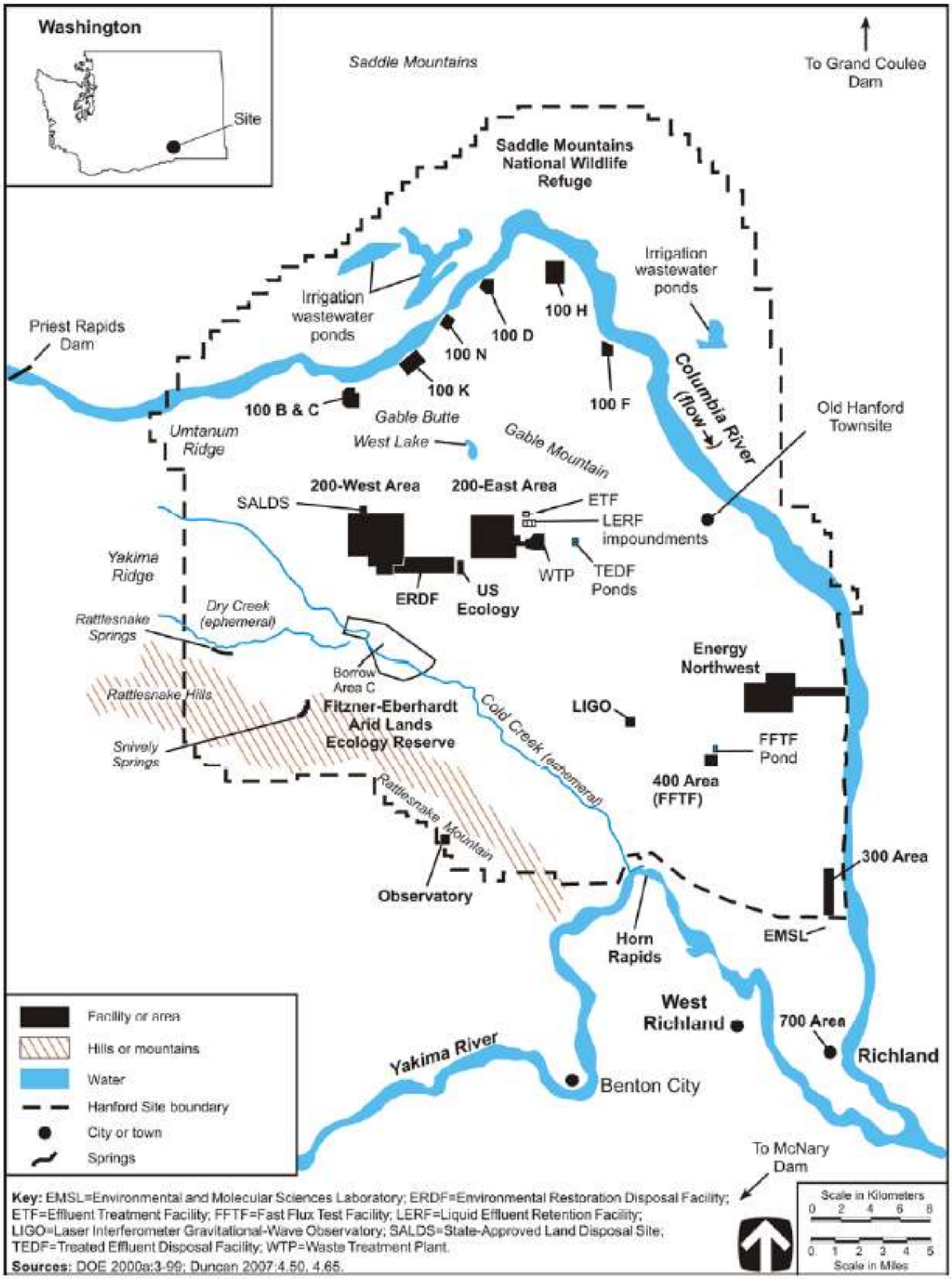
Surface water in the project area of the Hanford Site includes ponds associated with ongoing and past activities. Naturally occurring ponds include West Lake. Artificial, engineered ponds include the 200 Area Treated Effluent Disposal Facility (TEDF) and Liquid Effluent Retention Facility (LERF). Wetlands are those areas that are inundated or saturated by surface water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (33 CFR 328.3, "Definitions of Waters of the United States").

West Lake exists due to the intersection of the elevated regional water table with the land surface in the topographically low area. With the cessation of nuclear fuels processing activities on the Hanford Site, the amount of water discharged to the ground in the 200 Area has decreased significantly. Accordingly, over the past 10 years West Lake has decreased in size to the point that it consists of a group of small isolated pools and mudflats forming a wetland area. Predominant plants at West Lake include alkali salt grass, plantain, and salt rattlepod. Bulrush grows along the shoreline; however, the water is too saline to support aquatic macrophytes (i.e., large aquatic plants).

Artificial ponds primarily associated with waste management activities also exist in the project area of the Hanford Site. These include two TEDF disposal ponds and three LERF surface impoundments directly east of 200 East Area, and the FFTF ponds in the 400 Area (essentially dry since shutdown of the FFTF). The LERF consists of three lined surface impoundments with a nominal capacity of 29.5 million liters each. The effluent stored in LERF is treated at the Effluent Treatment Facility prior to being discharged underground to a State-Approved Land Disposal Site north of the 200 West Area. The TEDF is comprised of two five-acre rock lined basins in which the wastewater evaporates or infiltrates into the soil column. The TEDF does not include any wastewater treatment facilities since all wastewater is managed at each upstream facility source.

There are also several naturally occurring vernal ponds near Gable Mountain and Gable Butte that dry-up during the summer months. Figure 3-5 depicts surface water and wetland habitat features on the Hanford Site.

1 **Figure 3-5. Surface Water and Wetland Habitat Features on the Hanford Site.**



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Wetlands on the Hanford Site occur primarily on lands managed by the USFWS or others as part of the Hanford Reach National Monument. These areas include the Columbia River shorelines, wetlands within the Saddle Mountain National Wildlife Refuge and the Wahluke Unit, and spring-fed streams on the Fitzner-Eberhardt Arid Lands Ecology (ALE) Reserve. Riparian areas along the banks of rivers and streams are vegetated wetlands, and include shoreline areas along sloughs and backwaters. These areas are rich in species diversity, both within and between sites. Dominant species include common spikerush, needle spikerush, alkali bulrush, western lilaeopsis, broadleaf cattail, and various rushes.

Wetlands also include the vegetated shorelines of lakes, ponds, vernal pools, industrialized ponds, and irrigation wasteways and ponds. Riparian areas provide nesting and foraging habitat and escape cover for many species of birds and mammals. Such areas support a high concentration of wintering bald eagles and waterfowl. The forty-plus species of fish inhabiting the Hanford Reach support American white pelicans, gulls, terns and cormorants. Water birds, such as herons and egrets, have well established rookeries in several locations along the river. The riparian habitat is important for neo-tropical migrant species, as well as for the characteristic breeding species of riparian habitats in the interior Columbia River Basin.

3.4.2 Vadose Zone

The thickness of the vadose zone ranges from 0 meters (0 feet) near the Columbia River to greater than 100 meters (330 feet) beneath the 200 Areas. Unconsolidated glacio-fluvial sands and gravels of the Hanford Formation make up most of the vadose zone. In some areas, the fluvial-lacustrine sediments of the Ringold Formation make up the lower part of the vadose zone. The Cold Creek unit also makes up part of the vadose zone and contains a plio-pleistocene layer (cemented calcic horizon) under parts of 200 West Area. This cemented calcic horizon provides an impediment to downward flow of water.

Moisture movement through the vadose zone is important because it is the driving force for migration of mobile contaminants to the groundwater. Currently, the major source of moisture to the vadose zone is precipitation (in the past it was artificial recharge mounds from liquid discharges to ponds, ditches, and cribs which are no longer active). The amount of deep drainage (i.e., below the plant root zone) at any particular site is dependent on the total amount of water available at the time of the event, soil type, and the presence of vegetation. Usually, vegetation reduces the amount of deep drainage through the process of uptake and plant transpiration.

The vadose-zone stratigraphy influences the movement of liquid through the soil column. Lateral spreading can occur along any strata with contrasting hydraulic conductivity. Perched water zones form where downward-moving moisture accumulates on top of less-permeable soil lenses (silt or clay) or highly cemented calcic horizons. Lateral spreading can delay the arrival of contaminants at the groundwater.

Clastic dikes, which can be found in the project area, are vertical to subvertical tabular structures that crosscut normal sedimentary layers and are usually filled with multiple layers of unconsolidated sediments. Clastic dikes have the potential to act as preferential pathways or barriers to the movement of soil moisture in the vadose zone. At low water fluxes typical of vegetated areas, flow is dominated by the relatively finer-grained clastic dikes. At high input fluxes, the coarser-grained host sediments dominate flow (i.e., moisture takes the path of least resistance) suggesting clastic dikes containing fine sediment can actually retard vertical flow rather than act as conduits for fluids through the vadose zone (PNNL-14548, *Hanford Site Groundwater Monitoring for Fiscal Year 2003*).

3.4.3 Groundwater

Groundwater beneath the Hanford Site is found in both an upper unconfined aquifer system and deeper aquifer confined (i.e., sandwiched between) by basalt layers. The unconfined aquifer system is also referred to as the suprabasalt aquifer system. Portions of the suprabasalt aquifer system are locally confined. However, because the entire suprabasalt aquifer system is interconnected site-wide, it is referred to as the Hanford unconfined aquifer system. The depth to groundwater in the project area ranges from 0 meters (0 feet) near the Columbia River to greater than 100 meters (330 feet) beneath parts of the Central Plateau (i.e., 200 Areas).

Tritium and carbon-14 measurements indicate that groundwater residence time (time that ground water has been in the subsurface) is up to thousands of years for the unconfined aquifer and more than 10,000 years for groundwater in the shallow confined aquifer. Chlorine-36 and noble gas isotope data suggest groundwater ages of greater than 100,000 years in the deeper confined systems. These relatively long residence times are consistent with semiarid-site recharge conditions typical of the Hanford Site. However, groundwater travel time from the 200 Areas to the Columbia River has been shown to be much faster in the past (in the range of 10 to 30 years). This was due to artificial recharge from large volumes of wastewater that were disposed to the soil column until the mid-1990s and the relatively high permeability of Hanford formation sediments (PNNL-6415).

3.5 ECOLOGICAL AND BIOLOGICAL RESOURCES

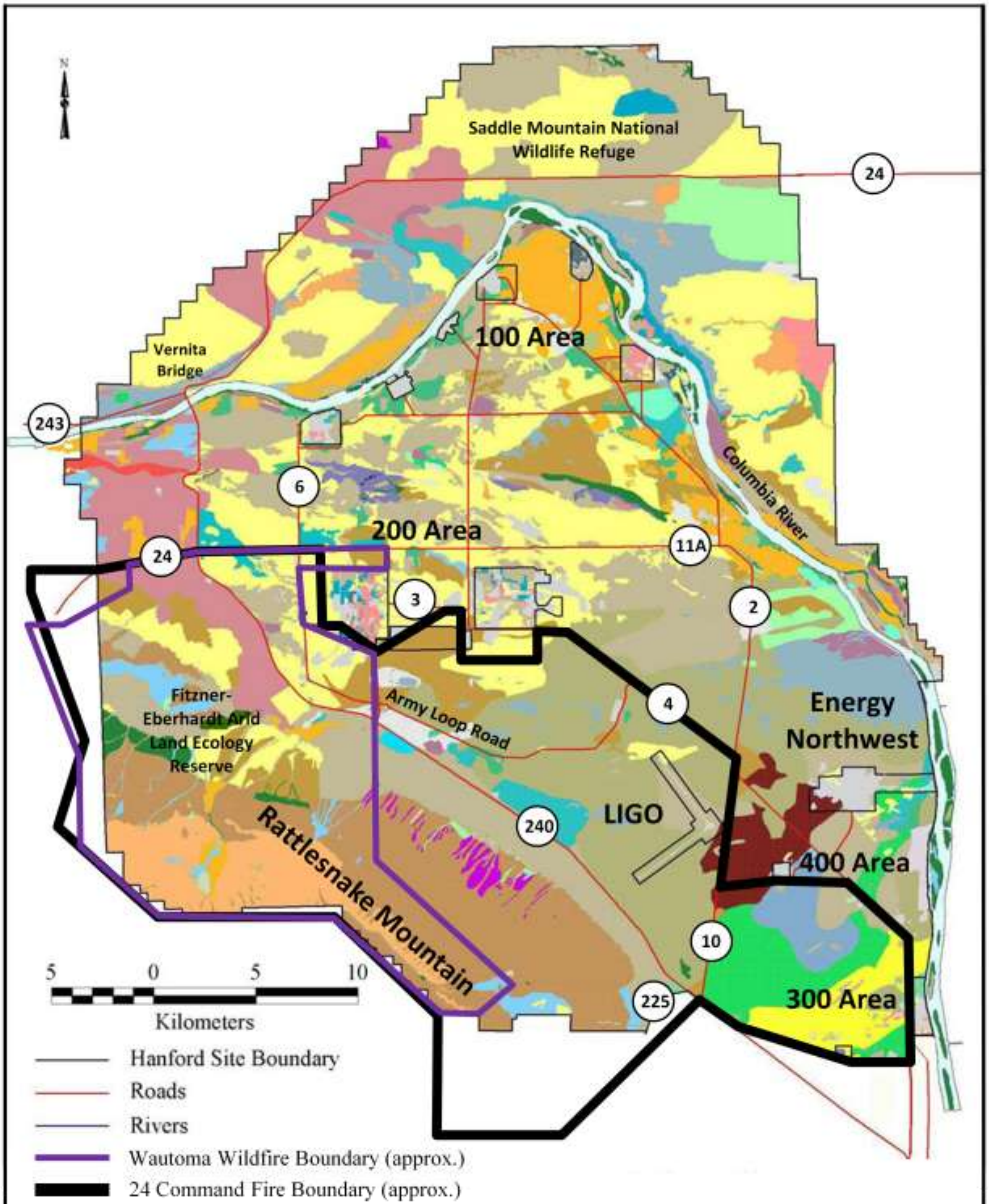
Ecological and biological resources include terrestrial habitat, wetland habitat, aquatic habitat, and special status species (e.g., threatened and endangered species). Wetland habitat was discussed in Section 3.4.1 as a surface water resource. Terrestrial resources are the plant and animal communities most closely associated with the land. Aquatic resources are associated with a water environment. Endangered species are those plants and animals in danger of extinction throughout all or a large portion of their range. Threatened species are those likely to become endangered within the foreseeable future. Other organisms may be designated by USFWS and the state as special status species (such as candidate, species of concern, sensitive, and watch). Plant and animal species found on the Hanford Site are listed in Appendix B.

3.5.1 Terrestrial Habitat and Biota

A variety of both native and non-native plant species are found on the Hanford Site. A total of 727 species of vascular plants has been recorded, of which 179 are non-native species. In addition, 29 soil lichens and 6 moss species have been identified. Prior to the 24 Command Fire in July 2000, studies identified as many as 48 vegetation communities.

Shrublands comprise the largest areas within the Hanford Site. Of the numerous types present, sagebrush-dominated communities predominate; other shrub communities vary with changes in soils and elevation. Typical vegetation in shrubland habitat includes big sagebrush, threetip sagebrush, bitterbrush, gray rabbitbrush, winterfat, snow buckwheat, and spiny hopsage. In the recent past, big sagebrush plant communities covered about 80 percent of the mapped land on the site; however, much of this area was burned by the 24 Command Fire in 2000 and again by the Wautoma Wildfire in 2007. Figure 3-6 generally depicts the distribution of vegetation types on the Hanford Site prior to the 24 Command and Wautoma wildfires. Appendix C provides a series of more detailed vegetation maps by major areas on the Hanford Site. Although the maps represent a snapshot in time (2006) and may not reflect current conditions, they are nevertheless useful to get a general idea of the plant species present at one time.

Figure 3-6. Distribution of Vegetation Types and Areas on the Hanford Site (Before 24 Command and Wautoma Wildfires). (Sheet 1 of 2)



NOTE: Hanford Site core area bounded by State Highway 240 and the Columbia River (remaining areas part of Hanford Reach National Monument)

Figure 3-6. Distribution of Vegetation Types and Areas on the Hanford Site (Before 24 Command and Wautoma Wildfires). (Sheet 2 of 2)

The WDFW created the Priority Habitat and Species Program to ensure species and habitats of concern to the state are identified and managed correctly to ensure their long-term survival. Based on this Program, WDFW considers pristine shrub-steppe habitat to be a priority habitat because of its relative scarcity in the state and its importance to several state-listed wildlife species.

While most grasses occur as understory in shrub-dominated plant communities, there are a number of grassland communities on the Hanford Site. Common species include Sandberg's bluegrass, needle-and-thread grass, Indian ricegrass, and thickspike wheatgrass. Invasive plants (i.e., Cheatgrass and Russian thistle) have replaced many native perennial grass species and are well established in many low-elevation (less than 244 meters [800 feet]) and/or disturbed areas.

Appendix B contains a list of noxious weeds that occur on the Hanford Site. Noxious weed species include, for example, Yellow Starthistle, Rush Skeletonweed, Medusahead, Babysbreath, Dalmatian Toadflax, Spotted Knapweed, Diffuse Knapweed, Russian Knapweed, Saltcedar, and Purple Loosestrife.

Biodiversity is defined as the diversity of ecosystems, species, and genes; and the variety and variability of life. Major components of biodiversity are plant and animal species, micro-organisms, ecosystems and ecological processes; and the inter-relationships between and among these components. Biodiversity is a qualitative measure of the richness and abundance of ecosystems and species in a given area.

Invasive plants and noxious weeds can have serious affects on the native plant biodiversity, wildlife habitat, and scenic values for which the Hanford Site is known ("Biodiversity Studies of the Hanford Site, Final Report: 2002-2003," Evans et al., 2003). At Hanford, as elsewhere in western North America, invasive plants and noxious weeds compete against and reduce habitat available for rare plant taxa and native plant species. Invasive plants and noxious weeds alter ecosystem structure and function, disrupt food chains and other ecosystem characteristics vital to wildlife (including threatened, endangered, and other special status species), and can dramatically alter key ecosystem processes such as hydrology, productivity, nutrient cycling, and wildfire regime ("Weed Control for the Preservation of Biological Diversity," Randall 1996; "Invasive Plants and Fire in the Deserts of North America," Brooks and Pyke, 2001; "Biotic Invasions: Causes, Epidemiology, Global Consequences, and Control," Mack et al., 2000). Past agricultural activities and more recently wildfires, have greatly increased regions of the Hanford Site dominated by invasive plant monocultures (primarily cheatgrass) and noxious weeds. Because of its extreme flammability, cheatgrass greatly increases the potential for wildfires on the Hanford Site.

Human activities involving habitat modification or destruction and habitat fragmentation can have profound effects on the biodiversity of an ecosystem or community. In addition to agricultural activities, destruction or modification of a habitat can occur when undisturbed areas are converted to other uses (i.e., industrial facilities). Habitat fragmentation occurs when disturbed areas break up a large community into smaller isolated undisturbed areas thereby impacting biodiversity because the smaller areas may not be capable of supporting the same number of species. The disturbed areas may serve as migration barriers for some species, effectively blocking recolonization of areas where small localized extinctions have occurred. Areas such as the Hanford Site serve to preserve regional biodiversity by providing refuges for species that have been eliminated by human activities in the surrounding region.

Microbiotic crusts on the Hanford Site commonly occur in the top 1 to 4 millimeters (0.04 to 0.16 inches) of soil and are composed primarily of algae, lichen, and mosses. Living organisms (primarily green algae) and their byproducts bind individual soil particles together to form these crusts. The functions of microbiotic crusts include soil stability and protection from erosion; fixation of atmospheric nitrogen; nutrient contribution to plants, thereby influencing soil-plant water relations; and increased water retention, seedling germination, and plant growth.

Approximately 300 species of terrestrial vertebrates have been observed on the Hanford Site, including 46 of mammals, 258 of birds, 10 of reptiles, and 5 of amphibians. Many species of insects occur throughout all of the habitats found on the Hanford Site. Butterflies, grasshoppers, and darkling beetles are among the most conspicuous of the approximately 1,500 species of insects identified from specimens collected on the site.

Other distinctive terrestrial habits in the project area of the Hanford Site include basalt outcrops and sand dunes. These areas exhibit special terrestrial habitats with unique characteristics associated with the natural features that define them.

3.5.2 Aquatic Habitat

Aquatic resources on the Hanford Site occur primarily on lands managed by the USFWS as part of the Hanford Reach National Monument and are not affected by activities addressed in this EA. These include the Columbia River, Yakima River, and springs on the ALE Reserve.

Within the project area, several clusters of vernal pools are distributed in the central part of Gable Butte and at the eastern end of Gable Mountain. Vernal pools are seasonally flooded depressions that occur in the spring and retain water much longer than the surrounding uplands; nonetheless, the pools are shallow enough to dry up each season. Only plants and animals that are adapted to this cycle of wetting and drying can survive in vernal pools over time. These pools can host freshwater crustaceans and other invertebrates and are of value to terrestrial species.

The LERF and TEDF, located in and adjacent to the 200 East Area, contain five ponds. There are three evaporation ponds associated with the LERF, each of which is about 0.8 hectares (2 acres) in size. The two disposal ponds associated with the TEDF are each about 2 hectares (5 acres) in size. While these ponds do not support fish populations, they are accessible to wildlife. West Lake, which has decreased in size in recent years, is the only other water body near the 200 Areas; however, the small isolated pools and mudflats do not support fish populations and are too saline to support aquatic plants although some plants exist along the shoreline.

3.5.3 Special Status Species

Endangered species are those plants and animals that are in danger of extinction throughout all or a large portion of their range. Threatened species are those species that are likely to become endangered within the foreseeable future. Endangered and threatened species are designated by the USFWS.

In addition to threatened and endangered species, the USFWS, National Marine Fisheries Services, and Washington State designate other plants and animals as candidate, species of concern, sensitive, watch, and review (collectively referred to as special status species for the purpose of this EA). Candidate species are plants and animals for which the USFWS has sufficient information on their biological status and threats to propose them as endangered or threatened, but for which development of a proposed listing regulation is precluded by other higher priority listing activities. Species of concern are species for which their conservation status is of concern, but additional information is needed before they could be listed as endangered or threatened. Sensitive species are vulnerable or declining and could become endangered or threatened in Washington State without active management or removal of threats. Watch species are more abundant and/or less threatened than previously assumed, but are still of interest to Washington State. Review Group 1 species are of potential concern, but additional fieldwork is needed before a status can be assigned. Review Group 2 species are of potential concern, but unresolved taxonomic questions exist. Although neither candidate nor species of concern receive legal protection, they are considered by DOE during project planning. Appendix B contains a listing of vascular plants, mammals, birds, reptiles, amphibians, fish, and threaten, endangered, and special status species potentially occurring on the Hanford Site.

At the Federal level, four species of plants are listed as species of concern (Columbia milkvetch, Gray cryptantha, Hoover's desert parsley, and Columbia yellowcress), and three are listed as candidates (Umtanum desert buckwheat, White Bluffs bladderpod, and White eatonella). At the State level, eleven plant species are listed as threatened (Awned halfchaff sedge, Chaffweed, Desert dodder, Geyer's milkvetch, Grand redstem, Great Basin gilia, Loeflingia, Lowland toothcup, Rosy pussypaws, White Bluffs bladderpod, and White eatonella), and two species are listed as endangered (Columbia yellowcress and Umtanum desert buckwheat). Numerous additional plant species are listed at the State level with special status designations including watch, sensitive, and Review Group 1 (there are no Review Group 2 species).

At the Federal level, there are no insects listed as threatened, endangered, or special status. At the State level, two insect species are listed as candidate (Columbia River tiger beetle, Silver-bordered fritillary). Several additional insect species are listed as monitor at the State level.

At the Federal level, there are two mollusk species of concern (California floater, Great Columbia River spire snail) that are also candidate at the State level. There is one additional candidate at the State level (Shortfaced lanx). Several mollusk species are listed as monitor at the State level.

At the Federal level, two species of fish are listed as threatened (Bull trout, Steelhead) that are also candidate at the State level. One species is listed at the Federal level as endangered (spring-run Chinook salmon) that is also candidate at the State level. At the Federal level, there are two species of concern (Pacific lamprey, River lamprey) that are also monitor and candidate, respectively, at the State level. Several additional fish species are candidate or monitor at the State level.

At the Federal level, there are two reptile species of concern (Sagebrush lizard, Western toad) that are also candidate at the State level. At the State level, one additional reptile species is listed as candidate (Striped whipsnake). Several additional reptile species are listed as monitor at the State level.

At the Federal level, eight species of birds are listed as species of concern (Bald eagle, Black tern, Burrowing owl, Ferruginous hawk, Loggerhead shrike, Northern goshawk, Olive-sided flycatcher, and Peregrine falcon) and one species is listed at candidate (Greater sage grouse). At the State level, two species of birds are listed as threatened (Ferruginous hawk and Greater sage grouse), two species are listed as endangered (American white pelican and Sandhill crane), and ten species are listed as candidate (Burrowing owl, Flammulated owl, Golden eagle, Lewis's woodpecker, Loggerhead shrike, Merlin, Northern goshawk, Sage sparrow, Sage thrasher, and Western grebe). Three species of birds are listed at the State level as sensitive (Bald eagle, Common loon, and Peregrine falcon). Several additional bird species are listed as monitor at the State level.

At the Federal level, one species of mammals is listed as candidate (Washington ground squirrel) and there are three species of concern (Long-legged myotis, Small-footed myotis, and Townsend's ground squirrel). At the State level, five species of mammals are listed as candidate (Black-tailed jackrabbit, Merriam's shrew, Townsend's ground squirrel, Washington ground squirrel, and White-tailed jackrabbit). Several additional mammal species are listed as monitor at the State level.

All vegetation management activities with a potential to affect federal- or state-listed special status species will comply with applicable requirements using the ecological compliance review process to minimize potentially adverse impacts to plant and animal species. The federal list of endangered and threatened species is maintained by the USFWS in 50 CFR 17.11, "Endangered and Threatened Wildlife and Plants; Endangered and Threatened Wildlife" and 50 CFR 17.12, "Endangered and Threatened Wildlife and Plants; Endangered and Threatened Plants." State lists are maintained by the Washington Natural Heritage Program (WNHP 2010, *Rare Plants Information Available from the Washington Natural Heritage Program*) and the Washington Department of Fish and Wildlife (WDFW 2010, *Species of Concern*). The ecological compliance review process supports the Hanford Site's waste management and environmental restoration mission (including vegetation management activities) by assuring compliance with laws and regulations including the *Endangered Species Act of 1973*, the *Bald and Golden Eagle Protection Act*, and the *Migratory Bird Treaty Act*, as well as compliance with Executive and DOE Orders.

3.6 CULTURAL RESOURCES

Cultural resources are of two primary categories. These include prehistoric resources, or physical properties reflecting human activities that predate written records; and historic resources, or physical properties that postdate the advent of written records (in the United States, generally considered to be those documented no earlier than 1492). These cultural resources are of special interest and importance to American Indians and include all areas, sites, and materials deemed important for religious or heritage-related reasons, as well as certain natural resources such as plants, which have many uses within various American Indian groups (e.g., sustenance, ceremonial, and medicine).

Historic and prehistoric cultural resources on the Hanford landscape are well documented. These cultural resources are defined and protected by a series of Federal laws, regulations, and guidelines. DOE/RL-98-10 establishes guidance for identifying, evaluating, recording, curating, and managing cultural resources. Cultural resource reviews are conducted whenever projects are proposed in previously unsurveyed areas (areas previously surveyed are verified with respect to the proposed project undertaking). Archaeological reconnaissance projects dating from 1926 to 1968 and more recent National Historic Preservation Act Section 106 and Section 110 surveys conducted since 1987 have resulted in formal recording of cultural resources on archaeological forms and Washington State Historic Property Inventory Forms. DOE maintains an archive of these records. Additionally, DOE consults with the Advisory Council on Historic Preservation, Washington State Historic Preservation Office, and American Indian tribes in support of cultural resource clearances prior to initiating projects, as DOE deems appropriate.

The National Park Service formalized the concept of the TCP in 1990 as a means to identify and protect cultural landscapes, places, and objects that have special cultural significance to American Indians and other ethnic groups. A TCP that is associated with the cultural practices or beliefs of a community that are rooted in history and are important in maintaining the cultural identity of the community is eligible for inclusion in the National Register of Historic Places (National Register).

The Hanford Site is central to the practice of American Indian religion of the region. Native plants and animals are used in ceremonial foods. Prominent landforms that are TCPs, such as Rattlesnake Mountain, Gable Mountain, and Gable Butte as well as various sites along and including the Columbia River, remain sacred. Only Gable Mountain and Gable Butte are within the affected environment addressed by this EA. American Indian TCPs within the Hanford Site include, but are not limited to, a wide variety of landscapes such as archaeological sites, cemeteries, trails and pathways, campsites and villages, fisheries, hunting grounds, plant-gathering areas, holy lands, landmarks, and important places of American Indian history and culture.

Approximately 32,630 hectares (80,640 acres) of the Hanford Site and adjacent areas have been surveyed for archaeological resources. Approximately 1,550 cultural resource sites and isolated finds and 531 buildings and structures have been documented. Forty-nine cultural resource sites are listed in the

National Register. Figure 3-7 depicts general areas of the Hanford Site that have been surveyed for cultural resources as of 2007 (latest update of the map). Additional areas have been surveyed for cultural resources since that time. Records for these surveys are maintained by the Hanford Cultural Resources Program. In order to protect resources, the National Historic Preservation Act (16 USC 470) Section 304, and Archaeological Resources Protection Act (16 USC 470aa) Section 9, requires agencies to withhold from public disclosure information on the location and character of cultural resources (PNNL-6415).

Prehistoric period sites common to the Hanford Site include remains of numerous pithouse villages, various types of open campsites, spirit quest monuments (rock cairns), hunting camps, game drive complexes, quarries in mountains and rocky bluffs, hunting and kill sites in lowland stabilized dunes, and small temporary camps near perennial sources of water away from the river. An assessment of possible effects of the 24 Command Fire and Wautoma Wildfire determined that a minimum of 190 previously recorded prehistoric and historic archaeological sites could have been affected. These sites range from lithic to can scatters, Indian hunting sites to ranch buildings, and spirit quest monuments to gas production wells. The assessment found that wooden structures were destroyed, but that other surface and subsurface artifacts such as glass and lithic debris were not severely altered by the fire. Post-fire surface visibility was greatly enhanced presenting opportunities for archaeologists and historians to refine the boundaries of known sites and to locate new sites. It also increased the potential for looting and vandalism.

Lewis and Clark were some of the first European Americans to visit the Hanford region during their 1804–1806 expedition. They were followed by fur trappers, military units, and miners. It was not until the 1860s that merchants set up stores, a freight depot, and the White Bluffs Ferry on what is today the Hanford Reach, and gold miners began to work the gravel bars in the Columbia River. Cattle ranches opened in the 1880’s, and farmers soon followed. Today, the remnants of homesteads, farm fields, ranches, and abandoned military installations can be found throughout the Hanford Site. There are nearly 5,260 hectares (13,000 acres) of abandoned agricultural lands on the site, most of which is covered with cheatgrass increasing the potential for wildfires.

3.7 HUMAN HEALTH AND SAFETY

Human health and safety risks of activities at the Hanford Site include acute and chronic exposures to ionizing radiation, hazardous chemicals, and industrial accidents. Exposure to wildfire hazards (fire and smoke) can also contribute to health and safety risks. The Hanford Site has ongoing programs to monitor releases and evaluate their potential human health and safety impacts. Additionally, studies have been conducted of the pathways and potential risks of radionuclide and toxic chemical releases from Hanford Site operations and their potential impacts on site workers and the general public.

3.7.1 Radiological Hazards

Major sources and average levels of background radiation exposure to individuals in the Hanford vicinity are shown in Table 3–5.

Figure 3-7. Areas Surveyed for Cultural Resources on the Hanford Site.

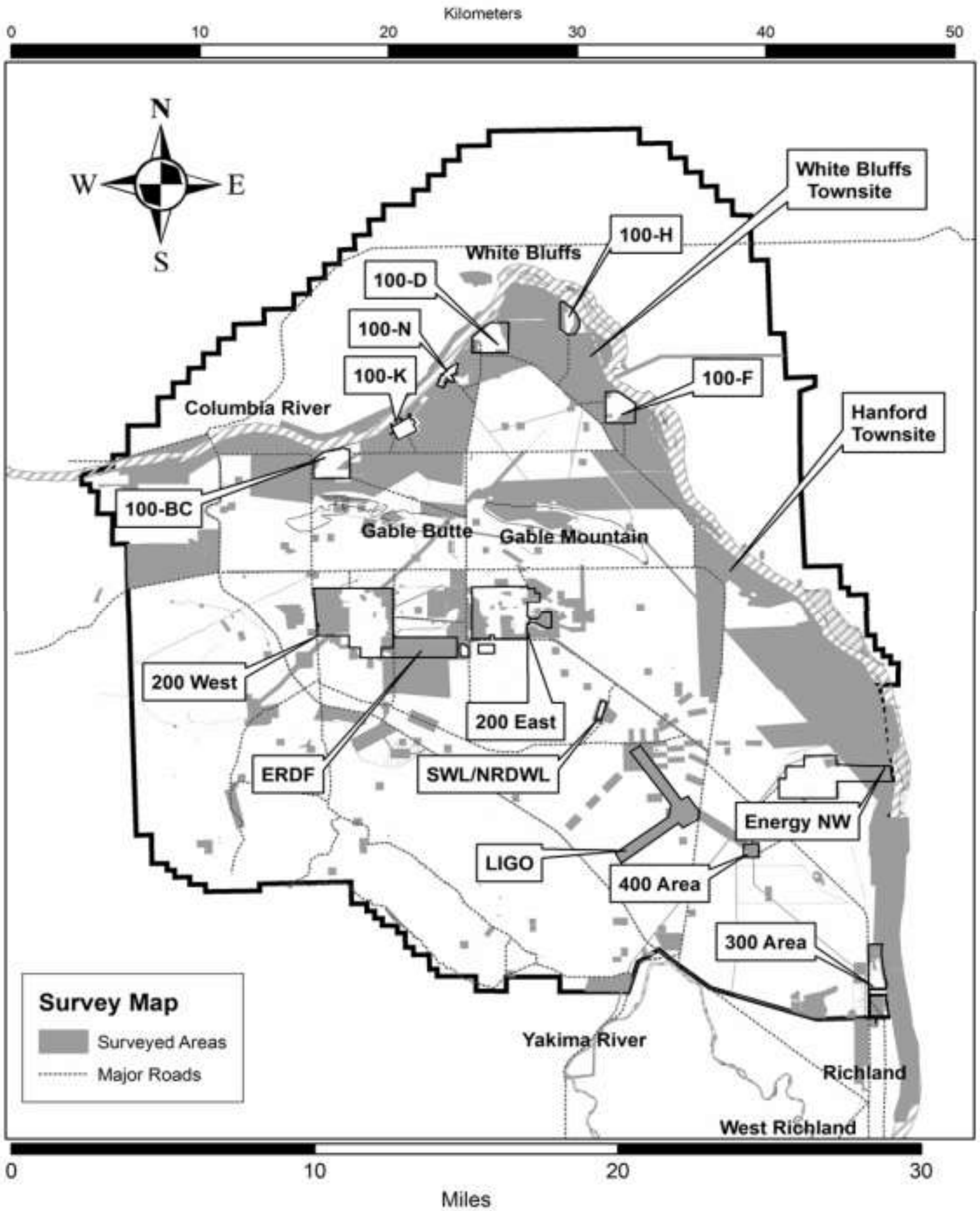


Table 3-5. Sources of Radiation Exposure to Individuals in Vicinity of Hanford Site Unrelated to Hanford Site Operations.

Source	Effective Dose Equivalent (mrem per year)[a]
Natural Background Radiation	
Cosmic and external terrestrial radiation	98
Internal radiation	30
Radon in homes (inhaled)	228
Other Background Radiation	
Diagnostic x-rays and nuclear medicine	300
Consumer and industrial products	13
Other (e.g., security, medical educational)	0.8
Total	670

[a] Averages for the United States.

Source: National Council on Radiation Protection, 2009

Doses to the public resulting from releases from Hanford Site operations are presented in Table 3-6. These doses fall within the limits established in DOE Order 5400.5, Chg 2 and are much lower than those due to background radiation.

Hanford workers receive the same dose as the general public from background radiation. They also receive an additional dose from working in and near facilities with radioactive materials. The average dose to the individual worker and the cumulative dose to all workers at Hanford from operations in 2006 are presented in Table 3–7.

Table 3-6. Comparison of 2009 Dose to Public from Hanford Site Versus Federal Standards and Natural Background.

Federal Standard	Hanford Site Dose	Percent of Standard or Background Dose
DOE - 100 mrem/yr all pathways MEI[a]	0.12	0.12
EPA - 10 mrem/yr air pathway MEI[b]	0.032	0.032
Background Dose		
356 mrem/yr average from natural background U.S. individual[c]	0.002	0.0006
150,700 person-rem/yr to population within 80 km (50 mi)	1.0	0.0007

[a] DOE Order 5400.5, Chg 2
[b] 40 CFR 61
[c] National Council on Radiation Protection and Measurements (2009)

MEI = Maximally exposed individual - A hypothetical member of the public residing near the Hanford Site who, by virtue of location and living habits, would reasonably receive the highest possible radiation dose from materials originating from the site.

Source: PNNL-19455

Table 3-7. Radiation Doses to Workers from Hanford Site Normal Operations in 2006 (Total Effective Dose Equivalent).

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard[a]	Actual
Average radiation worker (mrem)	5,000	70
Total of all radiation workers (person-rem)[b]	None	132.9

[a] No standard is specified for an "average radiation worker". The maximum dose to a worker is 5,000 mrem/yr (10 CFR 835, "Occupational Radiation Protection"). However, DOE's goal is to maintain radiological exposure as low as is reasonably achievable. DOE has therefore established the Administrative Control Level of 2,000 mrem/yr; the Hanford Site contractor sets facility administrative control levels below the DOE level, with 500 mrem/yr considered a reasonable goal for trained radiological workers and 100 mrem/yr for nonradiological workers.

[b] There were 1,911 workers with measurable doses in 2006.

Note: Total radiation worker dose differs from that calculated due to rounding.

Source: DOE/EIS-0391 (Draft).

3.7.2 Chemical Hazards

DOE policy requires that the workplace be as free as possible from recognized hazards (i.e., conditions likely to cause illness or physical harm). Exposure to hazardous chemicals (e.g., herbicides) used in vegetation management activities is minimized by appropriate training, use of personal protective equipment, monitoring of the workplace environment, limits on the duration of exposure, engineered and administrative controls, using licensed chemical operators and commercial pesticide applicators, and adherence to herbicide label requirements. Monitoring and controlling hazardous chemical usage in vegetation management activities helps to ensure that workplace standards are not exceeded and worker risk is minimized.

The *Emergency Planning and Community Right-to-Know Act of 1986* (EPCRA) and Title III of the *Superfund Amendments and Reauthorization Act of 1986* (SARA) require officials managing federal facilities that use, produce, or store extremely hazardous substances in quantities that exceed specific release thresholds to report these inventories and planned or accidental environmental releases to federal, state, and local emergency planning authorities. Two annual reports are required by EPCRA: (1) a Tier Two Emergency and Hazardous Chemical Inventory, which contains information about hazardous chemicals stored at each facility in amounts exceeding minimum threshold levels; and (2) a Toxic Chemical Release Inventory, which contains information about total annual releases of certain toxic chemicals and associated waste management activities. Types, quantities, and locations of hazardous chemicals are tracked through Chemical Management System requirements that are specific to prime Hanford Site Contractors.

The primary source of chemical hazards potentially resulting in human health and safety effects from vegetation management activities conducted in the project area of the Hanford Site would be associated with the storage, handling, application, and disposal of herbicides. Based on the herbicide application records the following amounts have been in storage and applied on the Hanford Site in recent years: 92,867 pounds in 2007; 106,122 pounds in 2008; and 66,536 pounds in 2009. The actual amount of "active ingredient" varies by product and is identified on the herbicide label (varies from a few percent to more than 50 percent).

In addition to the active ingredients, the remainder of the product comprises proprietary inert additives. For example, DiBro 2+2 (used for broadleaf weeds and grasses) contains 2 percent Diuron and 2 percent Bromacil as active ingredients and 96 percent proprietary inert ingredients. The majority of the herbicides used in vegetation management activities are EPA Category III with low toxicity or Category IV with slight toxicity. Of the active ingredients in herbicides used in the project area of the Hanford Site, only Diuron (an active ingredient in some Category III herbicides such as Dibro 2+2, Krovar IDF, Sahara DG, and Sprakil SK-26, and Topsite 2.5G) exceeds thresholds for reporting under EPCRA. Few Category I (high toxicity) and Category II (moderate toxicity) herbicides are used in support of vegetation management activities in the project area of the Hanford Site, and when used, they are applied in small quantities in accordance with label requirements by licensed chemical operators and commercial pesticide applicators.

Herbicides have widely variable chemical toxicity. Overexposure to herbicides can lead to an array of human health and safety affects that include irritation to eyes, skin, mucous membranes, and respiratory tract. Large doses of certain herbicides can lead to vomiting; diarrhea; headache; confusion; bizarre or aggressive behavior; anorexia; weight loss; metabolic acidosis; ulcers of the mouth and pharynx; and toxic injury to liver, kidneys, and central nervous system. All herbicides are stored, handled, applied, and disposed in accordance with label requirements to minimize potential impacts to human health and the environment. Also, personnel involved in the storing, handling, application, and disposal of herbicides are licensed chemical operators and commercial pesticide applicators. The normal margin of safety is generally considered by toxicologists to be sufficient to ensure that most people will experience no toxic effects from herbicides applied in accordance with label requirements. However, herbicide sensitive individuals may experience human health and safety affects from extremely small amounts of herbicides.

Specific herbicides are rotated during applications throughout the year to avoid development of plant resistance to any one product.

Occupational exposures to herbicides during mixing, spraying, and rinsing present the greatest chemical hazards and are, in general, represented by the following data in Tables 3-8, 3-9, and 3-10. While there are several different active ingredients in herbicides used in the project area of the Hanford Site, Diuron is the only one that has exceeded reporting thresholds (10,000 pounds annually) under EPCRA, Section 311. Despite its frequent application, Diuron sample concentrations measured during mixing, spraying, and rinsing operations are well below the Occupational Health and Safety Administration (OSHA) occupational exposure limit (OEL), OSHA permissible exposure limit (PEL) given as an 8-hour time weighted average, and American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV); all of which are 10 mg/m^3. Although exposure levels were measured to be very low during the mixing, spraying, and rinsing of herbicides, continued use of good work practices such as working upwind of the product and using appropriate personal protective equipment (in accordance with label requirements) would help to ensure that potential human health and safety effects due to herbicide exposures are kept as low as reasonably achievable (ALARA).

Table 3-8. Sample Results During Herbicide Mixing.

Krovar DF Herbicide (MSDS# 031566)				
Sample ID	**Agent**	**Occupational Exposure Limit**	**Sample Duration (minutes)**	**Sample Concentration**
11-60040-1-001	Diuron	10 mg/m^3	17	0.019 mg/m^3
11-60040-1-001	Bromacil	10 mg/m^3	17	0.02 mg/m^3
Echelon 4SC Herbicide (MSDS# 068845)				
Sample ID	**Agent**	**Occupational Exposure Limit**	**Sample Duration (minutes)**	**Sample Concentration**
11-60040-1-001	Sulfentrazone	None Established[(a)]	17	<0.00093 mg/m^3
11-60040-1-001	Prodiamine	None Established[(a)]	17	0.011 mg/m^3

[(a)] This chemical has not been evaluated by the ACGIH or OSHA for the development of an applicable TLV or PEL. However, due to comparable use and toxicology to bromacil and diuron, it is reasonable to assume that comparison with the 10 mg/m^3 TLV provides a conservative estimate of an appropriate occupational exposure limit.

Source: DOE Hanford Site Mission Support Contractor Industrial Hygiene Organization.

Table 3-9. Sample Results During Herbicide Spraying and Rinsing.

Krovar DF Herbicide (MSDS# 031566)				
Sample ID	**Agent**	**Occupational Exposure Limit**	**Sample Duration (minutes)**	**Sample Concentration**
11-60040-1-002	Diuron	10 mg/m^3	114	0.0035 mg/m^3
11-60040-1-002	Bromacil	10 mg/m^3	114	0.0033 mg/m^3
Echelon 4SC Herbicide (MSDS# 068845)				
Sample ID	**Agent**	**Occupational Exposure Limit**	**Sample Duration (minutes)**	**Sample Concentration**
11-60040-1-002	Sulfentrazone	None Established[(a)]	114	<0.00014 mg/m^3
11-60040-1-002	Prodiamine	None Established[(a)]	114	<0.0014 mg/m^3

[(a)] This chemical has not been evaluated by the ACGIH or OSHA for the development of an applicable TLV or PEL. However, due to comparable use and toxicology to bromacil and diuron it is reasonable to assume that comparison with the 10 mg/m^3 TLV provides a conservative estimate of an appropriate occupational exposure limit.

Source: DOE Hanford Site Mission Support Contractor Industrial Hygiene Organization.

Table 3-10. Eight-Hour Time Weighted Average (TWA).

Krovar DF Herbicide (MSDS# 031566)		
Agent	**Occupational Exposure Limit**	**8-hr TWA**
Diuron	10 mg/m^3	0.002 mg/m^3
Bromacil	10 mg/m^3	0.001 mg/m^3
Echelon 4SC Herbicide (MSDS# 068845)		
Agent	**Occupational Exposure Limit**	**8-hr TWA**
Sulfentrazone	None Established[(a)]	<0.0001 mg/m^3
Prodiamine	None Established[(a)]	<0.001 mg/m^3

[(a)] This chemical has not been evaluated by the ACGIH or OSHA for the development of an applicable TLV or PEL. However, due to comparable use and toxicology to bromacil and diuron it is reasonable to assume that comparison with the 10 mg/m^3 TLV provides a conservative estimate of an appropriate occupational exposure limit.

Source: DOE Hanford Site Mission Support Contractor Industrial Hygiene Organization.

The OSHA OEL and PEL represent the legal limit in the United States for exposure of an employee to a chemical substance. The OSHA PEL is usually given as a time-weighted average (TWA) that is the average exposure over a specified period of time, usually a nominal 8 hours. This means that, for limited periods, a worker may be exposed to concentrations higher than the PEL, so long as the average concentration over 8 hours remains lower. The sample duration reflects the typical amount of time a worker spends performing the activity (i.e., mixing, spraying, and rinsing). The 8-hour TWA is the value used to demonstrate regulatory compliance and reflects a combination of all activities.

The TLV of a chemical substance is a level to which a worker can be exposed day after day for a working lifetime without adverse health effects. Strictly speaking, TLV is a reserved term of the ACGIH. The TLV is a recommendation by ACGIH, with only a guideline status. As such, it should not be confused with exposure limits having a regulatory status, like those published and enforced by OSHA (29 CFR 1910.1000, Table Z1). The OSHA obtains their exposure limits from the National Institute of Occupational Safety and Health (NIOSH); which works under the Center for Disease Control, but for OSHA. The ACGIH is an independent and private organization that does their own lab testing to develop recommended exposure limits.

Appendix A contains a listing of herbicides used in the project area of the Hanford Site. Herbicides used by the Washington State Department of Transportation (WSDOT) are similar, and are also provided for comparison. The amount of herbicides stored, handled, applied, and disposed is expected to decline over time as control of invasive plants and noxious weeds in the project area of the Hanford Site is achieved through vegetation management activities addressed in this EA.

3.7.3 Industrial Hazards

The DOE records occupational injuries and illnesses in two primary categories pertinent to DOE NEPA analysis:

- Total recordable cases (TRC) are the total number of work-related injuries or illnesses that resulted in death, days away from work, job transfer or restriction, or “other recordable case" as identified in the OSHA Form 300, *Log of Work-Related Injury and Illness*.

- Lost workday cases represent the number of cases recorded resulting in days away from work or days of restricted work activity (DART), or both.

The TRC rates for DOE-RL averaged 1.1 cases per 200,000 worker hours during the period from 2003 through 2008, and DART rates averaged 0.5 per 200,000 worker hours. Comparable average rates over the same period for all DOE offices and contractors were 1.6 TRC and 0.7 DART cases per 200,000 worker hours. Rates for construction activities at DOE facilities were slightly higher during the same period, at 1.8 and 0.7 cases per 200,000 worker hours, respectively. For comparison, rates for U.S. industry during 2003-2007 were 4.6 TRC and 2.4 DART cases per 200,000 worker hours.

3.7.4 Fire Hazards

Prior to alteration of the shrub-steppe ecosystem of eastern Washington in the late1800's and early 1900's, big sagebrush and bluebunch wheatgrass were the dominant vegetation types over much of the Columbia Basin ("Steppe Vegetation of Washington," Daubenmire, 1970). At that time, the natural fire regime was small, high-intensity fires with a long fire return interval.

Since the early 1900's, wildfire suppression, land use practices, and invasive plants and noxious weeds have altered plant community structure and composition, reduced biodiversity through creation of monocultures, altered successional pathways and ecosystem processes, and altered the fire regime by contributing to artificially high fuel loads increasing the likelihood of more frequent large-scale wildfires. The contemporary wildfire regime is large, high intensity fires with a shorter fire return interval.

Numerous wildfires occur annually on lands in and surrounding the Hanford Site. The wildfire season on the Hanford Site is typically from May to mid-September. The majority of wildfires on the Hanford Site occur during the summer months of June, July, and August. Many fires are of anthropogenic (i.e., human) origin and are ignited by vehicle traffic along site roads and highways, equipment use, burning of adjacent agricultural lands and irrigation ditches, and arson. Fires of natural origin also frequently occur on lands within and adjacent to the Hanford Site and are typically ignited by lightning.

The potential for wildfires on the Hanford Site is high because of the presence of wildfire fuels such as cheatgrass and Russian thistle (i.e., tumbleweed) that invade and dominate disturbed areas. These highly flammable wildfire fuels are easily ignited by natural means (e.g., lightning) and anthropogenic means (e.g., vehicle accidents, lighted cigarettes, arson, etc.). Other invasive plants and noxious weeds, such as yellow star-thistle, can also become serious problems because they have the potential to increase flame lengths and alter fire frequency and intensity.

During the 21-year period from 1990 through 2010, a total of 302 wildfires burned an estimated 137,991 hectares (340,983 acres) on the Hanford Site. The largest wildfire occurred in the summer of 2000 when 68,027 hectares (168,099 acres) burned on the Hanford Site. This fire is known as the 24 Command Fire. The second largest wildfire occurred in the summer of 2007 when approximately 34,193 hectares (84,492 acres) burned on the Hanford Site. This fire is known as the Wautoma Wildfire. Table 3-11 lists the annual number of wildfires on the Hanford Site and the total estimated acreage burned. Figure 3-8 depicts the extent of the area burned during the 24 Command Fire and Wautoma Wildfire.

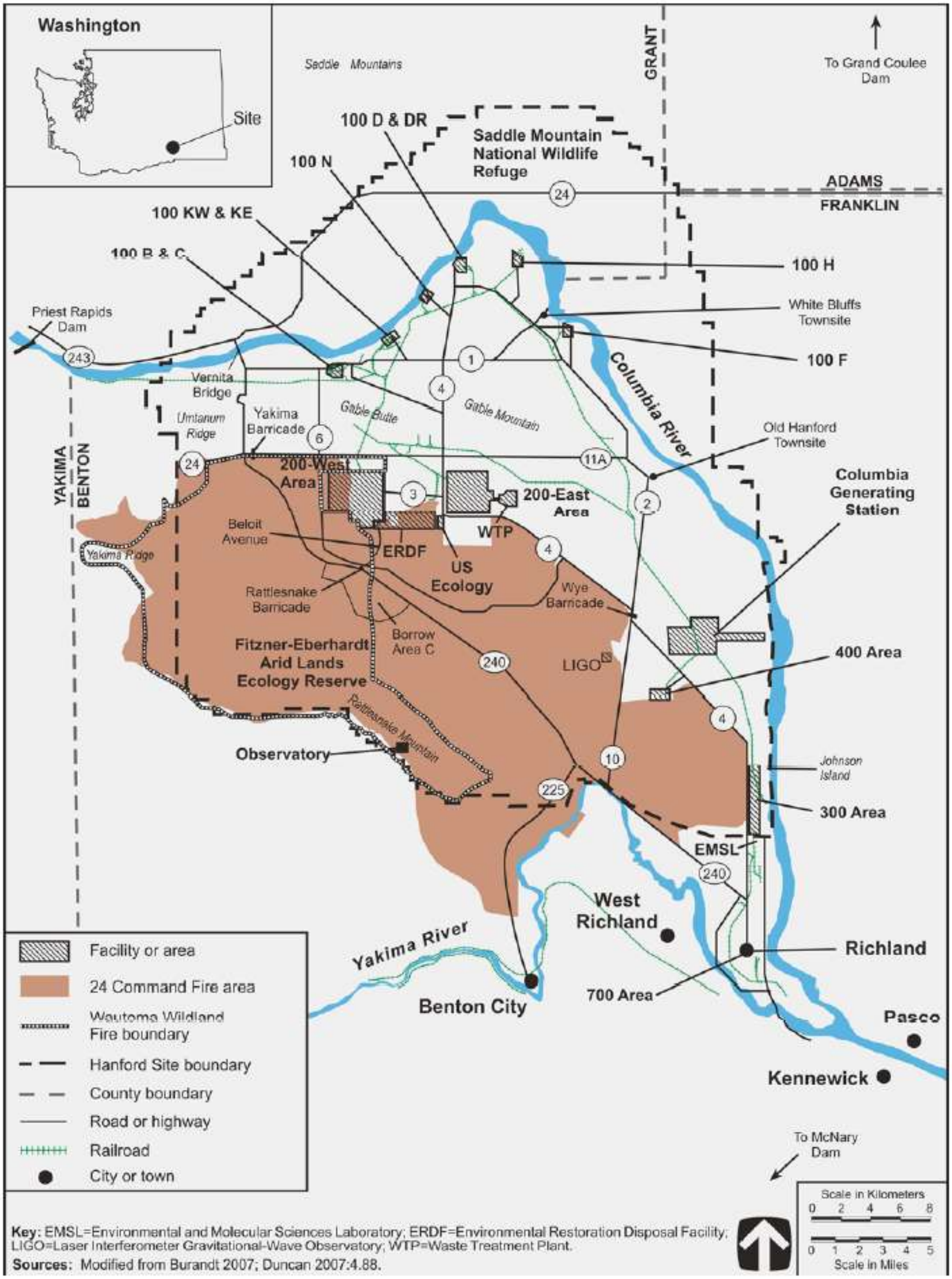
Table 3-11. Wildfire History on the Hanford Site – 1990 through 2010.

Calendar Year	Wildfires	Acreage Burned
1990	11	11,480
1991	18	784
1992	34	19,779
1993	18	1,473
1994	18	12,537
1995	19	612
1996	19	10,862
1997	7	15
1998	13	8,265
1999	25	1,287
2000	10	168,099
2001	5	1,238
2002	4	37
2003	8	631
2004	8	740
2005	5	12,173
2006	7	57
2007	13	84,492
2008	11	1,990
2009	16	2,843
2010	33	1,589

The relationship between human health and safety affects and fires is variable and complex. The principle factor to consider is whether the fire is a wildfire or a prescribed burn because there are fundamental differences in the amounts of smoke produced and smoke related human health and safety affects. The difference in the size and intensity of the fires is also such that human health and safety affects associated with smoke from wildfires is considered much greater than prescribed burning. Fires ignited during prescribed burning are lower intensity and produce less smoke than wildfires. Prescribed burning is designed to prevent the detrimental and catastrophic effects of wildfires. Occasional brief exposure to low concentrations of drift smoke from prescribed burning is more a temporary inconvenience and nuisance than a human health and safety problem. High smoke concentrations associated with wildfires is a very different and serious human health and safety matter.

Unlike the wildfires they are intended to prevent, prescribed burning can be planned and executed under ideal and controlled conditions that are conducive to proper smoke management. Such conditions include choosing of the areas to burn, the size of those areas, the climatological and meteorological conditions, and the condition of the vegetative fuel to be burned. Prescribed burning allows control over the size, frequency, duration, and intensity of the fire reducing smoke generation and associated human health and safety effects. The firefighter crew has the greatest potential for human health and safety effects from exposure to smoke. Smoke from controlled prescribed burning quickly dissipates.

Figure 3-8. Extent of Area Burned During the 24 Command and Wautoma Wildfires.



For an equivalent area, the airborne emissions due to smoke from prescribed burning in cheatgrass to reduce wildfire hazards would be reduced by a factor of roughly six when compared to airborne emissions from wildfires that start in cheatgrass stands and spread to sagebrush and grasslands. This reduction is due to the difference in fuel models and associated fuel loadings.

3.8 TRANSPORTATION

A DOE-maintained road network within the Hanford Site consists of 607 km (377 mi) of asphalt paved roads and provides access to the various work centers. Primary access roads to the industrial areas of the Hanford Site are Routes 1, 2, 3, 4, 5, 6, 10, 11, and Beloit Avenue. Public access to the 200 Areas and interior locations of the Hanford Site is restricted by guarded gates at the Wye Barricade (at the intersection of Routes 10 and 4), the Yakima Barricade (at the intersection of State Highway 240, State Highway 24, and Route 11A), and Rattlesnake Barricade south of the 200 West Area (along State Highway 240).

Traffic volumes have been projected to 2025 to be consistent with the timelines of typical long-range transportation planning efforts in the State of Washington. Table 3-12 provides baseline traffic projections for State Highways 24 and 240 (form the southern and western boundary of the Hanford Site project area) addressing average daily traffic, projected volume, and maximum average daily traffic (ADT) to maintain level of service capacity (LOSC). Although the actual numbers would vary, they provide perspective on the volume of traffic in the vicinity of the Hanford Site.

The primary commute to the Hanford Site requires most employees to travel through the city of Richland by way of State Highway 240 (Bypass Highway) or George Washington Way. Single-occupant vehicles account for 88 percent of all commute trips, while 12 percent of the vehicles are carpools or vanpools. These two roadways have an average daily traffic volume of between 30,000 and 40,000 vehicles. To help accommodate the high volume of traffic, the WSDOT expanded the Bypass Highway from four to six lanes in 2002. Similarly, the City of Richland made major capacity improvements on Stevens Drive north of State Highway 240.

Table 3-12. Baseline Traffic Projections.

Highway	Location	Existing Average Daily Traffic[a]	Projected 2025 Volume[b]	Maximum ADT To Maintain LOSC[c]
State Route 24	West of SR 240	2,900	6,900	12,000
State Route 24	North of SR 240	3,500	8,300	10,000
State Route 24	At Vernita Bridge	3,400	8,100	12,000
State Route 24	East of SR 243	830	2,000	11,000
State Route 240	North of SR 225	3,200	7,600	12,000
State Route 240	North of I-82	18,000	42,700	62,000

[a] Source: WSDOT 2003.
[b] Based on average annual traffic growth rate of 4% per year.
[c] Based on Highway Capacity Manual (TRB 2000) highway LOS procedures.

The average daily traffic volume across the State Highway 240 Yakima River Causeway was 55,000 in 2005, up from 47,000 in 1994. In 2007, WSDOT completed the expansion of State Highway 240 from Interstate Highway 182 south to the Columbia Center Interchange from four to eight lanes, and the expansion of the Interstate Highway 182 overcrossing extending from George Washington Way to southbound SR 240 from one to two lanes. These much needed capacity improvements substantially alleviate congestion during the daily commute. Figure 3-9 depicts major transportation routes on and near the Hanford Site.

3.9 NOISE

The *Noise Control Act of 1972* and its subsequent amendments (*Quiet Communities Act of 1978* and 40 CFR 201 through 211) direct the regulation of environmental noise to individual states. The State of Washington has adopted Revised Code of Washington (RCW) 70.107, "Noise Control," which authorizes Ecology to implement rules consistent with federal noise control legislation. RCW 70.107 and the implementing regulations embodied in WAC 173-60 through 173-70 define the management of environmental noise levels. Noise is technically defined as the intensity, duration, and character of sounds from any and all sources (RCW 70.107). Sound waves are characterized by frequency, measured in Hertz, and sound pressure expressed as decibels.

Maximum noise levels are defined for the zoning of the area in accordance with the environmental designation for noise abatement (EDNA). The project area of the Hanford Site is classified as a Class C EDNA on the basis of industrial activities. Unoccupied areas are also classified as Class C areas by default because they are neither Class A (residential) nor Class B (commercial). Maximum noise levels are established based on the EDNA classification of the receiving area and the source area (Table 3-13).

Table 3-13. Washington State Noise Limits for Hanford Site Based on Source and Receptor Environmental Designation for Noise Abatement Designation.

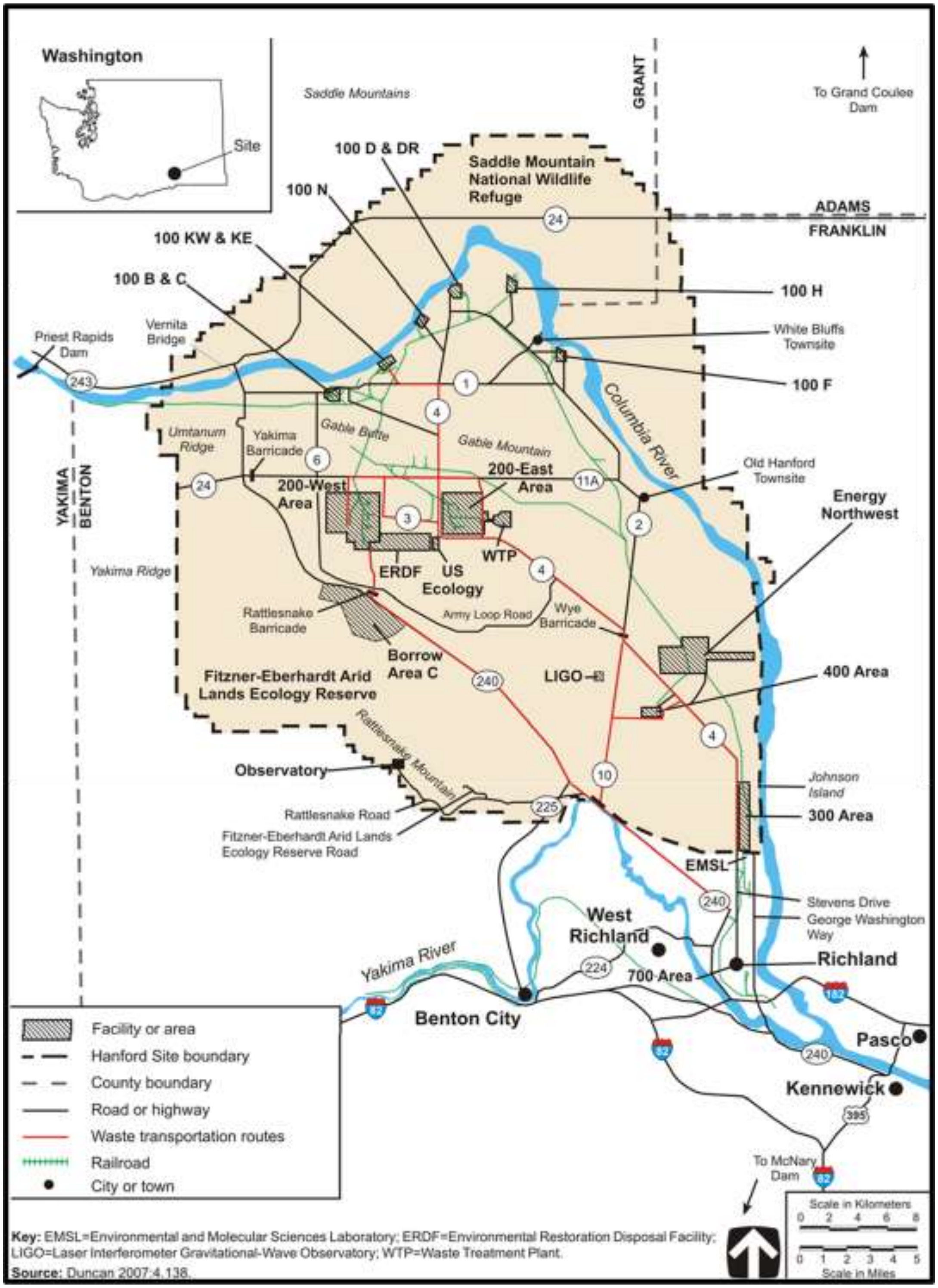
Source Hanford Site	Receptor		
	Class A Residential (dBA)	Class B Commercial (dBA)	Class C Industrial (dBA)
Class C - Day	60	65	70
Night	50	---	---

Background noise levels in the project area of the Hanford Site were measured during two surveys in 1996 and 2007. Data from a survey of 15 sites found that background noise levels (measured as the 24-hour equivalent sound level) ranged from 30 to 60.5 decibels A-weighted (dBA) (a unit of measurement that accounts for the frequency response of the human ear). A second survey of five isolated areas concluded that background sound levels in undeveloped areas could best be described as a mean 24-hour equivalent sound level of 24 to 36 dBA. Wind was identified as the primary contributor to background sound levels in the project area of the Hanford Site. Noise levels in the project area of the Hanford Site are lower than Washington State noise limits for the site based on source and receptor EDNA designation.

3.10 WASTE MANAGEMENT

Vegetation management activities in the project area of the Hanford Site result in the generation of solid waste (i.e., cardboard, plastic wrap, plastic containers) and in waste that is managed as if it were low-level radioactive waste (potentially contaminated tumbleweeds removed from radioactive and chemical waste management areas). Herbicides are stored in manufacturer's containers of various sizes, usually in 1 to 2 gallon jugs and 30 to 55 gallon drums. Once herbicides are used, the containers are rinsed three times or pressure rinsed, and the rinsate is collected and reused during remix operations. The empty containers are then disposed of as solid waste in an offsite municipal waste landfill. The 30 to 55 gallon drums are recycled. About 185 cubic yards of solid waste is generated yearly by vegetation management activities and shipped to the offsite municipal waste landfill for disposal.

Figure 3-9. Transportation Routes on and Near the Hanford Site.



The Hanford Site has a contract with a waste transfer company to manage municipal solid wastes generated from activities conducted in the project area of the Hanford Site. The waste transfer company has a contract with a local landfill for the disposal of the municipal solid wastes. Municipal solid wastes are delivered to the waste transfer company in garbage trucks operated by DOE on the Hanford Site. Large roll-off boxes are also rented from the waste transfer company to supplement the small fleet of garbage trucks. It is estimated that the total volume of municipal solid wastes generated from activities conducted in the project area of the Hanford Site and delivered to the waste transfer company for disposal in the offsite landfill was 25,800 cubic yards in FY 2010 (less than 1 percent of this waste was associated with vegetation management activities). The offsite municipal waste landfill is approximately 510 acres in size with a projected life-span of 100 years.

Approximately 10,000 cubic yards of unregulated (i.e., non-contaminated) tumbleweeds are piled and burned annually. Potentially contaminated tumbleweeds removed from radioactive and chemical waste management areas are compacted and disposed of as low-level radioactive waste in the ERDF on the Hanford Site. About 200 cubic yards of this waste is generated yearly. The ERDF, which is the permitted onsite disposal facility for low-level radioactive, hazardous, and mixed wastes generated during cleanup activities in the project area of the Hanford Site, has a disposal capacity of 6,000 cubic yards per day. Designed to be expanded as needed, ERDF comprises a series of cells or disposal areas. Each pair of cells is 70 feet deep, and 500 feet by 1,000 feet at the base; large enough to hold about 2.8 million tons of material. With the addition of super cells 9 and 10, ERDF capacity is 16.4 million tons. To date, nearly 11 million tons of contaminated material has been disposed in the facility.

The Hanford Site sustainability plan commits DOE and the Hanford Site to Pollution Prevention goals. Goals that relate to vegetation management activities addressed in this EA include the following:

- Minimizing the generation of waste and pollutants through source reduction
- Reducing and minimizing the quantity of toxic and hazardous chemicals and materials acquired, used, or disposed of
- Implementing integrated pest management (i.e., both plant and animal pests) and other appropriate landscape management practices;
- Decreasing use of chemicals where such decrease will assist in achieving greenhouse gas reduction targets under Section 2(a) & (b) of E.O.13514
- Reporting in accordance with the requirements of Sections 301 through 313 of EPCRA.

Many of these goals are stipulated in E.O. 13423 (see Section 3.2.5) and codified in Section 748 of the *2009 Omnibus Appropriations Act.* They are also supported by the *Resource Conservation and Recovery Act of 1976*, which requires minimizing hazardous waste generation, and the *Pollution Prevention Act*, which requires federal agencies to deploy pollution prevention as the first choice in environmental management.

3.11 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

The Hanford Site plays a dominant role in the socioeconomics of the Tri-Cities and other parts of Benton and Franklin Counties. The agricultural community also has a significant effect on the local economy. Any major changes in Hanford Site activities potentially affect the Tri-Cities and other areas of Benton and Franklin Counties. Figure 3-10 depicts the Hanford Site and surrounding communities.

Figure 3-10. Hanford Site and Surrounding Communities.

3.11.1 Economics and Demographics

Three major sectors have been the principal driving forces of the Tri-Cities economy since the early 1970s. These include DOE and its contractors operating the Hanford Site; Energy Northwest (formerly the Washington Public Power Supply System) in its construction and operation of nuclear power plants; and the agricultural community, including a substantial food-processing component. A growing number of technology-based businesses, many with roots in the Hanford Site and Pacific Northwest National Laboratory are playing a role in the expansion and diversification of the local private business sector.

In addition to these three major employment sectors, three other components can be readily identified as contributors to the economic base of the Tri-Cities. The first of these includes other major non-DOE contractor employers in the region. The second component is tourism. The third component to the economic base relates to the local purchasing power generated from retired former employees.

Low-income persons constitute approximately 16 percent of the total population in the ten counties surrounding the Hanford Site (i.e., Adams, Benton, Franklin, Grant, Kittitas, Klickitat, Walla Walla, and Yakima Counties in Washington; and Morrow and Umatilla Counties in Oregon). Historically, nearly 80 percent of the low-income population lives in Benton, Franklin, Grant, Yakima, and Umatilla Counties. Almost 40 percent of the low-income population lives in Yakima County.

An estimated 175,177 people lived in Benton County and 78,163 lived in Franklin County during 2010, totaling 253,340, an increase of roughly 32 percent from the 2000 Census. This growth rate is faster than the State of Washington, which has grown 14.1 percent since the 2000 Census. During 2010, Benton and Franklin Counties accounted for 3.8 percent of Washington's population. The population demographics of Benton and Franklin Counties are similar to those found within Washington State.

Approximately 90 percent of DOE contractor employees working on the Hanford Site live in Benton and Franklin Counties. Of these employees, approximately 73 percent resided in Richland, Pasco, or Kennewick (roughly 37 percent in Richland, 11 percent in Pasco, and 25 percent in Kennewick). Residents of other areas of Benton and Franklin Counties including West Richland, Benton City, and Prosser, account for the remaining 17 percent of total DOE contractor employment (PNNL-6415).

The demographic profile of the population from the year 2010 Census for the Hanford Site socioeconomic region of influence is presented in Table 3–14. In that year the population of the region of influence was 253,340. Self-designated minority individuals constituted 24.3 percent of the total population. The largest group of this minority population was Hispanic or Latino.

According to income information from 2009 (latest published by U.S. Census Bureau) for the Hanford Site socioeconomic region of influence (Table 3–15), the median annual household income in Benton County was slightly higher than that for Washington State, while Franklin County's was $8,760 lower than that for the State. Also, in 2009, only 11.3 percent of the population in Benton County was below the official poverty level, while 17.3 percent of the population in Franklin County was below that level. This compares to 12.3 percent for Washington State as a whole.

Table 3-14. Demographic Profile of Populations in the Hanford Site Socioeconomic Region of Influence during 2010.

Population Group	Benton County		Franklin County		Region of Influence	
	Population	% of Total	Population	% of Total	Population	% of Total
RACE						
Non-Minority						
White[a]	144,418	82.4	47,270	60.5	191,688	75.7
Minority						
Black or African American[a]	2,221	1.3	1,473	1.9	3,694	1.5
American Indian and Alaska Native[a]	1,574	0.9	531	0.7	2,105	0.8
Asian[a]	4,691	2.7	1,434	1.8	6,125	2.4
Native Hawaiian and other Pacific Islander[a]	253	0.1	107	0.1	360	0.1
Some other race[a]	15,798	9.0	24,881	31.8	40,679	16.1
Two or more races[a]	6,222	3.6	2,467	3.2	8,689	3.4
Total minority	30,759	17.6	30,893	39.5	61,652	24.3
Total	175,177	100.0	78,163	100.0	253,340	100.0
ETHNICITY						
Hispanic or Latino	32,696	18.7	40,004	51.2	72,700	28.7
Not Hispanic or Latino	142,481	81.3	38,159	48.8	180,640	71.3
Total	175,177	100.0	78,163	100.0	253,340	100.0

[a] Includes individuals who identified themselves as Hispanic or Latino.
Source: Census (U.S. Census Bureau), 2010, *2010 Census Interactive Population Search*, accessed at http://2010.census.gov/2010census/popmap/.

Table 3-15. Income Information for the Hanford Site Region of Influence.

Calendar Year 2009	Benton County	Franklin County	Washington State
Median household income	$57,603	$47,719	$56,479
Percent of persons below poverty level	11.3	17.3	12.3

Source: United States Census Bureau, Small Area Income and Poverty Estimates, accessed at http://www.census.gov/did/www/saipe/index.html.

3.11.2 Environmental Justice

E.O. 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" addresses the environmental and human health conditions of minority and low-income populations. The DOE's goals are to ensure that no segment of the population, regardless of race, color, national origin, income, or net worth bears disproportionately high and adverse human health and/or environmental impacts as a result of DOE's activities.

The area within an 80-kilometer (50-mile) radius of the Hanford Site encompasses parts of ten counties in two states: Adams, Benton, Franklin, Grant, Kittitas, Klickitat, Walla Walla, and Yakima Counties in Washington; and Morrow and Umatilla Counties in Oregon. Based on the 2010 Census, the total population of these counties was 811,495 of which the total minority population was 215,445 or about 27 percent. The ethnic composition of the ten counties is roughly 73.5 percent White, 1.1 percent Black or African American, 2.3 percent American Indian or Alaska Native, 1.5 percent Asian or Pacific Islander, 0.1 percent Native Hawaiian/Pacific Islander, 18.1 percent some other race, and 3.4 percent two or more races. Hispanics and Latinos account for 32.8 percent of the total population and roughly 80 percent of the total minority population in the ten counties. Approximately 80 percent of the minority population resides in Franklin, Benton, Yakima, and Grant Counties. Native Americans living in Washington State reside primarily on the Yakama Reservation and upstream of the Hanford Site near the town of Beverly, Washington. Table 3-16 shows populations in the potentially affected area surrounding the Hanford Site.

Table 3-16. Populations in the Potentially Affected Ten-County Area Surrounding the Hanford Site and the Two-State Region of Washington and Oregon in 2010. (2 sheets)

Population Group	Counties Surrounding Hanford Site		Washington and Oregon	
	Population	Percent of Total	Population	Percent of Total
RACE				
Non-Minority				
White Alone	596,050	73.5	8,400,976	79.6
Minority				
Black or African American[(a)]	9,299	1.1	309,248	2.9
American Indian and Alaska Native[(a)]	18,396	2.3	157,072	1.5
Asian[(a)]	12,083	1.5	622,330	5.9
Native Hawaiian and other Pacific Islander[(a)]	997	0.1	53,879	0.5
Some other race[(a)]	146,862	18.1	554,424	5.3
Two or more races[(a)]	27,808	3.4	457,685	4.3
Total minority	215,445	26.5	2,154638	20.4
Total	811,495	100.0	10,555,614	100.0

Table 3-16. Populations in the Potentially Affected Ten-County Area Surrounding the Hanford Site and the Two-State Region of Washington and Oregon in 2010. (2 sheets)

Population Group	Counties Surrounding Hanford Site		Washington and Oregon	
	Population	Percent of Total	Population	Percent of Total
ETHNICITY				
Hispanic or Latino	265,921[b]	32.8	1,205,852	11.4
Not Hispanic or Latino	545,574	67.2	9,349,762	88.6
Total	811,495	100.0	10,555,614	100.0

[a] Includes individuals who identified themselves as Hispanic or Latino.

[b] Includes individuals who identified their race as White and their ethnicity as Hispanic or Latino.

Source: Census (U.S. Census Bureau), 2010, *2010 Census Interactive Population Search*, accessed at http://2010.census.gov/2010census/popmap/

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4.0 IMPACTS OF NO ACTION ALTERNATIVE AND PROPOSED ACTION

This section discusses the environmental impacts of the No Action Alternative and the Proposed Action. The environmental impacts would result from vegetation management activities conducted in radioactive and chemical waste management areas, infrastructure areas, and open rangelands using physical, chemical, and biological methods, prescribed burning, and revegetation. The direct and indirect environmental impacts are discussed by resource area to allow for comparisons between the No Action Alternative and Proposed Action.

4.1 LAND USE AND VISUAL RESOURCES

Property in the project area of the Hanford Site where vegetation management would be conducted has multiple land use designations as discussed in Section 3.1.2. These designations include *Industrial-Exclusive* around radioactive and chemical waste management areas in the 200 East and 200 West Areas. Land use designations also include *Research and Development* around the Laser Interferometer Gravitational Wave Observatory (LIGO) Facility; *Industrial* around the Columbia Generating Station, 300 Area, 400 Area, and east of 200 East Area; *Preservation* of traditional cultural properties (i.e., Gable Mountain and Gable Butte); and *Conservation/Mining* in most other areas (i.e., infrastructure areas and open rangelands) bounded by the Columbia River and State Highway 240.

4.1.1 Land Use

There would be no foreseeable changes and no impacts to land uses due to vegetation management activities conducted in radioactive and chemical waste management areas, infrastructure areas, and open rangelands in the project area of the Hanford Site under either the No Action Alternative or the Proposed Action. Land use designations would remain unchanged regardless of whether the No Action Alternative or Proposed Action was implemented. Designated land uses although not impacted directly, however, would be in conflict with vegetation management activities under both the No Action Alternative and Proposed Action.

Potential land use conflicts would arise principally in areas designated for *Preservation* (i.e., Gable Mountain and Gable Butte traditional cultural properties) and *Conservation/Mining* (much of the infrastructure areas and open rangelands in the 600 Area). These areas, which are managed by DOE to preserve cultural, ecological, and natural resources, occupy approximately 80 percent of the project area of the Hanford Site (Table 3-1).

Under the No Action Alternative and Proposed Action, the ability to preserve cultural, ecological, and other natural resources in areas designated for *Preservation* or *Conservation/Mining* would be diminished by the conduct of vegetation management activities that rely on ground-disturbing methods, such as ground-based equipment to apply herbicides. The No Action Alternative would rely on ground-based vegetation management methods and equipment (treating approximately 1,365 hectares [3,373 acres] annually). The Proposed Action would rely on aerial application of herbicides that would minimize ground-disturbing activities and thereby reduce impacts to cultural, ecological, and other natural resources (treating up to 4,047 hectares [10,000 acres] annually). To maximize DOE’s ability to continue to manage these resources and minimize potential land use conflicts, DOE also would develop mitigation measures, based on cultural and ecological resources reviews, prior to initiating vegetation management activities. The outcome of these reviews would be to protect and preserve cultural, ecological, and other natural resources on approximately 12,891 hectares (31,855 acres) of land designated for *Preservation* and approximately 54,704 hectares (135,175 acres) designated for *Conservation/Mining*. In addition, under the Proposed Action, up to 2,428 hectares (6,000 acres) of open rangelands designated for

Conservation/Mining would be treated annually using a combination of other treatment methods (i.e., physical methods, biological methods, and prescribed burning) followed by revegetation with desirable shrubs, grasses, and forbs (i.e., the IVM approach).

4.1.2 Visual Resources

Visual resources within the project area of the Hanford Site are dominated by widely spaced, low-brush grasslands typical of shrub-steppe ecosystem, stabilized sand dunes (along the eastern boundary), and non-vegetated blowouts. Large areas have been blackened by wildfires and some are now recovering. Existing firebreaks maintained along site infrastructure (e.g., roadways, railways, power lines) create a mosaic pattern within the shrub-steppe habitat of desirable native vegetation and undesirable invasive plants and noxious weeds that infest disturbed areas (e.g., construction areas, wildfire impacted areas). This mosaic pattern is defined by the fire containment lines that protect the visual resources.

There would be no foreseeable impacts to visual resources (primarily regional shrub-steppe ecosystem and sand dunes) by vegetation management actions conducted in radioactive and chemical waste management areas under the No Action Alternative or the Proposed Action. Radiological and chemical waste management areas are either kept devoid of vegetation, or if stabilized with bunchgrasses, are maintained as such (i.e., visual resources do not exist in these areas as defined above).

Under the No Action Alternative, vegetation management actions in infrastructure areas and open rangelands located in the project area of the Hanford Site would focus on maintenance of existing firebreaks and treatment of small, localized infestations of invasive plants and noxious weeds within reach of existing roads. Such actions would have no direct impact on visual resources because maintenance of existing firebreaks would be in previously disturbed areas and not impact existing shrub-steppe habitat. Treatment of small, localized infestations of invasive plants and noxious weeds would target individual plants using selective physical (e.g., hand pulling) and chemical (e.g., hand spraying) methods with no expected impacts to existing shrub-steppe habitat. However, revegetation of wildfire impacted areas would serve to enhance visual resources by restoring desirable shrubs, grasses, and forbs lost to fire.

Under the Proposed Action, vegetation management actions in infrastructure areas would be the same as under the No Action Alternative, and therefore potential impacts to visual resources would be the same. In open rangelands, however, the use of the IVM approach would enhance visual resources by promoting eradication of invasive plants and noxious weeds, and developing shrub-steppe habitat and soil stabilizing vegetation over a larger area (up to 6,475 hectares [16,000 acres] annually) than under the No Action Alternative.

4.2 AIR QUALITY

As discussed in Section 3.2.5, the maximum Hanford Site concentrations for all criteria and other regulated air pollutants are well below the standard or guideline for ambient air quality, and EPA considers Benton County and the Hanford Site to be “in attainment” for federal and state ambient air quality standards. These air pollutant concentrations represent stationary sources (e.g., stacks, vents, risers) from facilities on the Hanford Site, and do not include possible contributions from vegetation management activities (e.g., prescribed burning, equipment emissions), wildfires, or vehicle emissions (and other mobile sources such as portable generators).

Although not directly comparable to federal and state ambient air quality standards, DOE has estimated the annual emissions of criteria air pollutants and greenhouse gases from vegetation management activities to provide perspective. Air quality impacts from implementing the No Action Alternative and the Proposed Action would be due principally to non-stationary sources including smoke from prescribed burning, and emissions from vehicles and equipment used in vegetation management. Wildfires, although not a direct result of implementing either the No Action Alternative or Proposed Action, also would contribute emissions (smoke) to the atmosphere. Impacts to air quality from prescribed burning and wildfires are described in Section 4.2.1 and greenhouse gas and other toxic pollutants from vehicle emissions are described in Section 4.2.2.

4.2.1 Prescribed Burning and Wildfire Impacts

Smoke from prescribed burning and wildfires would have potential air quality impacts. Prescribed burning would be employed under the No Action Alternative to maintain firebreaks within and along infrastructure by burning tumbleweed accumulations. Under the Proposed Action, DOE also would employ prescribed burning to manage vegetation within and along infrastructure, but also in larger areas of open rangelands (wildfire fuel areas that are primarily cheatgrass).

The air quality impacts from prescribed burning are minimized because of DOE's ability to control the conditions during prescribed burning (e.g., size of area, type of fuel, amount of fuel). Prescribed burning would be conducted within the limits of a burn plan and burn permit issued by the Benton Clean Air Agency (BCAA) that would describe the acceptable range of weather, moisture, fuel, and fire behavior parameters; smoke management methods; and the ignition method to achieve the desired results.

Based on information provided by the Hanford Fire Department, fuel types in shrub-steppe regions are typically grasses and shrubs. Where grass is the primary carrier of fire, Fuel Models 1 and 2 best describe the vegetation in the project area of the Hanford Site. For Fuel Model 1 (i.e., annual/perennial grasses), the fine fuel loading is 1.64 Mg/hectare (0.74 ton per acre). Fuel Model 1 would represent prescribed burning under controlled conditions (i.e., Proposed Action). For Fuel Model 2 (i.e., sagebrush/grasslands), the fine fuel loading is 4.43 Mg/hectare (2.0 ton per acre), the medium fuel loading is 2.22 Mg/hectare (1.0 ton per acre), the heavy fuel loading is 1.12 Mg/hectare (0.5 ton per acre), and the herbaceous fuel loading is 1.12 Mg/hectare (0.5 ton per acre); for a total of 8.89 Mg/hectare (4.0 ton per acre). Fuel Models 1 and 2 combined would represent wildfire conditions (i.e., No Action Alternative; where wildfire starts in annual/perennial grasses and spreads to sagebrush/grasslands).

Fuel Model

Fuel models are numeric descriptions of fire behavior and fire danger based on the type of vegetation as well as the horizontal and vertical arrangements of fuel, for example, short or tall grasses.

Airborne emissions from fires include particulates, carbon monoxide, volatile organics (as methane), and nitrogen oxides; sulfur oxides would be negligible (AP-42, Volume I, Fifth Edition). Based on methods presented in AP-42, "Compilation of Air Pollutant Emission Factors," (EPA-420-F-05-004, *Emission Facts – Greenhouse Gas Emissions from a Typical Passenger Vehicle*) and the fuel loadings for the Hanford Site, DOE estimated emissions that would occur from prescribed burning and wildfires using the following:

[Equation 1]: Fi = PiL
[Equation 2]: Ei = FiA = PiLA

Where:

- Fi equals the emission factor (mass of pollutant/unit area consumed)
- Pi equals the yield for pollutant "i" (mass of pollutant/unit mass of fuel consumed)
  - 8.5 kg/Mg (17 pound per ton [lb/ton]) for total particulate
  - 70 kg/Mg (140 lb/ton) for carbon monoxide
  - 12 kg/Mg (24 lb/ton) for total hydrocarbon (as CH_4)
  - 2 kg/Mg (4 lb/ton) for nitrogen oxides (NO_x)
- L equals the fuel loading consumed (mass of fuel/unit land area burned)
- A equals the land area burned
- Ei equals the total emissions of pollutant "i" (mass pollutant)

Table 4-1 provides total airborne pollutant emissions from wildfires and prescribed burning for Fuel Model 1 (i.e., prescribed burning in annual/perennial grasses - cheatgrass), Fuel Model 2 (i.e., burning of sagebrush/grasslands alone), and Fuel Models 1 plus 2 (i.e., wildfires that start in annual/perennial grasses and spread to sagebrush/grasslands) in the project area of the Hanford Site. The total airborne pollutant emissions are normalized to a per hectare basis for ease of comparison.

Table 4-1. Airborne Emissions from Wildfires and Prescribed Burning.

Emission Type[(a)]	Fuel Model[(b)]	Pollutant Yield (Pi); kg/Mg	Fuel Loading Consumed (L); Mg/hectare	Total Pollutant Emission (Ei); (kg)[(c)]
Annual/Perennial Grasses (prescribed burning only)				
Particulate	1	8.5	1.64	13.9
Carbon Monoxide	1	70	1.64	114.8
Methane	1	12	1.64	19.7
Nitrogen Oxides	1	2	1.64	3.3
Sagebrush/Grasslands (would be burned by wildfires that start in annual/perennial grasses)				
Particulate	2	8.5	8.89	75.6
Carbon Monoxide	2	70	8.89	622.3
Methane	2	12	8.89	106.7
Nitrogen Oxides	2	2	8.89	17.8
Annual/Perennial Grasses Plus Sagebrush/Grasslands (wildfire situation)				
Particulate	1 + 2	8.5	10.53	89.5
Carbon Monoxide	1 + 2	70	10.53	737.1
Methane	1 + 2	12	10.53	126.4
Nitrogen Oxides	1 + 2	2	10.53	21.1

(a) Emissions of carbon monoxide, nitrogen oxides and methane collectively represent greenhouse gas contributions to the atmosphere.
(b) Fuel Model 1 represents prescribed burning only in annual/perennial grasses (i.e., cheatgrass); Fuel Model 2 represents sagebrush/grasslands that would be burned by wildfires that start in annual/perennial grasses; Fuel Models 1 plus 2 represents wildfire; both annual/perennial grasses and sagebrush/grasslands would burn.
(c) Normalized to a per hectare basis for ease of comparison; pollutant emissions from wildfires about of factor of 6 higher than those from prescribed burning

Under the No Action Alternative up to 78,185 hectares (193,198 acres) of open rangelands (excludes 100, 200, 300, and 400 Areas) in the project area of the Hanford Site would be vulnerable to wildfires due to the focus on only maintaining firebreaks, treating small/localized infestations of invasive plants and noxious weeds, and prescribed burning of tumbleweed accumulations. During the 21-year period from 1990 through 2010, a total of 302 wildfires burned an estimated 137,991 hectares (340,983 acres) on the Hanford Site for an average of 6,571 hectares (16,237 acres) annually. Under the Proposed Action, DOE estimates that up to 2,023 hectares (5,000 acres) of wildfire fuel (primarily cheatgrass) would be treated annually using prescribed burning followed by revegetation to minimize the potential for high-intensity wildfires. Table 4-2 illustrates the estimated emissions of pollutants that would occur under the No Action Alternative and Proposed Action.

Table 4-2. Annual Airborne Emissions.[a]

Emission Type	No Action Alternative (kg)	Proposed Action (kg)
Particulate	588,105	28,120
Carbon Monoxide	4,843,484	232,240
Methane	830,574	39,853
Nitrogen Oxides	138,648	6,676

[a] Fuel Model 1 represents prescribed burning only in annual/perennial grasses (i.e., cheatgrass) (Proposed Action); Fuel Models 1 plus 2 represents wildfire situation where fire starts in annual/perennial grasses and spreads to sagebrush/grasslands (No Action Alternative).

Wildfires on the Hanford Site would occur under either the No Action Alternative or Proposed Action, although in the longer-term the amount of acreage impacted by wildfires under the Proposed Action is estimated to be less than under the No Action Alternative. The use of IVM techniques under the Proposed Action over larger areas of rangelands (relative to the No Action Alternative) would reduce wildfire fuels by increasing the removal of invasive plants and noxious weeds, and promoting revegetation of more fire-resistant plant communities. Table 4-3 provides estimated airborne emissions from a wildfire encompassing the same amount of land that would be treated by prescribed burning under the Proposed Action (for purposes of comparison only). Air emissions from wildfires would be about a factor of six higher than prescribed burning.

Table 4-3. Air Emissions from a Nominal Wildfire.[a]

Emission Type	Emissions (kg)
Particulate	181,059
Carbon Monoxide	1,491,153
Methane	255,707
Nitrogen Oxides	42,685

[a] Wildfire over 2,023 hectares (5,000 acres) of wildfire fuel (primarily cheatgrass) targeted for prescribed burning under the Proposed Action

In accordance with EPA's "Treatment of Data Influenced by Exceptional Events" (Federal Register, Volume 72, Number 55), wildfires are considered to be "natural events" that are one form of an "exceptional event" that does not affect "attainment status" with respect to National Ambient Air Quality Standards. A wildfire is an unplanned, unwanted fire (such as a fire caused by lightning in open rangelands), and includes unauthorized human-caused fires (such as arson or acts of carelessness by people) and escaped prescribed fire projects (e.g., escaped control due to unforeseen circumstances) where the appropriate management response is to suppress the fire. A prescribed fire is defined as any fire ignited by management actions to meet specific resource management objectives (i.e., prescribed burning). Although a prescribed fire cannot be considered a "natural event" given the extent of the direct human causal connection, prescribed fires would be conducted under controlled conditions to minimize potential impacts to attainment status and be considered an "exceptional event" because it would be unlikely to recur at a particular location (i.e., eliminate cheatgrass and revegetate with more wildfire tolerant shrubs, grasses, and forbs). It also addresses a situation that is not reasonably controllable or preventable without a prescribed fire (i.e., buildup of wildfire fuels, including dead plant biomass).

4.2.2 Vehicle Emission Impacts

Vegetation management activities under the No Action Alternative and the Proposed Action would utilize both diesel and gasoline powered vehicles. As such, there would be vehicle emissions related to greenhouse gases, and criteria and toxic pollutants.

Under the No Action Alternative, ten vehicles of various types (see Table 2-4) would be required to manage vegetation in the radioactive and chemical waste management areas and in infrastructure-related firebreaks. Under the Proposed Action, the number of vehicles would increase to a total of 12 (i.e., one additional truck-mounted sprayer and one additional boom-type sprayer) to manage vegetation as described under the No Action Alternative, but also to allow vegetation management in open rangelands (an additional 1,214 to 2,023 hectares [3,000 to 5,000 acres] annually) using integrated methods (e.g., "brown and burn" using herbicides followed by prescribed burning and revegetation). Much of the added acreage under the Proposed Action would be treated using subcontracted aerial methods and do not require larger increases in the Hanford Site vegetation management vehicle fleet.

Based on EPA-420-F-05-004, which includes cars and trucks, a gallon of fuel is assumed to produce 8.8 kilograms (or 19.4 pounds) of carbon dioxide. This number is calculated from values in the Code of Federal Regulations at 40 CFR 600.113-78, which EPA uses to estimate the fuel economy of vehicles, and relies on assumptions consistent with the Intergovernmental Panel on Climate Change guidelines.

In addition to carbon dioxide, vehicles emit methane and nitrous oxide from tailpipes, as well as hydrofluorocarbon (HFC) emissions from leaking air conditioners. The emissions of methane and nitrous oxide are estimated based on vehicle miles traveled rather than fuel consumption. The emissions of methane, nitrous oxide, and HFCs are not as easily estimated as carbon dioxide. On average, methane, nitrous oxide, and HFC emissions represent roughly 17 percent of the greenhouse gas emissions from vehicles, while carbon dioxide emissions account for 83 percent (considering the global warming potential of each greenhouse gas). These percentages are estimated from EPA-430-R-11-005, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2009.*

The following provides the basis for estimating annual greenhouse gas emissions from the vehicles used to implement vegetation management activities under the No Action Alternative and the Proposed Action. Emissions from vehicles under the No Action Alternative would be slightly lower due to the reduced number of vehicles.

Under the No Action Alternative, the following assumptions were used to estimate conservatively the annual greenhouse gas emissions due to vegetation management activities:

- (10 vehicles) × (200 miles/vehicle day) × (260 workdays/year) = 520,000 miles/year
- 10 miles/gallon of fuel used (conservative average) = 52,000 gallons

- 8.8 kilograms of carbon dioxide per gallon of fuel used = 457,600 kilograms
- Carbon dioxide represents 83 percent of greenhouse gas emissions from vehicles

The metric tons equivalent carbon dioxide (CO_2e) equal:

> (Vehicle miles traveled/miles per gallon) times (carbon dioxide [kilograms] per gallon) times (carbon dioxide content in percent/kilogram to metric ton conversion factor)

Accordingly,

$$(520{,}000 \div 10) \text{ X } 8.8 \text{ X } (0.83 \div 1{,}000) = 380 \text{ metric tons annually}$$

Since CO_2e represents 83 percent of the greenhouse gas emissions, then contributions from methane, nitrous oxide, and HFCs equals about 78 metric tons annually (combined).

Under the Proposed Action, the vehicle fleet would increase by two vehicles (one truck-mounted sprayer and one boom-type sprayer). Using the same assumptions and reflecting the addition of two vehicles, the estimated annual greenhouse gas emissions would be as follows.

- (12 vehicles) × (200 miles/vehicle day) × (260 workdays/year) = 624,000 miles/year
- 10 miles/gallon of fuel used (conservative average) = 62,400 gallons
- 8.8 kilograms of carbon dioxide per gallon of fuel used.= 549,120 kilograms
- Carbon dioxide represents 83 percent of greenhouse gas emissions from vehicles

The metric tons equivalent carbon dioxide (CO_2e) equal:

$$(624{,}000 \div 10) \text{ X } 8.8 \text{ X } (0.83 \div 1{,}000) = 456 \text{ metric tons annually}$$

Since CO_2e represents 83 percent of the greenhouse gas emissions, then contributions from methane, nitrous oxide, and HFCs equals 93 metric tons annually (combined).

By way of comparison, the total greenhouse gas emissions from mobile sources (primarily fleet vehicles, but also including gas-powered portable generators) during FY 2010 was 33,015 metric tons CO_2e (Table 3-4) across the entire Hanford Site. Estimated contributions of greenhouse gas emissions from vehicles used to implement either the No Action Alternative or Proposed Action for vegetation management in the project area of the Hanford Site would be small, representing less than 2 percent of the total greenhouse gas emissions from mobile sources during FY 2010. Although both would be small, the Proposed Action would increase greenhouse gas emissions over the No Action Alternative by about 20 percent.

In addition to greenhouse gas emissions, vegetation management vehicles would emit criteria and toxic air pollutants. Criteria pollutants include VOCs measured as non-methane organic gases (NMOG), carbon monoxide (CO), oxides of nitrogen (NO_x), oxides of sulfur (SO_x), and particulate matter (PM), including small-diameter PM-10, in some cases. Emissions of SO_x would be small due to the use of low sulfur fuel. Emissions of toxic air pollutants associated with vehicle operations were estimated for benzene, formaldehyde, acetaldehyde, 1,3-butadiene, and ethene as a fraction of NMOG emissions. The following emission factors (Table 4-4) were derived from the California Air Resources Board's EMFAC emissions factor model (UCD-ITS-96-12, *Emissions of Criteria Pollutants, Toxic Air Pollutants, and Greenhouse Gases from the Use of Alternative Transportation Modes and Fuels*) for criteria pollutants.

Table 4-4. Emission Factors for Gasoline and Diesel Fueled Vehicles.

Criteria Pollutant	Emission Factor (grams/mile)
NMOG Exhaust[a]	
Incremental Cold Start	2.376
Incremental Hot Start	0.358
Stabilized Running emissions	0.196
CO Exhaust[a]	
Incremental Cold Start	33.740
Incremental Hot Start	6.870
Stabilized Running emissions	3.030
NO_x Exhaust[a]	
Incremental Cold Start	2.250
Incremental Hot Start	1.190
Stabilized Running emissions	0.440
Other Emissions	
Exhaust PM[a]	0.010

[a] EMFAC estimated PM (not PM-10) emissions for catalyst-equipped automobiles and trucks with inspection and maintenance programs in place. For the final PM-10 emission estimates, one can multiply PM by the fraction that is PM-10. According to EPA's *Air Emissions Species Manual, Volume II* (1990), PM from gasoline vehicles is 97% PM-10, and PM from diesel-fuel vehicles is 100% PM-10 (EPA *Air Emissions Species Manual*, *Volume II*, 1990). It can also be assumed that PM from alternative fuel vehicles is 97% PM-10.

Source: UCD-ITS-96-12

Under the No Action Alternative, the vehicle fleet of ten vehicles would travel an estimated 520,000 miles annually. Under the Proposed Action, the vehicle fleet would increase to 12 vehicles and travel an estimated 624,000 miles annually. Based on these mileage estimates, the following mass of criteria pollutants in Table 4-5 would be expected.

Table 4-5. Estimated Criteria Pollutant Annual Emissions from Vegetation Management Vehicles. (2 sheets)

Criteria Pollutant	Airborne Emissions, kilogram [metric ton]	
	No Action Alternative	Proposed Action
NMOG Exhaust		
Incremental Cold Start	1,236 [1.24]	1,483 [1.5]
Incremental Hot Start	186 [0.19]	223 [0.2]
Stabilized Running emissions	102 [0.10]	122 [0.1]
CO Exhaust		
Incremental Cold Start	17,545 [17.5]	21,054 [21.1]
Incremental Hot Start	3,572 [3.6]	4,287 [4.3]
Stabilized Running emissions	1,576 [1.6]	1,891 [1.9]

Table 4-5. Estimated Criteria Pollutant Annual Emissions from Vegetation Management Vehicles. (2 sheets)

Criteria Pollutant	Airborne Emissions, kilogram [metric ton]	
	No Action Alternative	Proposed Action
NO_x Exhaust		
Incremental Cold Start	3,572 [3.6]	1,404 [1.4]
Incremental Hot Start	619 [0.62]	743 [0.7]
Stabilized Running emissions	229 [0.23]	275 [0.3]
Other Emissions		
Exhaust PM	5.2 [0.005]	6.2 [0.006]

For toxic air pollutants, DOE estimates the following emissions from the vegetation management vehicle fleet for the No Action Alternative (Table 4-7) and Proposed Action (Table 4-8) as a fraction of the NMOG emissions (Table 4-5) and the toxic air pollutant fractions for gasoline and diesel fuel (Table 4-6).

Table 4-6. Toxic Air Pollutants as a Fraction of Non-Methane Organic Gases Emission from Vehicles.

Pollutant	Gasoline[a]	Diesel[b]
Benzene	0.039	0.011
Formaldehyde	0.017	0.029
Acetaldehyde	0.005	0.008
1,3-butadiene	0.004	0.014
Ethene	0.059	0.000

[a] These are fractions of composite Federal Test Procedure emissions of non-methane organic compounds.

[b] The results of tests on two heavy-duty diesel vehicles (EPA, *Motor Vehicle-Related Air Toxics Study*, 1993).

Based on the fractions of NMOG emissions from vehicles, the DOE estimates emissions of toxic air pollutants for the No Action Alternative to be as follows:

Table 4-7. Estimated Toxic Air Pollutant Annual Emissions based on Non-Methane Organic Gases for No Action Alternative (metric ton).

Pollutant	Incremental Cold Start		Incremental Hot Start		Stabilized Running Emissions	
	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel
Benzene	0.048	0.014	0.007	0.002	0.004	0.001
Formaldehyde	0.021	0.036	0.003	0.006	0.002	0.003
Acetaldehyde	0.006	0.010	0.001	0.002	0.001	0.001
1,3-butadiene	0.005	0.017	0.001	0.003	0.0004	0.001
Ethene	0.073	0.000	0.011	0.000	0.006	0.000

Based on the fractions of NMOG emissions from vehicles, the DOE estimates emissions of toxic air pollutants for the Proposed Action to be as follows:

Table 4-8. Estimated Toxic Air Pollutant Annual Emissions based on Non-Methane Organic Gases for Proposed Action (metric ton).

Pollutant	Incremental Cold Start		Incremental Hot Start		Stabilized Running Emissions	
	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel
Benzene	0.059	0.017	0.008	0.002	0.004	0.001
Formaldehyde	0.026	0.044	0.003	0.006	0.002	0.003
Acetaldehyde	0.008	0.012	0.001	0.002	0.001	0.001
1,3-butadiene	0.006	0.021	0.001	0.003	0.0004	0.001
Ethene	0.089	0.000	0.012	0.000	0.006	0.000

The emission rates of gas-phase airborne toxic compounds (e.g., formaldehyde, acetaldehyde, benzene, 1,3-butaidene, and Ethene) from vehicles have steadily been reduced during the past decade as a result of the introduction of reformulated gasoline (i.e., E-85) and low-sulfur diesel fuel, advances in engine design and fuel metering systems, and the implementation of highly efficient exhaust after-treatment control devices. Of all the engine and vehicle technologies, the catalytic converter provides the greatest emission reductions. For gas-phase airborne toxic compounds, today's modern vehicles reduce emissions greater than 98 percent. Gas-phase airborne toxic compound emissions from vegetation management vehicles are expected to be small.

While airborne emissions from an aircraft engine during aerial application of herbicides would occur, these emissions would be small in comparison to ground-based methods required to treat the same acreage. An aerial spray contractor can treat up to 4,047 hectares (10,000 acres) in one to two days. It could take several years for ground-based crews to treat an equivalent area.

4.3 SOILS

The principal impacts to soils from the No Action Alternative and Proposed Action would be associated with use of physical and chemical methods, prescribed burning, and revegetation activities (biological methods are not expected to impact soils). Such impacts would be related to soil compaction under the weight of heavy equipment, effects of herbicide on soil properties, and effects of fire (i.e., prescribed burning and wildfires) on soil properties.

Under the No Action Alternative and Proposed Action, vegetation management in radioactive and chemical waste management areas would be the same and include the use of physical and chemical methods, and revegetation. The use of heavy equipment would compact soils reducing permeability, which would increase surface runoff and restrict plant root development and growth (*The Nature Conservancy Weed Control Methods Handbook*, Tu et al., 2001). Although desirable in tank farm and solid waste management areas that are maintained vegetation-free, such impacts would be undesirable in revegetated solid and liquid waste management areas. Soil compaction would be mitigated by avoiding traffic on wet soils; using machinery equipped with wide tires, dual tires, or tracks; minimizing vehicle weight; maintaining minimum tire inflation pressure; avoiding the use of oversized equipment; and minimizing the number of passes over the soil.

Similarly, the impacts of herbicides on soils under the No Action Alternative would be beneficial to efforts directed towards keeping these areas vegetation-free. However, in revegetated radioactive and chemical waste management areas the potential impacts of herbicides on soil could be detrimental. Herbicides potentially would change soil pH ("Effects of Lime, Fertilizer, and Herbicide on Forest Soil and Soil Solution Chemistry, Hardwood Regeneration, and Hardwood Growth Following Shelterwood Harvest," Schreffler and Sharpe, 2003) and microbial activity ("Effects of Glyphosate on Soil Microbial Activity and Biomass," Haney et al., 2000) thereby controlling the availability of nutrients to support plant growth. Also, herbicides would reduce the growth and function of mycorrhizal fungi decreasing the ability of plants to absorb and translocate nutrients from the soil (*Soil Microbial Biomass C and Symbiotic Processes Associated with Soybean Alter Sulfentrazone Herbicide Application*, Vieira et al., 2007). Adverse herbicide impacts on soils would be mitigated by application in accordance with label requirements using licensed chemical operators and commercial pesticide applicators.

Under the No Action Alternative, vegetation management in infrastructure areas and open rangelands in the project area would focus on maintaining firebreaks and treating small, localized infestations of invasive plants and noxious weeds within reach of existing roads. The impacts from soil compaction and herbicide applications (and mitigation) would be the same as those discussed for radioactive and chemical waste management areas. DOE, however, considers these impacts to be beneficial in these areas as the intent is to reduce or eradicate vegetation. Biological methods would not be expected to impact soils because the biological agents do not alter soil properties through compaction or other means.

Prescribed burning with low and more moderate temperature fires generally has long-term benefits for ecosystems that evolved with fire (*Fire's Effects on Ecosystems,* DeBano et al., 1998). Prescribed burning can speed up the plant recycling process (i.e., death and decomposition), returning nutrients to the soil and increasing nitrogen fixation for use by plants. However, prescribed burning of piled or windrowed debris, or burning under other conditions that create more intense fires can damage soil by igniting organic matter in the soil or altering soil physical and chemical properties.

In contrast, soil impacts from wildfires are magnified relative to those of prescribed burning. As described above in Section 4.2.1, wildfires on the Hanford Site would occur under the No Action Alternative and Proposed Action, although in the longer-term the amount of acreage impacted by wildfires under the Proposed Action is estimated to be less than under the No Action Alternative. Potential impacts on soils from wildfire would include alteration of chemical, biological, and physical properties from heat and oxidation of fuels ("Fire Effects on Belowground Sustainability," Neary et al., 1999). Higher soil temperatures typical of wildfires would potentially kill soil microbes (i.e., cryptogams), destroy soil organic matter, and alter soil nutrient and water status. Wildfires alter soil properties including soil structure, texture, porosity, wetability, infiltration rates, and water holding capacity. Intense wildfires can increase water repellency of soils (i.e., hydrophobicity) increasing the potential for water erosion.

Under the Proposed Action, the impacts to soils (i.e., compaction) from the use of physical methods would be the same as those discussed under the No Action Alternative. Chemical methods (i.e., herbicides) would be applied to larger areas (up to 4,047 hectares [10,000 acres] annually); however, treatment would be accomplished using aerial application methods. While the area subject to compaction would be reduced because of the use of aerial application methods for herbicides, the area experiencing herbicide related impacts on soil properties would be larger. Potential impacts of herbicides on soils would be mitigated by adherence to label requirements and application by licensed chemical operators and commercial pesticide applicators. Biological methods would not be expected to impact soils as discussed under the No Action Alternative.

In addition, areas treated to remove wildfire fuel would be revegetated with desirable shrubs, grasses, and forbs thereby reducing the potential for wildfires and impacts on soils. Removing mature vegetation (even invasive plants and noxious weeds) and replacing it with seeded or seedling species (i.e., desirable shrubs, grasses, and forbs) may temporarily increase soil erosion rates as young plants would use less water and take a period of time to become established. However, it is expected that over time areas would stabilize as newly planted vegetation matures. The impacts of revegetation on soils in desert ecosystems have been shown to produce beneficial ecological changes, including the formation of biological soil crusts that alter patterns of soil water storage, increasing the moisture content near the surface and changing soil texture and hydraulic properties ("Long-Term Effects of Revegetation on Soil Hydrological Processes in Vegetation-Stabilized Desert Ecosystems," Yu et al., 2010).

4.4 WATER RESOURCES

Vegetation management activities can affect water resources (i.e., surface water, vadose zone, and groundwater) in a variety of ways depending upon the method used. While surface water impacts tend to be direct, impacts on the vadose zone and groundwater would be indirect and result from possible migration of herbicides following application.

4.4.1 Surface Water and Wetland Habitat

The surface water resources in the project area of the Hanford Site include West Lake and artificial ponds (i.e., TEDF and LERF). There are several naturally occurring vernal (i.e., spring time) ponds near Gable Mountain and Gable Butte, however, they are small and dry-up during the summer months. The only wetland habitat that exists is associated with West Lake, north of the 200 Areas in open rangelands. West Lake consists of a group of small isolated pools and mudflats. Some vegetation exists along shorelines (e.g., alkali salt grass, plantain, salt rattlepod, and bulrush); however, the water is too saline to support large aquatic plants.

Vegetation management activities under the No Action Alternative would not take place in open rangelands occupied by West Lake and other surface water bodies and, therefore, there would be no impacts to these surface water sources or wetland habitat. Under the Proposed Action, DOE would implement an IVM approach using a combination of physical, chemical, and biological methods, prescribed burning, and revegetation in open rangelands. DOE anticipates, however, that impacts to surface water resources and associated wetland habitat would be unlikely.

Within and immediately adjacent to the wetland habitat, only physical methods would be employed. Physical methods (e.g., hand pulling) would not be expected to impact wetland habitat due to the small and localized nature of soil disturbance, unlikely potential for sediment deposition impacts, and highly selective nature of the method.

Chemical and biological methods, prescribed burning, and revegetation would be employed in the open rangelands, but not within or immediately adjacent to the wetland habitat (i.e., buffer zones would be established). While impacts from aerial application of herbicides are possible, albeit unlikely, herbicides would be applied in accordance with label requirements, equipment would be setup to minimize the potential for drift, buffer zones would be established around surface water resources, and only herbicides approved for aquatic use would be used nearby. In addition, herbicides would only be applied by licensed chemical operators and commercial pesticide applicators.

Biological methods also would not be expected to impact surface water resources and associated wetland habitat. Biological agents used to control vegetation are host specific targeting selective plant species and communities.

Prescribed burning would focus on the treatment of up to 2,023 hectares (5,000 acres) annually of wildfire fuel (primarily cheatgrass) followed by revegetation with desirable shrubs, grasses, and forbs.

Revegetation would be beneficial to surface water resources and associated wetland habitat by reestablishing desirable native plant communities; improving biological diversity and hydrologic processes; enhancing plant community structure, function, and connectivity; and reducing erosion.

4.4.2 Vadose Zone

Impacts to the vadose zone from vegetation management activities conducted under the No Action Alternative and Proposed Action would be principally indirect and result from herbicide migration following application. The impacts on surface soil properties (i.e., porosity, hydraulic conductivity, and leaching) and moisture movement through the vadose zone as influenced by the use of physical methods (i.e., compaction), prescribed burning (possible water repellency), and revegetation (compaction and plant transpiration) would be beneficial in terms of reducing herbicide migration into the vadose zone. In general, soil properties in the vadose zone impact the subsurface transport of moisture (including herbicides). Vadose zone soil properties typical of unsaturated flow regimes on the Hanford Site tend to impede flow due to silt layers, calcic horizons, and anisotropic properties (e.g., differing hydraulic conductivities) in the vertical and horizontal dimensions as evidenced by perched water. Geologic anomalies such as clastic dikes can impact the flow of moisture in the vadose zone either positively or negatively depending on structure and orientation.

In general, the impacts on the vadose zone beneath radioactive and chemical waste management areas and in infrastructure areas would be the same for the No Action Alternative and Proposed Action. Impacts in open rangelands, however, would occur over a greater area under the Proposed Action because up to an additional 4,047 hectares (10,000 acres) would be treated annually using aerial application of herbicides, but the nature and likelihood of impacts to the vadose zone would be the same for the No Action Alternative and Proposed Action by applying herbicides in accordance with label requirements. There are a multitude of processes that impact the mobility and persistence of herbicides and these would act to mitigate the potential impacts of herbicide migration. Such processes are those that affect mobility (sorption, volatilization, plant uptake, wind erosion, runoff, leaching) and those that affect persistence (photodegradation, chemical degradation, microbial degradation) (*Understanding Pesticide Persistence and Mobility for Groundwater and Surface Water Protection*, Kerle et al., 1996; *Environmental Transport Processes*, Logan, 1999; *Illustrated Handbook of Physical-Chemical Properties and Environmental Fate of Organic Chemicals*, Mackay et al., 1997; "Evaluation and Mitigation of Spray Drift," Felsot, 2005).

Of the processes that impact herbicide mobility, the potential for herbicide transport would be reduced because of sorption on dry soil typical of the Hanford Site (sorption is greater in dry soils regardless of soil type). Volatilization of herbicides sorbed onto soil would be high, especially during warmer months, due to high evaporation rates associated with higher temperatures and lower humidity. The most important factors impacting herbicide uptake are the plant species, growth stage, and intended use ("Pesticide Residues in Plants," Finlayson and MacCarthy, 1973). Plant uptake would restrict herbicide mobility due to high plant transpiration rates and the type of herbicide, herbicide formulation, method of application, and mode of action. Herbicide runoff would be minimal in the project area due to the relatively flat terrain, coarse-grained soils, low soil moisture content, low annual precipitation, and physicochemical properties of the herbicide ("Offsite Transport of Pesticides in Water: Mathematical Models of Pesticides Leaching and Runoff," Cohen et al., 1995). The ability of an herbicide to leach into groundwater depends not only upon its movement through the soil, but also upon its disappearance from the soil ("Biodegradation and Leaching of Pollutants," Waldman and Shevah, 1993; "Microbial Treatment of Soil to Remove Pentachlorophenol," Edgehill and Fin, 1983). Herbicides that would be used in the project area for vegetation management tend to persist and have soil residual properties for less than two years.

Herbicide persistence is affected by several processes including photochemical, chemical, and microbial decomposition ("Bioremediation of Pesticide Contaminated Soils," Kuhard et al., 2004; "Environmental Biotechnology: Challenges and Opportunities for Chemical Engineers," Chen and Mulchandani, 2005; "Biotechnology and Bioremediation – An Overview," Ward and Singh, 2004). Degradation may take from hours or days to years, depending on environmental conditions and the chemical characteristics of the herbicide; as previously stated herbicides that would be used tend to persist for up to two years. Microbial decomposition is the result of microbial metabolism of herbicides, and it is often the main source of herbicide degradation in soils (Waldman and Shevah, 1993; Edgehill and Fin, 1983; "Behavior of Pesticides in the Environment: Environmental Chemodynamics," Haque and Freed, 1974). Chemical decomposition occurs by different reactions including hydrolysis, oxidation-reduction, and ionization that usually take place in the presence of acidity or alkalinity (typical of soils in the project area of the Hanford Site), and is therefore related to the pH of the soil (*Environmental Soil and Water Chemistry: Principles and Applications*, Evangelou, 1998). Photochemical decomposition results from the breakdown of herbicides by sunlight. It can occur on foliage, on the surface of the soil, and in the air with the rate of breakdown a function of intensity and spectrum of light, length of exposure, and the properties of the herbicide (*Photochemical Transformations: Environmental Exposure from Chemicals*, Mill and Mabey, 1985).

Given the thickness of the vadose zone, characteristics of unsaturated flow regimes, and processes that impact herbicide mobility and persistence, travel times through the vadose zone to the groundwater and then to the Columbia River are expected to be sufficiently long that impacts would be negligible. Although travel times would be reduced as the thickness of the vadose zone decreases towards the Columbia River, potential impacts would be mitigated by applying herbicides in accordance with label requirements, establishing buffer zones, and using herbicides approved for aquatic use in these areas.

4.4.3 Groundwater

Similar to the vadose zone, potential groundwater impacts from vegetation management activities conducted under the No Action Alternative and the Proposed Action in radioactive and chemical waste management areas, infrastructure areas, and open rangelands in the project area of the Hanford Site would be principally indirect and result from potential herbicide migration following application. Although possible in areas of shallow groundwater such as near the Columbia River, groundwater impacts from herbicide applications under the No Action Alternative and Proposed Action are not expected based on the discussions in Section 4.4.2 regarding the mobility and persistence of herbicides. Furthermore, all herbicides would be applied by licensed chemical operators and commercial pesticide applicators in accordance with label requirements (e.g., use of herbicides approved for aquatic applications, as appropriate) and under favorable weather conditions intended to mitigate adverse impacts on the environment.

From the years of 1985 through 2010 nearly 24,000 data entries are documented in the Hanford Environmental Information System (HEIS) database relating to analyses for herbicides in groundwater. Groundwater samples have been analyzed by nearly a dozen analytical laboratories over the 25-year period. The EPA's "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," also known as SW-846, has been used to determine herbicide concentrations in Hanford Site groundwater samples. Of the nearly 24,000 data entries in the HEIS database for herbicides in Hanford Site groundwater, 99.5 percent of the data are non-detects. The remaining 0.5 percent of the data is estimated values at levels less than the Method Detection Limit, Required Detection Limit, or the Practical Quantitation Limit for the analyte. Based on these data, DOE does not expect impacts on groundwater from the application of herbicides in support of vegetation management activities conducted in the project area of the Hanford Site.

4.5 ECOLOGICAL AND BIOLOGICAL RESOURCES

Vegetation management activities can affect ecological and biological resources in a variety of ways depending upon the method used. Potential impacts on ecological and biological resources would occur in terrestrial, wetland, and aquatic habitats; and include potential impacts to threatened, endangered, or otherwise protected plant and animal species (i.e., special status species). Potential impacts on wetland habitat are discussed in Section 4.4.1.

Potential direct and indirect impacts on ecological and biological resources from vegetation management activities conducted under the No Action Alternative and Proposed Action in radioactive and chemical waste management areas, infrastructures areas, and open rangelands would be mitigated by conducting ecological resource reviews in accordance with the ECAMP prior to initiating work activities (subject to DOE Manager emergency declaration). Such ecological resource reviews would first determine the extent to which special status species occur in areas selected for vegetation management activities. If such species occur in those areas, the review would determine potential impacts and, if warranted, appropriate actions to mitigate those impacts.

4.5.1 Terrestrial Habitat and Biota

Invasive plants and noxious weeds (e.g., cheatgrass, yellow star-thistle, Russian thistle, rush skeletonweed and knapweed) have become established and constitute the second largest threat to the biological integrity of the shrub-steppe ecosystem on the Hanford Site (wildfires are the largest threat). Invasive plants and noxious weeds are extremely adaptable to disturbed conditions and often out-compete native species following ground disturbance, wildfire, and drought conditions ("Ecology and Restoration of California Grasslands with Special Emphasis on the Influence of Fire and Grazing of Native Grassland Species," D'Antonio et al., 2003). Many species can produce seed that remains dormant in the soil for decades and will germinate when growing conditions are favorable. Furthermore, invasive plants and noxious weeds are easily spread by wind, water, animals, vehicles and clothing expanding their foothold into shrub-steppe habitats as conditions allow. Invasive plants and noxious weeds pose a serious threat to native biodiversity, wildlife habitat, and connectivity. These plants alter ecosystem structure and function, disrupt food chains and other ecosystem characteristics vital to wildlife, and can dramatically alter key ecosystem processes such as hydrology, productivity, nutrient cycling, and fire regimes (Mack et al. 2000; Brooks and Pyke 2001; Tu et al. 2001).

Connectivity of terrestrial habitats is one of the features that promotes and sustains the biological diversity of species (*Do Habitat Corridors Provide Connectivity*, Beir and Noss 1998). Implementation of the Proposed Action would foster connectivity of terrestrial habitats by managing biological resources at a scale commensurate with the scale of the natural processes that sustain them rather than continuing the individual, project-specific, and localized efforts under the No Action Alternative. The Proposed Action would consider communities, ecosystems, and landscapes to ensure protection for a large number of species and their interrelationships. For example, vegetation management under the Proposed Action would be conducted to maintain evolutionary and ecological processes; minimize fragmentation by promoting the natural pattern and connectivity of habitats; restore degraded resources to enhance ecosystem integrity; avoid the introduction of invasive plants and noxious weeds and expansion of these species into native communities; protect rare and ecologically important species and unique or sensitive environments; maintain or mimic natural structural diversity; and monitor ecosystem integrity.

Under the No Action Alternative and the Proposed Action in radioactive and chemical waste management areas, DOE would continue to maintain the tank farms and some solid waste burial grounds vegetation free. There would be no impact on ecological and biological resources, however, because such resources do not routinely inhabit these areas, although Killdeer have been found in gravel-covered areas (like the tank farms). In radioactive and chemical waste management areas that would be treated with physical and chemical methods (i.e., selective herbicides), and revegetated with shallow-rooted bunchgrasses (i.e., liquid waste disposal areas and some solid waste burial grounds), invasive plants and noxious weed communities would be reduced or eradicated, although DOE considers this to be a beneficial impact. Revegetation, which would involve reseeding of stabilized areas to reestablish bunchgrasses, is not expected to impact ecological and biological resources due to the previously disturbed nature of these areas.

Under the No Action Alternative, vegetation management in infrastructure areas and open rangelands would focus on maintaining firebreaks; treating small, localized infestations of invasive plants and noxious weeds within reach of existing roads; and revegetation of wildfire impacted areas. The direct and indirect impacts of physical and chemical methods would be similar to those discussed in radioactive and chemical waste management areas. In addition, the use of heavy equipment to maintain firebreaks would result in damage to existing vegetation and plowed firebreaks would facilitate the establishment and spread of invasive plants and noxious weeds into areas where they have not existed previously. The treatment of small, localized infestations of invasive plants and noxious weeds within reach of existing roads would result in minor disturbance of vegetation, but would not be expected to impact plant community composition and function, or result in loss of connectivity through fragmentation.

During vegetation management actions in infrastructure areas and open rangelands, however, there exists the potential that special status species (e.g., ground nesting species like burrowing owls) could be harmed inadvertently when using physical methods. While manual techniques (e.g., hand pulling, hoeing) can be applied selectively, mechanical techniques (e.g., mowing, tilling) are non-selective and damage or destroy plants, microbiotic soil crusts, ground-nesting birds, small mammals, and arthropods. Biological processes such as feeding, pollination, and predation also would be disrupted (*Grassland Birds: An Overview of Threats and Recommended Management Strategies*, Vickery et al., 2000; *The Management of Lowland Neutral Grasslands in Britain: Effects of Agricultural Practices on Birds and their Food Resources*, Vickery et al., 2001). The use of physical methods also could promote inadvertently the regrowth of invasive plants and noxious weeds by increasing competitive, reproductive, and regenerative capacity of plants as a result of stressing desirable vegetation and/or causing dispersal of invasive plant and noxious weed propagules.

The use of herbicides could have unintended indirect impacts on non-target desirable plant species, species composition, and plant species richness and diversity. Because of herbicide selectivity, continued use of a particular herbicide may result in a shift within a plant community from susceptible to more herbicide-tolerant or resistant species; such impacts would be mitigated by using a variety of herbicide formulations in treated areas. Revegetation with desirable and competitive plant species would inhibit invasive plant and noxious weed growth ("Invasive Weeds in Rangelands: Species, Impacts, and Management," DiTomaso, 2000). Herbicides are designed to target biochemical processes, such as photosynthesis, that are unique to plants. Thus, herbicides typically are not acutely toxic to animals (*Toxicity, Transport, and Fate of Forest Herbicides*, Tatum, 2004). However, some herbicides can have subtle, but significant, physiological effects on animals including developmental effects. However, most observed effects of herbicides on wildlife are due not to toxicity, but to habitat changes and the decrease in abundance of species the wildlife rely on for food or shelter.

Biological methods would be used on a limited basis, and while effective in controlling invasive plant and noxious weed growth, the method would not eliminate the target plant species; some plant matter is required to sustain the biological agents. Biological methods would be expected to have little impact on terrestrial habitat and biota due to their host specificity and limited use.

Under the No Action Alternative, prescribed burning would only be used to treat tumbleweed accumulations (i.e., dead windblown tumbleweeds), and would have beneficial indirect impacts by reducing wildfire fuel and the intensity and duration of wildfires, thereby minimizing potential impacts on terrestrial habitat and biota. Wildfires typically kill the shrub component of terrestrial habitats, but usually not bunchgrasses; however the result would be indirect impacts on terrestrial habitat connectivity leading to the modification of habitat structure and function. Recovery to a native terrestrial habitat (even to bunchgrasses) would be less certain given that open rangelands would be a ready source of invasive plant and noxious weed seeds of the type that would enjoy a competitive advantage following a wildfire. Many animal species dependent on the sagebrush component of the terrestrial habitat are special status species (e.g., sage sparrow) and would be impacted by the loss of terrestrial habitat due to wildfire. Furthermore, wildfire suppression efforts would have direct impacts on the soil (e.g., creation of fire lines and erosion) with indirect impacts resulting in the spread of invasive plants and noxious weeds into open rangelands. Emergency use of equipment (e.g., disking) for wildfire suppression would have the potential to impact invasive plant and noxious weed abundance by clearing vegetation, destroying microbiotic crusts, and dispersing seeds. However, fire line construction would have beneficial impacts by containing wildfires when they are small, thereby limiting wildfire spread and the subsequent expansion of invasive plants and noxious weeds into thousands of acres of open rangelands. The impact of wildfire suppression tactics would be mitigated through pre-suppression planning (i.e., use of minimum impact suppression tactics), initial attack stipulations, use of existing firebreaks to confine and contain wildfire, and properly implemented post-fire revegetation treatments.

Direct impacts on wildlife in infrastructure areas and open rangelands would include short-term displacement and disturbance. Potential indirect beneficial impacts would include protection of desirable terrestrial habitat and microbiotic crusts through the early treatment of small populations of invasive plants and noxious thereby preventing their establishment and spread. The focus on maintaining firebreaks and treating small, localized infestations of invasive plants and noxious weeds would, however, have potential indirect impacts associated with spread of invasive plants and noxious weeds into open rangelands. Expanding invasive plants and noxious weeds alter the characteristics of wildfire regimes in open rangelands such as spread patterns, intensity, frequency, and seasonality. Long-term animal response to wildfire would be determined by habitat change, which influences feeding, movement, reproduction, and availability of shelter. The immediate and short-term impact of wildfire on terrestrial birds and mammals would include injury, mortality, emigration, and immigration.

Under the Proposed Action, vegetation management activities and associated environmental impacts in radioactive and chemical waste management areas, infrastructure areas, and open rangelands would be the same as discussed under the No Action Alternative. In addition, an IVM approach would be implemented in open rangelands. Increases in treatment of open rangelands using physical methods and biological methods over that treated under the No Action Alternative would be relatively small (both increase from 41 hectares [100 acres] to 202 hectares [500 acres] annually). Although the impacts from the use of physical and biological methods under the Proposed Action would be expected to increase, in general, they would be the similar to those discussed under the No Action Alternative. The more meaningful impacts under the Proposed Action would be associated with increased use of chemical methods, prescribed burning, and revegetation.

Under the Proposed Action, there would be a large increase in treated acreage (up to 4,047 hectares [10,000 acres] annually) using aerial application of herbicides. The treatment of invasive plants and noxious weeds using aerial application of herbicides would result in temporary non-target impacts on vegetation in the terrestrial habitat, but would not be expected to have long-term adverse impacts on plant community composition and function. Direct effects on wildlife would include short-term displacement and disturbance. Indirect impacts would include long-term beneficial effects on terrestrial habitat through the treatment of invasive plants and noxious weeds leading to improved resource conditions, wildlife habitat, and plant community stability and connectivity. Aerial application of herbicides would reduce potential damage to soil microbiotic crusts when compared to ground-based applications over the same area. Potential impacts of aerial application of herbicides on terrestrial habitat and biota would be mitigated by following label requirements such as controlling or selecting droplet size, boom length, application height, swath adjustment, and by applying herbicide in favorable meteorological conditions (wind direction and speed, temperature and humidity).

Prescribed burning would focus on the removal of wildfire fuel (primarily cheatgrass) followed by revegetation with desirable shrubs, grasses, and forbs. Up to approximately 2,023 hectares (5,000 acres) would be burned and revegetated annually. Revegetation would reestablish desirable native plant communities thereby promoting improved biological diversity; improved hydrologic processes; increased site health; and enhanced plant community structure, function, and connectivity. Some species, such as cheatgrass, may never be eradicated from a community. However, the level and type of treatment implemented would reduce direct competition with native species, and natural succession would, once native species are reestablished on site, reduce the relative distribution of cheatgrass. Reducing the distribution of cheatgrass within a plant community would reduce future wildfire impacts by reducing fire intensity and burn severity.

Reestablishment of native plant communities through revegetation also would improve terrestrial habitat and protect native species from displacement and competition by aggressive invasive plants and noxious weeds. For example, certain shrub-steppe dependent species including the burrowing owl, loggerhead shrike, sage sparrow, sagebrush lizard, Townsend's ground squirrel, and black-tailed jack rabbit depend on shrub-steppe habitat for most, if not all, of their life stages and have suffered substantial decline. Such decline has been due primarily to the reduction of shrub-steppe habitat through past agricultural and urban development, wildfires, and invasive plant and noxious weed infestations.

While prescribed burning and revegetation would have the potential to cause some microbiotic crust disturbance, revegetation would restore native plant associations and would occur primarily in areas where soil crusts have been previously disturbed by wildfire. Some microbiotic crust would be disturbed through drill seeding or broadcast/harrowing/cultipaction activities associated with reestablishment of native species.

4.5.2 Aquatic Habitat

Within the project area of the Hanford Site, several small clusters of vernal pools are distributed in the central part of Gable Butte and at the eastern end of Gable Mountain. Vernal pools are seasonally flooded depressions that occur in the spring and are shallow enough to dry up each season. Only plants and animals that are adapted to this cycle of wetting and drying can survive in vernal pools over time. These pools can host freshwater crustaceans and other invertebrates and are of temporary value to terrestrial species.

West Lake is located north of the 200 Areas. West Lake consists of a group of small isolated pools and mudflats. Located in and adjacent to the 200 East Area are five artificial ponds (LERF and TEDF). There are three evaporation ponds associated with the LERF and two disposal ponds associated with the TEDF. While these ponds do not support fish populations, they are accessible to wildlife.

The potential impacts of the No Action Alternative and the Proposed Action on aquatic habitat in radioactive and chemical waste management areas, infrastructure areas, and open rangelands would be minimal and the same as discussed in Section 4.4.1 for wetland habitat.

4.5.3 Special Status Species

Vegetation management activities in radioactive and chemical waste management areas (approximately 4,159 hectares [10,278 acres] annually) in the project area of the Hanford Site under either the No Action Alternative or the Proposed Action would not be expected to impact special status species because none routinely inhabit these areas, although Killdeer have been found in gravel-covered areas (like the tank farms). In radioactive and chemical waste management areas that have been revegetated with shallow-rooted bunchgrasses (i.e., liquid waste disposal areas and some solid waste burial grounds), the potential for management activities to impact special status species would exist, however, the likelihood is low because such species do not routinely inhabit stabilized radioactive and chemical waste management areas due to periodic application of selective herbicides and lack of sufficient vegetative cover to provide protection from predators.

Under the No Action Alternative, vegetation management in infrastructure areas and open rangelands in the project area of the Hanford Site (approximately 1,365 hectares [3,373 acres] annually) would focus on maintaining firebreaks; treating small, localized infestations of invasive plants and noxious weeds; and revegetation of wildfire impacted areas. The potential for impacting special status species would exist as a result of applying physical (e.g., hand pulling, mowing, disking) and chemical (e.g., herbicides) methods. Direct impacts to special status plant species (e.g., White Bluffs Bladderpod, White Eatonella, Umtanum Desert Buckwheat, Awned Halfchaff Sedge, Desert Doddler, Geyer's Milkvetch) would include trampling and cutting during application of physical methods, and damage or mortality from exposure to herbicides during application of chemical methods, although herbicides would be applied in accordance with label requirements. Direct impacts on special status animal species (e.g., Burrowing Owl, Loggerhead Shrike, Sage Sparrow, Sagebrush Lizard, Townsend's Ground Squirrel, Black-Tailed Jack Rabbit, Columbia River Tiger Beetle, etc.) would include short-term displacement and disturbance. Herbicides are typically not acutely toxic to animals; however, subtle physiological and developmental effects can occur. Due to the host specificity of biological methods, potential direct impacts to special status species would not be expected. Prescribed burning is unlikely to impact special status species because it would involve the piling and burning of tumbleweed accumulations in areas that are clear of plants and animals.

Under the Proposed Action, vegetation management activities and potential environmental impacts in infrastructure areas and open rangelands would be the same as discussed under the No Action Alternative. In addition, an IVM approach would be implemented in open rangelands. Increases in treatment of open rangelands using physical methods under the Proposed Action over that treated under the No Action Alternative would be relatively small (increase from 41 hectares [100 acres] to 202 hectares [500 acres] annually). Although impacts from the use of physical methods on special status species would be expected to increase, potential impacts would be small due to the selectivity of such methods (i.e., hand pulling and hoeing). Impacts from the potential use of non-selective physical methods (i.e., mowing) in open rangelands would be mitigated by conducting ecological resource reviews prior to conducting vegetation management activities to identify and protect special status species. Impacts of biological methods on special status species also are expected to be small because biological agents used to control vegetation are host specific targeting selective plant species and communities. The most significant potential impacts on special status species under the Proposed Action would result from increased use of chemical methods, prescribed burning, and revegetation in open rangelands.

Under the Proposed Action, there would be an increased potential for impacts to special status plant and animal species from the aerial application of herbicides over larger areas (up to 4,047 hectares [10,000 acres] annually). Herbicides applied to special status plant species, either directly or indirectly from spray drift, could damage or kill these species. DOE would mitigate these impacts by applying herbicides in accordance with label requirements, setting up equipment to minimize drift potential, and establishing buffer zones. Herbicides would only be applied by licensed chemical operators and commercial pesticide applicators. Impacts to special status animal species would be unlikely as herbicides are typically not acutely toxic to animals, however, subtle physiological and developmental effects can occur. Animal species are more likely to be impacted by changes in vegetation communities that provide food and shelter.

Prescribed burning (up to 2,023 hectares [5,000 acres] annually) also would have the potential to impact special status plant and animal species by inadvertently damaging plant tissue and propagules, and temporarily displacing or killing animals. Such impacts would be mitigated by performing ecological resource reviews prior to conducting prescribed burning.

In the longer term, revegetation of treated areas under the Proposed Action (up to 6,475 hectares [16,000 acres] annually) with desirable shrubs, grasses, and forbs would contribute to the protection and recovery of special status plant and animal species dependent upon such areas for food and shelter.

4.6 CULTURAL RESOURCES

Cultural resources are limited and non-renewable, unlike many natural resources that can be preserved, restored, and enhanced through adaptive management strategies. Vegetation management activities can affect cultural resources in a variety of ways depending upon the method used. Operation of heavy farm-type machinery (e.g., tractors, cultivators, spray rigs, brush trucks) over the ground surface would have the potential to impact cultural resources both on and below the surface through direct damage or alteration of the context within which they reside in the environment. Physical methods that use manual techniques (i.e., hand pulling, hoeing) could result in inadvertent trampling and damage of cultural resources on the ground surface.

Fire also can change the value of cultural resources. The ability to interpret the significance of a cultural resource is diminished when altered by fire. Rearranging the spatial relationship of materials within a site (e.g., during fire suppression activities) can diminish the ability to interpret human thought and behavior. Prescribed burning, in which fires remain below 500°C (932 °F) and have a residence time of half an hour or less, is likely to do little damage to cultural resources (*Introduction to Wildland Fire*, Pyne, 1996). However, an unintended, but potentially beneficial consequence of prescribed burning is to reveal cultural artifacts that were previously unknown and hidden by vegetative cover allowing them to be mapped, marked, collected, archived, or otherwise identified and protected. In contrast, post-fire activities can adversely impact cultural resources as some restoration efforts, such as revegetation, berm leveling, and construction of water control measures could alter cultural resource integrity (*Burning Questions: A Social Science Research Plan for Federal Wildland Fire Management*, Machlis, 2002; *Fire and Archaeology*, Swan and Francis, 1989).

Under either the No Action Alternative or the Proposed Action there would be no impacts to cultural resources from vegetation management activities in radioactive and chemical waste management areas because these areas have been previously disturbed as a result of construction, waste management operations, and stabilization activities. Nonetheless, cultural resource specialists would be consulted prior to conducting vegetation management activities to minimize the likelihood of inadvertent impacts to cultural resources due to new undertakings (i.e., a new or different activity in an area that may have been previously reviewed and cleared).

Under the No Action Alternative, vegetation management in infrastructure areas and open rangelands in the project area of the Hanford Site would have little or no impacts on cultural resources since existing firebreaks have been reviewed and cleared as not containing cultural resources. The potential exists for impacts to cultural resources that may exist in the small, localized infestations of invasive plants and noxious weeds that would be treated using limited physical and chemical methods and prescribed burning. Also, revegetation of wildfire impacted areas has the potential to impact cultural resources. Such impacts would be mitigated, however, by conducting cultural resource reviews prior to initiating work.

Under the Proposed Action, vegetation management in infrastructure areas and open rangelands would continue as discussed under the No Action Alternative, but there would be an increase in the total numbers of acres treated in open rangelands (up to 6,475 hectares [16,000 acres] annually). Most of this additional acreage (up to 4,047 hectares [10,000 acres] annually) would be treated by aerial methods to apply herbicides, which would result in no additional impacts to cultural resources. However, potential direct (damage, destruction, loss of context) impacts to cultural resources would occur when areas treated are revegetated. Physical methods, in particular, would impact cultural resources if not mitigated beforehand. Biological methods would not be expected to impact cultural resources due to the host specificity of the biological agents and the non-intrusive nature of the method, although trampling could occur as biological agents are being introduced into an invasive plant or noxious weed infestation. Fire from prescribed burning has the potential for direct impacts, albeit low, to cultural resources. Such impacts, however, would be less severe than those caused by wildfires, the severity and magnitude of which would be reduced over time by implementing the IVM approach under the Proposed Action. In sum, vegetation management activities under the Proposed Action are more likely to impact a greater number of cultural resources primarily because of treatment of additional rangelands than would occur under the No Action Alternative.

Under both the No Action Alternative and Proposed Action, prior to the implementation of any proposed vegetation management action that would potentially involve ground-disturbing activity, the appropriate level of cultural resource review would be undertaken in accordance with all applicable laws, procedures and protocols. Also, during the implementation of proposed vegetation management actions workers would be directed to watch for cultural and historic resources (e.g., bones, stone tools, arrowheads, rock features, hearths, historic footings, foundations, ceramics, bottles, cans, etc.). If cultural materials are encountered, work in the vicinity of the discovery would stop until a cultural resource specialist has been notified, the significance of the find determined, and if necessary, mitigation to minimize impacts to the find are arranged and implemented.

4.7 HUMAN HEALTH AND SAFETY

Vegetation management activities can impact human health and safety in a variety of ways depending upon the method used and location of the treated area. Workers and the public could be exposed to radiation and toxic chemicals; workers could also be subject to industrial accidents. Fires also could result in health and safety hazards.

4.7.1 Radiological Hazards

> **Units of Radiation**
>
> A **rem** is a unit of radiation dose (1,000 mrem equals 1 rem). The effects of radiation exposure on humans depend on the kind of radiation received, the total amount absorbed by the body, and the tissues involved. Rems are estimated by a formula that takes these three factors into account. The average individual in the United States receives a dose of 670 mrem from natural and medical sources each year.
>
> A **person-rem** is a unit of collective dose to an exposed population (or population dose), and is calculated by summing the estimated doses received by each member of the exposed population. The total dose received by the exposed population over a given period of time is measured in person-rem. For example, if 1,000 people each received a dose of 1 mrem, the collective dose would be 1 person-rem (1,000 persons × 0.001 rem = 1.0 person-rem).

DOE estimates that the annual dose to a radiation worker, one who is involved in day-to-day operations involving radiological materials and waste on the Hanford Site, is 70 mrem (DOE/EIS-0391). Workers engaged in vegetation management activities would be exposed to radiological materials and wastes only incidentally, that is, not on a daily basis and for several hours each day. Accordingly, their annual dose would be far less than 70 mrem. To provide perspective, the average background dose to an individual in the United States is estimated to be 670 mrem (see Table 3-5).

DOE also estimates that the workforce of 1,911 radiation workers received 132.9 person-rem (DOE/EIS-0391). The vegetation management workforce necessary to implement the No Action Alternative and the Proposed Action is estimated to be 19 and 21 workers, respectively. Because these workers would be exposed to radioactive materials and wastes only incidentally, their collective dose would be far less than that of radiation workers. Moreover, the difference in the collective doses to the workforces used to implement the No Action Alternative and Proposed Action would not be discernible.

DOE reports that the estimated annual dose to a maximally exposed member of the public from all activities, including ongoing vegetation management activities (No Action Alternative), on the Hanford Site is 0.12 mrem, and the collective dose to the population is 1.0 person-rem (PNNL-19455). Although vegetation management activities under the Proposed Action would annually treat up to 6,475 hectares (16,000 acres) more than under the No Action Alternative, DOE expects the offsite dose to the public would remain unchanged as most of the additional land undergoing management is open rangelands that has no or little radiological materials or waste.

4.7.2 Chemical Hazards

The primary source of chemical hazards potentially resulting in human health and safety impacts from vegetation management activities conducted in the project area of the Hanford Site would be associated with the storage, handling, application, and disposal of herbicides. Overexposure to herbicides would have the potential to affect human health with symptoms ranging from eye and skin irritation to impacts on the respiratory tract (e.g., difficulty breathing). Exposure to larger doses of certain herbicides with higher toxicity (e.g., EPA Category I herbicides such as ET herbicide/defoliant) would have human health impacts ranging from headaches and vomiting to damage to the liver, kidneys, and the central nervous system.

Approximately 85 percent of the herbicides used to manage vegetation under the No Action Alternative and the Proposed Action would be EPA Category III or IV having low to slight toxicity, 12 percent would be Category II having moderate toxicity, and the remaining 3 percent would be Category I (Appendix A). Category I herbicides are “restricted use” and would be applied only by using ground-based methods in sufficiently small quantities (less than 100 gallons annually), and in accordance with label requirements for personal protective equipment (e.g., gloves, masks, respirators), that impacts to human health are expected to be unlikely. Similarly, Category II herbicides, although used in greater quantities (about

1,500 gallons annually) than Category I herbicides, are expected to have minimal impacts on human health due to their application using ground-based methods, relatively limited quantities, and their application in accordance with label requirements by licensed chemical operators and commercial pesticide applicators.

The greatest potential for human health and safety impacts would be to workers involved in the mixing, spraying, and rinsing of Category III and IV herbicides. Worker exposures to herbicides during these operations are periodically evaluated by DOE to ensure potential impacts to human health and safety are kept ALARA. Tables 3-8, 3-9, and 3-10 provide representative sampling data for herbicides that would be used commonly to manage vegetation under either the No Action Alternative or Proposed Action. The sampling data include measured concentrations for Diuron, Bromacil, Sulfentrazone, and Prodiamine; these are common active ingredients in Category III/IV herbicides. In general, DOE found that herbicide concentrations during mixing, spraying, and container rinsing operations were two or more orders of magnitude below applicable occupational exposure limits established by the ACGIH.

Although occupational exposure levels under the No Action Alternative and Proposed Action would be low during the mixing, spraying, and rinsing of EPA Category III and IV herbicides, DOE would require the use of good work practices to reduce the potential for inadvertent exposures. Herbicides would be stored in leak-proof containers with proper spill containment under controlled environmental conditions. Workers would use personal protective equipment (e.g., long-sleeved shirts, long pants, chemical-resistant gloves, goggles, splash shields, respirators) and follow safety recommendations (e.g., wash hands before eating, drinking, or using tobacco products). Herbicide residues and containers would be disposed in accordance with label requirements (e.g., triple rinse or pressure wash containers, reuse rinsate/residues to mix herbicides, recycle containers, puncture and properly dispose of containers not recycled). Herbicides would only be applied by chemical operators and commercial pesticide applicators licensed in Washington State.

In radioactive and chemical waste management areas, the types of herbicides and method of application would be the same for the No Action Alternative and Proposed Action. In infrastructure areas and open rangelands under the No Action Alternative, herbicides, primarily EPA Category III and IV, would be applied to about 1,365 hectares (3,373 acres) annually using ground-based methods. Under the Proposed Action in these same areas DOE would apply the same herbicides; however, up to 4,047 hectares (10,000 acres) would be treated annually, primarily by aerial techniques in open rangelands. DOE would apply herbicides aerially in a manner that would minimize drift and the potential for workers (and the public) to be exposed. Meteorological conditions would dictate whether spraying could occur and, if so, when. DOE also would establish buffer zones around areas to be treated, notify workers of pending aerial spraying, and spray during off-shift hours when the onsite employee populations would be low. In addition, the potential for herbicide drift would be minimized by selecting and adjusting the ground-based and aerial equipment to optimize application. DOE would consider factors such as droplet size, application rate, nozzle pressure and orientation, swath adjustment and application height/altitude prior to applying herbicides. All herbicides would be applied in accordance with label requirements by licensed chemical operators and commercial pesticide applicators.

For these reasons, DOE concludes the potential for herbicide-related health effects to workers would be small for either the No Action Alternative or Proposed Action, regardless of the locations treated. DOE also concludes the potential for herbicide-related effects to the public to be remote because of the reasons described above, and because the public are further from areas to be treated chemically in the project area.

4.7.3 Industrial Hazards

Workers undertaking vegetation management activities would be subject to industrial hazards that could result in injuries and lost work time. Injuries could result from accidents, for example, involving the use of equipment such as farm-type machinery, and labor intensive manual activities such as hoeing and cutting vegetation. To minimize injuries to workers and lost work time, DOE requires a variety of mitigation measures, including but not limited to equipment operator training, administrative controls (procedures), and engineered features (e.g., safety interlocks, safety guards).

Under the No Action Alternative, 19 workers would be required for vegetation management. This workforce would include five equipment/chemical operators and two commercial pesticide applicators. In addition, a prescribed burning crew would consist of one prescribed burn boss, one safety officer, one firing boss, one firefighter, one engine boss, and three vehicle operators. Finally, a revegetation crew would consist of three vehicle operators and one field work supervisor.

Under the Proposed Action, two additional equipment/chemical operators would be required (a total of 21 workers). The additional workers would be necessary to manage up to an additional 5,180 hectares (12,800 acres) annually relative to the No Action Alternative.

The TRC rates for occupational injuries and illnesses, and lost workday cases resulting in days away from work or restricted work activity (DART) from 2003 through 2008 for construction-type activities (including vegetation management) at DOE facilities was 1.8 and 0.7 cases per 200,000 worker hours, respectively. Assuming a conservative analysis with all people working full-time for 12-months, the total available annual labor hours would be 2,080 hours per worker (40 hours per week times 52 weeks per year), although actual realized hours would be less due to holidays, vacations, and other absences. Under the No Action Alternative and the Proposed Action, workers would expend a total of 39,520 and 43,680 worker hours annually, respectively.

Based on TRC and DART rates, the No Action Alternative would result in an estimated 0.36 total recordable cases and 0.14 lost workday cases. There would be a small increase under the Proposed Action with an estimated 0.39 total recordable cases and 0.15 lost workday cases. For comparison, these rates and corresponding cases are much lower than U.S. industry averages of 4.6 TRC rates and 2.4 DART cases.

4.7.4 Fire Hazards

Besides the obvious impacts of fire itself on human health and safety, wildfire smoke has the potential to cause adverse impacts to workers. Wildfire smoke is a complex mixture of particulate matter, carbon dioxide, carbon monoxide, methane, nitrogen oxides, and sulfur oxides. Particulate matter is the principal pollutant of concern. Small particles with diameters less than or equal to 10 micrometers, also known as PM-10, can be inhaled deeply impacting the lungs and heart. Particles from wildfire smoke tend to be very small, with a size range near the wavelength of visible light (0.4 – 0.7 micrometers), and are nearly completely within the fine particle (PM-2.5) fraction. Wildfire smoke particles also efficiently scatter light and reduce visibility creating traffic hazards that would increase human health and safety impacts (*Wildfire Smoke – A Guide for Public Health Officials*, Lipsett et al., 2008).

Under the No Action Alternative up to 1,082 hectares (2,673 acres) of infrastructure would be treated annually by prescribed burning to maintain firebreaks. Under the Proposed Action, up to 3,105 hectares (7,673 acres) of infrastructure and open rangelands would be treated annually by prescribed burning to maintain firebreaks and reduce or eradicate invasive plants and noxious weeds followed by revegetation with desirable shrubs, grasses, and forbs. Although prescribed burning would produce smoke, the amount would be relatively small due to the controlled nature of prescribed burning as DOE would develop a burn plan that considered factors such as the size of area to be burned, type and amount of fuel present, and meteorological condition limits. Under both the No Action Alternative and Proposed Action, DOE would not anticipate any health effects to workers or the public from prescribed burning because of the controlled nature of the burn. All prescribed burning would be performed in accordance with applicable smoke management guidelines and regulations, prescribed burning plans, and prescribed burning permits (issued by the BCAA). If prescribed burning should exceed its prescription, alternative management strategies would be developed and implemented through a Wildfire Situation Analysis to mitigate impacts. All prescribed burning would be conducted under Standard Fire Orders; Watch-Out Situations; and Lookouts, Communications, Escape Routes, and Safety Zones established by the Hanford Fire Department.

Wildfires on the Hanford Site would occur under the No Action Alternative and Proposed Action, although the longer-term probability of such fires occurring under the Proposed Action would be less than under the No Action Alternative. The use of IVM methods under the Proposed Action over larger areas of rangelands (relative to the No Action Alternative) would reduce wildfire fuels by increasing the removal of invasive plants and noxious weeds and promoting revegetation of more fire-resistant plant communities. Unlike prescribed burning, a higher probability exists that workers would experience health effects from smoke inhalation because airborne emissions from wildfires are roughly a factor of six higher (Tables 4-1, 4-2, and 4-3) than that from prescribed burning. It is not possible to quantify such effects because of uncertainties regarding whether and where a wildfire would occur, the nature and size of the wildfire, the types of fuels involved, the fire's duration, and the extent to which workers would be exposed to smoke.

4.8 TRANSPORTATION

Vegetation management activities conducted under the No Action Alternative and the Proposed Action are not expected to result in changes in traffic or level of service either onsite or offsite. To the extent that trucks and other equipment travel roadways on and off the site, the relatively few pieces of equipment under the No Action Alternative (10 vehicles) and the Proposed Action (12 vehicles) would constitute a small fraction (0.06 percent) of the thousands of vehicles transiting these roads daily. However, the potential for transportation accidents and fatalities involving heavy equipment (i.e., trucks, tractors, spray rigs, etc.) movement in support of vegetation management activities would exist.

Accident and fatality statistics from traffic accidents involving heavy equipment have been compiled (ANL/ESD/TM-150, *State-Level Accident Rates of Surface Freight Transportation: A Reexamination*). For onsite and local/regional transportation involving heavy equipment in Washington State, the accident rate is 1.23E-07 accidents/truck-kilometer and the fatality rate is 8.3E-09 fatalities/truck-kilometer.

The No Action Alternative would involve 10 pieces of heavy equipment; 3 truck-mounted sprayers, 1 boom sprayer, 2 brush/grass trucks, 1 water tender, and 3 tractors with seed spreaders/cultipackers. Each piece of equipment would conservatively travel up to 125 kilometers (200 miles) per day, 5 days per week, 52-weeks per year, or a total of 325,000 truck-kilometers annually. Based on the accident and fatality rates previously mentioned, no accidents or fatalities would be expected for the No Action Alternative (i.e., 0.04 accidents/year and 0.003 fatalities/year).

The Proposed Action would require one additional truck-mounted spray and one boom sprayer, which would increase vehicle use to 390,000 truck-kilometers annually. The additional equipment is required to support treatment of up to an additional 6,475 hectares (16,000 acres) annually in open rangelands; although much of the additional acreage would be treated using aerial applications of herbicides. Similar to the No action Alternative, DOE does not expect accidents or fatalities from the transportation of equipment under the Proposed Action (i.e., 0.05 accidents/year and 0.003 fatalities/year). The Center for Disease Control has evaluated work-related pilot fatalities from aerial applications of herbicides and determined a rate of one death per 100,000 hours flown (Center for Disease Control website at http://www.cdc.gov). The DOE conservatively estimates that aerial applications of herbicides under the Proposed Action will not exceed 24 hours flown per year. DOE does not expect fatalities from aerial applications of herbicides under the Proposed Action (i.e., 0.02 fatalities/year).

Although DOE does not expect accidents or fatalities from transportation of heavy equipment, mitigation measures would still be employed including the use of pilot cars, roadway flaggers, and signage in vegetation management treatment areas. Onsite personnel would stop and direct traffic, as needed. Vegetation management activities along roadways would be conducted during low traffic, high-visibility periods of the day.

4.9 NOISE

Numerous vegetation management field activities that would be performed by Hanford Site workers have the potential to generate noise at levels above typical background noise levels. Based on surveys, noise levels in the project area of the Hanford Site have been reported up to 60.5 dBA. Typical vegetation management field activities (e.g., mowing, herbicide spray rig operation, tractors pulling seed spreaders and cultipackers, prescribed burning brush trucks and tenders) would generate noise levels ranging from 85 to 100 dBA at 15 m (49 ft). Noise levels would be reduced to 80 dBA at 30 to 150 m (98 to 492 ft), and 60 dBA at 250 to 1,300 m (820 to 4,270 ft) (*Introduction Handbook of Acoustical Measurements and Noise Control*, Harris 1991). Although there would be two additional pieces of the same type of equipment to be used under the Proposed Action (one truck-mounted sprayer, one boom sprayer), the noise levels would be the same as those generated under the No Action Alternative as it would be unlikely that all equipment would be in use at the same time in the same areas.

Noise impacts are assessed by establishing “regions of influence” for residential, commercial, and industrial receptors, with maximum allowable noise levels established for each region (WAC 173-60), as discussed in Section 3.9. Because of the remote locations at which vegetation management activities would occur, all public receptors would be located well beyond the applicable “region of influence,” within which noise levels would be limited to specified levels and either immeasurable or barely distinguishable from background noise levels. Potential noise impacts to vegetation management workers, such as vehicle operators, would be mitigated through the use of hearing protection (i.e., ear plugs, headphones, etc.).

4.10 WASTE MANAGEMENT

It is expected that the majority of the municipal solid waste resulting from vegetation management activities would be associated with the application of chemical herbicides and revegetation of treated areas (i.e., cardboard, plastic wrap, plastic containers, and paper bags). Vegetation management activities would be conducted out of the 275-W Office and Warehouse Building, the 2713-WC Storage Barn, and two conex box type hazardous materials storage units (HS0022 and HS0033) located in 200 West Area of the Hanford Site. Management of chemical herbicide product and municipal solid waste would be in accordance with label requirements for storage and disposal. Chemical herbicide product would be stored in leak-proof containers with proper spill containment provisions and under prescribed environmental conditions (e.g., temperature, humidity, etc.). Management of chemical herbicide waste would involve triple rinsing or pressure rinsing of containers (i.e., 1-2 gallon jugs and 30-55 gallon drums). The rinsate would be collected and reused during remix operations. After rinsing, small 1-2 gallon jugs would be punctured and disposed of at an approved offsite waste disposal facility along with cardboard, plastic wrap, and paper bags; large 30-55 gallon drums would be recycled. About 185 cubic yards of solid waste is generated yearly by vegetation management activities and shipped to the offsite municipal waste landfill for disposal.

Under the No Action Alternative and based on waste volumes disposed of in 2010, DOE estimates that the volume of municipal solid waste generated from vegetation management activities conducted in the project area of the Hanford Site and delivered to the waste transfer company for disposal in an offsite landfill would be 185 cubic yards annually (i.e., less than 1 percent of the total 25,800 cubic yards of municipal solid waste sent offsite for disposal from the entire Hanford Site). Under the Proposed Action, the volume of municipal solid waste is expected to roughly double in volume to 375 cubic yards (slightly more than 1 percent of the total annual municipal waste volume generated by the entire Hanford Site). The offsite municipal solid waste landfill is approximately 206 hectares (510 acres) in size with a projected life-span of 100 years. It would have sufficient capacity to accommodate municipal solid wastes generated from vegetation management activities into the foreseeable future.

About 200 cubic yards of regulated waste, potentially contaminated tumbleweeds collected from the radioactive and chemical waste management areas, would be generated yearly as a result of implementing the No Action Alternative or the Proposed Action because vegetation management activities would be the same in these areas. This vegetation would be compacted and disposed of in the ERDF; this is about 3 percent of the 6,000 cubic yard per day disposal capacity of the ERDF. Designed to be expanded as needed, ERDF comprises a series of cells or disposal areas. With the addition of super cells 9 and 10, ERDF capacity is 16.4 million tons. To date, nearly 11 million tons of contaminated material has been disposed in the facility. The ERDF is expected to have sufficient capacity to accommodate regulated wastes generated by vegetation management activities into the foreseeable future.

4.11 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

DOE estimates that under the No Action Alternative, a workforce of 19 people would be required. Under the Proposed Action, the workforce would increase to 21 people.

Vegetation management is expected to be accomplished using employees from the existing Hanford Site workforce. Total nonagricultural employment in Benton and Franklin Counties is over 98,500 people (*Tri-City Development Council, Tri-Cities, Washington, Non-Agricultural Employment, TRIDEC, February 2011)*, so even if vegetation management activities were to create additional service sector jobs, the total increase in employment as a result of the Proposed Action would be less than 1 percent (0.02 percent) of the current employment level. Increases of less than 5 percent of an existing labor force have minimal effect on an existing community (HUD-CPD-140, *Rapid Growth from Energy Projects, Ideas for State and Local Action*). Based on the above, vegetation management activities conducted in the project area of the Hanford Site would not impact existing unemployment or change economic conditions in the surrounding counties.

Per E.O. 12898, DOE seeks to ensure that no group of people bears a disproportionate share of negative environmental consequences resulting from proposed federal actions. DOE has also considered the guidance issued by the Council on Environmental Quality (CEQ) in preparing its analysis of environmental justice for this EA (*Considering cumulative Effects under the National Environmental Policy Act*, CEQ, 1997). Because access to the Hanford Site is restricted to the public and vegetation management activities in the project area are conducted in locations remote from the general public, the majority of potential environmental impacts from the Proposed Action would be associated with onsite activities and would not affect populations residing offsite, thus, the potential for environmental justice concerns would be small. There are no anticipated impacts associated with vegetation management activities comprising the Proposed Action that could reasonably be determined to impact any member of the public; therefore, they would not have the potential for high and disproportionately adverse impacts on minority or low-income groups.

4.12 CUMULATIVE IMPACTS

Cumulative impacts (or "cumulative effects" as they also are known) are defined in the CEQ regulations as follows:

> *"Cumulative impact" is the impact on the environment which results 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.*

However, CEQ cautioned that "The continuing challenge of cumulative effects analysis is to focus on important cumulative issues…" (CEQ, 1997).

Past, present, and reasonably foreseeable future actions that may contribute to cumulative impacts include actions that have occurred on the Hanford Site as well as in areas adjacent to the Site. Examples of past actions that have occurred onsite include operation of fuel fabrication plants, production reactors, the Plutonium-Uranium Extraction Plant, research facilities, and waste management and disposal operations.

Current onsite activities include, for example, site cleanup; waste treatment, storage, and disposal; and tank waste stabilization and retrieval. In addition, agencies and organizations other than DOE continue certain activities on the Hanford Site. These include, for example, transport of U.S. Navy reactor compartments for disposal in the 200 East Area, operation of the Columbia Generating Station, operation of the US Ecology Commercial Low-Level Radioactive Waste Disposal Facility, operation of LIGO, and management of the Hanford Reach National Monument by the USFWS.

Examples of past, present, and foreseeable future offsite activities that may contribute to cumulative impacts include future land use changes as described in comprehensive land use plans, management of the Columbia and Yakima Rivers, power generation and transmission line projects, wind energy projects, and pipeline projects.

The existing environmental conditions of the project area, as described in Section 3.0 of this EA, include the impacts of past and present actions on the environment that the No Action Alternative and Proposed Action would affect. For this reason, the environmental impact analyses of Section 4.0 generally encompass the impacts of past and present actions. Moreover, based on those analyses, DOE expects that the incremental impacts of either the No Action Alternative or the Proposed Action would not contribute in a meaningful way to cumulative impacts when considering other future DOE and non-DOE actions. In general, DOE considers the potential adverse impacts that would occur from implementing the No Action Alternative or the Proposed Action to be small, and, for the most part, localized to the interior of the Hanford Site (the project area).

To amplify, the analyses of Section 4.0 (for both the No Action Alternative and Proposed Action) demonstrate that vegetation management activities would not result in impacts to land uses, surface water and groundwater, socioeconomic conditions, traffic conditions on and offsite, and to onsite and offsite landfills from the disposal of wastes, however, scenic values would improve over time. Further, the analyses demonstrate it is unlikely that the health and safety of workers or the public would be jeopardized from potential exposure to radiological materials and wastes, toxic chemicals, or noise. Industrial accidents and traffic accidents also would be unlikely to result in increased injuries or fatalities.

In contrast, both the No Action Alternative and Proposed Action would contribute to impacts to cultural resources. Although prior to implementing either the No Action Alternative or Proposed Action, DOE would undertake cultural resource reviews and implement measures to mitigate adverse impacts to these resources. Both the No Action Alternative and Proposed Action also would generate criteria and toxic air pollutants, but when considered with other future projects the attainment status of Benton County and the Hanford Site would not be threatened.

The analyses of Section 4.0 also demonstrate the potential for adverse and beneficial impacts to ecological resources, which would contribute to cumulative impacts when considering actions in the Hanford Reach National Monument. The Hanford Reach National Monument, managed by the USFWS (66,773 hectares [165,000 acres]), DOE (11,736 hectares [29,000 acres]), and WDFW (405 hectares [1,000 acres]); comprises 78,914 hectares (195,000 acres) surrounding the project area of the Hanford Site. The Hanford Reach National Monument was established, in part, because of the extensive shrub-steppe ecosystem and the diversity of native plant and animal species. The USFWS, DOE, and WDFW manage the Hanford Reach National Monument to protect those resources. Under the No Action Alternative and the Proposed Action, vegetation management activities in open rangelands have the potential to adversely impact certain biological resources, such as threatened, endangered, or other special status plant and animal species, which would contribute to cumulative impacts to the same animals and plants from similar management actions on the Hanford Reach National Monument. In the longer term, however, DOE's implementation of the Proposed Action in particular would help restore desirable plant communities and wildlife habitat in the shrub-steppe ecosystem and reduce the potential for wildfires. This would constitute a beneficial cumulative impact when considering similar management efforts by the USFWS and WDFW on the Hanford Reach National Monument.

4.13 MITIGATION OF POTENTIAL IMPACTS FROM PROPOSED ACTION

Various types of mitigation would be required for activities comprising the Proposed Action (some mitigation measures have been previously discussed under individual resource areas). Such mitigation would depend on the nature of specific actions and the outcomes of cultural, ecological, and other resource reviews conducted before and during operations.

Prior to conducting vegetation management under the Proposed Action, cultural and ecological resource reviews would be conducted in areas proposed for treatment. Cultural and historic resource impacts would be mitigated by conducting a review in accordance with DOE/RL-98-10 and other applicable guidance (e.g., *National Historic Preservation Act*, Section 106). Vegetation management activities conducted on traditional cultural properties (e.g., Gable Mountain and Gable Butte) in the project area would be mitigated by complying with the provisions of existing programmatic agreements, treatment plans, management plans, memoranda of agreement, and other documentation. Potential impacts of vegetation management activities on cultural and historic resources would be identified in the review, evaluated, quantified, mitigated, and documented.

Ecological and biological resource impacts would be mitigated by conducting a review to determine the occurrence of plant and animal species protected under the *Endangered Species Act* (ESA); candidates for such protection; species listed as threatened, endangered, candidate, sensitive, or monitor by the State of Washington; and species protected under the *Migratory Bird Treaty Act* (MBTA) consistent with the requirements of the ECAMP. Potential impacts of vegetation management activities on ecological and biological resources would be identified in the review, evaluated, quantified, mitigated, and documented.

When performing physical methods (manual or mechanical), potential health and safety impacts to workers would be mitigated by requiring the use of safety glasses or goggles, and hearing protection to provide protection from flying debris and noise. The operability of all equipment safety features would be verified prior to use (e.g., safety shields, guards, interlocks, etc.). All equipment would be maintained and used in accordance with manufacturer's recommendations and safety precautions by properly trained individuals.

When performing chemical methods using EPA-registered herbicides, label requirements for storage, handling, mixing, spraying, rinsing, and disposal would be followed to minimize potential impacts on human health and the environment. Herbicides would be applied by chemical operators and commercial pesticide applicators licensed in the State of Washington to mitigate potential impacts of misapplication. Annual herbicide treatments to the same land would not be required in all cases due to the residual nature of some herbicides (e.g., Tordon 22k has a residual effectiveness of three or more years), and would diminish over time decreasing to spot applications as populations are brought under control. Herbicide use would be reduced over time, but continued vigilance would be required due to the prolific nature of invasive plants and noxious weeds.

When performing prescribed burning, potential impacts would be mitigated by reducing the area burned (e.g., mosaic burning), reducing the fuel load (e.g., mechanical removal and thinning), reducing the fuel production (e.g., chemical treatment), reducing the fuel consumed (e.g., high moisture content in fuel), scheduling burns before new fuel appears (e.g., burn before green-up), increasing combustion efficiency (e.g., dry conditions and backfires), and redistributing emissions (e.g., good dispersion, smaller units, more frequently). Additional mitigation measures may become necessary to protect cultural and ecological resources and may include the establishment of buffer zones to mitigate potential impacts. Prescribed burning would be performed in accordance with applicable smoke management guidelines and regulations, prescribed burning plans, and prescribed burning permits by Hanford Fire Department personnel. If prescribed burning should exceed its prescription, alternative management strategies would be developed and implemented through a Wildfire Situation Analysis to mitigate impacts. All prescribed burning would be conducted under Standard Fire Orders; Watch-Out Situations; and Lookouts, Communications, Escape Routes, and Safety Zones.

When performing revegetation with desirable shrubs, grasses, and forbs, potential impacts would be mitigated in ways similar to those discussed under physical methods. Additional mitigation measures may become necessary in some situations to protect cultural and ecological resources, and may include the establishment of buffer zones. Revegetation also may include the use of herbicides and fertilizers that would be handled in accordance with label requirements and manufacturer's recommendations to mitigate potential impacts to human health and the environment.

Monitoring of invasive plant and noxious weed treatment effectiveness would be conducted as part of an adaptive management process that builds upon past successes and learns from past mistakes to mitigate potential impacts. During the planning of vegetation management activities, treatment objectives, standards, and guidelines would be established so that treatment outcomes could be measured, evaluated, and used to guide future treatment actions. This approach would help ensure that vegetation treatment processes are effective, adaptive, reduced to minimal levels, and based on prior knowledge and experience.

5.0 STATUTORY AND REGULATORY REQUIREMENTS

The Hanford Site is owned by the U.S. Government and is managed by the U.S. Department of Energy (DOE). It is the policy of the DOE to carry out its operations in compliance with all applicable federal, state, and local laws and regulations, presidential executive orders, DOE directives, treaty rights, and permits. Environmental regulatory authority over the Hanford Site is vested both in federal agencies, primarily the U.S. Environmental Protection Agency (EPA), and in Washington State agencies, primarily Ecology and the DOH. In addition, the BCAA has certain regulatory authority over Hanford activities, including open burning, asbestos removal, and fugitive dust control. Significant environmental laws, regulations, and other requirements that may be relevant to vegetation management activities conducted in the project area of the Hanford Site are discussed in this section in the following order:

- Federal Environmental Laws
- Federal and State Regulations
- Executive Orders
- DOE Directives
- Treaties, Statutes, and Policies Relating to Native American Tribes of the Hanford Region
- Permits and Licenses.

5.1 FEDERAL ENVIRONMENTAL LAWS

Significant federal environmental laws potentially applicable to vegetation management activities on the Hanford Site include the following:

- *Antiquities Act (16 USC 431 et seq.)*
- *American Indian Religious Freedom Act (42 USC 1996)*
- *Archaeological and Historic Preservation Act (16 USC 469 et seq.)*
- *Archaeological Resources Protection Act* (16 USC 470aa *et seq.*)
- *Bald and Golden Eagle Protection Act*
- *Clean Air Act* (CAA) (42 USC 7401 *et seq.*)
- *Clean Water Act* (CWA) (33 USC 1251 *et seq.*); also known as the *Federal Water Pollution Control Act*
- *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) as amended by the *Superfund Amendments and Reauthorization Act* (SARA) (42 USC 9601 *et seq.*)
- *Emergency Planning and Community Right-to-Know Act* (EPCRA) (42 USC 11001 *et seq.*)
- *Endangered Species Act (16 USC 1531 et seq.)*
- *Farmland Protection Policy Act of 1981 (7 USC 4201 et seq.)*
- *Federal Insecticide, Fungicide, and Rodenticide Act*, as amended by PL 110-246 (7 USC 121)

- *Federal Noxious Weed Act (7 USC 2801 et seq.)*
- *Fish and Wildlife Coordination Act (16 USC 661 et seq.)*
- *Hanford Reach Study Act* (PL 100-605), as amended by PL 104-333
- *Hazardous Materials Transportation Act (49 USC 5101 et seq.)*
- *Migratory Bird Treaty Act (16 USC 703 et seq.)*
- *National Historic Preservation Act* (16 USC 470 *et seq.*)
- *Native American Graves Protection and Repatriation Act (25 USC 3001 et seq.)*
- *National Environmental Policy Act* (NEPA) (42 USC 4321 *et seq.*)
- *Noise Control Act (42 USC 4901 et seq.)*
- *Pollution Prevention Act (42 USC 13101 et seq.)*
- *Resource Conservation and Recovery Act of 1976* (RCRA) as amended by the Hazardous and Solid Waste Amendments (42 USC 6901 *et seq.*) of 1984
- *Rivers and Harbors Appropriation Act of 1899 (33 USC 401 et seq.)*
- *Safe Drinking Water Act* (42 USC 300f *et seq.*)
- *Toxic Substances Control Act* (15 USC 2601 *et seq.*).

In addition, the *Atomic Energy Act* (42 USC 2011 *et seq.*), the *Low-Level Radioactive Waste Policy Act* (42 USC 2021b *et seq.*), and the *Nuclear Waste Policy Act* (42 USC 10101 *et seq.*), while not environmental laws per se, contain provisions under which environmental regulations applicable to the Hanford Site may be or have been promulgated.

5.2 FEDERAL AND STATE REGULATIONS

Under the Supremacy Clause of the U.S. Constitution (Article VI, Clause 2), activities of the federal government are ordinarily not subject to regulation by the states unless Congress creates specific exceptions. Congress has created exceptions with respect to environmental regulation and provisions in several federal laws giving specific authority to the states to regulate federal activities affecting the environment. These waivers (or partial waivers) of sovereign immunity appear in Section 118 of the CAA, Section 313 of the CWA, Section 4 of the Noise Control Act, Section 1447 of the *Safe Drinking Water Act*, Section 6001 of RCRA, and Section 120 of CERCLA/SARA.

It is the policy of DOE to carry out its operations in compliance with all federal, state, and local laws and regulations; Presidential executive orders; DOE orders; and procedures. Both federal and state laws apply to vegetation management activities conducted on the Hanford Site. Based on the types of activities to be conducted, it is anticipated that environmental requirements would include, but may not be limited to, the following:

- **Air Quality.** The federal CAA and the *Washington Clean Air Act* (RCW 70.94) provide the statutory basis for air quality regulation of Hanford Site activities. Section 118 of the CAA (42 U.S.C. 7418) requires that each federal agency with jurisdiction over any property or facility that might discharge air pollutants comply with "all federal, state, interstate, and local requirements" with regard to the control and abatement of air pollution. Air emissions are regulated by the EPA under 40 CFR 50 through 99. Radionuclide emissions are regulated under the National Emission Standards for Hazardous Air Pollutants Program under 40 CFR Part 61.

  The State of Washington, Department of Health (DOH) regulations in WAC 246-247 contain standards and permit requirements for the emission of radionuclides to the atmosphere. The State of Washington, Department of Ecology (Ecology) air pollution control regulations, promulgated under the Washington CAA, appear in WAC 173-400 through 173-495. The State of Washington has delegated much of its authority under the Washington CAA to the BCAA. However, except for certain air pollution sources (e.g., asbestos removal, fugitive dust, and open burning) administered by the BCAA, Ecology continues to administer air pollution control requirements for the Hanford Site.

- **Water Quality.** The CWA and the *Washington Water Pollution Control Act* provide the statutory basis for the regulation of water quality in Washington State. The CWA established the National Pollutant Discharge Elimination System (NPDES) to limit the amount of pollutants that could be discharged.

- **Hazardous Waste Management.** Regulation of hazardous wastes at Hanford is conducted under RCRA, CERCLA, the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989), and the *Washington State Hazardous Waste Management Act*. RCRA (42 USC 6901 et seq.) and WAC 173-303, "Dangerous Waste Regulations" apply to the generation, transport, treatment, storage, and disposal of hazardous and dangerous wastes. RCRA regulations require treatment of many hazardous wastes before they can be disposed of in landfills. RCRA permits are required for the treatment, storage, or disposal of hazardous wastes. Ecology has been authorized by EPA to administer the RCRA program within Washington State, using its own dangerous waste regulation program in lieu of major portions of the RCRA program. The state regulations include a larger universe of regulated materials than the federal hazardous waste program. SARA was signed into federal law in 1986. Title III of SARA is also known as EPCRA or the Community Right-to-Know regulation. The State of Washington adopted the federal Title III law and regulations in 1987. The Community Right-to-Know provisions help increase the public's knowledge and access to information on chemicals at individual facilities, their uses, and releases into the environment. States and communities, working with facilities, can use the information to improve chemical safety and protect public health and the environment.

- **Species Protection.** The *Endangered Species Act* (16 USC 1531 et seq.), *Bald and Golden Eagle Protection Act* (16 USC 668 et seq.), and *Migratory Bird Treaty Act* (16 USC 703-712) all identify requirements that must be met to protect native plant and animal species and the ecosystems upon which they depend. The *Endangered Species Act* requires that if a federal action may affect a threatened or endangered species or designated critical habitat, the agency must consult with the USFWS or National Marine Fisheries Service to ensure the action is not likely to jeopardize the continued existence of these species. The *Bald and Golden Eagle Protection Act* prohibits anyone (without a permit issued by the Secretary of the Interior) from taking bald eagles, including their parts, nests, or eggs. The *Migratory Bird Treaty Act* prohibits harm to migratory birds, their nests, or eggs.

- **Cultural and Historical Resource Protection**. Federal agencies must preserve and protect cultural and historic resources in a spirit of stewardship to the extent feasible given the agency's mission.

DOE recognizes the cultural, historic, and scientific value of the resources that may exist on the properties under its management or over which it has direct or indirect control. DOE responsibilities are defined by a number of regulations and policies, including the *Antiquities Act* (16 USC 431 *et seq.*), *American Indian Religious Freedom Act* (42 USC 1996), *National Historic Preservation Act* (16 USC 470 et seq.), *Archaeological and Historic Preservation Act* (16 USC 469 *et seq.*), *Archaeological Resources Protection Act of 1979* (16 USC 470aa et seq.), *Native American Graves Protection and Repatriation Act* (25 USC 3001 et seq.), and *DOE Native American Indian & Alaska Native Tribal Government Policy*.

- **Land Use**. The Hanford Reach National Monument was created on June 9, 2000, by Presidential proclamation under the authority of the *Antiquities Act*. The Monument includes 78,914 hectares (195,000 acres) of federally owned land making up a portion of the Hanford Site. The USFWS manage approximately 66,773 hectares (165,000 acres) of Monument lands that are within the ALE Unit and the Wahluke Slope (Wahluke Unit and Saddle Mountain Unit) under permit from DOE. The WDFW manages approximately 405 hectares (1,000 acres). DOE manages the remaining 11,736 hectares (29,000 acres) of the Monument (i.e., McGee Ranch/Riverlands, Hanford Sand Dunes, and Borrow Area C). The DOE has issued the Hanford Comprehensive Land-Use Plan Environmental Impact Statement, Record of Decision, and Supplement Analysis. These documents establish reasonably foreseeable land uses, land use policies, and management controls that are in effect for the Hanford Site.

- **Noxious Weed Control**. RCW 17.10, "Noxious Weeds -- Control Boards," limits economic loss and adverse effects to Washington's agricultural, natural, and human resources due to the presence and spread of noxious weeds on all terrestrial and aquatic areas in the state. The intent of the legislature is that the chapter be liberally construed, and that the jurisdiction, powers, and duties granted to the county noxious weed control boards by the chapter are limited only by specific provisions of the chapter or other state and federal law.

- **Pesticide Control**. The *Federal Insecticide, Fungicide, and Rodenticide Act*, as amended, governs the storage, use, and disposal of pesticides through product labeling, registration, and user certification. Under RCW 15.58, "Washington Pesticide Control Act," the formulation, distribution, storage, transportation, and disposal of any pesticide and the dissemination of accurate scientific information as to the proper use, or non-use, of any pesticide, is important and vital to the maintenance of a high level of public health and welfare both immediate and future, and is declared to be a business affected with the public interest. The provisions of the chapter are enacted in the exercise of the police powers of the state for the purpose of protecting the immediate and future health and welfare of the people of the state.

- **Pesticide Application**. Under RCW 17.21, "Washington Pesticide Application Act," the application and the control of the use of various pesticides is important and vital to the maintenance of a high level of public health and welfare both immediate and future, and is declared to be affected with the public interest. The provisions of the chapter are enacted in the exercise of the police power of the state for the purpose of protecting the immediate and future health and welfare of the people of the state.

- **Environmental Protection**. The NEPA, as amended, establishes a national policy that encourages awareness of the environmental consequences of human activities and promotes consideration of those environmental consequences during the planning and implementing stages of a project. Under the NEPA, federal agencies are required to prepare detailed statements to address the environmental effects of proposed major federal actions that might significantly affect the quality of the human environment. The Washington State legislature enacted the *State Environmental Policy Act* (SEPA) in 1971. The SEPA applies to all branches of state government, including state agencies, municipal and public corporations, and counties. It requires each agency to develop procedures implementing and supplementing SEPA requirements and rules. Although the SEPA does not apply directly to federal actions, the term "government action" with respect to state agencies is defined to include the issuance of licenses, permits, and approvals. Thus, as in the NEPA, proposals (federal, state, or private) are evaluated, and may be conditioned or denied through the permit process, based on environmental considerations. The SEPA does not create an independent permit requirement, but overlays all existing agency permitting activities.

- **Safety.** The *Occupational Safety and Health Act*, as amended, establishes standards to enhance safe and healthy working conditions in places of employment throughout the United States. The act is administered and enforced by the OSHA, an agency of the United States Department of Labor. Although the OSHA and the EPA both have a mandate to limit exposures to toxic substances, the jurisdiction of the OSHA is limited to safety and health conditions in the workplace. In general, each employer is required to furnish a place of employment free of recognized hazards likely to cause death or serious physical harm to all employees. The OSHA regulations establish specific standards telling employers what must be done to achieve a safe and healthy working environment. Employees have a duty to comply with these standards and with all rules, regulations, and orders issued by OSHA.

5.3 EXECUTIVE ORDERS

DOE is subject to a number of Presidential executive orders (E.O.s) concerning environmental matters. Some of these orders that may be potentially relevant to vegetation management activities include:

- E.O. 11514, "Protection and Enhancement of Environmental Quality"
- E.O. 11593, "Protection and Enhancement of the Cultural Environment"
- E.O. 11738, "Providing for Administration of the Clean Air Act and the Federal Water Pollution Control Act with Respect to Federal Contracts, Grants, or Loans"
- E.O. 11988, "Floodplain Management"
- E.O. 11990, "Protection of Wetlands"
- E.O. 12088, "Federal Compliance with Pollution Control Standards"
- E.O. 12196, "Occupational Safety and Health Programs for Federal Employees"
- E.O. 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations"
- E.O. 13007, "Indian Sacred Sites"
- E.O. 13045, "Protection of Children from Environmental Health Risks and Safety Risks" (as amended by E.O. 13296)
- E.O. 13112, "Invasive Species"
- E.O. 13175, "Consultation and Coordination with Indian Tribal Governments"

- E.O. 13186, “Responsibilities of Federal Agencies to Protect Migratory Birds”
- E.O. 13195, “Trails for America in the 21st Century”
- E.O. 13287, “Preserve America”
- E.O. 13423, “Strengthening Federal Environmental, Energy, and Transportation Management”

The E.O.’s likely to be most relevant to vegetation management activities conducted in the project area of the Hanford Site would include, but may be limited to, the following:

- **E.O. 11593, “Protection and Enhancement of the Cultural Environment” -** Requires federal agencies to direct their policies, plans, and programs in a way that preserves, restores, and maintains federally owned sites, structures, and objects of historical or archaeological significance.
- **E.O. 11988, “Floodplain Management” -** Directs Federal agencies to establish procedures to ensure that the potential effects of flood hazards and floodplain management are considered for actions undertaken in a floodplain. This order further directs that floodplain impacts are to be avoided to the extent practicable.
- **E.O. 11990, “Protection of Wetlands” -** Governmental agencies are directed by E.O. 11990 to avoid, to the extent practicable, any short- and long-term adverse impacts on wetlands wherever there is a practicable alternative.
- **E.O. 13007, “Indian Sacred Sites” -** Directs federal agencies to take measures to protect and preserve American Indian tribes’ religious practices. Federal agencies shall, to the extent practicable and permitted by law, and when consistent with essential agency functions, accommodate access to and ceremonial uses of sacred sites by American Indian tribes’ religious practitioners. Further, the Executive Order states that federal agencies will comply with presidential direction to maintain government-to-government relations with tribal governments.
- **E.O. 13112, “Invasive Species” -** Issued on February 11, 1999, E.O. 13112 is intended to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause. The Executive Order established an Invasive Species Council which created a National Invasive Species Management Plan detailing and recommending performance-oriented goals, objectives and specific measures of success for federal agencies concerned about invasive species.
- **E.O. 13175, “Consultation and Coordination with Indian Tribal Governments” -** Further ensures that federal government agencies recognize the unique legal relationship the United States has with Indian tribal governments as set forth in the Constitution of the United States, treaties, statutes, other Executive Orders, and court decisions. It once again recognizes the right of Indian tribes to self-government and to “exercise inherent sovereign powers over their members and territory.” It directs federal agencies to work with Indian tribes on a government-to-government basis to address issues concerning Indian tribal self-government, tribal trust resources, and Indian tribal treaty and other rights.

5.4 U.S. DEPARTMENT OF ENERGY DIRECTIVES

Categories of DOE directives include orders, policy statements, standards, notices, manuals, and contractor requirements documents. Directives with particular application to DOE’s environmental activities are found in the 400 series of the new series directives and the 5000 series (particularly the 5400 and 5800 series) under the old series directives.

Topics covered in DOE directives include environmental protection, safety and health protection standards; hazardous and radioactive-mixed waste management; cleanup of retired facilities; safety requirements for the packaging and transportation of hazardous materials; safety of nuclear facilities; radiation protection; and other standards for the safety and protection of workers and the public. Regulations and standards of other federal agencies and standard setting entities are incorporated by reference into some DOE directives.

5.5 TREATIES, STATUTES, AND POLICIES RELATING TO NATIVE AMERICAN TRIBES OF THE HANFORD REGION

Representatives of the United States negotiated treaties with leaders of various Columbia Plateau Native American Tribes and Bands in June 1855 at Camp Stevens in the Walla Walla Valley. The negotiations resulted in three treaties, one with the 14 tribes and bands of the group that would become the Confederated Tribes and Bands of the Yakama Nation, one with the three tribes that would become the Confederated Tribes of the Umatilla Indian Reservation, and one with the Nez Perce Tribe of Idaho. The U.S. Senate ratified the treaties in 1859.

The Hanford Site is within the ceded lands of the Confederated Tribes and Bands of the Yakama Nation and the Confederated Tribes of the Umatilla Indian Reservation. The treaties reserved to the Tribes certain lands for their exclusive use (i.e., reservation lands). The treaties also secure to the Tribes certain rights and privileges to continue traditional activities outside the reservations. These included (1) the right to fish at usual and accustomed places in common with citizens of the United States, and (2) the privileges of hunting, gathering roots and berries, and pasturing horses and cattle on open and unclaimed lands.

DOE's relationship with Native American Tribes and Bands is based on treaties, statutes, executive orders, and DOE policy statements. The DOE interacts and consults regularly and directly with the three federally recognized Tribes affected by Hanford Site operations; that is, the Nez Perce Tribe of Idaho; the Confederated Tribes of the Umatilla Indian Reservation, Oregon; and the Confederated Tribes and Bands of the Yakama Nation, Washington. In addition, the Wanapum, who still live adjacent to the Hanford Site, are a non-federally recognized Tribe that has strong cultural ties to the Hanford Site. The Wanapum are also consulted on cultural resource issues in accordance with DOE policy and relevant legislation although they do not have treaties.

5.6 PERMITS AND LICENSES

Information on the status of environmental permits at Hanford is included in the *Annual Hanford Site Environmental Report*. The report includes information on environmental permitting under RCRA; *Toxic Substances Control Act*; CAA; CWA; the State Waste Discharge, Hydraulic Permit, and Underground Injection Control Programs; the Onsite Sewage System Program; and the Petroleum Underground Storage Tank Program.

The Hanford Site is considered a single facility for purposes of RCRA and the Washington State Hazardous Waste Management Act. Hanford's RCRA permit (No. WA7890008967) was originally issued in two portions, one by EPA Region 10 and the other by Ecology. The EPA portion of the permit covered the Hazardous and Solid Waste Amendments. The Ecology portion of the permit covered the dangerous waste provisions and was most recently modified by Ecology in February 2001. The Ecology portion of the permit was issued on September 27, 1994. The permit is the foundation for RCRA permitting on the Hanford Site in accordance with provisions set forth in the *Hanford Federal Facility Agreement and Consent Order* (also known as the Tri-Party Agreement [TPA]) (Ecology et al. 1989). The permit expired on September 27, 2004, and DOE continues to operate under the old permit until a revised permit is issued by Ecology. Ecology is now fully authorized to implement the dangerous waste program in lieu of the Federal RCRA program (except for delisting authority and variances from land disposal restriction treatment standards); therefore, there is no need or authority for EPA to separately issue a hazardous solid waste amendment component of the Hanford RCRA permit.

Clean Air Act compliance requires both facility and site-wide compliance. The *Annual Hanford Site Environmental Report* identifies existing facility-specific and site-wide CAA compliance activities. The air operating permit for the Hanford Site issued by Ecology became effective in July 2001 and has been renewed since that time. Prescribed burning activities on the Hanford Site require a burn permit issued by the BCAA.

The Hanford Site NPDES Permit (WA-002591-7) governs liquid process effluent discharges to the Columbia River. The permit authorizes Hanford Site Contractors to discharge from outfalls 001, 003, and 004 to the Columbia River in accordance with effluent limitations, monitoring requirements, and other conditions set forth in the NPDES Permit. The NPDES permit covers three outfalls: one outfall for the 300 Area TEDF (Outfall 001), and two outfalls in the 100-K Area (Outfalls 003 and 004). CH2M HILL Plateau Remediation Company is the holder of this permit. During 2009, the outfall for the 300 Area TEDF was removed from the permit because the facility was shut down. DOE has asserted a federally reserved water withdrawal right with respect to its Hanford operations. Current Hanford activities use water withdrawn under the DOE’s federally reserved water rights.

Washington State's pesticide licensing program includes 12 license types. All licenses except the Limited Private Applicator and Rancher Private Applicator must be renewed annually. Many people who use, sell, or consult on the use of pesticides are required to be licensed by the Washington State Department of Agriculture (WSDA); including those applying herbicides to lands in the project area of the Hanford Site. This requirement does not generally apply to homeowners who use home and garden pesticides on their own property. Pesticides include many different types of products such as herbicides, insecticides, fungicides, weed and feed, moss control agents, fumigants and marine antifouling paints to name a few. At the Hanford Site, two types of licenses are maintained. These include “Commercial Applicator” and “Commercial Operator.” A Commercial Applicator is a person engaged in the business of applying pesticides to the land or property of another. This land can either be publicly or privately owned. A Commercial Operator is a person employed by a WSDA-licensed Commercial Applicator to apply pesticides to the land or property of another. This property can also either be publicly or privately owned.

6.0 DISTRIBUTION OF THE ENVIRONMENTAL ASSESSMENT

Advance notice of DOE's intent to prepare this EA and briefings as requested were provided to various Tribal governments, agencies, and other organizations. In addition, the draft EA will be provided to the following for review and comment:

- Nez Perce Tribe
- Confederated Tribes of the Umatilla Indian Reservation
- Confederated Tribes and Bands of the Yakama Nation
- Confederated Tribes of the Colville Indian Reservation
- Wanapum
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- State of Washington, Department of Ecology
- Oregon Department of Energy
- Franklin County
- Hanford Advisory Board
- Benton County
- City of Richland

A 30-day public comment period is expected to begin early August 2011. Comments will be addressed in a Responsiveness Summary that will be an appendix to the final document. During the public comment period, the draft EA will be provided upon request to interested individuals. It will also be made available in the DOE Public Reading Room (Consolidated Information Center at Washington State University-Tri-Cities) and through the DOE-RL website (http://www5.hanford.gov/hanford/eventcalendar/).

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7.0 REFERENCES

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29 CFR 1910, "Occupational Safety and Health Standards," Title 29, *Code of Federal Regulations*, Part 1910, as amended.

33 CFR 328, "Definition of Waters of the United States," Title 33, *Code of Federal Regulations*, Part 328, as amended.

40 CFR 50, "National Primary and Secondary Ambient Air Quality Standards," Title 40, *Code of Federal Regulations*, Part 50, as amended.

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," Title 40, *Code of Federal Regulations*, Part 61, as amended.

40 CFR 201, "Noise Emission Standards for Transportation Equipment; Interstate Rail Carriers," Title 40, *Code of Federal Regulations*, Part 201, as amended.

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APPENDIX A

HERBICIDES USED ON THE HANFORD SITE AND BY THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

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Table A-1. Herbicides Used on the Hanford Site and by the Washington State Department of Transportation. (6 Sheets)

Product Name	Product Type	Description	Application	Herbicide Active Ingredient	Herbicide Toxicology/Risk Information
Actamaster	Water Conditioner	Binds iron and calcium cations. Effective as an adjuvant for 2,4-D (amine), glyphosate, and glufosinate herbicides.	100% non-rad	Not Applicable	Not Applicable
Agri Star Brox 2EC	Herbicide	Selective post-emergent herbicide for control of broadleaf weeds. Primarily a contact herbicide. Not systemic.	100% rad	Bromoxynil	Category II, Moderate Toxicity, WSDOT, PAN Database
Arsenal	Herbicide	Controls annual and perennial grasses and broadleaf weeds. Pre- or post-emergent applications to weeds.	100% non-rad	Imazapyr	Category III, Low Toxicity, WSDOT, USDA, PAN Database
Bio-Barrier II	Herbicide Fabric	Durable, nonwoven, polypropylene geotextile fabric with permanently attached nodules containing trifluralin. Nodules engineered to slowly release trifluralin, creating a zone where root growth is inhibited.	100% rad	Trifluralin	Category III, Low Toxicity, EPA Integrated Risk Information System (IRIS), PAN Database
Choice	Water Conditioner	Formulated to aid performance and mixing of spray solutions in hard water with high pH. Sequesters and chelates hard water ions.	100% non-rad	Not Applicable	Not Applicable
Clean Crop Actamaster	Water Conditioner	Binds iron and calcium cations. Effective as an adjuvant for 2,4-D (amine), glyphosate, and glufosinate herbicides.	100% non-rad	Not Applicable	Not Applicable
Dibro 2+2	Herbicide	Dust-free granular herbicide containing 2% Diuron and 2% Bromacil, for use on broadleaf weeds and grasses in industrial areas. Industry standard for over twenty years.	10% non-rad, 90% rad	Diuron, Bromacil	Category III/IV, Low to Slight Toxicity, WSDOT, PAN Database

Table A-1. Herbicides Used on the Hanford Site and by the Washington State Department of Transportation. (6 Sheets)

Product Name	Product Type	Description	Application	Herbicide Active Ingredient	Herbicide Toxicology/Risk Information
Diuron 80DF	Herbicide	Control of annual and perennial grasses and herbaceous weeds	10% non-rad, 90% rad	Diuron	Category III, Low Toxicity, WSDOT, PAN Database
Endurance Herbicide	Herbicide	Provides pre-emergent control of a variety of grasses and broadleaf weeds. Good as a rotational herbicide.	100% non-rad	Prodiamine	Category III, Low Toxicity, PAN Database
ET Herbicide Defoliant	Herbicide	Contact herbicide for broadleaf weed control, defoliation, and desiccation. Designed for use as a contact herbicide.	30% non-rad, 70% rad	Pyraflufen ethyl	Category I, High Toxicity, WSDOT, PAN Database
Fighter F	Defoamer	Controls foam when mixing sprays, eliminates material waste, provides accurate metering of agricultural sprays, eliminates foam overflow at fill site.	30% non-rad, 70% rad	Not Applicable	Not Applicable
Grounded	Drift Control	Spray additive that increases spray droplet size reducing spray drift.	100% non-rad	Not Applicable	Not Applicable
Hardball	Herbicide	Hardball is a selective post-emergent herbicide for the control of hard-to-kill annual broadleaved weeds. Contains 2,4-D.	30% non-rad, 70% rad	2,4-D	Category III, Low Toxicity, WSDOT, USDA, PAN Database
Horse Power Selective Herbicide	Herbicide	Selective broadleaf weed control in ornamental lawns and turf grasses.	100% non-rad	MCPA, Triclopyr, Dicamba	Category III, Low Toxicity, WSDOT, USDA, PAN Database
Hi-Light Blue Liquid	Dye	Temporary liquid colorant to mark spray application area to identify skips and overlaps.	30% non-rad, 70% rad	Not Applicable	Not Applicable
Krovar IDF	Herbicide	Dispersible granule herbicide to be mixed in water and applied as a spray for selective control of weeds.	30% non-rad, 70% rad	Diuron, Bromacil	Category III/IV, Low to Slight Toxicity, WSDOT, PAN Database

Table A-1. Herbicides Used on the Hanford Site and by the Washington State Department of Transportation. (6 Sheets)

Product Name	Product Type	Description	Application	Herbicide Active Ingredient	Herbicide Toxicology/Risk Information
Liberate	Surfactant	Uptake enhancing non-ionic surfactant blend. Provides uniform droplets and defoaming properties.	100% non-rad	Not Applicable	Not Applicable
Magnafloc 155	Soil Dust Control	Biodegradable flocculant.	30% non-rad, 70% rad	Not Applicable	Not Applicable
Metgard 60DF	Herbicide	Total vegetation control on rangelands and grasslands using water dispersible granules.	100% rad	Metsulfuron methyl	Category III, Low Toxicity, WSDOT, USDA, PAN Database
Milestone VM Herbicide	Herbicide	Broad spectrum control of invasive and noxious weeds. Post emergence weed control for broadleaf and woody plants.	100% non-rad	Aminopyralid	Category IV, Slight Toxicity WSDOT, USDA, PAN Database
MSO Concentrate	Surfactant	Spray adjuvant to enhance activity of post-applied herbicides. Contains surfactants and emulsifiers for easy mixing in spray solutions.	30% non-rad, 70% rad	Not Applicable	Not Applicable
Oust Herbicide	Herbicide	Broad spectrum herbicide used at varying rates for bare ground treatments, selective weeding on roadsides, and in other industrial turf applications. Controls annual and perennial grasses and broadleaf weeds.	100% rad	Sulfometuron methyl, Metsulfuron methyl	Category III, Low Toxicity, WSDOT, USDA, PAN Database
Overdrive	Herbicide	Post-emergent, selective, herbicide that provides a broad spectrum of control of annual broadleaf weeds.	30% non-rad, 70% rad	Dicamba	Category III, Low Toxicity, WSDOT, USDA, PAN Database
Payload Herbicide	Herbicide	Pre-emergent control of grasses and broadleaf weeds on bare ground. Effective on Russian Thistle.	30% non-rad, 70% rad	Flumioxazin	Category III, Low Toxicity, WSDOT, PAN Database

Table A-1. Herbicides Used on the Hanford Site and by the Washington State Department of Transportation. (6 Sheets)

Product Name	Product Type	Description	Application	Herbicide Active Ingredient	Herbicide Toxicology/Risk Information
Pendulum AquaCap	Herbicide	Pre-emergent grass and broadleaf weed control. Will not control established weeds.	100% non-rad	Pendimethalin	Category III, Low Toxicity, WSDOT, PAN Database
Perfect Spike (Lutz)	Fertilizer	Contains 4.8% combined Sulfur (S), 3.3% Iron Sulfate (Fe) and 3.2% Manganese Sulfate (Mn). Binders for time release.	100% non-rad	Not Applicable	Not Applicable
Phase	Surfactant	Wetting agent that lowers surface tension of liquid herbicides allowing easier and more even applications.	100% non-rad	Not Applicable	Not Applicable
Plateau	Herbicide	Controls annual and perennial grasses and broadleaf weeds. Effective cheatgrass control.	100% non-rad	Imazapic	Category IV, Slight Toxicity, WSDOT, USDA, PAN Database
Predict Herbicide	Herbicide	Post-emergent with residual activity for control of broad spectrum of annual broadleaf weeds.	30% non-rad, 70% rad	Norflurazon	Category IV, Slight Toxicity, WSDOT, PAN Database
Quest	Surfactant	Wetting agent that lowers surface tension of liquid herbicides allowing easier and more even applications.	30% non-rad, 70% rad	Not Applicable	Not Applicable
Quicksilver IVM Herbicide	Herbicide	Designed to be mixed with water and applied for selective post-emergent control of broadleaf weeds.	30% non-rad, 70% rad	Carfentrazone ethyl	Category III/IV, Low to Slight Toxicity, PAN Database
Roundup Pro Concentrate	Herbicide	Control wide range of annual and perennial grasses, broadleaf weeds, and sedges.	30% non-rad, 70% rad	Glyphosate	Category II, Moderate Toxicity, WSDOT, USDA, PAN Database
Sahara DG	Herbicide	Dispersible granule herbicide to be mixed in water and a spray adjuvant and applied as a spray for control of annual and perennial grasses and broadleaf weeds.	30% non-rad, 70% rad	Imazapyr, Diuron	Category III, Low Toxicity, WSDOT, USDA, PAN Database

Table A-1. Herbicides Used on the Hanford Site and by the Washington State Department of Transportation. (6 Sheets)

Product Name	Product Type	Description	Application	Herbicide Active Ingredient	Herbicide Toxicology/Risk Information
Scent Bubble Gum	Scent	Bubble gum fragrance for herbicides to mask chemical smell.	30% non-rad, 70% rad	Not Applicable	Not Applicable
Soak-Up	Spill Control	Spill control agent to absorb herbicide spills.	30% non-rad, 70% rad	Not Applicable	Not Applicable
Spike 80DF	Herbicide	Control of brush species; including sagebrush. Granular formulation.	100% rad	Tebuthiuron	Category III, Low Toxicity, WSDOT, PAN Database
Sprakil SK-26	Herbicide	Bare ground granular herbicide for controlling wide range of broadleaf weeds and grasses. Total vegetation control.	30% non-rad, 70% rad	Tebuthiuron, Diuron	Category III, Low Toxicity, WSDOT, PAN Database
Support	Surfactant	Wetting agent that lowers surface tension of liquid herbicides allowing easier and more even applications.	30% non-rad, 70% rad	Not Applicable	Not Applicable
Tank & Equipment Cleaner	Cleaner	All purpose cleaner for herbicide application equipment.	30% non-rad, 70% rad	Not Applicable	Not Applicable
Topsite 2.5G	Herbicide	Control of many annual and perennial grasses and broadleaf weeds. Granular formulation. Long-term bare ground vegetation control.	100% rad	Imazapyr, Diuron	Category III, Low Toxicity, WSDOT, USDA, PAN Database
Tordon 22K	Herbicide	Control of most noxious and invasive weeds. Soil residual for lasting perennial weed control.	100% non-rad	Picloram	Category II, Moderate Toxicity, WSDOT, USDA, PAN Database

Table A-1. Herbicides Used on the Hanford Site and by the Washington State Department of Transportation. (6 Sheets)

Product Name	Product Type	Description	Application	Herbicide Active Ingredient	Herbicide Toxicology/Risk Information
Trimec Plus	Herbicide	Post-emergent broadleaf weed control.	100% non-rad	2,4-D	Category III, Low Toxicity, WSDOT, USDA, PAN Database
Tuff Trax Foam Marker	Foam Marker	Foam marker to facilitate herbicide applications.	30% non-rad, 70% rad	Not Applicable	Not Applicable
UAP Timberland Platoon Herbicide	Herbicide	Control of many broadleaf weeds and brush. Pre- and post-emergent applications.	30% non-rad, 70% rad	2,4-D	Category III, Low Toxicity, WSDOT, USDA, PAN Database
Vanquish	Herbicide	Controls deciduous and coniferous brush species and broadleaf weeds.	30% non-rad, 70% rad	Diglycolamine	Category III, Low Toxicity, PAN Database
Veteran 720 Herbicide	Herbicide	Water-soluble herbicide for brush and broadleaf weed control. Selective weed control. Tolerant to native grasses.	30% non-rad, 70% rad	2,4-D	Category III, Low Toxicity, WSDOT, USDA, PAN Database
Vista Herbicide	Herbicide	Selective control of warm and cool season grasses including fescue, cheatgrass, and native grass species.	30% non-rad, 70% rad	Fluroxypyr	Category II, Moderate Toxicity, WSDOT, USDA, PAN Database

NOTES:

(1) WSDOT information at www.wsdot.wa.gov/Maintenance/Roadside/herbicideuse.htm

(2) U.S. Department of Agriculture (USDA) information at www.fs.fed.us/foresthealth/pesticide/risk.shtml

(3) Pesticide Action Network (PAN) database information at www.pesticideinfo.org

(4) EPA information at www.epa.gov/IRIS.htm

Herbicides Approved for Use on WSDOT Rights of Way

When making herbicide applications:

1. Always read and follow product labels
2. Always use personal protective equipment when mixing, loading, and applying

Chemical Name	*Product Name*	*Where Used*	*How/Why Used*	*Cautions*	*Restrictions*	*Special Notes*
2,4-D	Weedar 64 Amine 4 Veteran 720 Curtail	Nuisance and noxious weed control Zones 2 and 3	Selective broadleaf treatment	Amine formulation causes irreversible eye damage and is highly toxic to rainbow trout, all 2,4-D products pose risks of off target damage when applied near grapes and other sensitive crops	Amine formulations of 2,4-D are restricted for use within 60' of all water	Ester and acid formulations of 2,4-D may provide a good alternative to amine formulations
Aminopyralid	Milestone	Nuisance and noxious weed control Zones 2 and 3	Selective broadleaf treatment	None	None	Newly developed herbicide, introduced in 2005. Still being evaluated for effectiveness in roadside applications.
Bromacil	Krovar Hyvar	Zone 1	Nonselective pre-emergent grass and weed control	Bromacil highly mobile in soil, high potential to leach into ground water	Westside - Restricted for use Eastside - Krovar restricted for use within 60' of all water.	None
Bromoxynil	Buctril 2EC	Nuisance and noxious weed control Zones 2 and 3	Selective broadleaf treatment	Highly toxic to fresh water fish	Westside - Restricted for use Eastside - Restricted for use within 60' of all water	Effective broadleaf weed control without grass seed surpression
Chlorsulfuron	Telar	Nuisance and noxious weed control Zones 2 and 3	Selective broadleaf treatment	None	None	Product highly effective on Canadian thistle and Horse tail
Clopyralid	Transline Curtail	Nuisance and noxious weed control Zones 2 and 3	Selective broadleaf treatment	Curtial contains 2,4-D amine which causes irreversible eye damage and is highly toxic to rainbow trout	Curtail is restricted for use within 60' of all water because of 2,4-D amine content	Transline is a clopyralid formulation without 2,4-D
Dicamba	Vanquish Veteran 720	Nuisance and noxious weed control Zones 2 and 3	Selective broadleaf treatment	Veteran 720 contains 2-4-D amine which causes irreversible eye damage and is highly toxic to rainbow trout	Veteran 720 is restricted for use within 60' of all water because of 2,4-D amine content	Vanquish is the dicamba formulation without 2,4-D
Dichlobenil	Norosac 4G Casoron	Ornamental planting beds	Pre-emergent weed control in ground cover beds. Post emergent control of grasses.	Dichlobenil is highly toxic to aquatic insects	Restricted for use within 60' of all water	Highly effective for preemergent control of unwanted weeds in ornamentals
Diflufenzopyr	Overdrive	Nuisance and noxious weed control Zones 2 and 3	Selective broadleaf treatment	None	None	None
Diuron	Karmex Direx 80 DF	Zone 1	Nonselective pre-emergent grass and weed control	Highly toxic to fish.	Westside - Restricted for use Eastside - Restricted for use within 60' of all water	Cost effective weed control for Zone 1 in Eastern Washington
Flumioxazin	Payload	Zone 1	Nonselective pre-emergent grass and weed control	Highly toxic to estuarine invertebrates	Restricted for use within 60' of all salt water	Second year of use in zone 1, still evaluating

Herbicides Approved for Use on WSDOT Rights of Way

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Fluroxypyr	Vista	Nuisance and noxious weed control Zones 2 and 3	Selective broadleaf treatment	Highly toxic to Eastern Oyster, high surface runoff potential.	None	None
Fosamine	Krenite S	Tree and brush control in Zones 2 & 3	Selective broadleaf treatment	None	None	Effective broadleaf tree control without visual impacts
Glyphosate	Roundup Rodeo Aquamaster	Zone 1, spot spray around shrub and tree plantings, aquatic weed control (Rodeo, Aquamaster)	Nonselective weed control	None	None	Aquatic version approved for use with NPDES permit for in or over water treatements
Imazapic	Plateau	All zones	Pre-emergent control of undesirable grasses in newly seeded areas	Moderate to high potential to leach into groundwater	Westside - Restricted for use Eastside - Restricted for use within 60' of all water	Plateau is being evaluated for effectiveness particularly in former Zone 1 areas being re-established with native grasses
Imazapyr	Arsenal Habitat	Zone 1	Pre and post-emerent non-selective control of all vegetation	High surface runoff potential, high potential to leach into ground water	None	Habitat is an aquatic version of Arsenal - good alternativie to glyphosate in certain cases
Isoxaben	Gallery 75DF	Turf & Ornamental	Pre-emergent weed control in ground cover beds	High surface runoff potential	Restricted for use within 60' of all water	Works well by itself or with Ronstar
Metsulfuron-methyl	Escort	Nuisance and noxious weed control Zones 2 and 3	Selective broadleaf and conifer treatment	None	None	None
Norflurazon	Predict	Zone 1	Pre-emergent Weed control in Zone 1 and ground cover beds	High surface runoff potential	Restricted for use within 60' of all water	Good Zone 1 product but difficult to keep in suspension
Oryzalin	Oryzalin	Zone 1 Ornamental planting beds	Pre-emergent Weed control in Zone 1 and ground cover beds	Highly toxic to fish	Restricted for use within 60' of all water	Product requires additional rinsing to thoroughly remove residues from empty container
Oxadiazon	Ronstar 50 WSP	Turf & Ornamental	Pre-emergent weed control in ground cover beds	Highly toxic to fish	Restricted for use within 60' of all water, gardens, plants bearing ediable fruit	Works well by itself or with Gallery
Pendimethalin	Pendulum	Zone 1 Turf & Ornamental	Nonselective Pre-emergent grass and weed control	Highly toxic to fish, high potential for loss on erroded soil	Westside - Restricted for use. Eastside - Restricted for use within 60' of all water	None
Picloram	Tordon	Nuisance and noxious weed control Zones 2 and 3	Selective broadleaf treatment	Highly mobile in soil and plant tissue, readily absorbed through roots	Westside - Restricted for use Eastside - Restricted for use within 60' of all water	Highly effective for conifer and broadleaf control in Eastern Washington
Pyraflufen	Edict	Nuisance and noxious weed control Zones 2 and 3	2,-4-D substitue, effective on Kochia,Russian thistle	Irreversable eye damage, highly toxic to Rainbow Trout	Restricted for use within 60' of all water	Effective with Roundup for Kochia control
Sulfentrazone	Portfolio	Zone 1	Nonselective pre-emergent grass and weed control	High surface runoff potential, high potential to leach into ground water	Westside - Restricted for use. Eastside - Restricted for use within 60' of all water	New product available for use in 2006

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Sulfometuron-methyl	Oust	Zone 1	Nonselective pre/post emergent grass and weed control	None	None	None
Tebuthiuron	Spike 80DF	Zone 1	Nonselective pre-emergent grass and weed control	High surface runoff potential. High potential to leach into ground water	Westside - Restricted for use. Eastside - Restricted for use within 60' of all water	None
Triclopyr Amine	Garlon 3A	Nuisance and noxious weed control Zones 2 and 3	Selective broadleaf treatment	Irreversible eye damage	None	None
Triclopyr Ester	Garlon 4	Nuisance and noxious weed control Zones 2 and 3	Selective broadleaf treatment	Highly toxic to fish	Restricted for use within 60' of all water	Works well for invert applications

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APPENDIX B

HANFORD SITE PLANT AND ANIMAL SPECIES LIST

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This appendix contains seven tables that list species of vascular plants, mammals, birds, reptiles and amphibians, and fish that have been sighted on the Hanford Site; including threatened, endangered, and other special status species, and noxious weeds. The lists are for those species that may be encountered on the Site and are not intended to represent a complete listing of all species. When appropriate, more comprehensive listings have been identified.

The federal list of endangered and threatened species is maintained by the USFWS in 50 CFR 17.11, "Endangered and Threatened Wildlife and Plants; Endangered and Threatened Wildlife" and 50 CFR 17.12, "Endangered and Threatened Wildlife and Plants; Endangered and Threatened Plants." State lists are maintained by the Washington Natural Heritage Program (WNHP 2010, *Rare Plants Information Available from the Washington Natural Heritage Program*) and the Washington Department of Fish and Wildlife (WDFW 2010, *Species of Concern*).

Table B-1. Common Vascular Plants on the Hanford Site, Washington.* (3 sheets)

Species	Scientific Name
A. Shrub-Steppe	
Shrub	
big sagebrush	*Artemisia tridentata*
bitterbrush	*Purshia tridentata*
gray rabbitbrush	*Ericameria nauseousa*
green rabbitbrush	*Chrysothamnus viscidiflorus*
snow buckwheat	*Eriogonum niveum*
spiny hopsage	*Grayia (Atriplex) spinosa*
threetip sagebrush	*Artemisia tripartita*
Perennial Grasses	
bluebunch wheatgrass	*Pseudoroegnaria spicata*
bottlebrush squirreltail	*Elymus elymoides*
crested wheatgrass	*Agropyron desertorum (cristatum)*[(a)]
Indian ricegrass	*Achnatherum hymenoides*
needle-and-thread grass	*Stipa comata*
prairie junegrass	*Koeleria cristata*
sand dropseed	*Sporobolus cryptandrus*
Sandberg's bluegrass	*Poa sandbergii (secunda)*
thickspike wheatgrass	*Elymus macrourus*
Biennial/Perennial Forbs	
bastard toad flax	*Comandra umbellata*
buckwheat milkvetch	*Astragalus caricinus*
Carey's balsamroot	*Balsamorhiza careyana*
Cusick's sunflower	*Helianthus cusickii*
cutleaf ladysfoot mustard	*Thelypodium laciniatum*
Douglas' clusterlily	*Brodiaea douglasii*
dune scurfpea	*Psoralea lanceolata*
Franklin's sandwort	*Arenaria franklinii*
Gray's desertparsley	*Lomatium grayi*
hoary aster	*Machaeranthera canescens*

Table B-1. Common Vascular Plants on the Hanford Site, Washington.* (3 sheets)

Species	Scientific Name
hoary falseyarrow	*Chaenactis douglasii*
sand beardtongue	*Penstemon acuminatus*
yarrow	*Achillea millefolium*
yellow bell	*Fritillaria pudica*
yellow salsify	*Tragopogon dubius*[(a)]
Annual Forbs	
annual Jacob's ladder	*Polemonium micranthum*
blue mustard	*Chorispora tenella*[(a)]
bur ragweed	*Ambrosia acanthicarpa*
clasping pepperweed	*Lepidium perfoliatum*
Indian wheat	*Plantago patagonica*
jagged chickweed	*Holosteum umbellatum*[(a)]
Jim Hill's tumblemustard	*Sisymbrium altissimum*[(a)]
matted cryptantha	*Cryptantha circumscissa*
pink microsteris	*Microsteris gracilis*
prickly lettuce	*Lactuca serriola*[(a)]
Russian thistle (tumbleweed)	*Salsola kali*[(a)]
spring whitlowgrass	*Draba verna*[(a)]
storksbill	*Erodium cicutarium*[(a)]
tall willowherb	*Epilobium paniculatum*
tarweed fiddleneck	*Amsinckia lycopsoides*
threadleaf scorpion weed	*Phacelia linearis*
western tansymustard	*Descurainia pinnata*
white cupseed	*Plectritis macrocera*
whitestem stickleaf	*Mentzelia albicaulis*
winged cryptantha	*Cryptantha pterocarya*
Annual Grasses	
cheatgrass	*Bromus tectorum*[(a)]
slender sixweeks	*Festuca octoflora*
small sixweeks	*Festuca microstachys*
B. Riparian	
Trees and Shrubs	
black cottonwood	*Populus trichocarpa*
black locust	*Robinia pseudo-acacia*[(a)]
coyote willow	*Salix exigua*
peach, apricot, cherry	*Prunus* spp.[(a)]
peachleaf willow	*Salix amygdaloides*
willow	*Salix* spp.
white mulberry	*Morus alba*[(a)]

Table B-1. Common Vascular Plants on the Hanford Site, Washington.* (3 sheets)

Species	Scientific Name
Perennial Grasses and Forbs	
bentgrass	*Agrostis* spp.[(b)]
blanket flower	*Gaillardia aristata*
bulrushes	*Scirpus* spp.[(b)]
cattail	*Typha latifolia*[(b)]
Columbia River gumweed	*Grindelia columbiana*
dogbane	*Apocynum cannabinum*
hairy golden aster	*Heterotheca villosa*
heartweed	*Polygonum persicaria*
horsetails	*Equisetum* spp.
horseweed tickseed	*Coreopsis atkinsoniana*
lovegrass	*Eragrostis* spp.[(b)]
lupine	*Lupinus* spp.
meadow foxtail	*Alopecurus aequalis*[(b)]
Pacific sage	*Artemisia campestris*
prairie sagebrush	*Artemisia ludoviciana*
reed canary grass	*Phalaris arundinacea*[(a,b)]
rushes	*Juncus* spp.
Russian knapweed	*Centaurea repens*[(a)]
sedge	*Carex* spp.[(b)]
water speedwell	*Veronica anagallis-aquatica*
western goldenrod	*Solidago occidentalis*
wild onion	*Allium* spp.
wiregrass spikerush	*Eleocharis* spp.[(b)]
C. Aquatic Vascular	
Canadian waterweed	*Elodea canadensis*
duckweed	*Lemna minor*
pondweed	*Potamogeton* spp.
spiked water milfoil	*Myriophyllum spicatum*
watercress	*Rorippa nasturtium-aquaticum*

*Taxonomy follows "Flora of the Pacific Northwest," Hitchcock and Cronquist 1973. See PNNL-13688, *Vascular Plants of the Hanford Site,* for a complete listing of Hanford Site vascular plants.

(a) Introduced

(b) Perennial grasses and graminoids.

Table B-2. Mammals that Have Been Observed on the Hanford Site, Washington. (2 sheets)

Common Name	Scientific Name
Shrews (family Soricidae)	
Merriam's shrew	*Sorex merriami*
vagrant shrew	*Sorex vagrans*
Evening bats (family Vespertilionidae)	
pallid bat	*Antrozous pallidus*
big brown bat	*Eptesicus fuscus*
silver-haired bat	*Lasionycteris noctivagans*
hoary bat	*Lasiurus cinereus*
California myotis	*Myotis californicus*
small-footed myotis	*Myotis leibii*
little brown myotis	*Myotis lucifugus*
long-legged myotis	*Myotis volans*
Yuma myotis	*Myotis yumanensis*
western pipistrelle	*Pipistrellus hesperus*
Hares, rabbits (family Leporidae)	
black-tailed jackrabbit	*Lepus californicus*
white-tailed jackrabbit	*Lepus townsendii*
Nuttall's (or mountain) cottontail	*Sylvilagus nuttallii*
Chipmunks, marmots, Squirrels (family Sciuridae)	
yellow-bellied marmot	*Marmota flaviventris*
Townsend's ground squirrel	*Spermophilus townsendii*
Washington ground squirrel	*Spermophilus washingtoni*
least chipmunk	*Tamias minimus*
Pocket gophers (family Geomyidae)	
northern pocket gopher	*Thomomys talpoides*
Heteromyid rodents, pocket mice (family Heteromyidae)	
Great Basin pocket mouse	*Perognathus parvus*
Beavers (family Castoridae)	
beaver	*Castor canadensis*
Campagnols, mice, rats, souris, voles (family Muridae)	
sagebrush vole	*Lemmiscus curtatus*
montane vole	*Microtus montanus*
house mouse	*Mus musculus*
bushy-tailed woodrat	*Neotoma cinerea*
muskrat	*Ondatra zibethicus*
northern grasshopper mouse	*Onychomys leucogaster*
deer mouse	*Peromyscus maniculatus*
Norway rat	*Rattus norvegicus*
western harvest mouse	*Reithrodontomys megalotis*

Table B-2. Mammals that Have Been Observed on the Hanford Site, Washington. (2 sheets)

Common Name	Scientific Name
New World porcupines (family Erethizontidae)	
porcupine	*Erethizon dorsatum*
Coyotes, dogs, foxes, jackals, wolves (family Canidae)	
coyote	*Canis latrans*
Raccoons (family Procyonidae)	
raccoon	*Procyon lotor*
Martins, weasels, wolverines, otters, badgers (family Mustelidae)	
river otter	*Lontra canadensis*
short-tail weasel	*Mustela erminea*
long-tailed weasel	*Mustela frenata*
mink	*Mustela vison*
badger	*Taxidea taxus*
Skunks (family Mephitidae)	
striped skunk	*Mephitis mephitis*
Cats (family Felidae)	
bobcat	*Lynx rufus*
mountain lion	*Puma concolor concolor*
Caribou, cervids, deer, moose, Wapiti (family Cervidae)	
Rocky Mountain elk	*Cervus elaphus*
moose	*Alces alces*
mule deer	*Odocoileus hemionus*
white-tailed deer	*Odocoileus virginianus*

Sources: (PNL-8916, *A Preliminary Survey of Selected Structures on the Hanford Site for Townsend's Big-Eared Bat (Plecotus townsendii)*; "The Status, Distribution, and Ecology of Wildlife on the U.S. DOE Hanford Site: A Historical Overview of Research Activities;" Fitzner and Gray 1991).

Table B-3. Common Bird Species Known to Occur on the Hanford Site, Washington. (4 sheets)

Common Name	Scientific Name	Season of Highest Abundance
Gaviiformes - Loons or divers		
common loon	*Gavia immer*	Yr
Podicipediformes - Grebes		
eared grebe	*Podiceps nigricollis*	W
horned grebe	*Podiceps auritus*	W
pied-billed grebe	*Podilymbus podiceps*	Yr
western grebe	*Aechmophorus occidentalis*	W
Pelecaniformes - Pelicans and allies		
American white pelican	*Pelecanus erythrorhynchos*	Yr
double-crested cormorant	*Phalacrocorax auritus*	Yr
Anseriformes - Waterfowl		
American green-winged teal	*Anas crecca*	Yr
American wigeon	*Anas americana*	W
Barrow's goldeneye	*Bucephala islandica*	W
blue-winged teal	*Anas discors*	B
bufflehead	*Bucephala albeola*	W
cinnamon teal	*Anas cyanoptera*	B
Canada goose	*Branta canadensis*	Yr
common goldeneye	*Bucephala clangula*	W
common merganser	*Mergus merganser*	Yr
gadwall	*Anas strepera*	Yr
hooded merganser	*Lophodytes cucullatus*	W
mallard	*Anas platyrhynchos*	Yr
northern pintail	*Anas acuta*	Yr
northern shoveler	*Anas clypeata*	Yr
redhead	*Aythya americana*	W
ruddy duck	*Oxyura jamaicensis*	Yr
Gruiformes - Cranes, rails, and allies		
American coot	*Fulica americana*	Yr
sora	*Porzana carolina*	B
Virginia rail	*Rallus limicola*	B
Charadriiformes - Shorebirds and allies		
California gull	*Larus californicus*	Yr
Forster's tern	*Sterna forsteri*	B
American avocet	*Recurvirostra americana*	B
black-crowned night-heron	*Nycticorax nycticorax*	B
Caspian tern	*Sterna caspia*	B
common snipe	*Gallinago gallinago*	B
dunlin	*Calidris alpinis*	M
glaucous-winged gull	*Leucosticte tephrocotis*	Yr
great blue heron	*Ardea herodias*	Yr
great egret	*Casmerodius albus*	B

Table B-3. Common Bird Species Known to Occur on the Hanford Site, Washington. (4 sheets)

Common Name	Scientific Name	Season of Highest Abundance
greater yellowlegs	*Tringa melanoleuca*	M
herring gull	*Larus argentatus*	W
killdeer	*Charadrius vociferus*	B
lesser yellowlegs	*Tringa flavipes*	M
long-billed curlew	*Numenius americanus*	B
long-billed dowitcher	*Limnodromus scolopaceus*	M
red-necked phalarope	*Larus glaucescens*	M
ring-billed gull	*Larus delawarensis*	Yr
sandhill crane	*Grus canadensis*	M
spotted sandpiper	*Actitis macularia*	B
solitary sandpiper	*Tringa solitaria*	M
western sandpiper	*Calidris mauri*	M
Galliformes - Chicken-like birds		
California quail	*Callipepla californica*	Yr
chukar	*Alectoris chukar*	Yr
grey partridge	*Perdix perdix*	Yr
ring-necked pheasant	*Phasianus colchicus*	Yr
Falconiformes - Diurnal birds of prey		
American kestrel	*Falco sparverius*	Yr
bald eagle	*Haliaeetus leucocephalus*	W
Cooper's hawk	*Accipiter cooperii*	W
ferruginous hawk	*Buteo regalis*	B
golden eagle	*Aquila chrysaetos*	Yr
merlin	*Falco columbarius*	M
northern harrier	*Circus cyaneus*	Yr
northern rough-legged hawk	*Buteo lagopus*	W
osprey	*Pandion haliaetus*	B
prairie falcon	*Falco mexicanus*	Yr
red-tailed hawk	*Buteo jamaicensis*	Yr
sharp-shinned hawk	*Accipiter striatus*	W
Swainson's hawk	*Buteo swainsoni*	B
Strigiformes - Owls		
burrowing owl	*Athene cunicularia*	B
common barn-owl	*Tyto alba*	Yr
great horned owl	*Bubo virginianus*	Yr
long-eared owl	*Asio otus*	Yr
short-eared owl	*Asio flammeus*	Yr
Coraciiformes - Rollers and allies		
belted kingfisher	*Ceryle alcyon*	Yr
Columbiformes - Pigeons		
mourning dove	*Zenaida macroura*	Yr
rock dove	*Columba livia*	Yr

Table B-3. Common Bird Species Known to Occur on the Hanford Site, Washington. (4 sheets)

Common Name	Scientific Name	Season of Highest Abundance
Caprimulgiformes - Nightjars and allies		
common nighthawk	*Chordeiles minor*	B
common poorwill	*Phalaenoptilus nuttallii*	B
Apodiformes - Hummingbirds, swifts		
rufous hummingbird	*Selasphorus rufus*	M
Piciformes - Woodpeckers and allies		
northern flicker	*Colaptes auratus*	Yr
Passeriformes - Perching birds		
American crow	*Corvus brachyrhynchos*	Yr
American goldfinch	*Carduelis tristis*	Yr
American robin	*Turdus migratorius*	Yr
bank swallow	*Riparia riparia*	B
barn swallow	*Hirundo rustica*	B
Bewick's wren	*Thryomanes bewickii*	B
black-billed magpie	*Pica pica*	Yr
black-headed grosbeak	*Pheucticus melanocephalus*	B
blue-headed vireo	*Vireo solitarius*	M
Brewer's blackbird	*Euphagus cyanocephalus*	B
Brewer's sparrow	*Spizella breweri*	B
brown-headed cowbird	*Molothrus ater*	B
Bullock's oriole	*Icterus galbula*	B
canyon wren	*Catherpes mexicanus*	B
cedar waxwing	*Bombycilla cedrorum*	M
chipping sparrow	*Spizella passerina*	M
cliff swallow	*Hirundo pyrrhonota*	B
common raven	*Corvus corax*	Yr
dark-eyed junco	*Junco hyemalis*	Yr
eastern kingbird	*Tyrannus tyrannus*	B
European starling	*Sturnus vulgaris*	Yr
golden-crowned kinglet	*Regulus satrapa*	M
golden-crowned sparrow	*Zonotrichia atricapilla*	M
grasshopper sparrow	*Ammodramus savannarum*	B
gray-crowned rosy finch	*Phalaropus lobatus*	M
Hammond's flycatcher	*Empidonax hammondii*	M
horned lark	*Eremophila alpestris*	Yr
house finch	*Carpodacus mexicanus*	Yr
house sparrow	*Passer domesticus*	Yr
house wren	*Troglodytes aedon*	B
lark sparrow	*Chondestes grammacus*	B
lazuli bunting	*Passerina amoena*	B
Lincoln's sparrow	*Melospiza lincolnii*	M
loggerhead shrike	*Lanius ludovicianus*	Yr
MacGillivray's warbler	*Oporornis tolmiei*	B
marsh wren	*Cistothorus palustris*	B

Table B-3. Common Bird Species Known to Occur on the Hanford Site, Washington. (4 sheets)

Common Name	Scientific Name	Season of Highest Abundance
Nashville warbler	*Vermivora ruficapilla*	M
northern rough-winged swallow	*Stelgidopteryx serripennis*	B
orange-crowned warbler	*Vermivora celata*	M
Pacific-slope flycatcher	*Empidonax difficilis*	M
red-breasted nuthatch	*Sitta canadensis*	W
red-winged blackbird	*Agelaius phoeniceus*	B
rock wren	*Salpinctes obsoletus*	B
ruby-crowned kinglet	*Regulus calendula*	M
rufous-sided towhee	*Pipilo erythrophthalmus*	B
sage sparrow	*Amphispiza belli*	B
sage thrasher	*Oreoscoptes montanus*	B
savannah sparrow	*Passerculus sandwichensis*	B
Say's phoebe	*Sayornis saya*	B
song sparrow	*Melospiza melodia*	Yr
Townsend's solitaire	*Myadestes townsendi*	M
Townsend's warbler	*Dendroica townsendi*	M
tree swallow	*Tachycineta bicolor*	M
varied thrush	*Ixoreus naevius*	W
vesper sparrow	*Pooecetes gramineus*	B
violet-green swallow	*Tachycineta thalassina*	M
warbling vireo	*Vireo gilvus*	M
western kingbird	*Tyrannus verticalis*	B
western meadowlark	*Sturnella neglecta*	Yr
white-crowned sparrow	*Zonotrichia leucophrys*	W
western tanager	*Piranga ludoviciana*	M
western wood-pewee	*Contopus sordidulus*	M
Wilson's warbler	*Wilsonia pusilla*	M
winter wren	*Troglodytes troglodytes*	W
yellow-breasted chat	*Icteria virens*	B
yellow-rumped warbler	*Dendroica coronata*	M
yellow warbler	*Dendroica petechia*	M
yellow-headed blackbird	*xanthocephalus xanthocephalus*	B

Season Code: Yr = all year, W = winter, B = Breeding, M = Migration

Sources: Fitzner and Gray 1991; WHC-EP-0402, *Status of Birds at the Hanford Site in Southeastern Washington*; "Use of Riparian Habitats by Spring Migrant Landbirds in the Shrub Steppe of Washington,").

Table B-4. Reptiles and Amphibians Found on the Hanford Site, Washington.

Common Name	Scientific Name
Reptiles	
common garter snake	*Thamnophis sirtalis*
Great Basin gopher snake	*Pituiphis melanoleucus*
night snake	*Hypsiglena torquata*
northern sagebrush lizard	*Scleroporus graciosus*
northern pacific rattlesnake	*Crotalus oreganus*
painted turtle	*Chrysemys picta*
pine gopher snake	*Pituophis melanoleucus*
short-horned lizard	*Phrynosoma douglassii*
side-blotched lizard	*Uta stansburiana*
striped whipsnake	*Masticophis taeniatus*
western rattlesnake	*Crotalus viridis*
western yellow-bellied racer	*Coluber constrictor*
Amphibians	
bullfrog	*Rana catesbeiana*
Great Basin spadefoot	*Scaphiopus intermontanus*
tiger salamander	*Ambystoma tigrinum*
western toad	*Bufo boreas*
Woodhouse's toad	*Bufo woodhousii*

Table B-5. Fish Species in the Hanford Reach, Washington, Region of the Columbia River. (2 sheets)

Common Name	Scientific Name
Paddlefishes, spoonfishes, sturgeons (family Acipenseridae)	
white sturgeon	*Acipenser transmontanus*
Anchovies, herrings (family Clupeidae)	
American shad	*Alosa sapidissima*
Cyprins, minnows, suckers (family Catostomidae)	
chiselmouth	*Acrocheilus alutaceus*
bridgelip sucker	*Catostomus columbianus*
largescale sucker	*Catostomus macrocheilus*
mountain sucker	*Catostomus platyrhynchus*
common carp	*Cyprinus carpio*
peamouth	*Mylocheilus caurinus*
northern pikeminnow	*Ptychocheilus oregonensis*
longnose dace	*Rhinichthys cataractae*
leopard dace	*Rhinichthys falcatus*
speckled dace	*Rhinichthys osculus*
redside shiner	*Richardsonius balteatus*
tench	*Tinca tinca*
Livebearers (family Poeciliidae)	
western mosquitofish	*Gambusia affinis*
Cods (family Gadidae)	
burbot	*Lota lota*
Pipefishes, sticklebacks (family Gasterosteidae)	
threespine stickleback	*Gasterosteus aculeatus*
Perch-like fishes (family Centrarchidae)	
pumpkinseed	*Lepomis gibbosus*
bluegill	*Lepomis macrochirus*
smallmouth bass	*Micropterus dolomieui*
largemouth bass	*Micropterus salmoides*
yellow perch	*Perca flavenscens*
white crappie	*Pomoxis annularis*
black crappie	*Pomoxis nigromaculatus*
walleye	*Sander vitreus*

Table B-5. Fish Species in the Hanford Reach, Washington, Region of the Columbia River. (2 sheets)

Common Name	Scientific Name
Trout perches (family Perocpsidae)	
sand roller	*Percopsis transmontana*
Lampreys (family Petromyzontidae)	
river lamprey	*Lampetra ayresii*
Pacific lamprey	*Lampetra tridentata*
Salmonids, salmons, trouts (family Salmonidae)	
lake whitefish	*Coregonus clupeaformis*
bull trout	*Salvelinus confluentus*
cutthroat trout	*Oncorhynchus clarkii*
coho salmon	*Oncorhynchus kisutch*
rainbow trout (steelhead)	*Oncorhynchus mykiss*
sockeye salmon	*Oncorhynchus nerka*
Chinook salmon	*Oncorhynchus tshawytscha*
mountain whitefish	*Prosopium williamsoni*
Chabots, sculpins (family Cottidae)	
prickley sculpin	*Cottus asper*
mottled sculpin	*Cottus bairdii*
piute sculpin	*Cottus beldingii*
reticulate sculpin	*Cottus perplexus*
torrent sculpin	*Cottus rhotheus*
Bullhead catfishes, North American freshwater catfishes (family Ictaluridae)	
yellow bullhead	*Ameiurus natalis*
brown bullhead	*Ameiurus nebulosus*
black bullhead	*Ameiurus melas*
channel catfish	*Ictalurus punctatus*

Source: "Checklist and Relative Abundance of Fish Species from the Hanford Reach of the Columbia River," **(**Gray and Dauble 1977)

Table B-6. Hanford Site Threatened, Endangered, and Other Special Status Species. (4 sheets)

Common Name	Scientific Name	Status	
		Federal	State
PLANTS			
Annual paintbrush	*Castilleja exilis*		Watch
Annual sandwort	*Minuartia pusilla* var. *pusilla*		Review Group 1
Awned halfchaff sedge	*Lipocarpha (=Hemicarpha) aristulata*		Threatened
Basalt milkvetch	*Astragalus conjunctus* var. *rickardii*		Watch
Beaked spike-rush	*Eleocharis rostellata*		Sensitive
Bristly combseed	*Pectocarya setosa*		Watch
Canadian St. John's wort	*Hypericum majus*		Sensitive
Chaffweed	*Centunculus minimus*		Threatened
Columbia milkvetch	*Astragalus columbianus*	Species of concern	Sensitive
Columbia yellowcress	*Rorippa columbiae*	Species of concern	Endangered
Columbia River mugwort	*Artemisia lindleyana*		Watch
Coyote tobacco	*Nicotiana attenuata*		Sensitive
Crouching milkvetch	*Astragalus succumbens*		Watch
Desert cryptantha	*Cryptantha scoparia*		Sensitive
Desert dodder	*Cuscuta denticulate*		Threatened
Desert evening primrose	*Oenothera caespitosa* ssp. *caespitosa*		Sensitive
Dwarf evening primrose	*Camissonia (=Oenothera) pygmaea*		Sensitive
False pimpernel	*Lindernia dubia* var. *anagallidea*		Watch
Fuzzytongue penstemon	*Penstemon eriantherus whitedii*		Sensitive
Geyer's milkvetch	*Astragalus geyeri*		Threatened
Giant helleborine	*Epipactis gigantea*		Watch
Grand redstem	*Ammannia robusta*		Threatened
Gray cryptantha	*Cryptantha leucophaea*	Species of concern	Sensitive
Great Basin gilia	*Gilia leptomeria*		Threatened
Hedgehog cactus	*Pediocactus simpsonii* var. *robustior*		Review Group 1
Hoover's desert parsley	*Lomatium tuberosum*	Species of concern	Sensitive
Kittitas larkspur	*Delphinium multiplex*		Watch
Loeflingia	*Loeflingia squarrosa* var. *squarrosa*		Threatened
Lowland toothcup	*Rotala ramosior*		Threatened
Medic milkvetch	*Astragalus speirocarpus*		Watch
Pigmy-weed	*Crassula aquatica*		Watch
Piper's daisy	*Erigeron piperianus*		Sensitive
Porcupine sedge	*Carex hystericina*		Watch
Robinson's onion	*Allium robinsonii*		Watch
Rosy balsamroot	*Balsamorhiza rosea*		Watch
Rosy pussypaws	*Calyptridium roseum*		Threatened
Scilla onion	*Allium scilloides*		Watch
Shining flatsedge	*Cyperus bipartitus (rivularis)*		Watch
Small-flowered evening primrose	*Camissonia* (=*Oenothera*) *minor*		Sensitive
Small-flowered nama	*Nama densum* var. *parviflorum*		Watch
Smooth cliffbrake	*Pellaea glabella var. simplex*		Watch

Table B-6. Hanford Site Threatened, Endangered, and Other Special Status Species. (4 sheets)

Common Name	Scientific Name	Status	
		Federal	State
Southern mudwort	*Limosella acaulis*		Watch
Snake River cryptantha	*Cryptantha spiculifera (= C. interrupta)*		Sensitive
Stalked-pod milkvetch	*Astragalus sclerocarpus*		Watch
Suksdorf's monkey flower	*Mimulus suksdorfii*		Sensitive
Umtanum desert buckwheat	*Eriogonum codium*	Candidate	Endangered
Vanilla grass	*Hierchloe odorata =(Anthoxanthm hirtum)*		Review Group 1
White Bluffs bladderpod	*Lesquerella tuplashensis*	Candidate	Threatened
White eatonella	*Eatonella nivea*	Candidate	Threatened
Winged combseed	*Pectocarya penicillata*		Watch
INSECTS			
Bonneville skipper	*Ochlodes sylvanoides bonnevilla*		Monitor
Canyon green hairstreak	*Callophrys sheridanii neoperplexa*		Monitor
Columbia River tiger beetle[(a)]	*Cicindela columbica*		Candidate
Coral hairstreak	*Harkenclenus titus immaculosus*		Monitor
Juba skipper	*Hesperia juba*		Monitor
Nevada skipper	*Hesperia nevada*		Monitor
Northern checkerspot	*Chlosyne palla palla*		Monitor
Pasco pearl	*Phyciodes cocyta pascoensis*		Monitor
Persius' duskywing	*Erynnis persius*		Monitor
Purplish copper	*Lycaena helloides*		Monitor
Ruddy copper	*Lycaena rubida perkinsorum*		Monitor
Silver-bordered fritillary	*Boloria selene atrocostalis*		Candidate
Silver-spotted skipper	*Epargyreus clarus californicus*		Monitor
Viceroy	*Limenitis archippus lahontani*		Monitor
MOLLUSKS			
California floater	*Anodonta californiensis*	Species of concern	Candidate
Great Columbia River spire snail	*Fluminicola (=Lithoglyphus) columbiana*	Species of concern	Candidate
Oregon floater	*Anodonta oregonensis*		Monitor
Shortfaced lanx	*Fisherola nuttalli*		Candidate
Western floater	*Anodonta kennerlyi*		Monitor
Western pearlshell	*Margaritifera falcata*		Monitor
FISH			
Bull trout[(b)]	*Salvelinus confluentus*	Threatened	Candidate
Leopard dace[(b)]	*Rhinichthys flacatus*		Candidate
Mountain sucker[(b)]	*Catastomus platyrhynchus*		Candidate
Pacific lamprey	*Lampetra tridentata*	Species of concern	Monitor
Piute sculpin	*Cottus beldingi*		Monitor
Reticulate sculpin	*Cottus perplexus*		Monitor
River lamprey[(b)]	*Lampetra ayresi*	Species of concern	Candidate
Sand roller	*Percopsis transmontana*		Monitor
Spring-run Chinook salmon	*Oncorhynchus tshawytscha*	Endangered[(c)]	Candidate
Steelhead	*Oncorhynchus mykiss*	Threatened[(d)]	Candidate

Table B-6. Hanford Site Threatened, Endangered, and Other Special Status Species. (4 sheets)

Common Name	Scientific Name	Status	
		Federal	State
REPTILES AND AMPHIBIANS			
Night snake	*Hypsiglena torquata*		Monitor
Sagebrush lizard	*Sceloporous graciosus*	Species of concern	Candidate
Short-horned lizard	*Phrynosoma douglassii*		Monitor
Striped whipsnake	*Masticophis taeniatus*		Candidate
Western toad	*Bufo boreas*	Species of concern	Candidate
Woodhouse's toad	*Bufo woodhousii*		Monitor
BIRDS			
American white pelican	*Pelecanus erythrorhynchos*		Endangered
Arctic tern[(b)]	*Sterna paradisaea*		Monitor
Ash-throated flycatcher[(b)]	*Myiarchus cinerascens*		Monitor
Bald eagle[(e)]	*Haliaeetus leucocephalus*	Species of concern	Sensitive
Black tern	*Chlidonias niger*	Species of concern	Monitor
Black-crowned night-heron	*Nycticorax nycticorax*		Monitor
Black-necked stilt	*Himantopus mexicanus*		Monitor
Bobolink[(b)]	*Dolichonyx oryzivorus*		Monitor
Burrowing owl	*Athene cunicularia*	Species of concern	Candidate
Caspian tern	*Sterna caspia*		Monitor
Clark's grebe	*Aechmophorus clarkii*		Monitor
Common loon	*Gavia immer*		Sensitive
Ferruginous hawk	*Buteo regalis*	Species of concern	Threatened
Flammulated owl[(b)]	*Otus flammeolus*		Candidate
Forster's tern	*Sterna forsteri*		Monitor
Golden eagle	*Aquila chrysaetos*		Candidate
Grasshopper sparrow	*Ammodramus savannarum*		Monitor
Gray flycatcher	*Empidonax wrightii*		Monitor
Great blue heron	*Ardea herodias*		Monitor
Great egret	*Ardea alba*		Monitor
Greater sage grouse	*Centrocercus urophasianus*	Candidate	Threatened
Gyrfalcon[(b)]	*Falco rusticolus*		Monitor
Horned grebe	*Podiceps auritus*		Monitor
Lesser goldfinch	*Carduelis psaltria*		Monitor
Lewis's woodpecker[(b)]	*Melanerpes lewis*		Candidate
Loggerhead shrike	*Lanius ludovicianus*	Species of concern	Candidate
Long-billed curlew	*Numenius americanus*		Monitor
Merlin	*Falco columbarius*		Candidate
Northern goshawk[(b)]	*Accipter gentilis*	Species of concern	Candidate
Olive-sided flycatcher	*Contopus cooperi*	Species of concern	Not Listed
Osprey	*Pandion haliaetus*		Monitor
Peregrine falcon	*Falco peregrinus*	Species of concern	Sensitive
Prairie falcon	*Falco mexicanus*		Monitor
Red-necked grebe[(b)]	*Podiceps grisegena*		Monitor
Sage sparrow	*Amphispiza belli*		Candidate

Table B-6. Hanford Site Threatened, Endangered, and Other Special Status Species. (4 sheets)

Common Name	Scientific Name	Status	
		Federal	State
Sage thrasher	*Oreoscoptes montanus*		Candidate
Sandhill crane	*Grus canadensis*		Endangered
Snowy owl	*Nyctea scandiaca*		Monitor
Swainson's hawk	*Buteo swainsoni*		Monitor
Turkey vulture[b]	*Cathartes aura*		Monitor
Western bluebird	*Sialia mexicana*		Monitor
Western grebe	*Aechmophorus occidentalis*		Candidate
MAMMALS			
Badger	*Taxidea taxus*		Monitor
Black-tailed jackrabbit	*Lepus californicus*		Candidate
Long-legged myotis	*Myotis volans*	Species of concern	Monitor
Merriam's shrew	*Sorex merriami*		Candidate
Northern grasshopper mouse	*Onychomys leucogaster*		Monitor
Pallid bat	*Antrozous pallidus*		Monitor
Sagebrush vole	*Lagurus curtatus*		Monitor
Small-footed myotis	*Myotis leibii*	Species of concern	Monitor
Townsend's ground squirrel	*Spermophilus townsendii*	Species of concern	Candidate
Washington ground squirrel[b]	*Spermophilus washingtoni*	Candidate	Candidate
Western pipistrelle	*Pipistrellus hesperus*		Monitor
White-tailed jackrabbit	*Lepus townsendii*		Candidate

NOTES:
[a] Probable but not observed on the Hanford Site.
[b] Reported but seldom seen on the Hanford Site.
[c] Protected as an Evolutionarily Significant Unit for the upper Columbia River.
[d] Protected as an Evolutionarily Significant Unit for the middle Columbia River.
[e] Removed from the list of threatened wildlife in the lower 48 states effective August 8, 2007 (72 FR 37346).

Federal:
Candidate: Current information indicates the probable appropriateness of listing as endangered or threatened.
Endangered: In danger of extinction throughout all or a significant portion of its range.
Species of Concern: Conservation standing is of concern, but status information is still needed (not published in the *Federal Register*).
Threatened: Likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

State:
Candidate: Current information indicates the probable appropriateness of listing as endangered or threatened.
Endangered: In danger of becoming extinct or extirpated from Washington State within the foreseeable future if factors contributing to its decline continue.
Review Group 1: Of potential concern; additional fieldwork is needed before a status can be assigned.
Review Group 2: Of potential concern; unresolved taxonomic questions.
Sensitive: Vulnerable or declining and could become endangered or threatened in Washington State without active management or removal of threats.
Threatened: Likely to become endangered in Washington State within the foreseeable future if factors contributing to its decline, habitat degradation, or loss are allowed to continue.
Watch: More abundant and/or less threatened than previously assumed, but still of interest to the state.
Monitor: Of interest to the state.

Source: PNNL-19455.

Table B-7. Washington State Designated Noxious Weeds Potentially Occurring on the Hanford Site.

Scientific Name	Common Name	High Priority	Class
Sorghum halepense	Johnsongrass		A
Alhagi psedalhagi (= A. maurorum)	Camelthorn		B
Acroptilon repens	Russian knapweed	X	B
Carduus acanthoides	Plumeless thistle		B
Cenchrus longispinus	Longspine sandbur		B
Centaurea diffusa	Diffuse knapweed	X	B
Centaurea maculosa (= C. biebersteinii)	Spotted knapweed	X	B
Centaurea solstitialis	Yellow starthistle	X	B
Chondrilla juncea	Rush skeletonweed	X	B
Cyperus esculentus	Yellow nutsedge		B
Lepidium latifolium	Perennial pepperweed		B
Linaria genistifolia dalmatica	Dalmation toadflax	X	B
Lythrum salicaria	Purple loosestrife	X	B
Myriophyllum spicatum	Eurasian water milfoil		B
Sonchus arvensis	Perennial sowthistle		B
Sphaerophysa salsula	Swainsonpea		B
Agropyron repens	Quackgrass		C
Cardaria draba	Hoary cress		C
Cirsium arvense	Canada thistle		C
Cirsium vulgare	Bull thistle		C
Conium maculatum	Poison hemlock		C
Convolvulus arvensis	Field bindweed		C
Hypericum perforatum	Common St. Johnswort		C
Gypsophila paniculata	Babysbreath	X	C
Kochia scopria	Kochia		C
Linaria vulgaris	Yellow toadflax		C
Secale cereale	Cereal rye		C
Solanum dulcamara	Bitter nightshade		C
Taeniatherum caput-medusae	Medusahead	X	C
Tamarix spp.	Saltcedar	X	C
Tanacetum vulgare	Common tansy		C
Tribulus terrestis	Puncturevine		C
Verbascum thapsus	Common mullein		C
Xanthium spinosum	Spiny cocklebur		C

Class A species are non-native with limited distribution in the state. Eradication of all Class A noxious weeds is required by law. Class B species are non-native with limited distribution in the state. Class B species are designated for control and preventing new infestations is a high priority. Class C species are already widespread in the state or are of special interest to the agricultural industry.

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APPENDIX C

HANFORD SITE VEGETATION MAPS

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Figure C-1. Vegetation/Land Coverage Map for the 100-B/C Area, Hanford Site, Washington, during 2006.

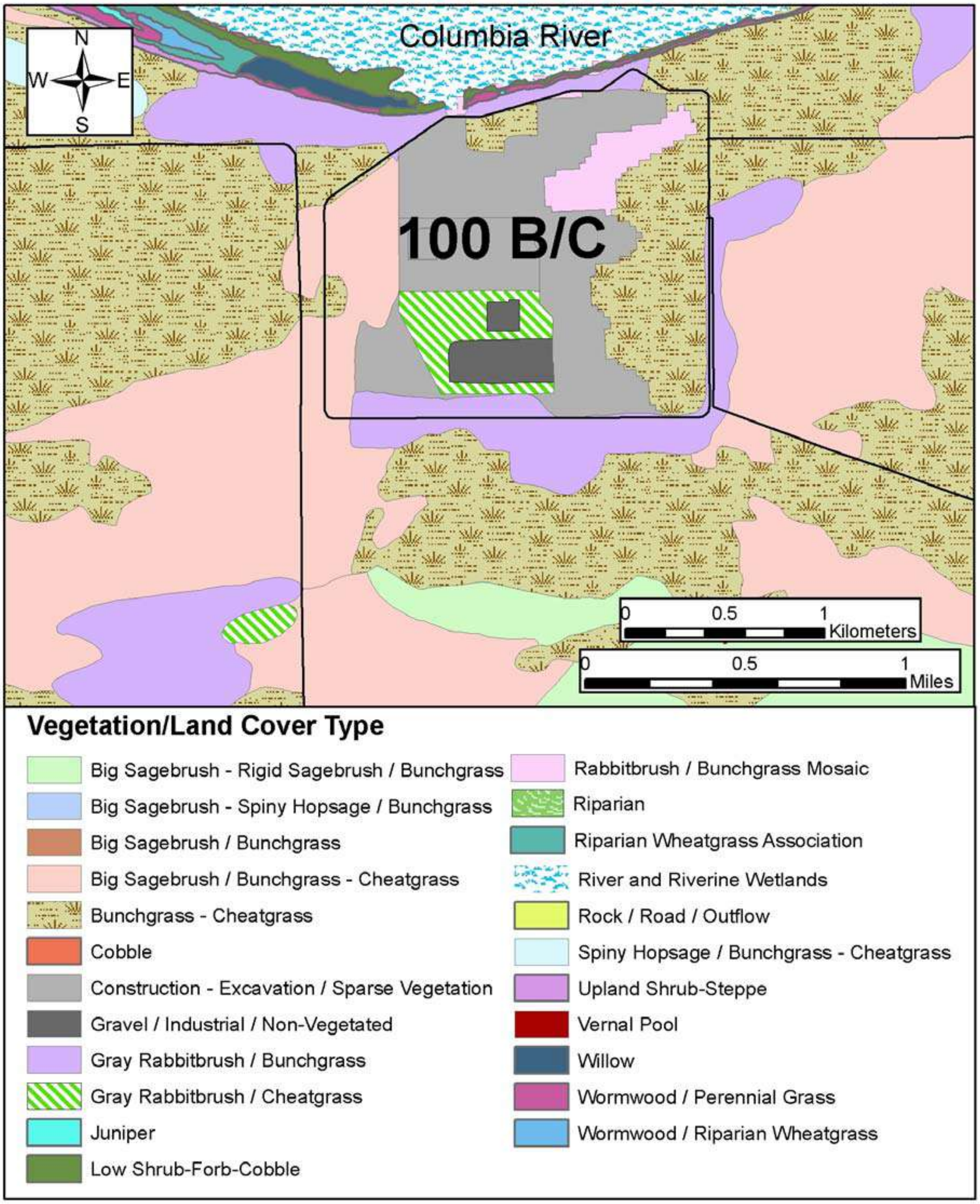


Figure C-2. Vegetation/Land Coverage Map for the 100-D Area, Hanford Site, Washington, during 2006.

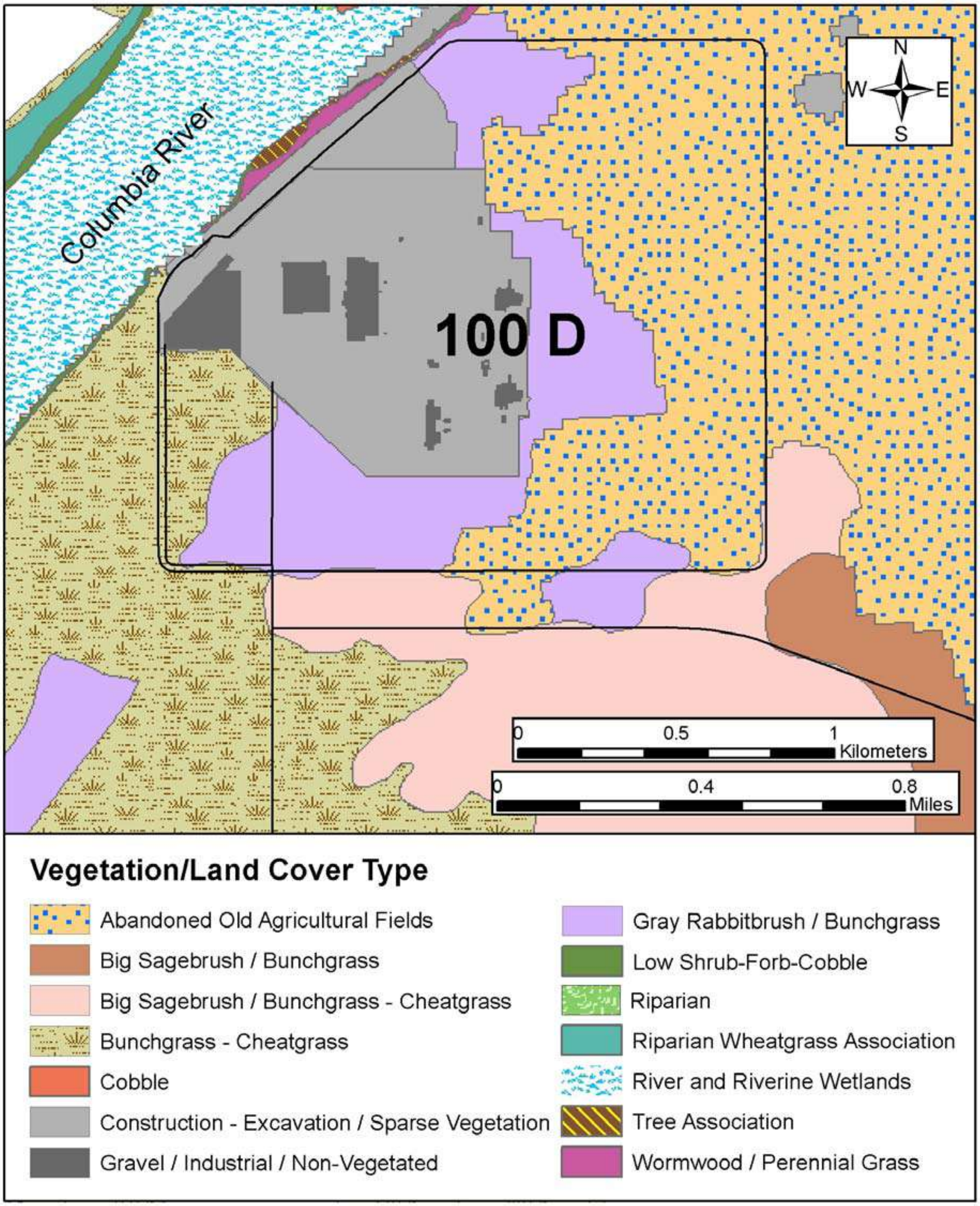


Figure C-3. Vegetation/Land Coverage Map for the White Bluffs Boat Launch Vicinity, Hanford Site, Washington, during 2006.

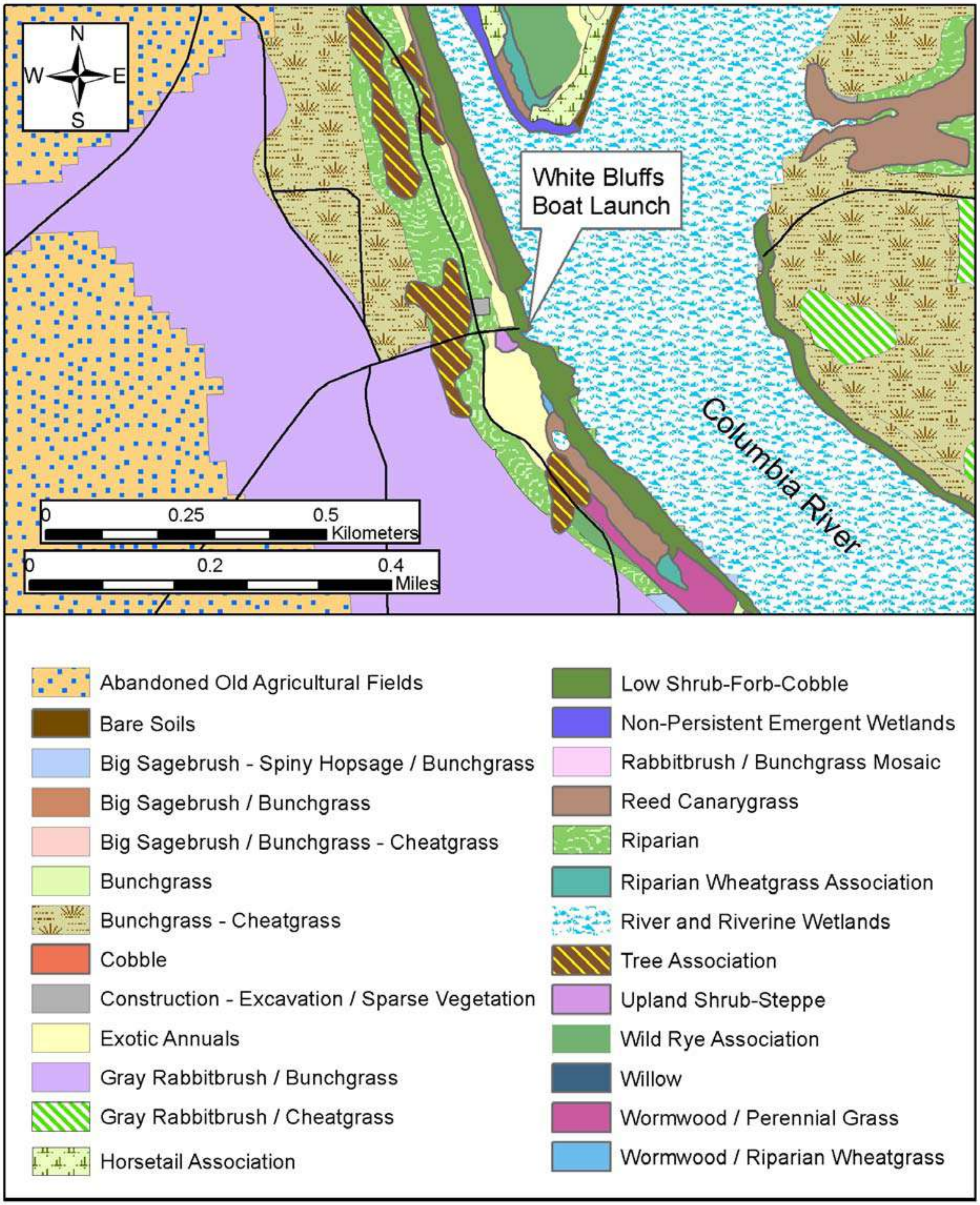


Figure C-4. Vegetation/Land Coverage Map for the 100-F Area, Hanford Site, Washington, during 2006.

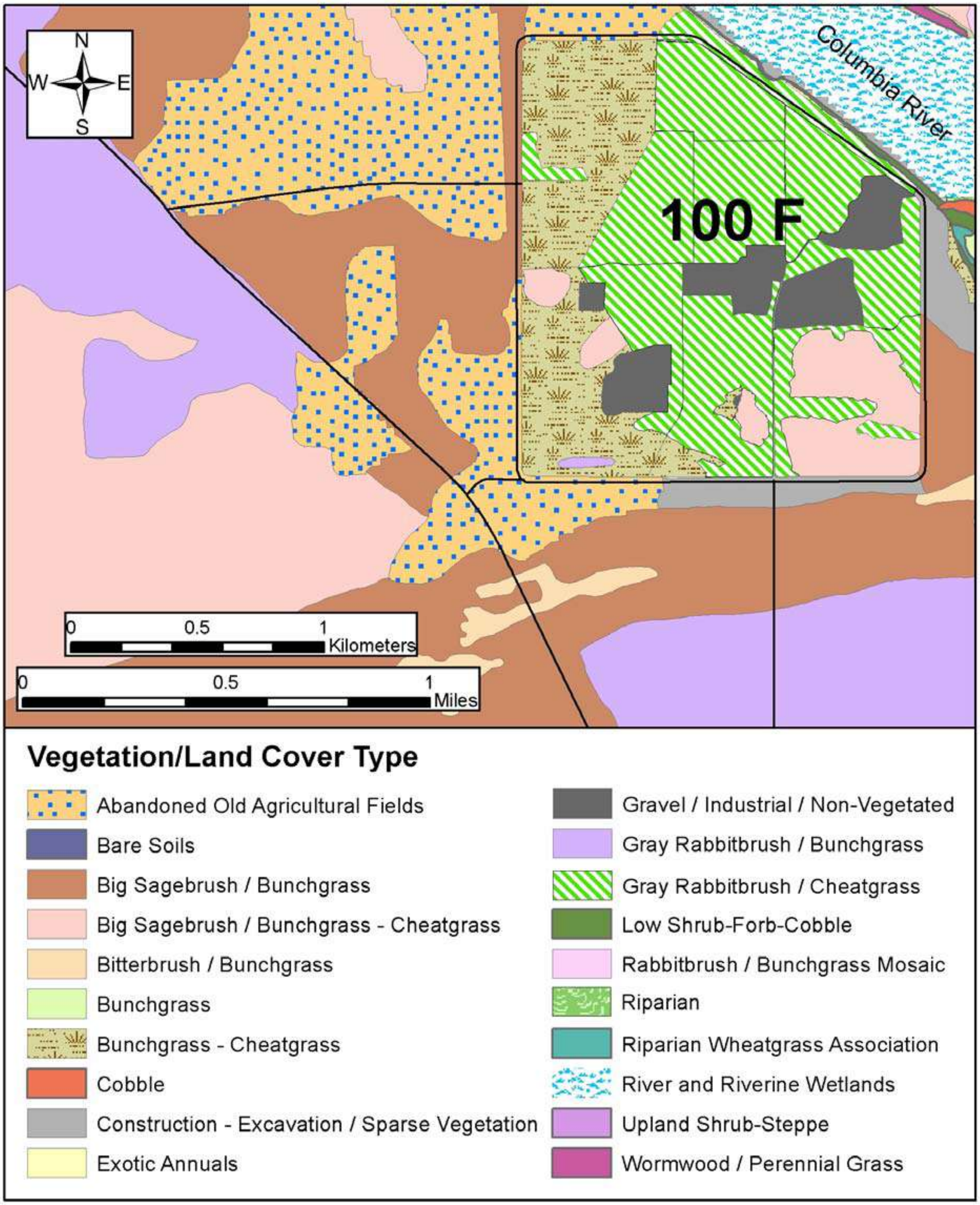


Figure C-5. Vegetation/Land Coverage Map for the 100-H Area, Hanford Site, Washington, during 2006.

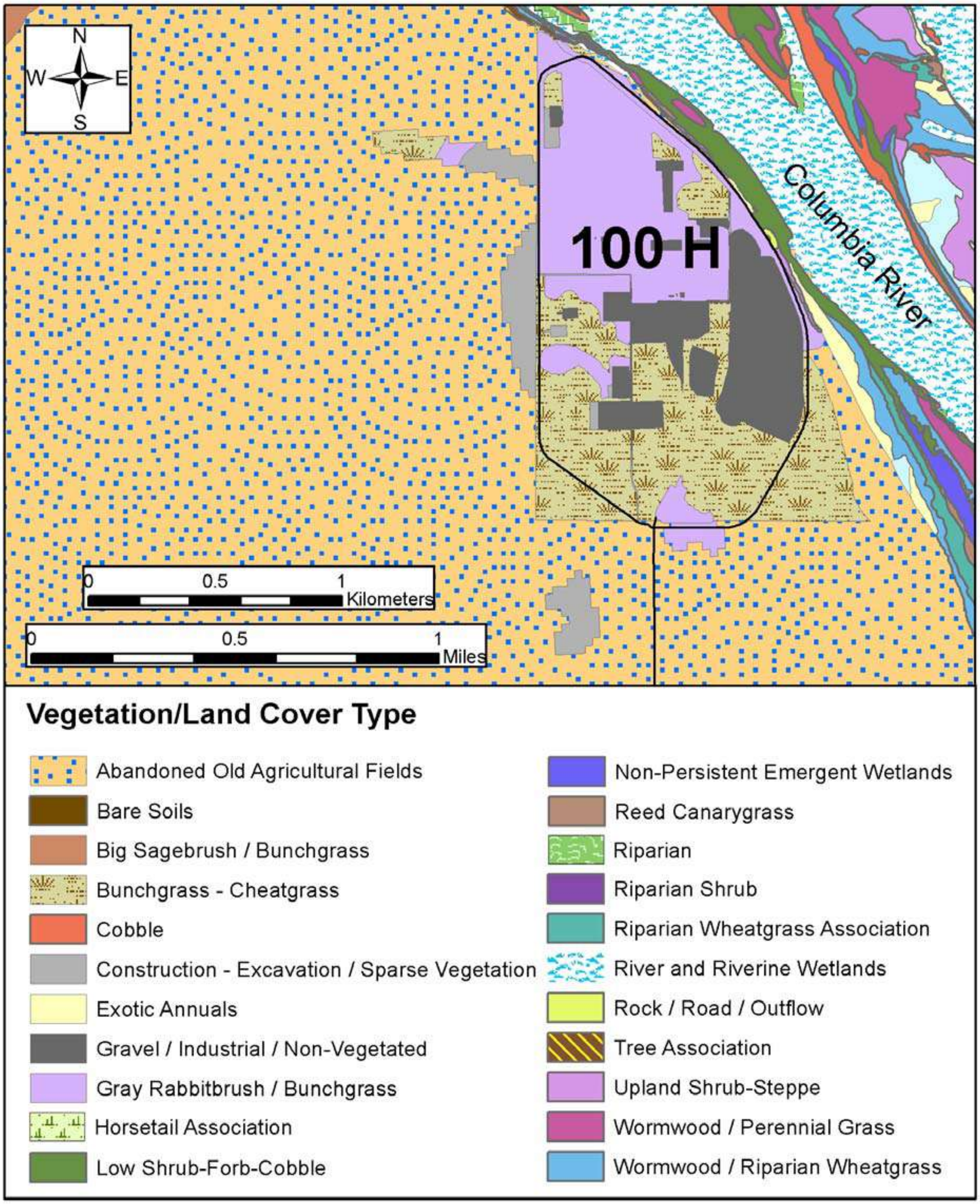


Figure C-6. Vegetation/Land Coverage Map for the 100-K Area, Hanford Site, Washington, during 2006.

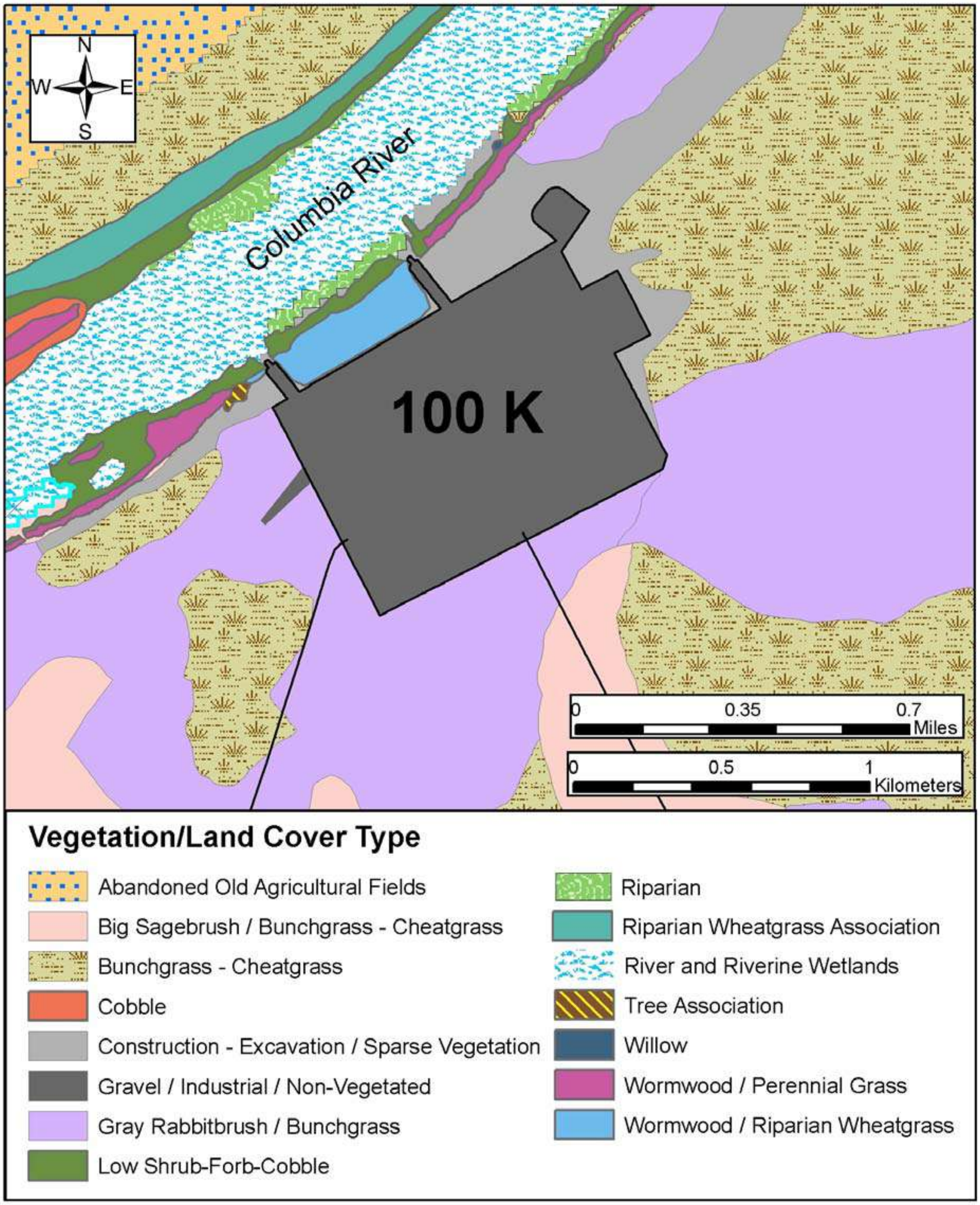


Figure C-7. Vegetation/Land Coverage Map for the 100-N Area, Hanford Site, Washington, during 2006.

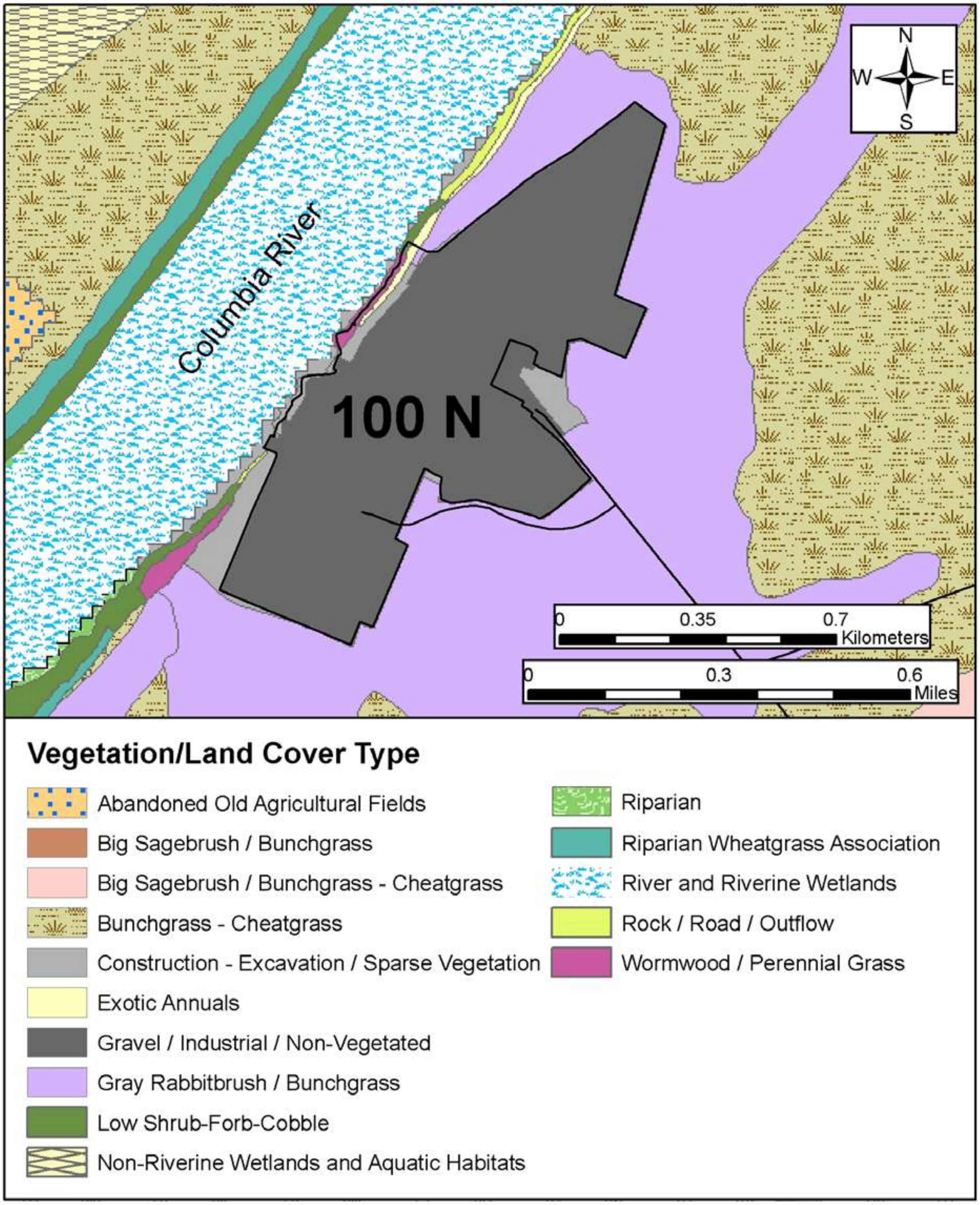


Figure C-8. Vegetation/Land Coverage Map for the Hanford Town Site Vicinity, Hanford Site, Washington, during 2006.

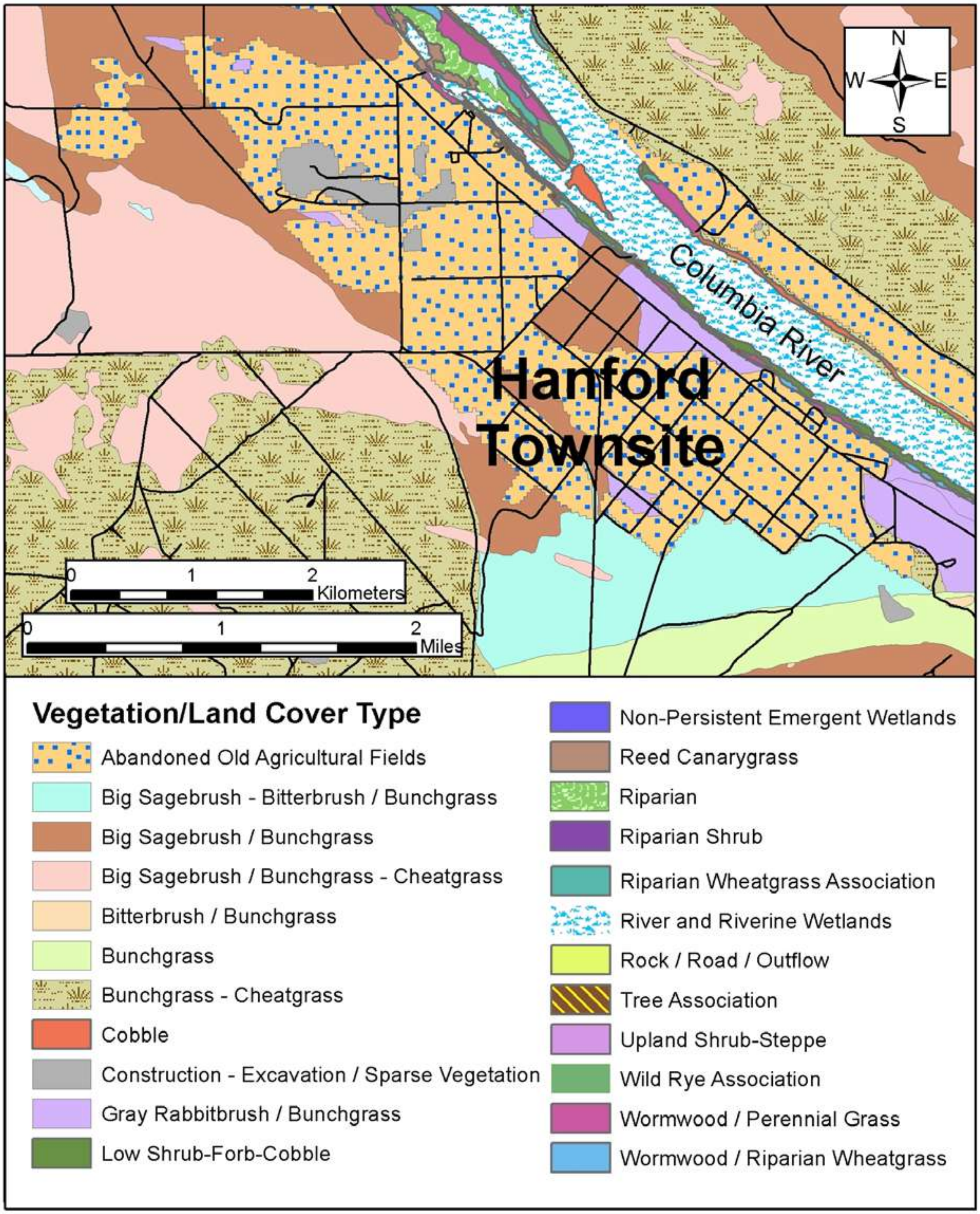


Figure C-9. Vegetation/Land Coverage Map for the 300 Area, Hanford Site, Washington, during 2006.

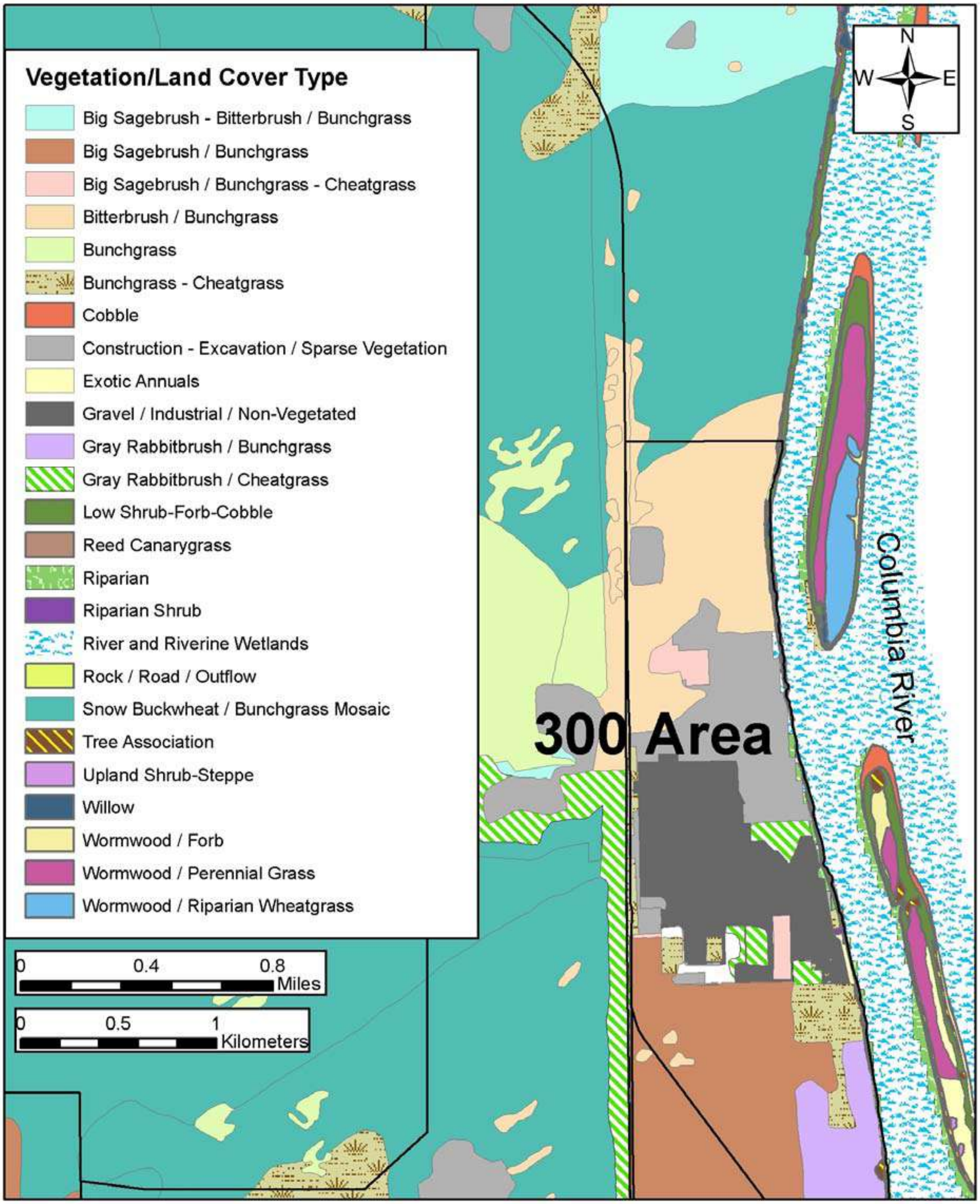


Figure C-10. Vegetation/Land Coverage Map for the 200 East Area, Hanford Site, Washington, during 2006.

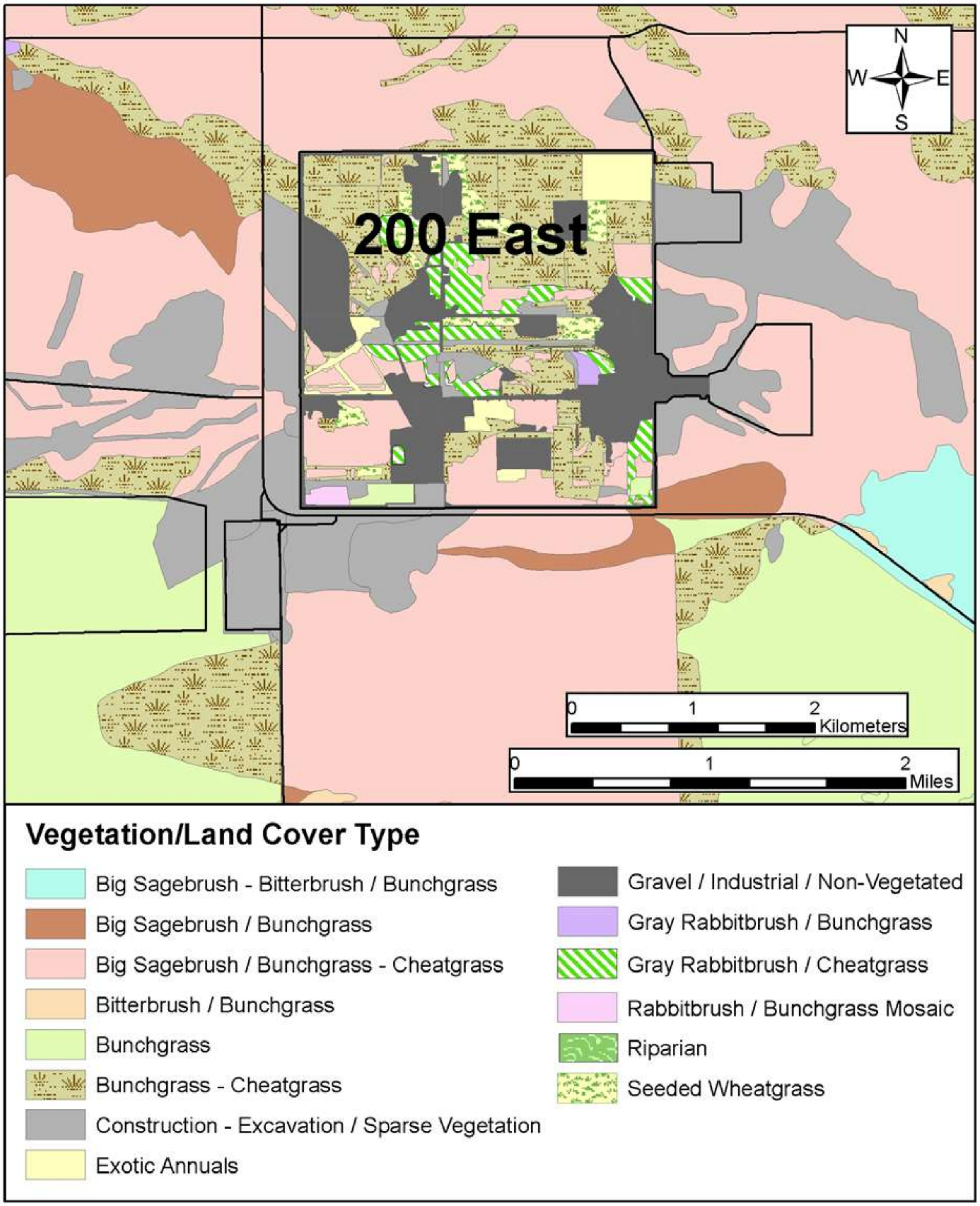
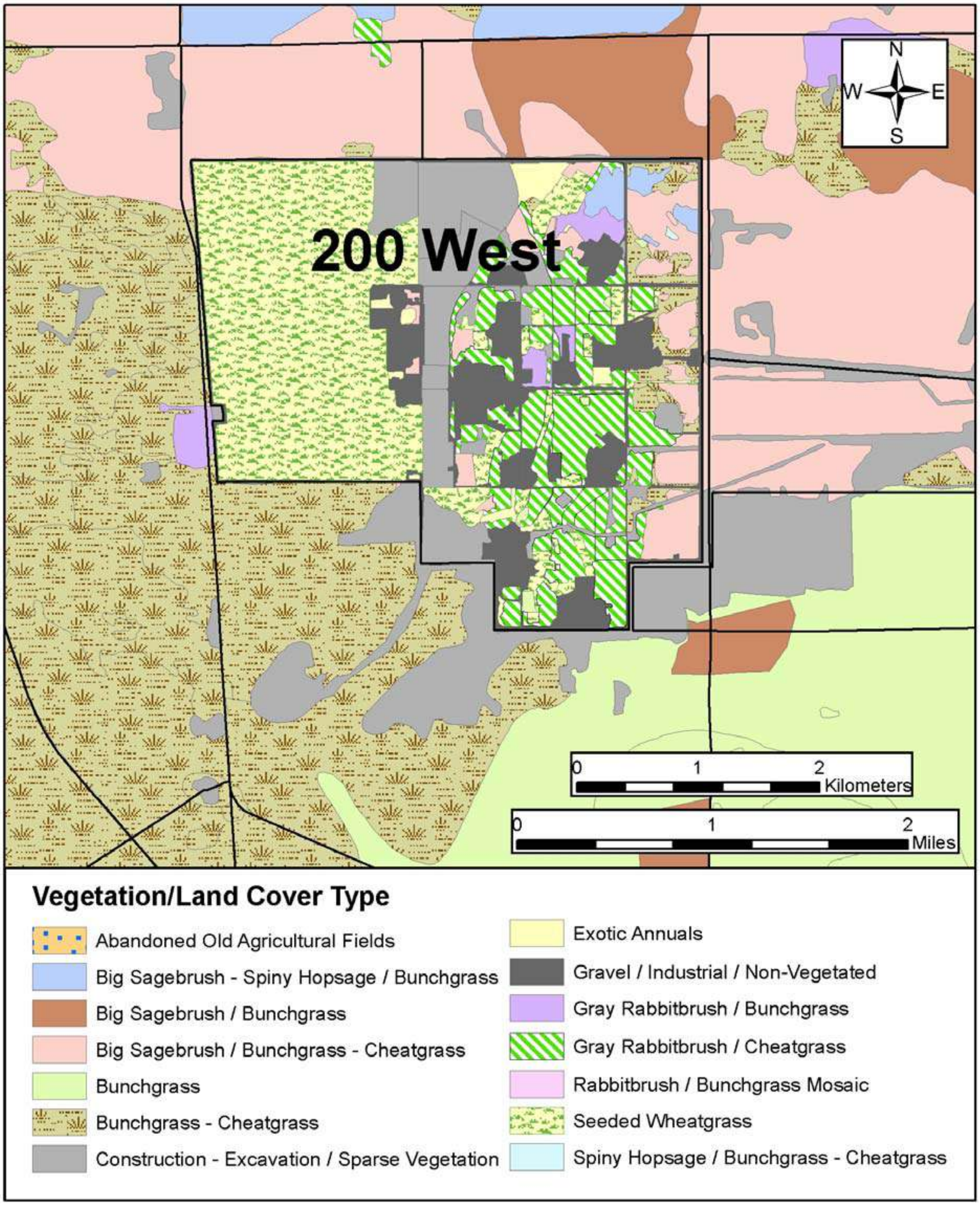


Figure C-11. Vegetation/Land Coverage Map for the 200 West Area, Hanford Site, Washington, during 2006.



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