Appendix D: Hanford's Biological Resources: Geographic Information System-Based Resource Maps, Species of Concern Data Tables, and Their Technical Basis

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Hanford's Biological Resources: Geographic Information System-Based Resource Maps, Species of Concern Data Tables, and Their Technical Basis

This appendix provides detailed information about Hanford's biological resources. The best available data were used to prepare resource descriptions and to conduct data analyses. Resource data are depicted in two main ways: Geographic Information System (GIS)-based map layers that spatially depict resource occurrence and tabular information (principally associated with species of concern data). Keep in mind that resource maps can change at any time. See www.pnl/ecology/ecosystem for the most current maps.

These data represent a snapshot in time, and moreover, the degree of data accuracy differs across location and taxa; for example, although about 10% of the upland areas of the Hanford Site have been surveyed for rare plants, survey intensity varied across this area (Caplow and Beck 1996). Throughout Appendix D, there has been an attempt to identify missing data and assess the accuracy of available data. This information can be used to set priorities for future biological diversity inventory needs at the Hanford Site. For now, data gaps and the degree of data reliability must be accounted for when using and interpreting the available data as a basis for management decisions.

The information presented in this Appendix concentrates on Hanford habitats, plant communities, and species of concern. The presentation begins, however, with a brief description of the relevance of Hanford's relationship to the Columbia Basin Ecoregion and the availability of data to determine the significance of Hanford's role within this ecoregion.

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D.1 Columbia Basin Ecoregion

The Hanford Site is located within the Columbia Basin Ecoregion. The boundaries of this ecoregion, and the character and condition of the natural resources contained therein, provide the relevant context for assessing management prescriptions affecting Hanford's biological resources. These boundaries are important because an ecosystem management approach requires that ecological (versus administrative) boundaries be used when identifying biological resources, their relative importance, and appropriate management goals and objectives.

To provide the ecological context for Hanford's biological resources, information on the ecoregion's current land cover, potential species diversity, and ownership/protection status is needed. At this level of regional analysis, use of satellite imagery is necessary to gain information about land cover at large geographic scales. The imagery is classified into corresponding land cover classes and depicted in a GIS-based map layer. Three sources of satellite imagery data were evaluated for their usefulness in defining Hanford's regional ecological context: Washington Department of Fish and Wildlife data that covered only a portion of eastern Washington, Interior Columbia Basin Ecosystem Management Project (ICBEMP) data for the entire ecoregion (only in part based on satellite imagery), and Washington Gap Analysis Project data for Washington.[1] There are advantages and disadvantages with each of the data sets.

The ICBEMP data were developed to support a project whose coverage was greater than the Columbia Basin Ecoregion. The satellite imagery data, collected in 1990, was modified by the use of successional models and other factors. The mapping unit size is crude and cover class delineation fairly broad. Besides current land cover information, the available ICBEMP data also included historic land cover data (i.e., pre-European).

The Washington State Gap Analysis Project, as part of a nationwide program administered by the U.S. Geological Survey's Biological Resources Division, has mapped existing land cover (Cassidy et al. 1997) for Washington State and breeding distributions of all terrestrial vertebrates. The information was used to identify ecosystems, species, and areas having high vertebrate diversity and that lack representation in the current network of reserves managed either entirely, or in part, for biodiversity.

The conclusions and management implications from the Washington Gap Analysis Project serve to focus regional concerns on steppe zones in the state and demonstrate the regional importance of Hanford lands to biological resource conservation. The three Washington vegetation zones with highest Conservation Priority Indices (CPIs) are located in the steppe, and seven of nine zones with high or moderately high CPIs are in steppe zones. The section on Conclusions and Management Implications of the Washington Gap Final Report (Cassidy et al. 1997) states that, "The buffer areas around Hanford that are currently managed as refuges are the Saddle Mountain Unit, the Fitzner/Eberhardt Arid Lands Ecology Reserve Unit, and the Wahluke Unit. These three reserves combined comprise 35% of all Status 1 and Status 2 lands in the Columbia Basin, and their removal from the reserve system (which is under consideration) would have a considerable negative impact on the conservation status of the Columbia Basin and on most Basin-dependent species."

As better GIS data become available, use and interpretation will be improved. The data, whether its coverage is state or region wide, will hopefully enable the following determinations:

- extent of a particular cover type present state-/region-wide (as compared to prehistoric levels)
- percentage of the cover types state/region/wide that Hanford possesses
- landscape-level estimates of fragmentation, block sizes, and potential wildlife movement corridors
- centers of potential high native biodiversity and their protection status.

Appendix C contains an analysis of the available regional data (i.e., the WDFW and ICBEMP data). The ICBEMP data enabled a comparison of historic and current land cover class data.

[1] Gap analysis is a geographical approach to the protection of biodiversity that matches predictions of habitat association and distribution for many different species with the distribution of protected areas to assess where there are "gaps" in the protection of biodiversity (Scott et al. 1993). The Gap Analysis Project is operated out of the Washington Cooperative Fish and Wildlife Research Unit at the University of Washington. The project involves a number of agency, university, and institution cooperators.

D.2 Hanford Biological Resources

This section describes Hanford's biological resources in terms of land cover classes, habitat-based resources, plant communities, administrative areas, and species of concern. The resource information is grouped into these categories to facilitate presentation of data and associated technical basis concerning their derivation and use.

D.2.1 Land Cover Classes

The starting point for deriving most GIS-based map layers in the BRMaP is a land cover map. A land cover map identifies what actually exists on the surface at the time data are collected. The map is a combination of vegetation associations, land forms, and human structures and residuals. It differs from a potential vegetation map in that it portrays what currently exists and not what might be expected in the future. Potential vegetation, however, is still a useful piece of information for biological resource management planning; therefore, where possible, this information layer and others are retained in the GIS data base in a manner that enables different geographic areas to be assigned multiple attributes.

D.2.1.1 Hanford Site Land Cover Classes

The Hanford land cover class map (Figure D.1) is a composite map of information drawn from 1987 and 1991 aerial photographs and field survey information and mapping obtained from The Nature Conservancy (TNC) of Washington.[2] The 1991 photographs were obtained from the Benton County Land Use Planning Office and, thus, only included the portion of the Hanford Site that falls within the Benton County boundaries. Field assessments and mapping were conducted in 1993 to refine the information obtained from the aerial photographs. TNC surveyed and mapped land cover on the ALE Unit, the Wahluke Unit, and central core of Hanford during 1994, 1995, and 1997. In general, mapping unit resolution for these portions of the cover map is about 0.8 ha.

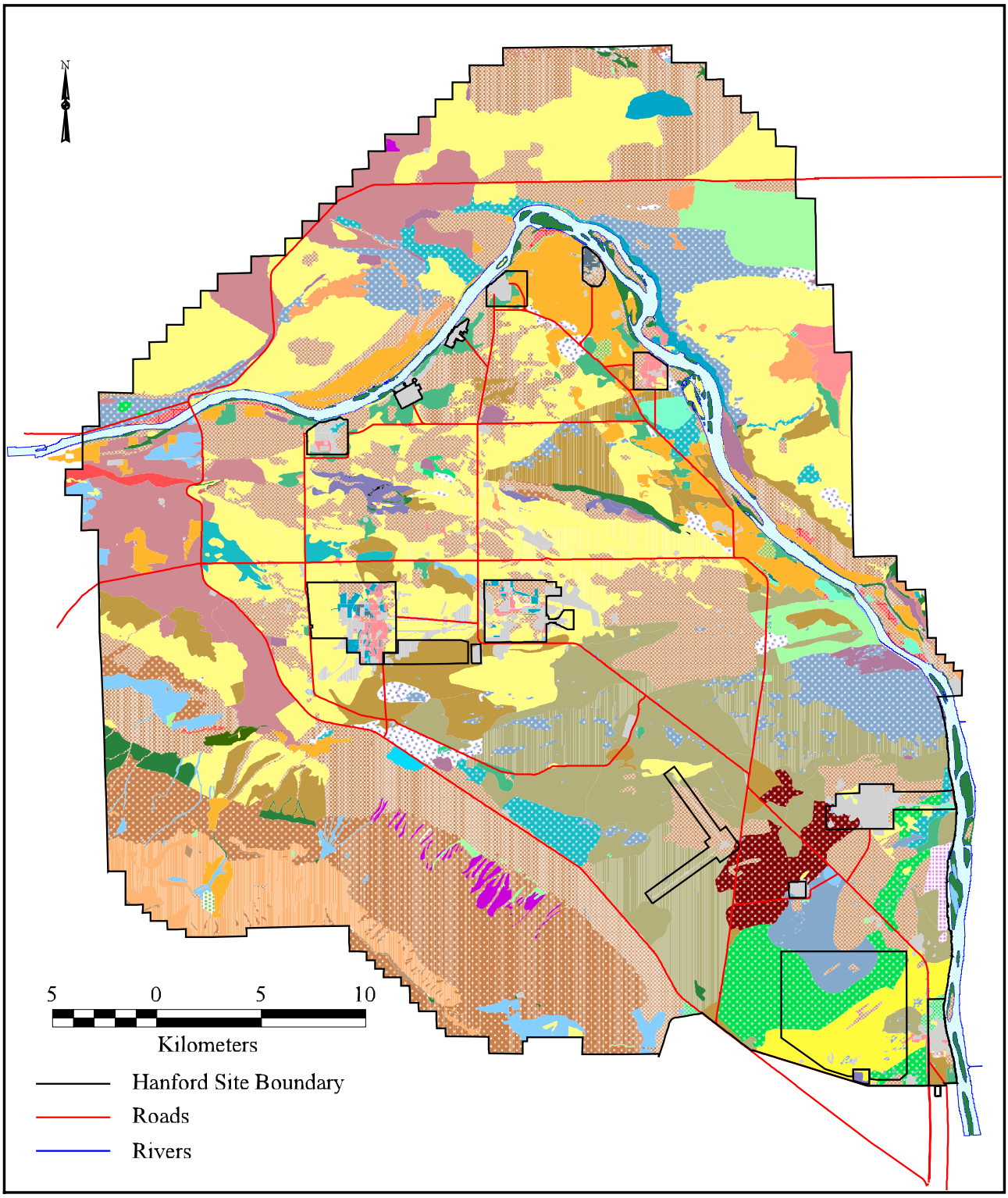
To arrive at the BRMaP classification, the following four attributes of the data were considered important to retain:

1. The identity of individual TNC classes, though combined in many cases to form more inclusive classes within the land cover map, was retained within the GIS data base for use in other resource mapping layers (see below)
2. Where raw data enabled, and class description was similar for each data source, classifications for the ALE Unit, the Wahluke Unit, and central Hanford were standardized
3. Where possible, areas with understories dominated by native bunchgrasses were distinguished from areas dominated by non-native grasses. Also, where possible and relevant, a cover class attempted to include both the dominant shrub(s) and the dominant grass
4. Because much of the central core was mapped as mosaics of two to four cover types, the classification was based on the dominant shrubs and the relative percentage of each cover class in the mapped polygon. The understory component was most often classified as bunchgrasses.

TNC data generally included a finer spatial breakdown in what constituted the dominant grass within areas containing the same dominant shrub(s). To address this and simplify the classification scheme, BRMaP used three conventions:

1. For each dominant shrub class, where both appropriate and possible, areas with a dominant, native grass understory were distinguished in the classification from areas with a dominant, non-native grass understory (e.g., spiny hopsage/bunchgrasses and spiny hopsage/cheatgrass).
2. If data indicated the shrub was associated with only one species of native bunchgrass, the specific species was identified as part of the classification (e.g., black greasewood/Sandberg's bluegrass).

[2] The existing cover class data for each area were provided by TNC, digital data and correspondence, 1995, 1998, 1999); TNC's reports on the biodiversity of Hanford (TNC 1995, 1996, 1998, and 1999) contain data on potential plant community types but not on existing cover classes.



Data Collected: 1994, 1997/The Nature Conservancy
1991, 1999 Pacific Northwest National Laboratory
Map Created: September 1999/Pacific Northwest National Laboratory

Figure D.1 Distribution and Extent of Land Cover Classes Across the Hanford Site (Map)

LEGEND

- Abandoned Old Agricultural Fields
- Alkali Saltgrass - Cheatgrass
- Big Sagebrush - Bitterbrush / Bunchgrass
- Big Sagebrush - Bitterbrush / Needle-and-Thread Grass
- Big Sagebrush - Bitterbrush / Sandberg's Bluegrass
- Big Sagebrush - Rigid Sagebrush / Bunchgrass
- Big Sagebrush - Rock Buckwheat / Bunchgrass
- Big Sagebrush - Spiny Hopsage / Bunchgrass
- Big Sagebrush - Spiny Hopsage / Sandberg's Bluegrass - Cheatgrass
- Big Sagebrush / Bluebunch Wheatgrass
- Big Sagebrush / Bunchgrass
- Big Sagebrush / Needle-and-Thread Grass
- Big Sagebrush / Sand Dropseed
- Big Sagebrush / Sandberg's Bluegrass - Cheatgrass
- Bitterbrush / Bunchgrass
- Bitterbrush / Indian Ricegrass
- Bitterbrush / Needle-and-Thread Grass
- Black Greasewood / Alkali Saltgrass
- Bluebunch Wheatgrass - Needle-and-Thread Grass
- Bluebunch Wheatgrass - Sandberg's Bluegrass
- Bunchgrass - Cheatgrass
- Crested Wheatgrass
- Disturbed
- Gray Rabbitbrush - Snow Buckwheat / Bunchgrass
- Gray Rabbitbrush / Bunchgrass
- Gray Rabbitbrush / Cheatgrass
- Gray Rabbitbrush / Needle-and-Thread Grass
- Gray Rabbitbrush / Sand Dropseed
- Gray Rabbitbrush / Sandberg's Bluegrass - Cheatgrass
- Needle-and-Thread Grass - Indian Ricegrass
- Needle-and-Thread Grass -Sandberg's Bluegrass
- Non-Riverine Wetlands and Associated Deepwater Habitats
- Rabbitbrush / Bunchgrass
- Rigid Sagebrush / Sandberg's Bluegrass
- Riparian
- Riverine Wetlands and Associated Deepwater Habitats
- Sand Dropseed - Sandberg's Bluegrass - Cheatgrass
- Sandberg's Bluegrass - Cheatgrass
- Snow Buckwheat - Bitterbrush / Bunchgrass
- Snow Buckwheat / Bunchgrass
- Snow Buckwheat / Sandberg's Bluegrass - Cheatgrass
- Spiny Hopsage / Sandberg's Bluegrass - Cheatgrass
- Talus
- Threetip Sagebrush / Bunchgrass
- Thymeleaf Buckwheat / Sandberg's Bluegrass
- Vernal Pool
- White Bluffs
- Winterfat / Bunchgrass

Figure D.1 Distribution and Extent of Land Cover Classes Across the Hanford Site (Legend)

3. If the data indicated the shrub may be associated with more than one species of native bunchgrass (generally TNC data), the general classification of bunchgrasses was used (e.g., the spiny hopsage/bunchgrasses class actually consists of areas where understories are dominated by one of three different native bunchgrasses).

Again, as above, the identity of specific TNC map units was retained for use in other data layers, as needed. The BRMaP cover class map uses "rabbitbrush" as a generic category to refer to either species.

As noted above, accurate identification of the understory is limited with aerial photography. Moreover, the central core of Hanford is, in many areas, heterogeneous with respect to both dominant shrub and dominant grass. To address uncertainties about grasses, the grass composition for many areas on the land cover map was identified as bunchgrasses-cheatgrass to indicate the heterogeneity of the understory (i.e., at some locations within these particular land cover classes cheatgrass may predominate in the understory and at other locations a species of native bunchgrass may predominate). Shrub species heterogeneity occurs particularly in areas that are in ecological succession (mostly a result of the 1984 fire). These areas also contain a mosaic pattern of dominant grasses (Downs et al. 1993), and in many cases, areas are mapped as mosaics containing more than one distinguishable cover type.

Previous maps of the site (Downs et al. 1993) included two cover classes that were associated with open/flowing water and the immediately adjacent vegetation (i.e., that vegetation found in close association with permanent or at least seasonally intermittent surface water): water and riparian. The riparian cover class on these earlier maps was associated with both flowing and standing water; however, riparian vegetation is more traditionally associated with just flowing water. BRMaP reclassified the water and riparian cover classes in the following ways as shown in Figure D.1:

- portions of the original water cover class associated with flowing water are now classified as "Riverine Wetlands and Associated Deepwater Habitats"
- portions of the original riparian cover class associated with flowing water are retained as the new "Riparian" cover class
- the remaining areas of standing water and associated vegetation are now classified as "Nonriverine Wetlands and Associated Deepwater Habitats."

This reclassification facilitates comparisons with Washington State Department of Fish and Wildlife and U.S. Fish and Wildlife Service wetland/riparian habitat classifications (see Sections D.2.2.2 and D.2.2.4). The identification of flowing water was based on the water data layer associated with the U.S. Geological Survey's topographic maps.

D.2.1.2 Industrial Areas

As a result of recent environmental restoration and site development activities, the pace of human-related disturbances that alter the cover class characteristics of the land has quickened at Hanford. The future portends the continuation of this trend, at least in certain areas of the site. The industrial areas of Hanford include the 100, 200, 300, 400, and 1100 Areas (see Figure D.2). These areas are shown (unlabeled) on Figure D.1. Because of the potential for rapid alteration of the landscape within these areas, the Ecological Compliance Assessment Project (now the Hanford Biological Resources Laboratory) has mapped changes in the land cover classes for each area annually since 1994.

Figures D.3 through D.11 depict the land cover classes and species of concern sightings within Hanford's industrial areas (except the 1100 Area) as mapped by the Hanford Biological Resources Laboratory's 1995 baseline surveys. Cover classes are essentially the same as used in Figure D.1 with minor exceptions. Areas dominated by Russian thistle are mapped separately from the other disturbance categories (i.e., buildings, parking lots, etc.). The boundaries of individual cover class occurrences were mapped by a Global Positioning System (GPS) to an accuracy of 2 m (6.6 ft). The smallest mapped area was about 0.09 ha (900 m^2).

D.2.2 Habitat-Based Resources

One of DOE-RL's program-wide biological resource management goals is to expand the focus of biological resource management from threatened and endangered species and their critical habitat needs to include a broader array of fish, wildlife, plants, and habitats (see Chapter 2.0). The focus

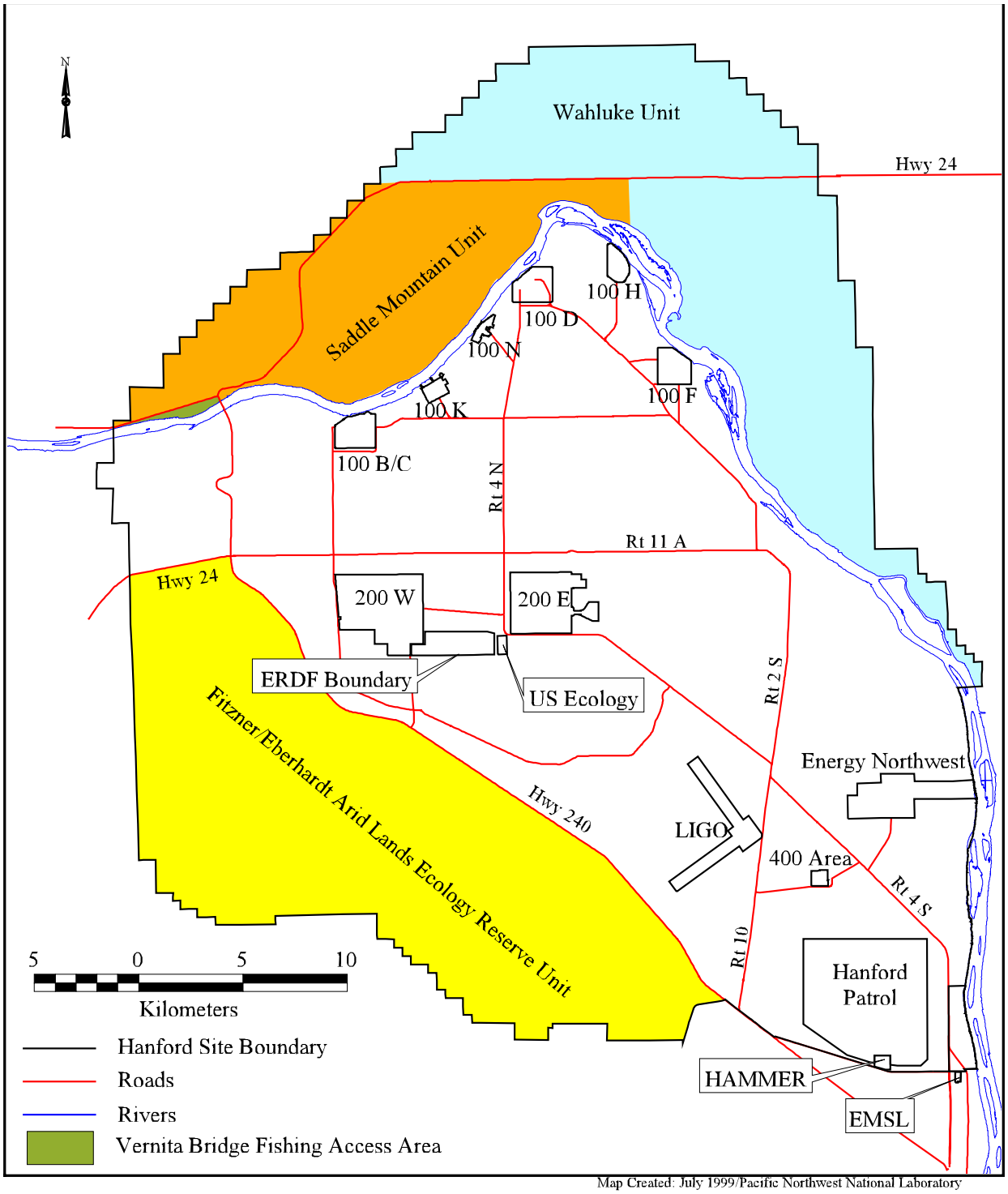
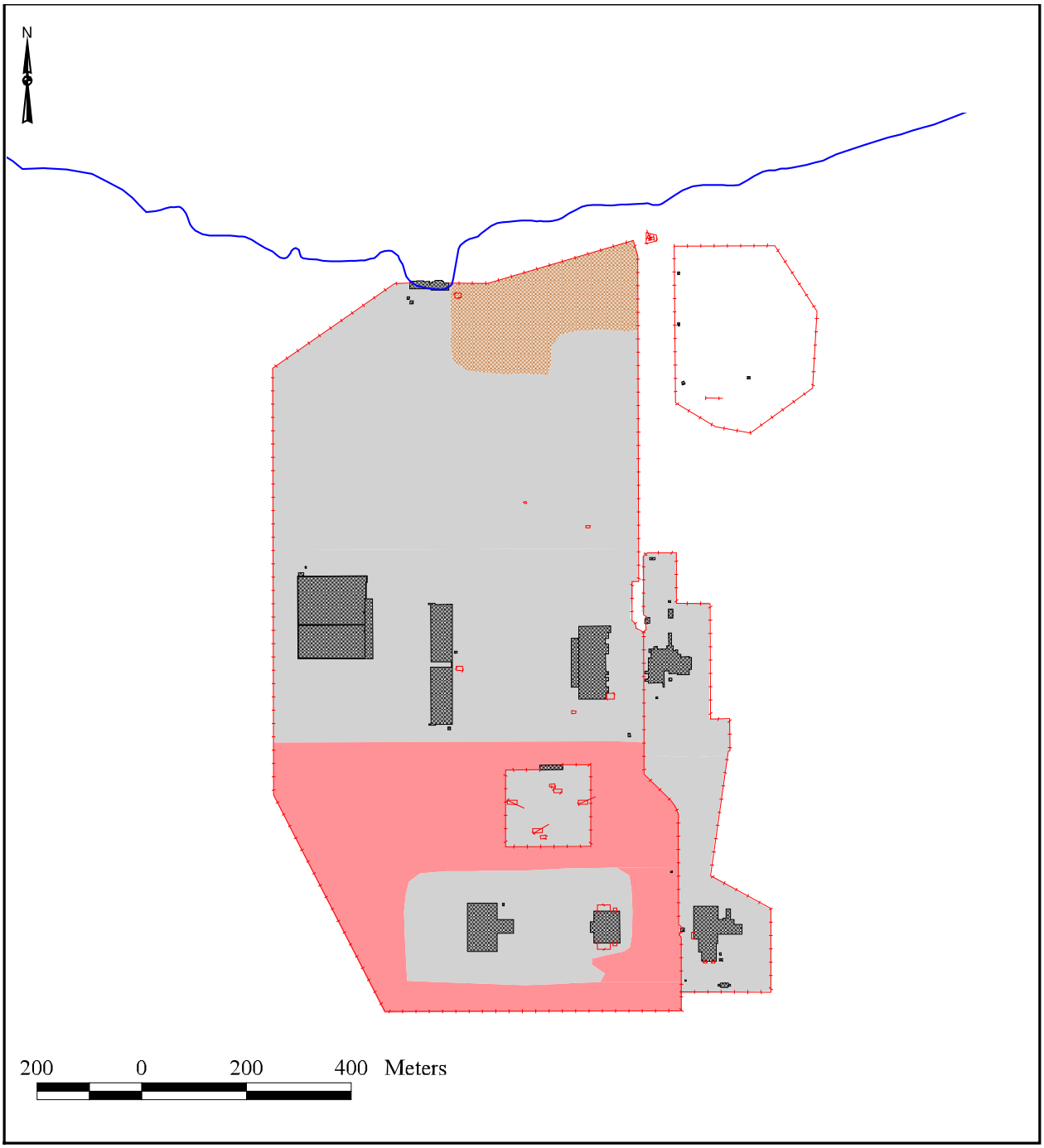


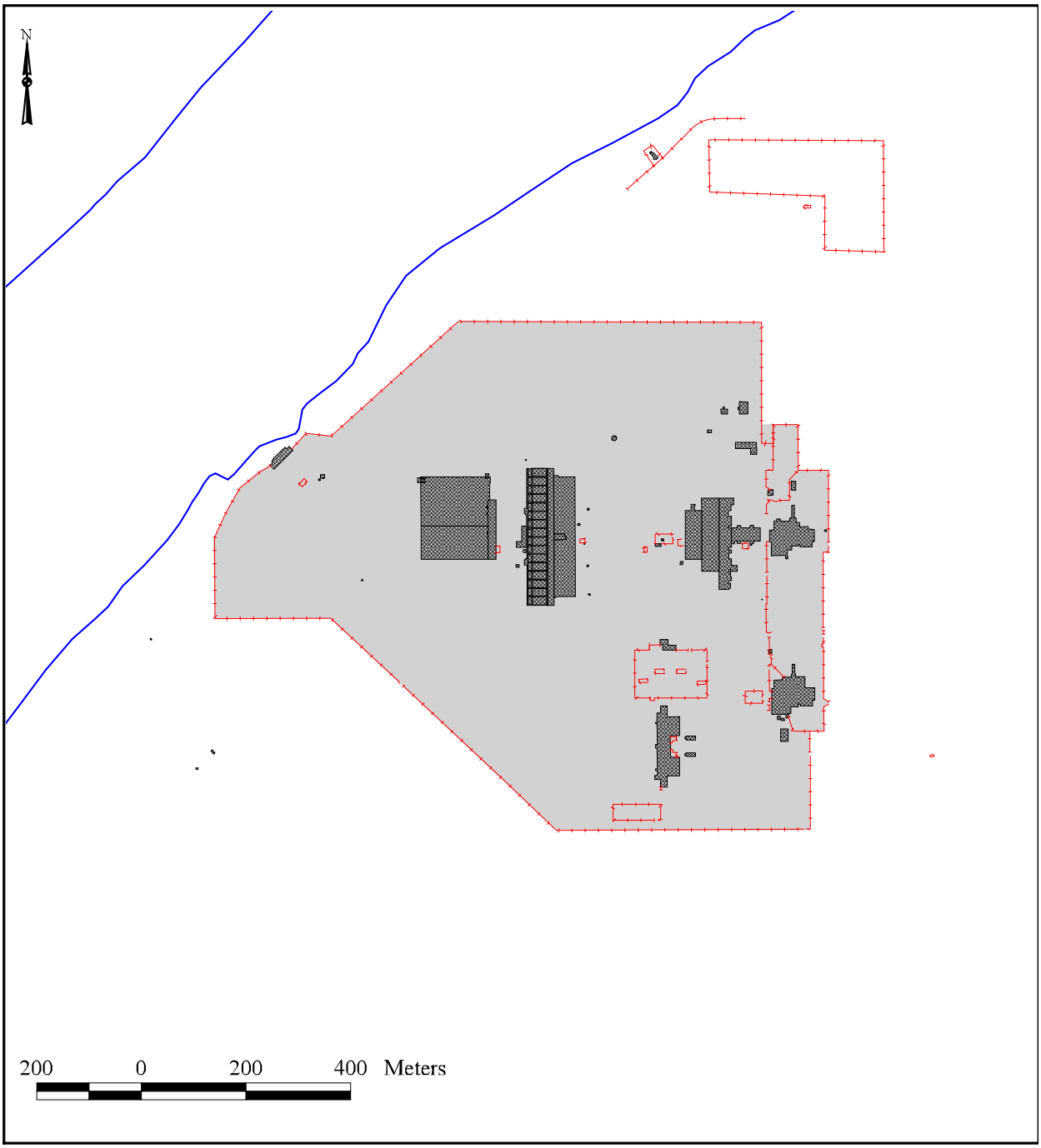
Figure D.2 Hanford Site Facilities and Land Use Areas (ERDF = Environmental Restoration Disposal Facility, LIGO = Laser Interferometer Gravitational-Wave Observatory, HAMMER = Hazardous Materials Management and Emergency Response Training Center, EMSL = Environmental Molecular Sciences Laboratory; *Energy Northwest formerly was the Washington Public Power Supply System)



Disturbed
Gray Rabbitbrush / Cheatgrass
Sandberg's Bluegrass - Cheatgrass

Data Collected: Spring 1999
Map Created: September 1999/Pacific Northwest National Laboratory

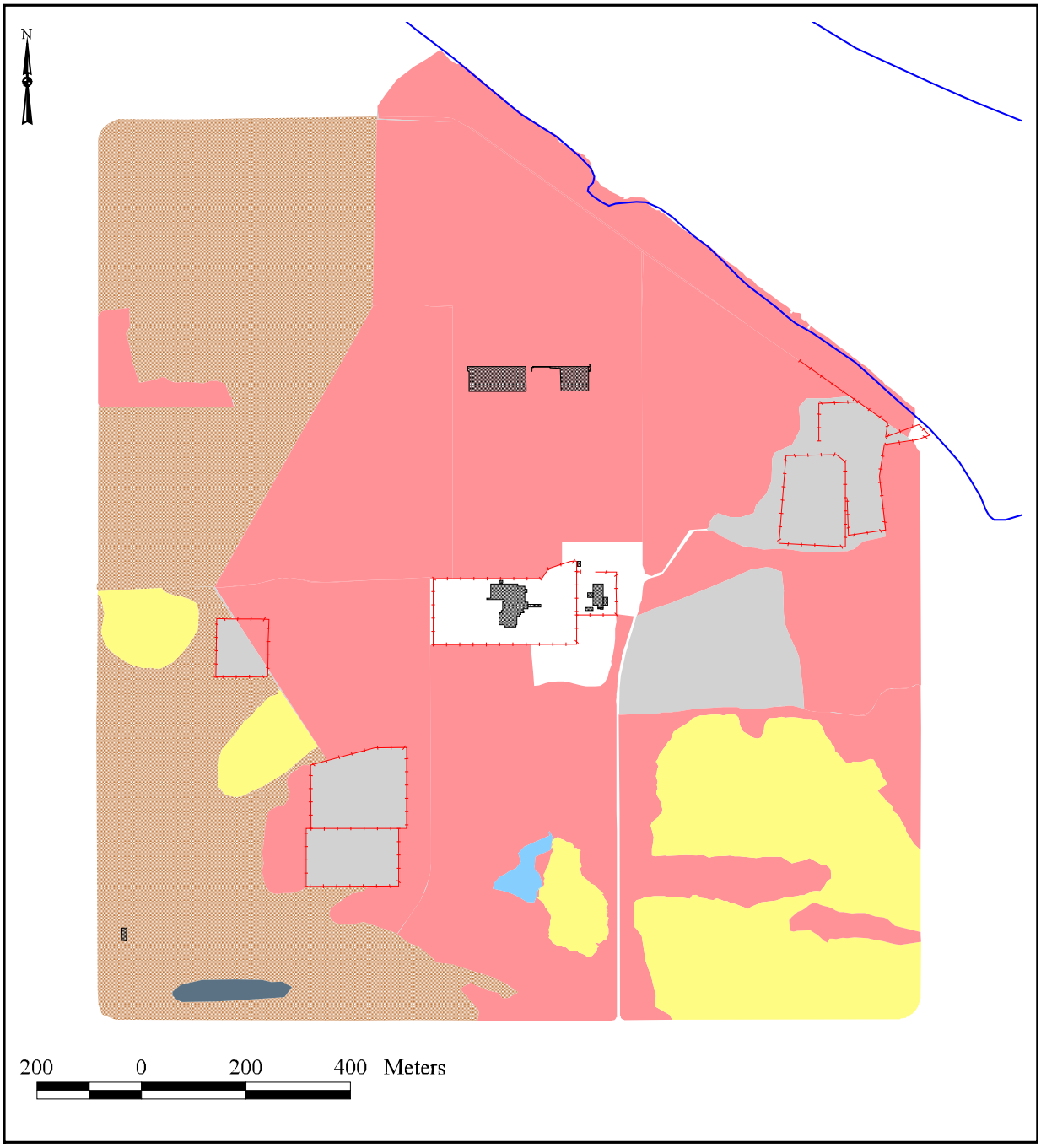
Figure D.3 100 B/C Area Land Cover Classes



Disturbed

Data Collected: Spring 1999
Map Created: September 1999/Pacific Northwest National Laboratory

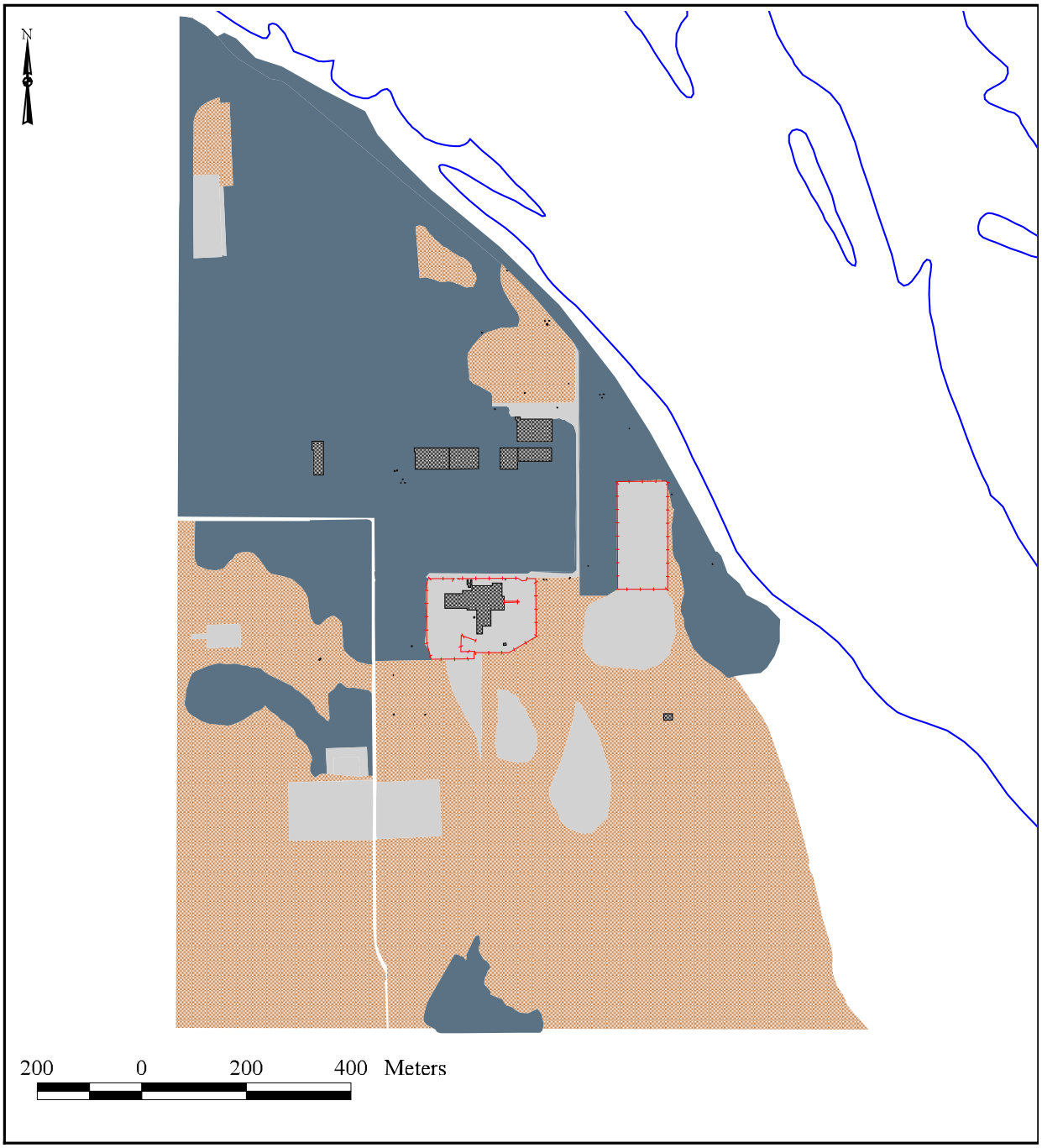
Figure D.4 100 D Area Land Cover Classes



Data Collected: Spring 1999
Map Created: September 1999/Pacific Northwest National Laboratory

- Big Sagebrush / Sandberg's Bluegrass - Cheatgrass
- Bunchgrass - Cheatgrass
- Disturbed
- Gray Rabbitbrush / Bunchgrass
- Gray Rabbitbrush / Cheatgrass
- Sandberg's Bluegrass - Cheatgrass

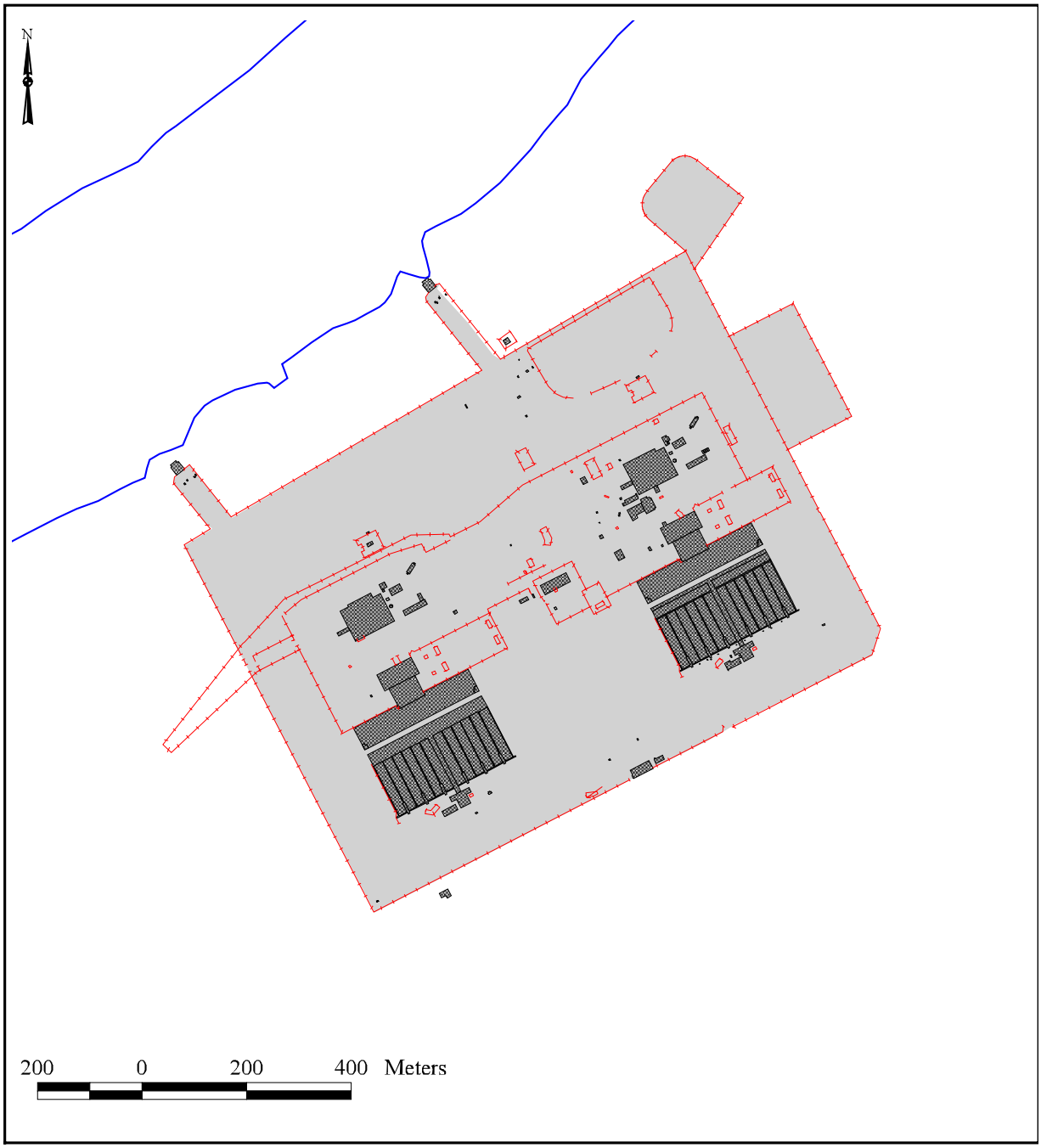
Figure D.5 100 F Area Land Cover Classes



Data Collected: Spring 1999
Map Created: September 1999/Pacific Northwest National Laboratory

Disturbed
Gray Rabbitbrush / Bunchgrass
Sandberg's Bluegrass - Cheatgrass

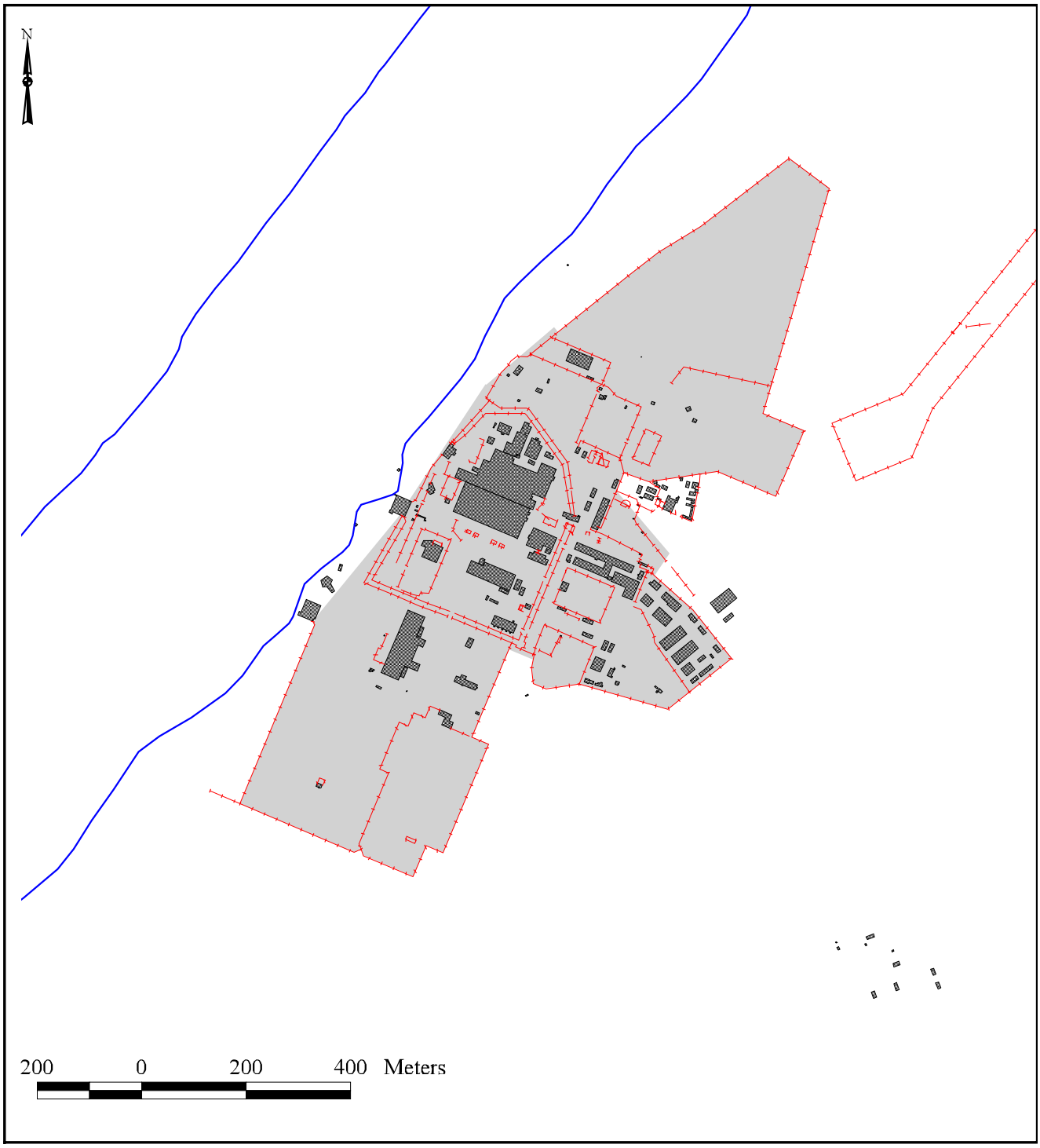
Figure D.6 100 H Area Land Cover Classes



Disturbed

Data Collected: Spring 1999
Map Created: September 1999/Pacific Northwest National Laboratory

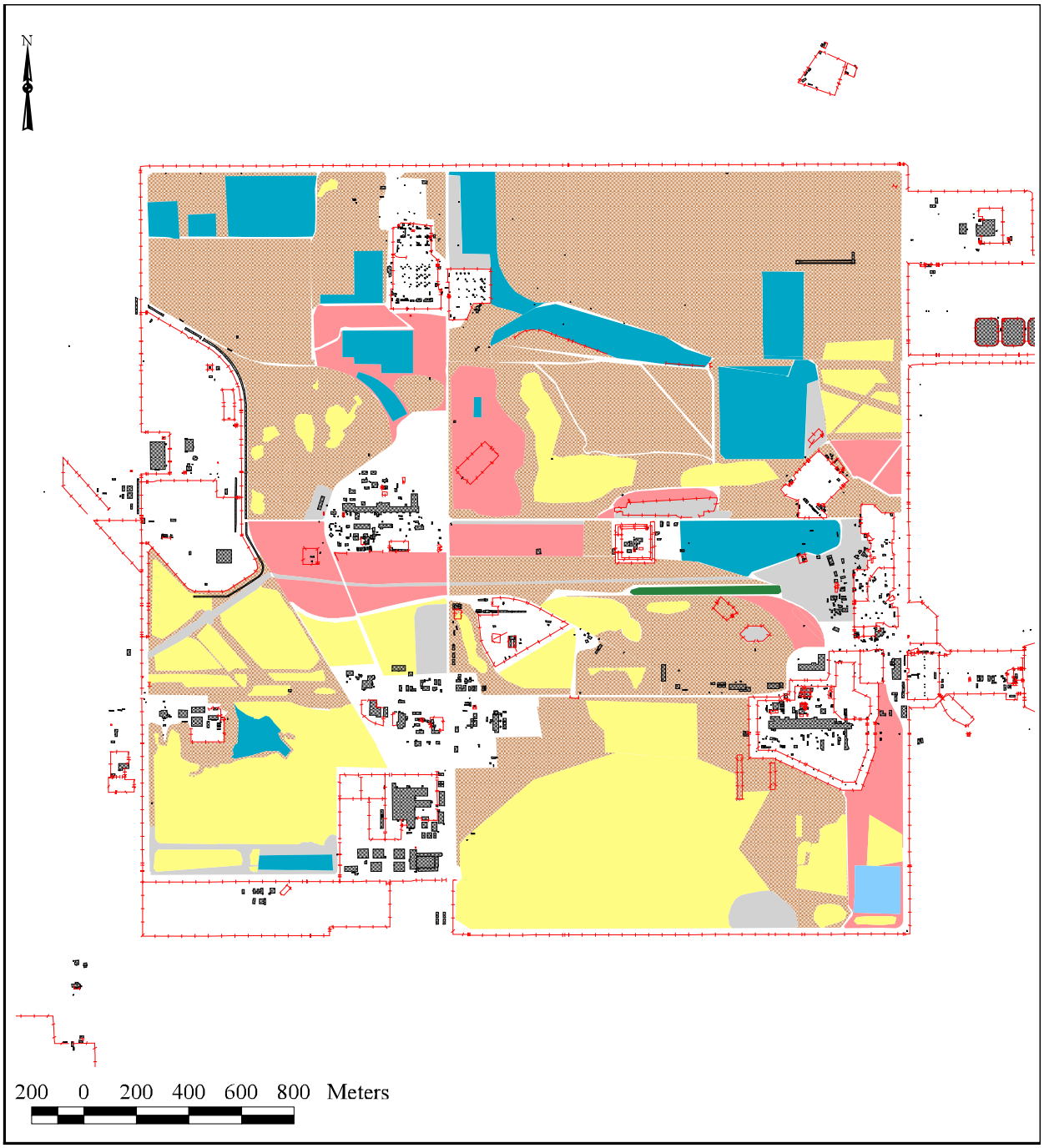
Figure D.7 100 K Area Land Cover Classes



Disturbed

Data Collected: Spring 1999
Map Created: September 1999/Pacific Northwest National Laboratory

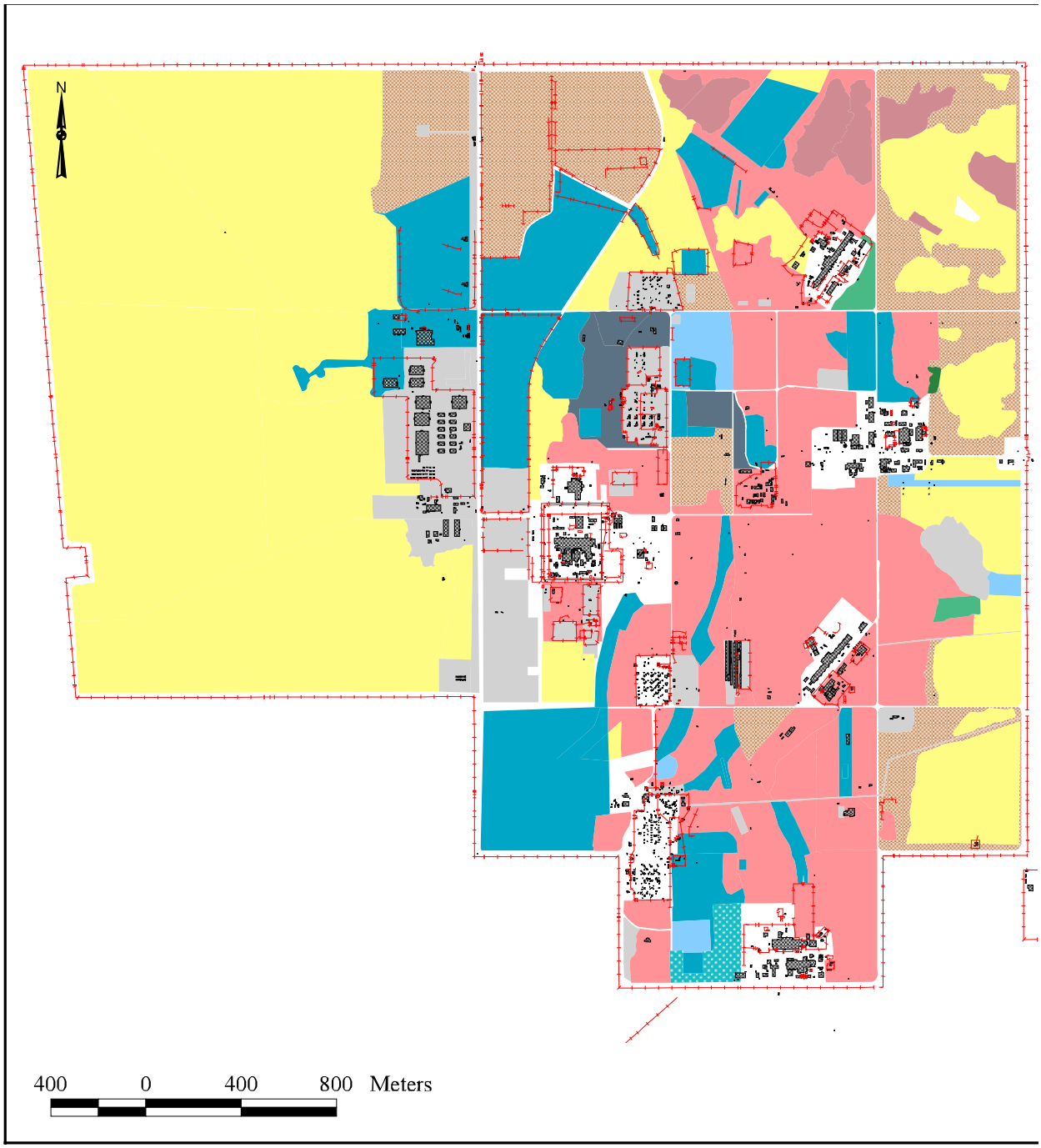
Figure D.8 100 N Area Land Cover Classes



Big Sagebrush / Sandberg's Bluegrass - Cheatgrass
Bunchgrass - Cheatgrass
Crested Wheatgrass
Disturbed
Gray Rabbitbrush / Cheatgrass
Riparian
Sandberg's Bluegrass - Cheatgrass

Data Collected: Spring 1999
Map Created: September 1999/Pacific Northwest National Laboratory

Figure D.9 200 E Area Land Cover Classes



Data Collected: Spring 1999
Map Created: September 1999/Pacific Northwest National Laboratory

- Big Sagebrush - Spiny Hopsage / Sandberg's Bluegrass - Cheatgrass
- Big Sagebrush / Sandberg's Bluegrass - Cheatgrass
- Bunchgrass - Cheatgrass
- Crested Wheatgrass
- Disturbed
- Gray Rabbitbrush - Snow Buckwheat / Bunchgrass
- Gray Rabbitbrush / Bunchgrass
- Gray Rabbitbrush / Cheatgrass
- Gray Rabbitbrush / Sandberg's Bluegrass - Cheatgrass
- Rabbitbrush / Bunchgrass
- Riparian
- Sandberg's Bluegrass - Cheatgrass

Figure D.10 200 W Area Land Cover Classes

Big Sagebrush / Sandberg's Bluegrass - Cheatgrass

Disturbed

Gray Rabbitbrush / Cheatgrass

Data Collected: Spring 1999
Map Created: September 1999/Pacific Northwest National Laboratory

Figure D.11 300 Area Land Cover Classes

is not on single species but on habitats and plant communities as umbrella levels of ecological organization that contain species and ecosystem processes of concern. Such a change in focus is not at the expense of listed species; their management needs must still be met. Rather, the purpose of the shift is to head off future species listing by managing for the needs of a broader array of species and habitats now within a landscape perspective. This strategy is in line with an ecosystem management approach that recognizes that, although all levels of the biodiversity hierarchy have value, limited management resources must be focused on higher levels of the hierarchy.

Habitat is the combination of biotic and abiotic components that provides the ecological support system for plant and animal populations. Identification of habitats of concern on Hanford implies that areas designated as such have high fish or wildlife usage value or are important havens for populations of plant species of concern. This section discusses habitats of concern on Hanford and their relationship to WDFW priority habitats, habitat improvement areas, and specific sensitive resource areas, such as: wetlands, floodplains, rare habitats, and late-successional sagebrush-steppe habitat.

D.2.2.1 Habitats of Concern

Figure D.12 depicts Hanford's habitats of concern (as of September 1999). The map was derived from the Hanford Site land cover map (Figure D.1) by eliminating cover classes of low habitat value. Such classes reflect present human-induced disturbance (e.g., buildings) or the persistent effects of past human-induced disturbance (e.g., abandoned old fields, areas dominated by non-native grasses). Excluded cover classes included:

- rabbitbrush/cheatgrass
- Sandberg's bluegrass-cheatgrass
- planted non-native grass
- abandoned old fields
- buildings/parking lots/gravel pits/disturbed areas.

Individually, species of concern may use the excluded cover classes, and, thus, in accordance with the level of concern by which they are defined, they must still be addressed by appropriate management actions; however, the cover classes listed above in and of themselves are not considered crucial for individual species viability or overall Hanford ecosystem integrity. (Depending on where they are located in the landscape, some occurrences of the excluded cover classes may still have importance as wildlife movement corridors or as locations within which habitat improvements can relieve the effects of fragmentation.) The remaining cover classes are considered important because they represent native habitat (albeit of variable quality) for species of concern Because maintaining the integrity of these habitats on Hanford will provide assurances that viable populations of associated species of concern will be maintained, the habitats of concern themselves will require status monitoring, impact assessment (and mitigation via avoidance and/or minimization), and, as appropriate, mitigation via rectification and/or compensatory mitigation. For purposes of maintaining continuity with the land cover map (Figure D.1) and to enable monitoring of species diversity and wildlife usage within different plant community types, vegetation associations are retained as the principal means of identifying habitat.

The Ecosystem Monitoring Project and Hanford Biological Resources Laboratory both maintain data bases that contain species of concern sighting information obtained from a number of sources for the Hanford Site (600 Area and the industrial areas, respectively). Data from the TNC surveys also are included. Sighting information documents the occurrence of particular species at Hanford and also provides some data on relative abundance and habitat association. Such information is useful in establishing which habitats are important to conserve.

Other than to infer something about habitat relationships, outside of the industrial areas most sighting data are not used directly in the BRMaP to identify specific resource areas of concern (bald eagles, ferruginous hawks, fall chinook salmon, steelhead, and rare plant populations are conspicuous exceptions). There are three reasons for this. First, other than consideration of listed species and species associated with specific locations—e.g., rare plant population locations and salmon redds—the management approach taken here emphasizes habitat as an umbrella to protect a broad array of individual species. Second, incomplete sighting information can be misleading. For many species that occur at Hanford, complete distributional information is lacking. An absence of sighting data for a particular species in an area may reflect either inappropriate

habitat or simply that the area was not surveyed. Third, species distributions across a landscape can be dynamic, especially for migratory species that do not return to the same locale each year to breed. Even annual plants may occur in different locations from year to year depending on seasonal weather patterns.

Because one implementation goal of BRMaP is a comprehensive monitoring (and inventory) strategy for Hanford's biological resources, future resource mapping may be able to make better use of sighting data. Because BRMaP emphasizes an ecosystem management approach, the emphasis is better placed on data that address the overall patterns of species diversity and not necessarily individual species.

D.2.2.2 Washington Department of Fish and Wildlife Priority Habitats

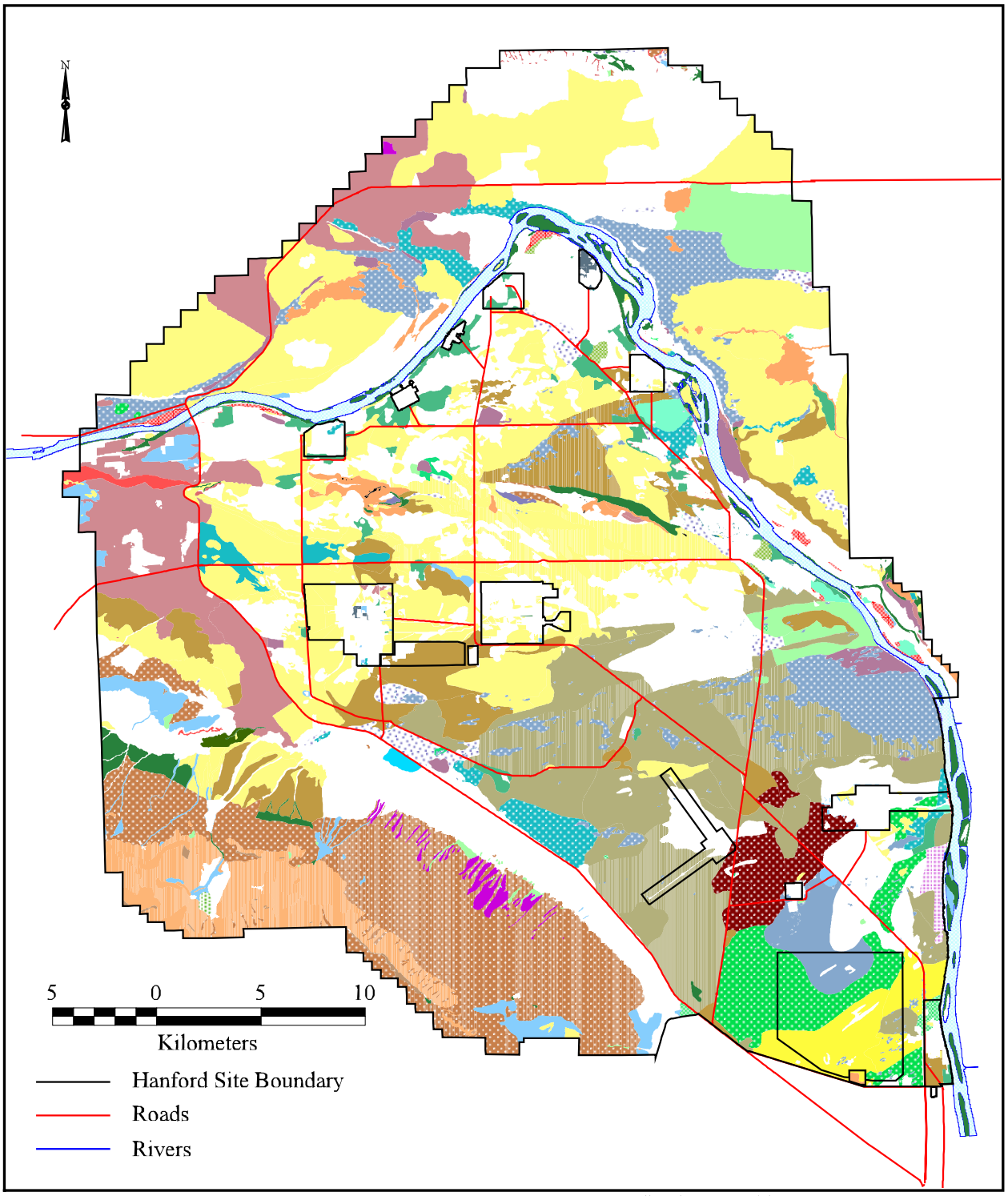
The WDFW has adopted the Hanford habitats of concern map (Figure D.12), minus the alkali saltgrass-cheatgrass cover class, as the basis for its priority habitat map for the Hanford Site.[3] The Habitat Program of WDFW publishes a priority habitats and species (PHS) list, which catalogs habitats and species considered to be priorities for conservation and management in the state of Washington (www.wa.gov/wdfw/hab/phspage.htm). According to WDFW, priority habitats (priority species are discussed in Section D.2.5.12) "are those habitat types or elements with unique or significant value to a diverse assemblage of species. Priority habitats may consist of a unique vegetation type or dominant plant species, a described successional stage, or a specific structural element." To be classified and mapped as a priority habitat, an area must contain one or more of the following attributes:

- comparatively high fish and wildlife density
- comparatively high fish and wildlife species diversity
- important fish and wildlife breeding habitat
- important fish and wildlife seasonal ranges
- important fish and wildlife movement corridors
- limited availability
- high vulnerability to habitat alteration
- unique or dependent species.

In the context of biological resource management amidst meeting growing human needs, WDFW uses the PHS program as a proactive measure to help mitigate human impacts on the state's fish and wildlife resources by identifying and preserving the best and most important habitats. The WDFW's adoption of the habitats of concern map (Figure D.12) as its priority habitat map for Hanford is further indication of the significant biological resources that Hanford contains.

Table D.1 indicates how the different cover classes that constitute the habitats of concern map (Figure D.12) correspond with WDFW's priority habitat elements (www.wa.gov/wdfw/hab/phspage.htm). In a number of instances, there is not a complete correspondence. For example, in the Hanford habitats of concern classification, basalt outcrops include talus plus four lithosol, shrub-steppe plant communities. Additionally, riparian and wetland habitat classifications are problematic. Riparian habitat is an area adjacent to aquatic systems with flowing water. In riparian systems, the biota and abiota of the terrestrial ecosystem are influenced by the juxtaposition of perennial or intermittent water. Simultaneously, the aquatic ecosystem (instream habitat) is influenced by the adjacent terrestrial vegetation. In WDFW's classification, the boundary between riparian habitat and instream habitat occurs at the ordinary high water mark; however, it is possible to have non-riverine wetland habitat (freshwater wetlands in the WDFW classification scheme) below the ordinary high water mark. For the land cover and habitats of concern maps (Figures D.1 and D.12), however, riparian habitat includes this wetland habitat [i.e., that area that contains hydrophytic vegetation but not including the zone of nonpersistent emergent vegetation (Cowardin et al. 1979)].

[3] Letter from T. A. Clausing, Regional Ecosystem Director, WDFW to J. E. Rasmussen, DOE-RL, Office of Site Services, dated March 4, 1996. The alkali saltgrass-cheatgrass community occurs in one locality on the North Slope. Because of its high stand quality and rarity, it qualifies as a Washington State Natural Heritage Program Element Occurrence (TNC 1995). This qualifies it as a Level IV resource and as such it is retained on the Hanford habitats of concern map.



Data Collected: 1994, 1997/The Nature Conservancy
1991, 1999 Pacific Northwest National Laboratory
Map Created: September 1999/Pacific Northwest National Laboratory

Figure D.12 Habitats of Concern for the Hanford Site (Map)

LEGEND

- Alkali Saltgrass - Cheatgrass
- Big Sagebrush - Bitterbrush / Bunchgrass
- Big Sagebrush - Bitterbrush / Needle-and-Thread Grass
- Big Sagebrush - Bitterbrush / Sandberg's Bluegrass
- Big Sagebrush - Rigid Sagebrush / Bunchgrass
- Big Sagebrush - Rock Buckwheat / Bunchgrass
- Big Sagebrush - Spiny Hopsage / Bunchgrass
- Big Sagebrush - Spiny Hopsage / Sandberg's Bluegrass - Cheatgrass
- Big Sagebrush / Bluebunch Wheatgrass
- Big Sagebrush / Bunchgrass
- Big Sagebrush / Needle-and-Thread Grass
- Big Sagebrush / Sand Dropseed
- Big Sagebrush / Sandberg's Bluegrass - Cheatgrass
- Bitterbrush / Bunchgrass
- Bitterbrush / Indian Ricegrass
- Bitterbrush / Needle-and-Thread Grass
- Black Greasewood / Alkali Saltgrass
- Bluebunch Wheatgrass - Needle-and-Thread Grass
- Bluebunch Wheatgrass - Sandberg's Bluegrass
- Bunchgrass - Cheatgrass
- Gray Rabbitbrush - Snow Buckwheat / Bunchgrass
- Gray Rabbitbrush / Bunchgrass
- Gray Rabbitbrush / Needle-and-Thread Grass
- Gray Rabbitbrush / Sand Dropseed
- Gray Rabbitbrush / Sandberg's Bluegrass - Cheatgrass
- Needle-and-Thread Grass - Indian Ricegrass
- Needle-and-Thread Grass -Sandberg's Bluegrass
- Non-Riverine Wetlands and Associated Deepwater Habitats
- Rabbitbrush / Bunchgrass
- Rigid Sagebrush / Sandberg's Bluegrass
- Riparian
- Riverine Wetlands and Associated Deepwater Habitats
- Sand Dropseed - Sandberg's Bluegrass - Cheatgrass
- Snow Buckwheat - Bitterbrush / Bunchgrass
- Snow Buckwheat / Bunchgrass
- Snow Buckwheat / Sandberg's Bluegrass - Cheatgrass
- Spiny Hopsage / Sandberg's Bluegrass - Cheatgrass
- Talus
- Threetip Sagebrush / Bunchgrass
- Thymeleaf Buckwheat / Sandberg's Bluegrass
- Vernal Pool
- White Bluffs
- Winterfat / Bunchgrass

Figure D.12 Habitats of Concern for the Hanford Site (Legend)

Table D.1 Hanford Habitats of Concern Cover Classes and WDFW Priority Habitat Elements

WDFW Priority Habitat	Hanford Habitats of Concern
Cliffs	Cliffs (White Bluffs)
Riparian	Riparian
Shrub-steppe (small and large blocks)	Big sagebrush - bitterbrush/bunchgrass Big sagebrush - bitterbrush/needle-and-thread grass Big sagebrush - bitterbrush/Sandberg's bluegrass Big sagebrush - rigid sagebrush/bunchgrass Big sagebrush - rock buckwheat/bunchgrass Big sagebrush - spiny hopsage/Sandberg's bluegrass - cheatgrass Big sagebrush/bunchgrass Big sagebrush/bluebunch wheatgrass Big sagebrush/needle-and-thread grass Big sagebrush/sand dropseed Big sagebrush/Sandberg's bluegrass - cheatgrass Big sagebrush-spiny hopsage/bunchgrass Bitterbrush/bunchgrass Bitterbrush/Indian ricegrass Bitterbrush/needle-and thread grass Black greasewood/alkali saltgrass Bluebunch wheatgrass - needle-and-thread grass Bluebunch wheatgrass - Sandberg's bluegrass Bunchgrass - cheatgrass Gray rabbitbrush/needle-and-thread grass Gray rabbitbrush/sand dropseed Gray rabbitbrush/Sandberg's bluegrass - cheatgrass Needle-and-thread grass- Indian ricegrass Needle-and-thread grass - Sandberg's bluegrass Rabbitbrush - snow buckwheat/bunchgrass Rabbitbrush/bunchgrass Rigid sagebrush/Sandberg's bluegrass Sand dropseed - Sandber'g bluegrass - cheatgrass Snow buckwheat - bitterbrush/bunchgrass Snow buckwheat/bunchgrass Spiny hopsage/Sandberg's bluegrass - cheatgrass Threetip sagebrush/bunchgrass Thymeleaf buckwheat/Sandberg's bluegrass Winterfat/bunchgrass Winterfat/cheatgrass
Talus	Talus
Freshwater wetlands and deepwater habitats	Non-riverine wetlands and associated deepwater habitats
Instream	Riverine wetlands and associated deepwater habitats
	Alkali saltgrass-cheatgrass

D.2.2.3 Sensitive Resource Areas: Wetlands

Sensitive resource areas are, in part, defined by DOE's NEPA Implementing Procedures and Guidelines (10 CFR 1021) (e.g., wetlands and floodplains) and, in part, by the rarity and fragility of specific resources typical of the Columbia Basin Ecoregion. These resource areas are not defined by the presence of one or a few species of concern; instead, they represent areas of high species richness or unique species assemblages.

Wetlands are areas that under normal circumstances have one or more of the following attributes (defined in Cowardin et al. 1979):

- at least periodically, the land supports predominantly hydrophytic vegetation

- the substrate is predominantly undrained hydric soil
- the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year.

In arriving at a determination of what wetlands constitute sensitive resources, federal regulations and guidelines make no distinction between human-made and natural wetlands (33 CFR 328.3); however, the formal jurisdictional delineation of wetlands exempts certain human-made waste treatment systems [(33 CFR 328.3(a)(7)]. Wetlands are often found in close association with deepwater habitats. Deepwater habitats are permanently flooded lands; they are defined separately because the term wetland has not been traditionally defined to include deep permanent water (Cowardin et al. 1979).

Although many areas on the Hanford Site can be considered wetlands, no formal delineation of wetlands on Hanford has been made. The system of jurisdictional delineation of wetlands is based on a 1987 U.S. Army Corps of Engineer's wetlands identification manual (ACOE 1987). Other wetland characterization schemes are also available that, even though they do not reflect a jurisdictional classification with respect to permitting requirements, provide a useful classification of different types of wetland habitat. Figures D.13 and D.14 identify wetlands and deepwater habitats of the Hanford Site based on National Wetlands Inventory (NWI) data that were obtained in digital format from the USFWS. Figure D.14 is a more detailed view of the northern portion of the Hanford Site that better illustrates the wetlands of the Wahluke Unit and portions of the Hanford Reach. The classification of the types of wetlands in the NWI data is based on Cowardin et al. (1979). For the areas depicted in Figures D.13 and D.14, the classification is based on aerial photographs (with most likely some ground truthing) that for different parts of the Hanford Site were taken in either June of 1976 or August of 1982.

The Cowardin et al. (1979) classification scheme is hierarchical and includes deepwater habitats as well as wetlands. Although the scheme encompasses five levels of classification plus modifying terms that can be applied at two of the levels, the data have been simplified in Figures D.13 and D.14 to reflect only three levels of classification without modifiers.

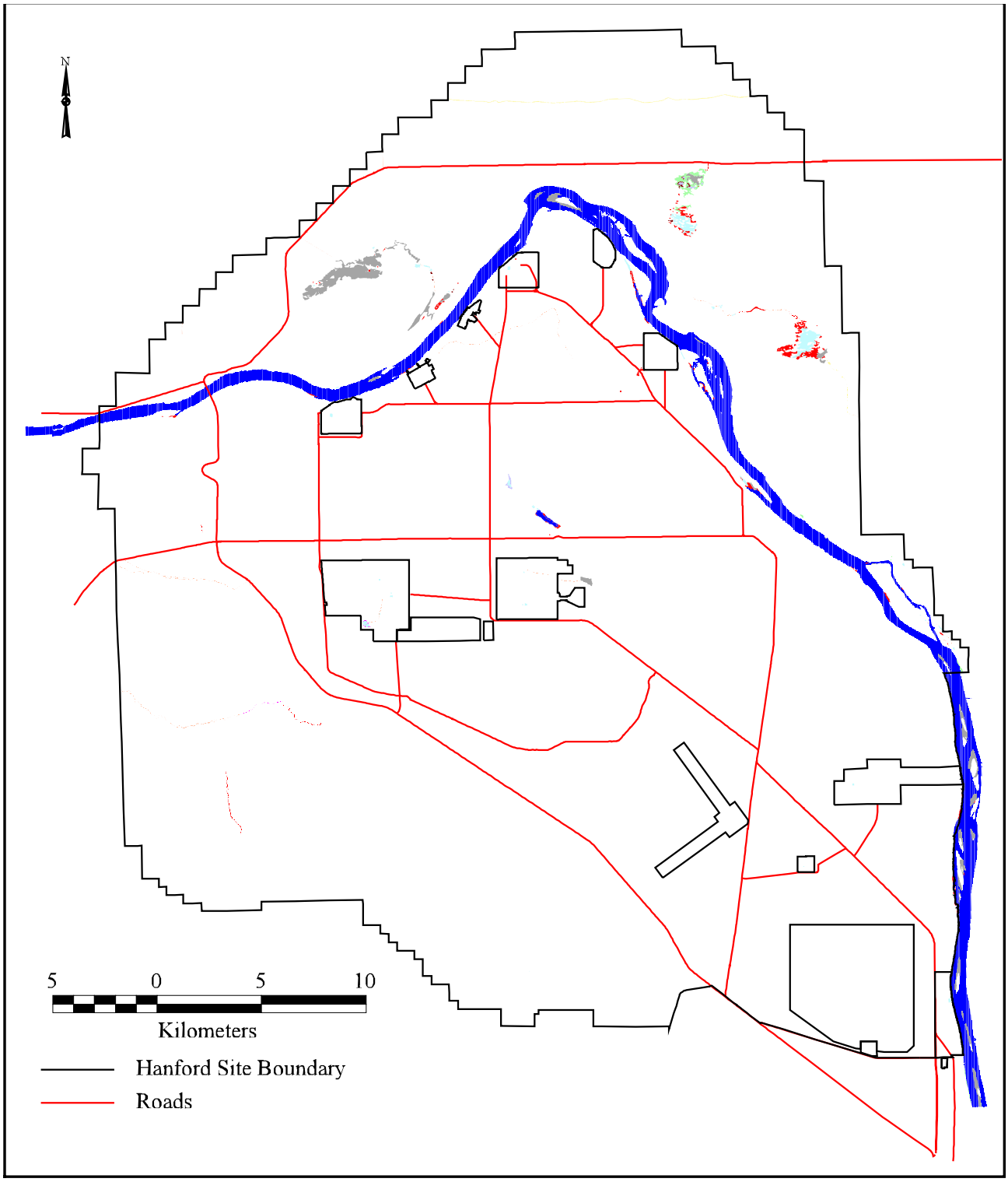
Table D.2 provides a breakdown of the classification scheme as used in Figures D.13 and D.14 with a brief definition/description for each of the relevant terms (see Cowardin et al. 1979 for more complete definitions and the complete classification scheme). Because Hanford has only freshwater habitats, Table D.2 does not address the effects of salinity on the classification scheme.

The advantage of the NWI wetland and deepwater habitat data versus the wetland cover classes of Figures D.1 and D.12 is that its classification scheme better reflects the ecological processes occurring and the potential floral/faunal associations present within each type of wetland or deepwater habitat. This is especially true at the class level of the classification scheme. Class-level descriptions define the habitat in terms of either the dominant life form of the vegetation (aquatic bed, scrub-shrub, emergent, and forested in Table D.2) or the physiography and composition of the substrate (unconsolidated bottom and unconsolidated shore in Table D.2) (Cowardin et al. 1979). Class designations are meant to apply to average conditions over a number of years. Because wetlands are dynamic, the correct classification of a wetland may require data to be collected over several years (Cowardin et al. 1979).

Although useful in indicating the breadth of wetland habitat present on the Hanford Site, there are some disadvantages associated with using the NWI data. First, the aerial photography data are 14 to 20 years old and represent only a snapshot in time of a dynamic system. Some areas that are depicted as wetlands in the central part of Hanford no longer exist. The accuracy of the data would be improved by ground-truthing current conditions. Second, the NWI data do not represent a jurisdictional delineation; although this is a disadvantage from a permitting perspective, it may not be too important a constraint [i.e., NWI data are recognized by DOE at 10 CFR 1022.11(c)(1) as a useful source of wetlands information]. Finally, some errors exist in the classification. The most glaring example is the classification of the entire Hanford Reach as a lake (lacustrine) (see below).

D.2.2.4 Sensitive Resource Areas: Floodplains

It is DOE's policy to (1) avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains, (2) avoid the support of floodplain development whenever there is a practicable alternative, and



Data Collected: 1976, 1982/U.S. Fish & Wildlife
Map Created: September 1999/Pacific Northwest National Laboratory

Figure D.13 Wetlands and Deepwater Habitats of the Hanford Site (Map)

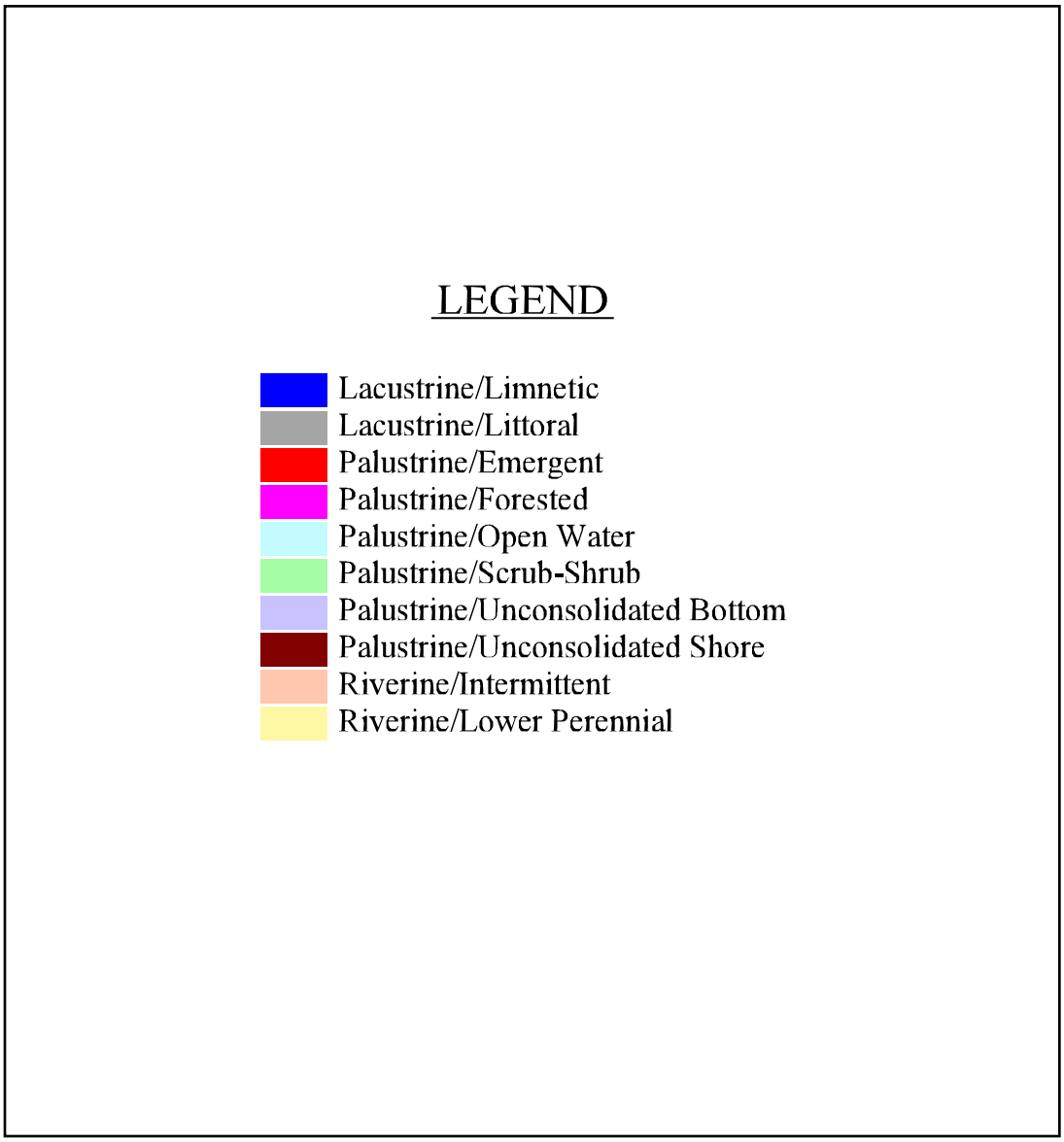
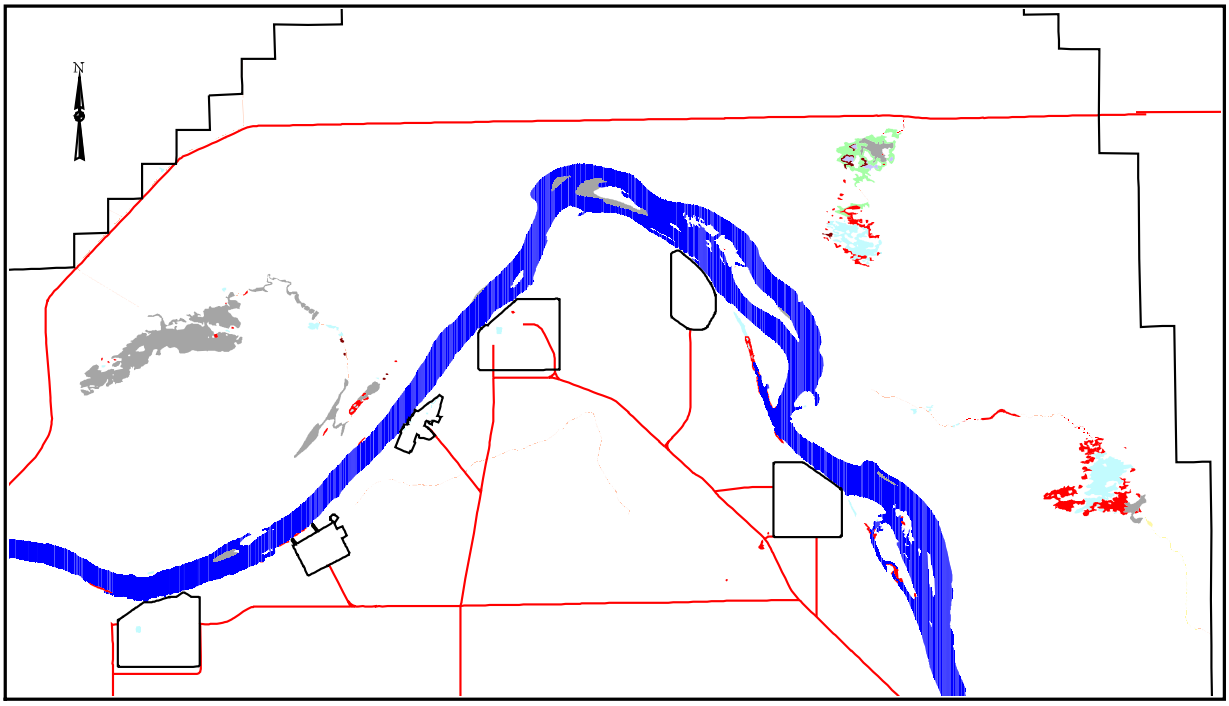


Figure D.13 Wetlands and Deepwater Habitats of the Hanford Site (Legend)



Hanford Site Boundary

Roads

Data Collected: 1976, 1982/U.S. Fish & Wildlife
Map Created: September 1999/Pacific Northwest National Laboratory

LEGEND

- Lacustrine/Limnetic
- Lacustrine/Littoral
- Palustrine/Emergent
- Palustrine/Forested
- Palustrine/Open Water
- Palustrine/Scrub-Shrub
- Palustrine/Unconsolidated Bottom
- Palustrine/Unconsolidated Shore
- Riverine/Intermittent
- Riverine/Lower Perennial

Figure D.14 Wetlands and Deepwater Habitats of the Hanford Site (Enlargement of the Northern Portion of the Site)

Table D.2 Description of the Classification Scheme Used in Figures D.13 and D.14

System	Subsystem	Class	Definition/Description
Riverine			All wetlands and deepwater habitats[(a)] contained within a channel except where the wetlands are dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens.
	Upper Perennial		Abiotic: gradient high and water velocity fast; some water flows throughout the year; oxygen concentrations normally near saturation; very little floodplain development; substrate rock, cobbles, or gravel with occasional patches of sand. Biotic: fauna characteristic of running water; few or no planktonic forms.
	Lower Perennial		Abiotic: gradient low and water velocity slow; some water flows throughout the year; oxygen deficits may sometimes occur; floodplain well developed; substrate mainly mud and sand. Biotic: fauna composed mostly of species that reach their maximum abundance in still water; true planktonic organisms are common.
	Intermittent		The channel contains flowing water for only part of the year; when nonflowing, the water may remain in isolated pools or surface water may be absent.
Lacustrine			All wetlands and deepwater habitats that: (1) are situated in a topographic depression or a dammed river channel; (2) lack trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30% areal coverage; and (3) have a total area exceeding 8 ha (smaller areas are included if an active wave-formed or bedrock shoreline feature makes up all or part of the boundary, or if the water depth in the deepest part of the basin exceeds 2 m at low water).
	Limnetic		All deepwater habitats within the lacustrine system
	Littoral		All wetland habitats in the lacustrine system from the shoreward boundary of the system to a depth of 2 m below low water or to the maximum extent of nonpersistent emergents, if these grow at depths greater than 2 m.
Palustrine			Abiotic (where vegetation is lacking): All wetlands with all of the following characteristics—(1) have an area less than 8 ha, (2) lack an active wave-formed or bedrock shoreline, and (3) have a water depth in the deepest part of the basin less than 2 m at low water. Biotic (where vegetation is present): All wetlands dominated by trees, shrubs, persistent emergents, and emergent mosses or lichens
		Unconsolidated Bottom	Wetlands with at least 25% cover of particles smaller than stones and a vegetative cover less than 30%. This class is characterized by the lack of large stable surfaces for plant and animal attachment. Particle size of the substrate and water regime determine the types of plant and animal communities present.
		Unconsolidated Shore	Wetlands having: (1) unconsolidated substrates with less than 75% areal cover of stones, boulders, or bedrock; (2) less than 30% areal cover of vegetation other than pioneering plants; and (3) water regimes that are intermediate between permanently exposed and permanently flooded. Associated landforms included in this class are beaches and bars.
		Aquatic Bed	Wetlands dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. The plants are either attached to the substrate or float freely in the water above the bottom or on the surface.
		Scrub-Shrub	Wetland areas dominated by woody vegetation less than 6 m tall. The species include true shrubs, young trees, and trees or shrubs that are stunted because of environmental conditions.
		Emergent	Wetland areas characterized by erect, rooted, usually perennial, herbaceous hydrophytes, excluding mosses and lichens. Vegetation is present for most of the growing season in most years. Persistent emergent wetlands are dominated by species that normally remain standing at least until the beginning of the next growing season.
		Forested	Wetland areas dominated by woody vegetation that is 6 m tall or taller.

(a) The boundary between wetland and deepwater habitat in the riverine and lacustrine systems lies at a depth of 2 m below low water; however, if emergents, shrubs, or trees grow beyond this depth at any time, their deepwater edge is the boundary. The palustrine system by definition does not include deepwater habitat (Cowardin et al. 1979).

(3) restore and preserve the natural and beneficial values served by floodplains (10 CFR 1022.3). Although the Hanford Reach is the last free-flowing U.S. stretch of the Columbia River upstream of Bonneville Dam, its flow regime is dam-regulated. Still, the periodic high river flows that can occur on the Hanford Reach, even under dam-regulated conditions, are important for maintaining natural processes within the Hanford Reach ecosystem. For example, the flushing of sloughs and scouring of shorelines removes fine sediments which could be important for the maintenance of native vegetation and other ecological conditions that native fish and wildlife depend on. The flood plain associated with such high river flows is thus of ecological significance.

Previous floodplain mapping for the Hanford Reach of the Columbia River has focused on accident-induced flooding (e.g., an upstream dam failure), historic floods previous to dam construction, and projected catrostrophic natural flooding (i.e., greater than 500-year periodicity) (Neitzel 1999); however, the appropriate floodplain of concern for protecting biological resource values is based on Executive Order 11988, "Floodplain Management." This Executive Order establishes the base or 100-year floodplain as that floodplain that should be considered for restoring and protecting the natural values of floodplains. The DOE implements Executive Order 11988 through 10 CFR 1022.

The relevance of the 100-year floodplain is somewhat arbitrary from a biological perspective. Consequently, the 100-year floodplain could be liberal or conservative in regard to protecting ecological processes that occur under high flow conditions on the Hanford Reach (e.g., flushing of sloughs). In the absence of specific information on the cause and effect relationship between river flow rates and ecological processes, the BRMaP relies on the regulatory floodplain of concern (i.e., that floodplain identified by Executive Order 11988) to protect biological resource values. Neitzel (1999) identifies the flow rate for the 100-year dam-regulated flood as 440,000 cubic feet per second (cfs) (12,460 m^3/s).[4]

To support the development of a floodplain map relevant to the protection of biological resources, water surface elevations at a number of different river flow rates, including 440,000 cfs, were computed using the PNL-CHARIMA river simulation model (Walters et al. 1994).[5] Figure D.15 shows the simulated water surface elevations that result for each of four flow rates. For reference, Priest Rapids Dam is at river mile 397 and the mouth of the Yakima River is at river mile 335. To determine the area that is flooded by a given flow rate, the simulated water surface elevations are compared to an elevation map. Additionally, to best illustrate changes in the extent of the floodplain under different flow regimes, comparisons that cover the extremes of expected flows are used. For the dam-regulated case, the water surface elevation curves in Figure D.15 that reflect the presence and effect of McNary Dam are the relevant curves.

The elevation map for the Hanford Site is typically based on the contour information contained on USGS topographic maps. Unfortunately, these maps are based on conditions when the Hanford Reach section of the Columbia River was at high flow. Thus, there is insufficient elevation information in USGS maps to model river flow conditions under the full range of flow conditions. To correct for this problem, additional elevation data were incorporated into the elevation base map. In October 1995, the U.S. Army Corps of Engineers recorded Hanford Reach channel elevation data (this included elevations below the water surface). These data were collected along irregularly spaced transects that were oriented approximately perpendicular to the river channel. An inverse distance weighting program was used to interpolate elevation values for locations between transects and between points on a transect within a 200 m (656 ft) area bounding the USGS river boundary on either side. This area included all transect points as well as areas, such as to the northeast of Savage Island, that were outside the transect data. After interpolation, the interpolated data were compared to the USGS elevations and a new elevation map was constructed with the interpolated points replacing the USGS elevations within the 200 m (656 ft) boundary whenever the interpolated elevations were less than the USGS elevations.

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4 The documented source of this flow rate as the 100-year flow rate is obscure; however, it was provided in a letter from D. Sweger, Department of the Army, Seattle District Corps of Engineers to R. A. Chitwood, Washington Public Power Supply System, dated May 30, 1980.

5 Model data provided by M. Richmond, Hydrologist, Pacific Northwest National Laboratory, Richland, Washington, 1995.

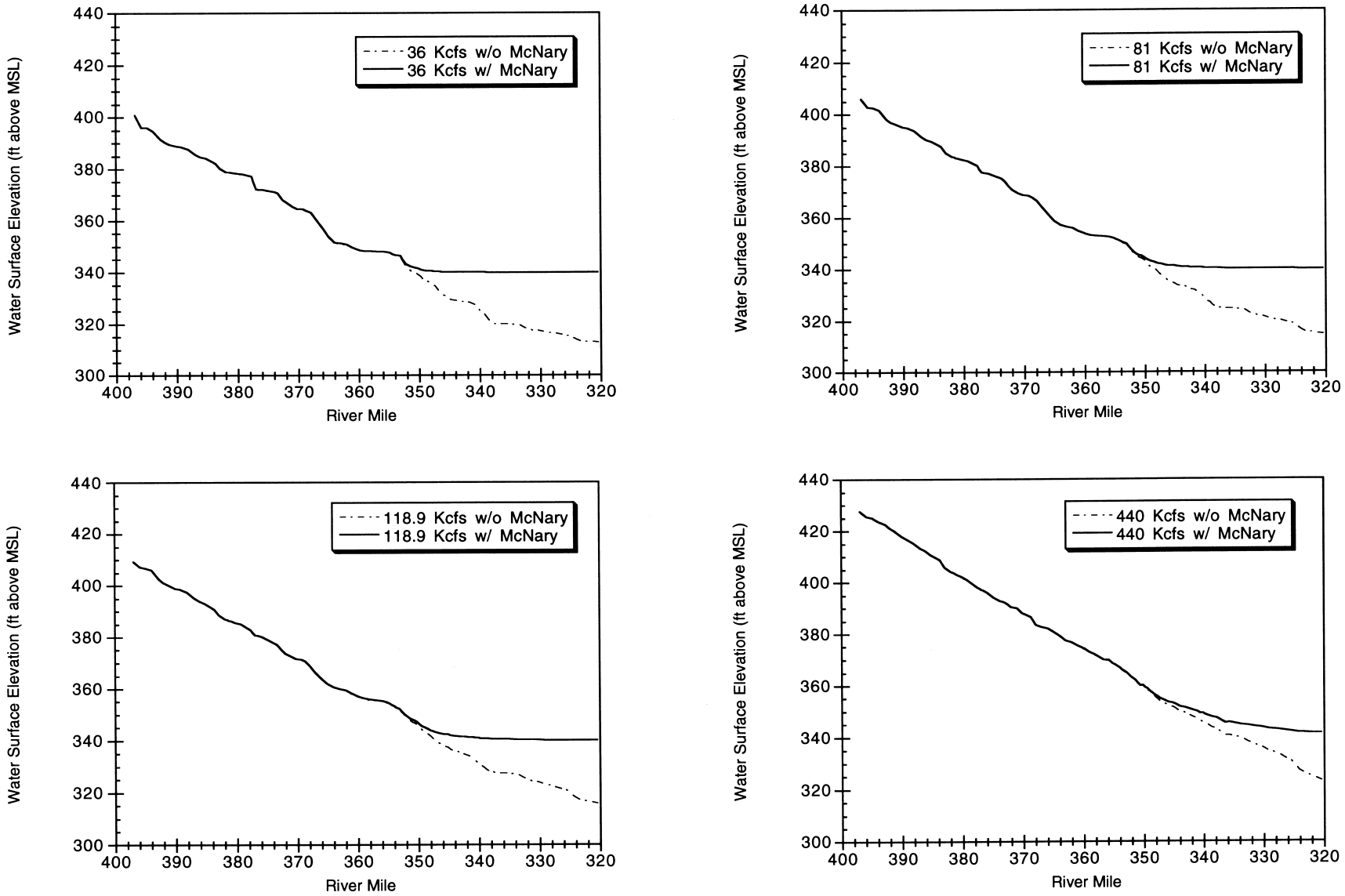


Figure D.15 Simulated Water Surface Elevations for the Columbia River Downstream from Priest Rapids Dam With and Without the Effect of McNary Dam

The new elevation base map was then compared to water surface elevation data from the PNNL-CHARIMA model for two flow rates, 440,000 cfs and 36,000 cfs (1020 m^3/s; the post Priest Rapids Dam, legally allowed low flow rate), to generate a floodplain map of the Hanford Reach portion of the Columbia River (Figure D.16). Because the river simulation model produces water surface elevation estimates at discrete distances along the river, the inverse distance weighting program was again used to interpolate elevations between modeled data points. Simulated water surface elevations greater than or equal to points on the elevation base map were considered under water. The base or 100-year dam-regulated floodplain is depicted in Figure D.16 as that area covered by water that is in addition to the amount of river channel present when flow rate is at the legal minimum.

The map represents one approximation of the dam-regulated floodplain; changes to the interpolation algorithm or increases in the available recorded elevation data points or simulated water surface elevation points could affect the depiction of the floodplain. The effects, however, are not expected to be major.

The curves in Figure D.15 also serve a second useful purpose. Within a dammed river channel, the terminal boundary of the lacustrine system formed behind a dam can best be defined by the extent of its reservoir. This is not a static condition, however, as the effect of a downstream dam's operating pool changes with upstream river flow rates.[6] The minimum flow rate of the upstream river in conjunction with the maximum operating level elevation of the downstream dam sets the maximum reservoir length. At higher river flow rates, the pool effect is lessened (i.e., the river functions as a free-flowing river farther downstream). Figure D.15 depicts water surface elevation curves, with and without the effect of the presence of McNary Dam, for two additional flow rates besides 36,000 cfs and 440,00 cfs: (1) the post Priest Rapids Dam mean flow during mid-November [i.e., peak period of fall chinook salmon spawning; 81,000 cfs (2290 m^3/s)] and (2) based on a 76-year record, the long-term mean flow rate [i.e., 118,900 cfs (3370 m^3/s)].

For each flow rate, the limits of the McNary Dam pool effect for the Hanford Reach can be determined by comparing the curves with and without McNary Dam. Based on model calibration accuracies, differences between the curves of less than a foot are not significant (M. Richmond 1995, pers. comm.). Thus, at minimum river flow (i.e., 36,000 cfs), the McNary reservoir (i.e., Lake Wallula) extends to about river mile 352; whereas, under mean flow conditions (i.e., 118,900 cfs), the reservoir terminates at about river mile 350.

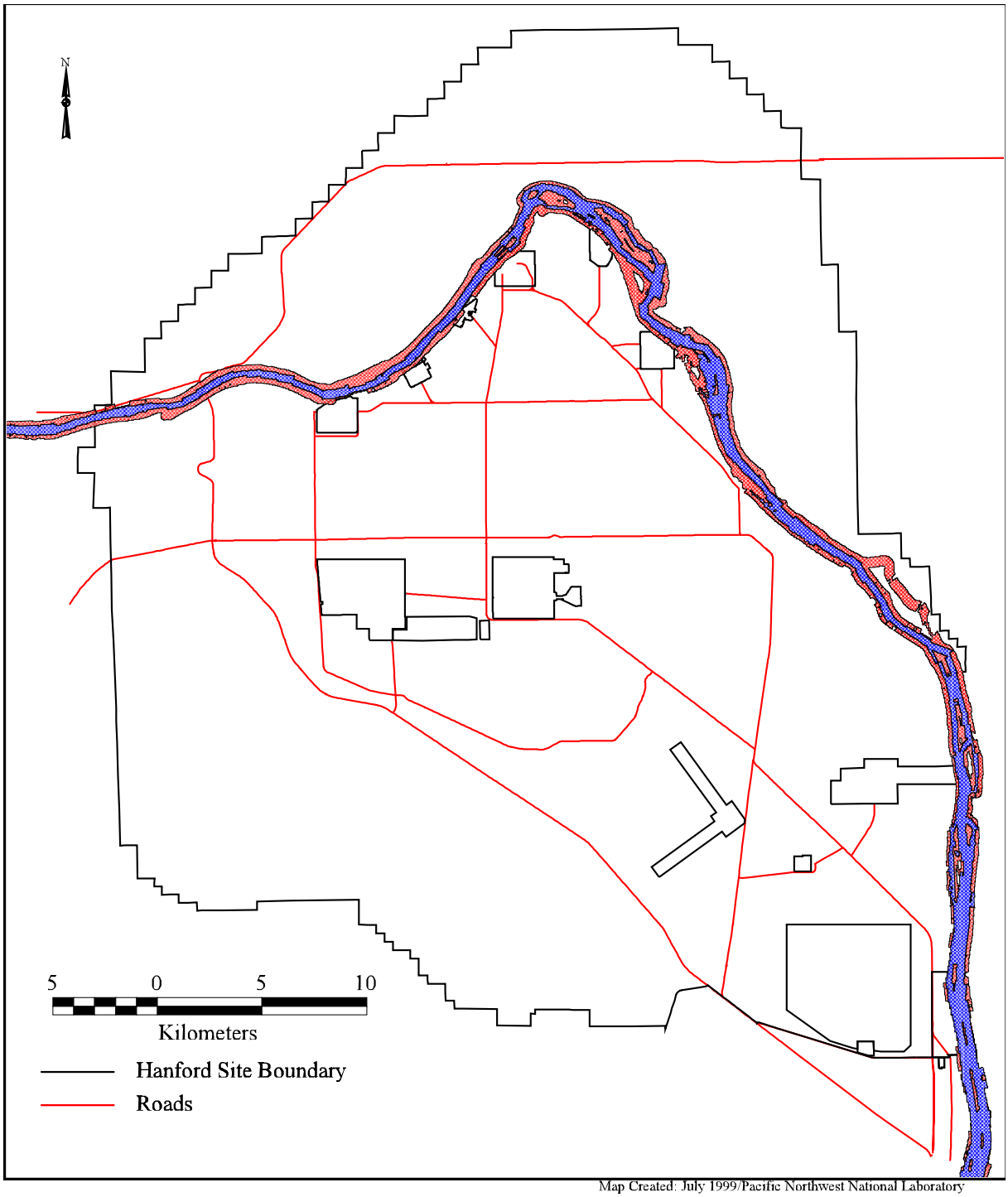
Additionally, the change from a free-flowing to a more static flow condition is not immediate, as indicated by the shallow slope portions of the curves that precede the point at which the dam operating pool elevation is reached [i.e., 340 ft (103.6 m) above mean sea level (MSL)]. Thus, the free-flowing, riverine habitat of the Hanford Reach on average extends for about 75.6 km (about 47 mi) downstream from Priest Rapids Dam; however, below river mile 352, the transition point from river to lake is variable.

D.2.2.5 Rare Habitats

Rare habitats are defined here as those habitats important for plant, fish, and wildlife species that have low availability throughout the ecoregion, especially those in a protected status. The rare habitats at Hanford can be characterized on the basis of landform characteristics; however, a number of the habitats are associated with rare plant communities. Figure D.17 depicts the following kinds of rare habitat and their distribution on the Hanford Site and provides a basis for their protection:

- basalt outcrops: limited availability, associated rare plant communities, rare plants, easily disturbed, threatened by resource extraction
- cliffs (White Bluffs): limited availability, specialized wildlife usage, rare plants, threatened by groundwater seepage
- desert streams: limited availability, associated rare plant communities, high wildlife usage, unique species assemblages
- upland springs: limited availability, rare wildlife species, high wildlife usage

[6] Changes in operating pool elevation obviously also affect reservoir length. The normal pool elevation for McNary Dam is assumed to be no greater than 340 ft above mean sea level. With operating pool elevation held constant, changes in reservoir length are strictly dependent on upstream river flow rates.



River Flow at 440,000 cfs (100 Year Flood)

River Flow at 36,000 cfs (Legal Minimum)

Figure D.16 Dam-Regulated 100-Year Floodplain of the Hanford Reach

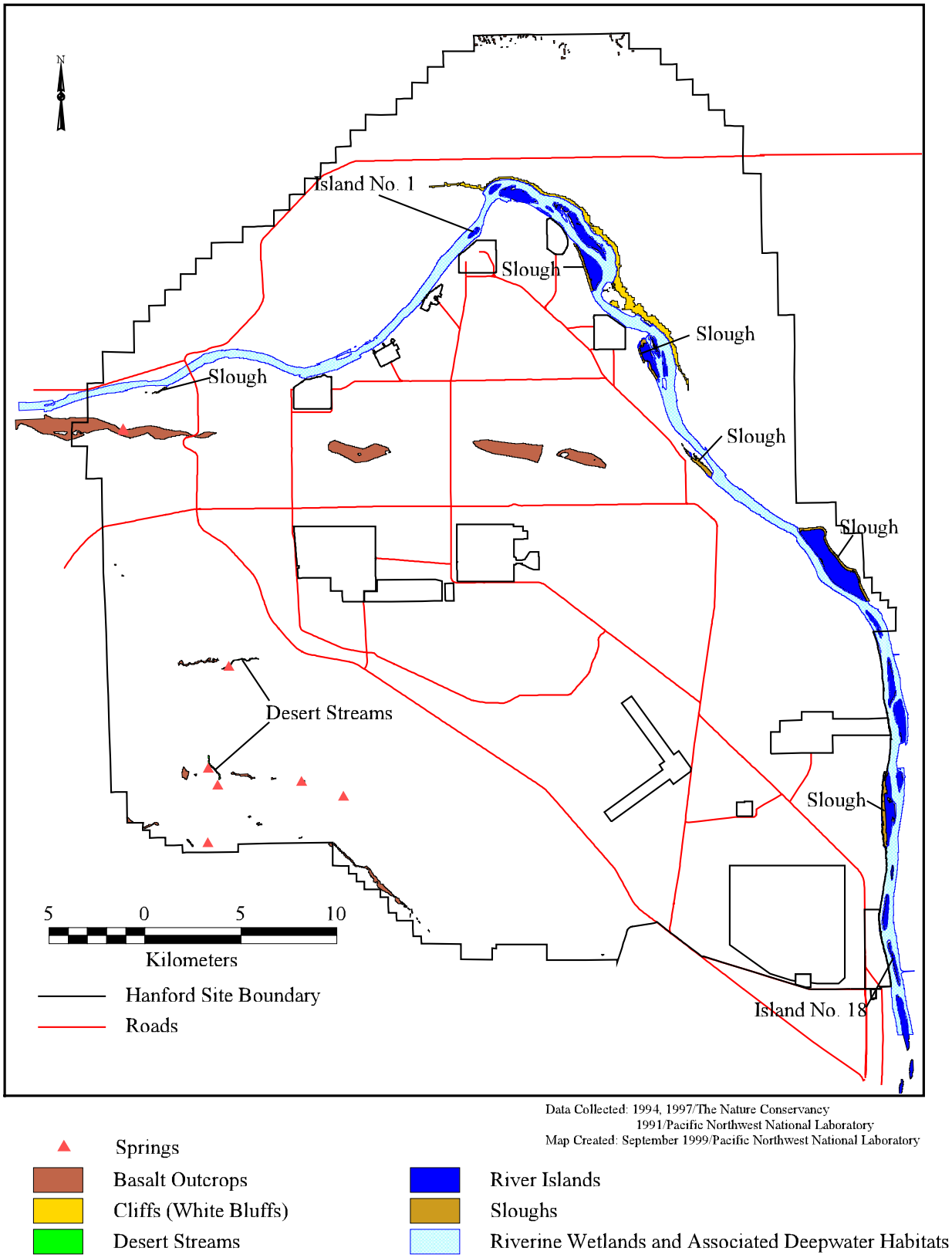


Figure D.17 Rare Habitats Present on the Hanford Site

- Columbia River sloughs: limited availability, high fish and wildlife usage (provide important habitat diversity within the Hanford Reach), associated rare plant communities, rare plants
- Columbia River islands: limited availability, high wildlife usage, rare plants.

More detailed information on each of these habitats and their associated fauna/flora can be found in Downs et al. (1993).

Basalt outcrops and cliffs (White Bluffs) are mapped the same as in Downs et al. (1993). As a generalized habitat class, however, basalt outcrops may consist of limited amounts of cliff (scarps) and talus (screes) habitat in addition to outcrop-associated, lithosol plant communities that have been identified by TNC and are included on the land cover map (Figure D.1). On Hanford, basalt outcrops are found along the crests and slopes of the Rattlesnake Hills, Yakima Ridge, Umtanum Ridge, Saddle Mountains, Gable Mountain, and Gable Butte. The White Bluffs occur along the eastern shore of the Hanford Reach.

The desert streams on the ALE Unit are identified on the Hanford land cover map (Figure D.1) as strips of riparian vegetation. There are two streams: Snively Creek, which extends as a permanent stream for about 2 km (1.25 mi) (Downs et al. 1993), and Dry Creek, which extends for about 2.5 km (1.55 mi) (Neitzel 1999). Most of the flow of Snively Creek is contributed by two springs: Snively Spring and Lower Snively Spring (Schwab et al. 1979). The permanent flow associated with Dry Creek is contributed by Rattlesnake Springs (Downs et al. 1993); however, depending on rainfall patterns, the flow and extent of Dry Creek can be quite variable.

Typically, both streams originate and terminate on the ALE Unit; however, under flood conditions, Dry Creek will cross State Highway 240. Snively Creek qualifies as a wetland and aquatic ecosystem element occurrence under the Natural Heritage Program (WDNR 1995).[7] Wetland and aquatic ecosystem elements are physical hydrologic systems and their component biota. Snively Spring is considered a representative of a low elevation stream and riparian system element. This element has a high priority for protection (WDNR 1995).

Other representatives of low-elevation stream and riparian system elements that qualify as element occurrences are present along the Hanford Reach of the Columbia River. A more complete description of element occurrences, their priority rankings, and their significance to biological resource management is provided in Section D.2.3.

Cold springs also are identified by the Natural Heritage Program as a wetland and aquatic ecosystem element (WDNR 1995). Two springs that occur on the ALE Unit—Snively Spring and Lower Snively Spring—are considered element occurrences by the Natural Heritage Program (C. Chappell, Plant Ecologist, WDNR, pers. comm., 1996). Not all potential spring areas are included in Figure D.17. The locations of the more prominent upland springs on the ALE Unit and Umtanum Ridge were digitized from USGS topographic maps for the Hanford Site. The spring locations digitized were:

- Lower Snively Spring
- Snively Spring
- Upper Snively Spring
- Rattlesnake Spring
- Benson Spring
- Doke Spring
- Juniper Springs (Lower)
- Juniper Springs (Upper).

Descriptions of each of these springs are provided in Frest and Johannes (1993) and/or Schwab et al. (1979). The first six springs listed are located on the ALE Unit and the last two are found on Umtanum Ridge. Frest and Johannes found that most springs had signs of human modifications such as diversion, addition of pipes, bulldozing, and excavation. They suggested that such modifications frequently negatively impacted the native land and freshwater mollusc fauna. During their surveys for molluscs they encountered one previously unknown land snail species on Umtanum Ridge (see Table D.6). Although the mollusc fauna may have been negatively impacted by mostly pre-Hanford activities, springs are still an important oasis for wildlife within the arid portions of the Hanford Site.

[7] The status of Snively Creek in regard to its qualification as an element occurrence is identified in a letter from M. Sheehan, Manager, Washington Natural Heritage Program, Washington Department of Natural Resources to L. Cadwell (PNNL), dated February 27, 1996.

Sloughs or backwater areas are waterbodies connected and adjacent to the main channel of the Hanford Reach. Sloughs are important breeding and foraging locations for a number of species. Although the advent of dams on the Columbia and Snake rivers has resulted in the loss of some backwater habitat and the gain of others, most of what has been gained is qualitatively different from the slough habitat on the Hanford Reach. On the Reach, the occasional high flows of the free-flowing river periodically connect the sloughs to the flow of the river. This periodic cycling of the nutrient conditions within the slough is typical of a natural river. The backwater areas of dammed stretches of the river do not experience this periodic flushing. The slough locations along the Hanford Reach were digitized from USGS topographic maps for the area. The USGS maps are based on conditions at one particular river flow rate; in actuality, total slough area will be different at different river flow rates.

River islands are a limited resource for those species that require isolation from ground predators to carry out portions of their life cycle. Colonial waterbirds and mule deer, for example, use the Columbia River islands for nesting and fawning, respectively. The rarity of islands and the relative importance of the islands that are present within the Hanford Reach can best be exemplified by the following: the ratio of island shoreline to river shoreline distance is 0.337 to 1 in the Hanford Reach as compared with 0.024 to 1 north of Priest Rapids Dam to the Canadian border (calculated from data from Table 1 in Payne et al. 1976). Figure D.17 shows the locations of the islands along the Hanford Reach from Island No. 1 near 100 D Area to Island No. 18 opposite the 300 Area (see Downs et al. 1993: Table 2.1, for information on ownership/administration of these islands). Islands 14 through 18 are included within the USFWS McNary National Wildlife Refuge, and three additional islands farther upstream are administered by the Bureau of Land Management as areas of critical environmental concern (NPS 1994).

Bathymetric profiles of the entire Hanford Reach do not exist, although some sounding data are available. There is a need to map the Hanford Reach so that critical habitat can be identified for aquatic species. For example, there may be a relationship between depth (or other hydraulic variables) and spawning sites for fall chinook salmon. Additionally, white sturgeon are known to overwinter in deep holes prior to migration to spawning and feeding areas in the spring (Haynes et al. 1978). Finally, some mollusc species may exist in deep water habitat, though no surveys have been made. Designation of deepwater habitats greater than 10 m would be useful in limiting potential impacts to species that require these areas during some portion of their life cycle.

Finally, various kinds of wetland habitat, either associated with the Hanford Reach or the Wahluke Unit, also may be worthy of protection as rare habitat. Such delineation, however, awaits a more refined mapping of wetland habitat on the Hanford Site (Section D.2.3.3 describes those wetland areas that have been mapped and that qualify as element occurrences).

D.2.2.6 Late-Successional Sagebrush-Steppe Habitat

The steppe[8] and shrub-steppe communities of the Columbia Basin Ecoregion have undergone substantial loss or degradation in the post-European era that can be attributed primarily to human-induced change (Dobler 1992; Noss et al. 1995; see further discussion in Appendix C). Although prior to federal acquisition the Hanford Site experienced a moderate level of agricultural development and livestock grazing, the subsequent use of Hanford for the production of defense nuclear materials and later as a center of environmental restoration ironically has protected much of the Site from industrial development and continued encroachment by agricultural and grazing practices (Gray and Becker 1993; Gray and Rickard 1989). Because of this, the Hanford Site retains the largest remnants of native shrub-steppe in the Columbia Basin Ecoregion (Smith 1994).

Prior to the introduction to the shrub-steppe of nonnative annual plants, fire maintained the shrub-steppe in a mosaic of different successional stages (see Knick and Rotenberry 1995, for a similar

[8] Also referred to as steppe without big sagebrush (Franklin and Dyrness 1973) or grassland-steppe (Noss et al. 1995), though in actuality steppe also can contain shrubs including big sagebrush (Daubenmire 1970). Shrub-steppe is a physiognomic subdivision of steppe. Hanford is within the shrub-steppe vegetation zones (Daubenmire 1970; see Appendix C for additional details).

overview of this topic as it applies to Great Basin shrub-steppe). With the presence of non-natives across the landscape, fire frequencies have increased, and the role of fire has changed to one that creates increased opportunities for colonization by aggressive, non-native annual species. The consequences of this new fire pattern and other human impacts to the shrub-steppe have been twofold: (1) within the existing shrub-steppe, the proportion that is late-successional[9] is less than that during pre-European times, and (2) once disturbed, the recovery of early successional stages of shrub-steppe to a late-successional stage is less likely. Thus, late-successional shrub-steppe communities, especially those on deep soils and those that have been left relatively undisturbed, are at a premium within the Columbia Basin Ecoregion.

The DOE-RL recognizes both the importance of late-successional shrub-steppe habitat to the Columbia Basin Ecoregion and the role Hanford plays as a refugium for this habitat.[10] Moreover, the Hanford habitats of concern map (Figure D.12) indicates that all shrub-steppe community types and successional stages of reasonable quality are considered important from the standpoint of impact mitigation.

Although preservation of a mosaic of different successional stages of shrub-steppe on Hanford is vital for maintaining the full diversity of shrub-steppe dependent species, the late-successional stages are most important because recent wildfires have removed much of this habitat. The remainder is at risk from potential land conversion due to waste management and CERCLA cleanup activities on the central plateau of Hanford (an area that contains extensive blocks of late-successional shrub-steppe, principally sagebrush-steppe).

Within the area on Hanford that is covered by late-successional plant communities, there is a mix of shrub and understory conditions (e.g., native perennial bunchgrasses versus non-native annual grasses). To better assess the quality (condition) of the late-successional communities, and by so doing identify those areas for which adverse impacts should be mitigated, a habitat association model is presented below that relates the condition of the habitat to its suitability for use by a shrub-steppe obligate species: the sage sparrow. This species is known to be strongly associated with native shrub-steppe communities containing mature shrubs, especially sagebrush (Braun et al. 1976; Dobler 1992; Rotenberry and Wiens 1978; Schuler et al. 1993).

Typical habitat association models, such as Habitat Suitability Index Models developed by the USFWS, attempt to derive a linear or other relationship between continuous measures of habitat quality and use (e.g., some measure of success in reproduction within the habitat) by an evaluation species. Conversely, the sage sparrow habitat association model presented here is a threshold model, in that the model output indicates a particular locale is suitable for sage sparrows or it is not. The model is applied conservatively. The decision rule associated with application of the model minimizes the error of identifying an area as unsuitable for sage sparrows when in actuality it was.[11] To improve its accuracy, the model should be evaluated in the field in the future.

Model variables for characterizing suitable sage sparrow habitat were based on the literature for sagebrush-dominated plant communities. Sage sparrow probability of occupancy and densities within sagebrush-steppe habitats show a positive relationship with increasing sagebrush coverage (Knick and Rotenberry 1995; Rotenberry and Wiens 1978). At least for density, there seems to be a threshold (about 10% coverage or so) above which the habitat is saturated; that is, sage sparrow density does not increase further (Rotenberry and Wiens 1978). Other studies have assessed differences in sagebrush coverage at sites at which sage sparrows occurred versus sites at which they did not. Although the different results may reflect other site-specific habitat variables or landscape effects not taken into account, sage sparrows seemed to use sites with higher than average sagebrush coverage when the average coverage was low (i.e., less

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9 As defined for the purposes of this section, late-successional shrub-steppe is characterized by a relatively constant plant species composition and by large shrubs (usually big sagebrush) whose canopy cover is relatively stable in the absence of a disturbance.

10 Letter from J. E. Rasmussen to The Hanford Natural Resource Trustees, dated May 22, 1995. Cumulative Impacts on the Mature Shrub-Steppe Habitat of the Central Plateau (200 Area and Vicinity) of the Hanford Site.

11 In applied science, such as when determining biological resource preservation needs, it is important to avoid errors of commission. This is because errors of this type can have irreversibly adverse impacts to biological resources. See Noss (1994) and Shrader-Frechette and McCoy (1993) for an analogous discussion.

than about 10%) (Dobler 1994; Larson and Bock 1986; Wiens 1985). At coverages above about 20%, sage sparrows may select for areas that match the average coverage or are slightly less than average (Larson and Bock 1986; Petersen and Best 1985; Wiens 1985). Based on the preceding data, sagebrush coverage of 10% or more was chosen as a model threshold variable.

Nest-site selection by sage sparrows may be affected by the size distribution of available shrubs and may even include selecting sites on the ground (Winter and Best 1985). Nest-site selection may depend on both maintaining adequate vegetation above the nest for cover and avoiding the high temperatures present at ground level (Winter and Best 1985). Also, selection of the nest shrub may depend on the overall vertical profile of the surrounding vegetation, as well as on the height of the nest shrub itself. The sage sparrow generally selects areas and nest shrubs of above average shrub height (Larson and Bock 1986; Petersen and Best 1985). Finally, sage sparrows generally select sagebrush as nest shrubs that are at least 50 cm (20 in.) in height (Petersen and Best 1985; Reynolds 1981, Rich 1980a). The second model threshold variable was set as: average sagebrush height of at least 50 cm.

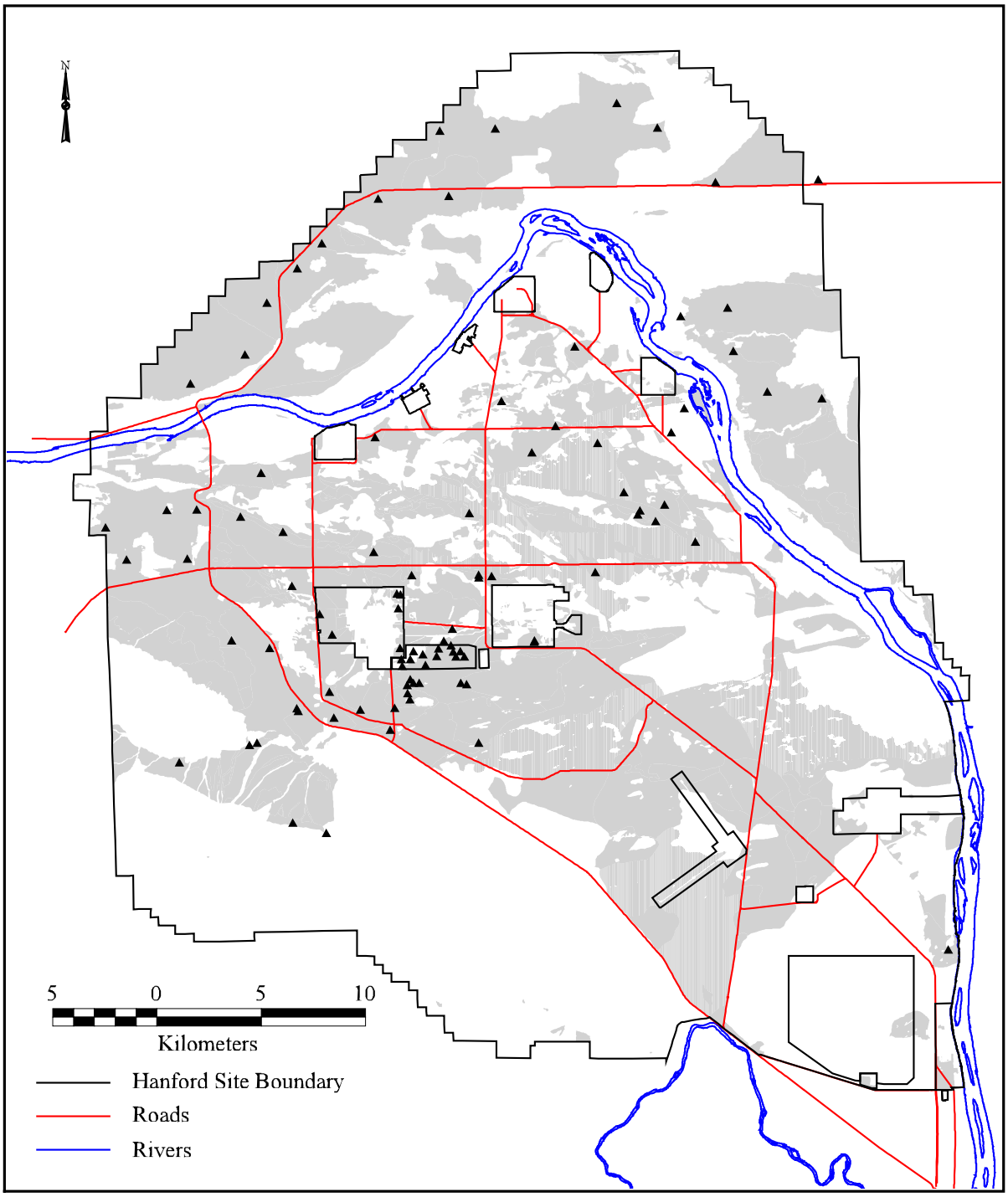
Together, the thresholds for the first two variables establish criteria that focus management attention on late-successional sagebrush-steppe habitat. The third model variable addresses the condition of that habitat in regard to the amount of non-native annual grasses that it contains. Most studies that have addressed aspects of sage sparrow habitat association have not dealt directly with the effect of non-native annual grasses, generally cheatgrass, on that association. Indirectly, however, a number of studies have indicated that sage sparrows select areas for nesting that have a greater amount of bare ground than unoccupied areas (Larson and Bock 1986; Rotenberry and Wiens 1980; Wiens 1985).

Sage sparrows spend a significant amount of time on the ground foraging; thus, sufficient amounts of bare ground in the habitat may be necessary to provide favorable foraging locations (Petersen and Best 1985; Wiens 1985). On Hanford, areas in which cheatgrass dominates tend to have less bare ground as compared with areas in which native perennial bunchgrasses are the major understory component. A few studies compared annual grass coverage (essentially cheatgrass) in occupied versus unoccupied sites (Dobler 1994; M. Vander Haegen, Senior Research Biologist, WDFW, letter report to J. Hall, dated August 2, 1995). Although the data suggest that sage sparrows, on average, use sites with less cheatgrass coverage (mean values of less than 20%) than what is found in unoccupied sites, the relationship between cheatgrass coverage and usage by sage sparrows seems to be more complex (Vander Haegen, Ibid., 1995).

Two considerations govern the selection of an appropriate threshold value for cheatgrass coverage within the habitat association model. First, the information above indicates there is uncertainty relative to the effect of the presence of cheatgrass on habitat usage by sage sparrows. Second, when conducting annual baseline surveys, Hanford Biological Resources Laboratory field crew members qualitatively evaluate ground coverage for each plant species by use of coverage scales that include a range of values (e.g., 5–10%, 10–25%, 25–50%, etc.). Based on these considerations, a threshold value of no greater than 25% ground cover of cheatgrass was used in the model. This value accounts for both the uncertainty of cheatgrass's role in habitat selection by sage sparrows and the manner of vegetation sampling used during baseline surveys of Hanford's industrial areas.

Measured values for the above variables were used to construct a map of suitable sage sparrow habitat via a multi-step process. The first step consisted of determining the modeling region (i.e., that area of the Hanford Site for which the model would apply). Because the model is for late-successional sagebrush-steppe, the modeling region did not include the post-fire land cover class, nor any of the other cover classes in which big sagebrush was not the dominant contributor to cover. The cover classes that were included in the modeling region were (1) big sagebrush/bunchgrasses-cheatgrass, and (2) big sagebrush-spiny hopsage/bunchgrasses-cheatgrass (Figure D.18).

Step two consisted of assembling vegetation transect data. Within the areal extent of the two cover classes identified above, data were available for the three habitat variables at 96 different locations (Figure D.18). These data were assembled from a number of different projects that collected vegetation characterization data using a consistent sampling protocol. Data sources the Ecosystem Monitoring Project (data from spring/summer of 1993 collected in the 600 Area), from Westinghouse Hanford (data from the summer of 1993 collected within



Transect Locations

Big Sagebrush Dominated Cover

Data Collected: 1994, 1997/The Nature Conservancy
1991, 1999 Pacific Northwest National Laboratory
Transect Data Collected: 1993 - 1995/Pacific Northwest National Laboratory
Map Created: September 1999/Pacific Northwest National Laboratory

Figure D.18 Areal Extent of Late-Successional, Big Sagebrush-Dominated Cover Classes and Vegetation Transect Sampling Locations

the 200 Areas), characterization data for the Environmental Restoration Disposal Facility (ERDF) from the Hanford Biological Resources Laboratory (data from the summer of 1994 within and in proximity to the ERDF site), and data from additional sampling conducted by the laboratory within the 200 Areas (summer of 1995). A total of 69 locations were sampled in 1993, 22 in 1994, and 5 in 1995.

The habitat variable data were collected along 100-m- (330-ft-) long transects that extended in a randomly oriented direction. The location of each transect was recorded using topographic maps in 1993 and a GPS in 1994 and 1995. Three replicates of sagebrush cover and mean height were measured along each transect within 10 x 10 m (3.3 x 3.3 ft) plots (spaced at 25–35 m, 50–60 m, and 75–85 m along the transect). Twenty replicates of herbaceous canopy cover were visually estimated using modified Daubenmire plot frames [0.1 m^2 (1.1 ft^2); Daubenmire 1959] spaced 5 m (16 ft) apart. The Daubenmire procedure was modified by placing a 10-cm x 10-cm (4 x 4 in.) grid within the plot frame to aid in estimating percent cover. Cheatgrass cover was recorded as a percentage of ground cover.

For many of the sampling locations, big sagebrush was not the only shrub present. When big sagebrush accounted for roughly 80% or more of the shrub cover recorded along a transect, total shrub cover was used as the value for sagebrush cover, and the height of all shrubs was used to calculate mean shrub height. In these cases, the secondarily dominant shrub was either spiny hopsage or bitterbrush. Both of these shrubs are tall shrubs as is big sagebrush. In other cases, when big sagebrush was not the dominant shrub along the transect, the dominant shrub was rabbitbrush. Rabbitbrush are medium stature shrubs and are generally indicative of a seral stage. For these sampling locations, zero values were assigned for sagebrush cover and height.

Step three consisted of conducting a geostatistical analysis of the habitat data. Geostatistics is a specialized form of statistics that focuses on the spatial continuity (or spatial autocorrelation) of data distributed in space (Isaaks and Srivastava 1989). Most classical statistical analysis techniques assume that data are completely independent of one another. This assumption is incorrect for the majority of environmental data (e.g., geological, soils, or botanical data), because the data normally result from the action of physical and chemical processes that operate continuously over distinct regions of the earth. This results in a strong correlation between data from nearby locations (i.e., a spatial autocorrelation). Geostatistics attempts to quantitatively model this spatial autocorrelation and use the models to improve the accuracy of maps.

The majority of the geostatistical analysis was performed using the averages of the replicate measurements for each variable. The average cover and height of sagebrush at the 96 sample locations were symmetrically distributed around means of 16% and 83 cm (33 in.), respectively. The average cheatgrass cover had a distribution with a slight positive skew with mean and median cover of 20 and 18%, respectively. Examination of the bivariate relationships between the three variables did not reveal any correlation between them (i.e., the highest Spearman rank correlation coefficient was 0.28 between average shrub cover and shrub height).

Variogram analysis and modeling (Isaaks and Srivastava 1989) was performed to determine quantitative models of the spatial continuity of each of the three variables. The variogram plots the average squared difference between pairs of data values separated by a given distance as a function of that distance (Figure D.19). Environmental data normally have lower variogram values for pairs of nearby data points and higher values for pairs of points separated by greater distances. Mathematical functions (e.g., exponential or spherical functions, Isaaks and Srivastava 1989) can then be fit to the experimental variogram to quantitatively describe the spatial continuity of the data set.

Because the geostatistical mapping technique employed in the study was sequential Gaussian simulation (see description below), a normal score transform (Deutsch and Journel 1992) was first applied to the data to transform it to a Gaussian (i.e., normal) distribution. Omnidirectional variogram models were used because no preferential direction of spatial continuity could be detected in the data and there was no prior ecological reason to postulate that any of the three variables would be more continuous in one direction than another. Spherical variogram models (Isaaks and Srivastava 1989) were fit to the normal score transforms of the three variables:

- cheatgrass cover: $((h) = 0.30 + 0.70\ Sph_{4240}(h)$
- sagebrush cover: $((h) = 0.34 + 0.66\ Sph_{3840}(h)$
- sagebrush mean height: $((h) = 0.28 + 0.72\ Sph_{2720}(h)$

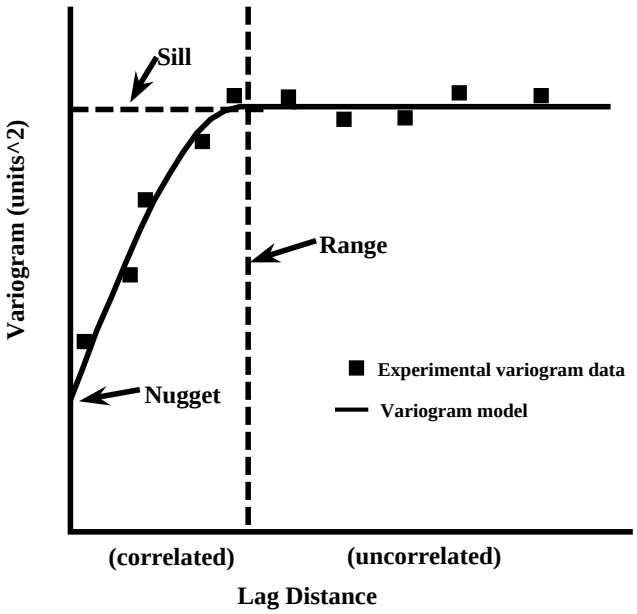


Figure D.19 Sample Variogram Model. The variogram is a geostatistical tool that measures the average squared difference between pairs of data values separated by a given lag distance. At distances less than the range, the variogram is a function of distance related to the degree of spatial correlation. Points separated by distances greater than the range are uncorrelated. The variogram is constant beyond the range, at a value termed the sill, which is usually equal to the total variance. The value of the variogram is defined as zero for a distance of zero, but the nugget can be used to model short-range variability that exists at distances smaller than the sampling interval.

The equations indicate that, for example, the range of spatial continuity of cheatgrass cover was 4240 m (13,910 ft), and that 70% of the total variability in the data can be explained by spatial dependence. The remaining 30% is due to measurement error and small-scale spatial variability that occurs at distances less than the shortest interval between sample pairs [see Isaaks and Srivastava (1989) for a more complete discussion of variogram modeling for the quantification of spatial continuity].

The geostatistical technique used to map the habitat variables was conditional simulation. Conditional simulation is a Monte Carlo technique that can be used to generate large numbers of equally probable maps of a variable. Each of the equally probable maps honors the conditioning sample data and the variogram model of spatial continuity. The simulations are generated at a regular series of locations (grid nodes) laid across the area. The grid spacing for the simulations of shrub height, shrub cover, and cheatgrass cover produced for this study was 100 m (330 ft). At each grid node, the surrounding data and the variogram model are used to estimate the conditional distribution of the variable at that node. A uniform random number between 0 and 1 is then used to draw a value from the conditional distribution. For this study, 100 conditional simulations of each variable were then generated using the sequential Gaussian simulation program SGSIM (Deutsch and Journel 1992). Conditional simulations honor the available data, the frequency distribution (histogram) of the data, and the spatial continuity model (variogram model) fit to the data. The simulations were generated independently because no correlation was detected between the three variables.

For step four, the output of the geostatistical analysis was used to determine the suitability of each location on the 100-m grid as sage sparrow habitat. A program was written to read in the three simulated values at each grid node within a geographic area (the simulation space) that includes the modeling region. (At the end of the process, the output values of the simulation outside of the modeling region were masked out.) To determine if the grid node would be mapped as sage sparrow habitat, the following test was applied for each simulation:

- suitable habitat = cheatgrass ground cover ≤25% AND sagebrush cover ≥10% AND sagebrush mean height ≥50 cm (20 in.).

If the grid node tested positive for sage sparrow habitat for that simulation, then a counter was incremented. The output of the program was an array that contained the counts of the number of simulations for which sage sparrow habitat tested positive at each grid node. This Monte Carlo approach was used to estimate the probability that the area represented by a given grid node contains sage sparrow habitat by using the proportion of simulations for which the test was positive. For example, if 45 simulations out of 100 at a grid node tested positive for sage sparrow habitat, then the estimated probability of suitability for that area would be 45%.

Because the impact to suitable habitat may be irreversible, the model was applied conservatively (see earlier discussion above). Therefore, for the map of suitable habitat, only five simulations had to be positive for a given grid node to be considered suitable sage sparrow habitat. For the final

step, the cover map (Figure D.18) was then applied as a mask to the results of the probability map to blank all areas outside of the modeling region (i.e., areas that did not contain late-successional sagebrush-steppe habitat). The final result of habitat association modeling for the sage sparrow is presented in Figure D.20. In addition to removing certain areas from consideration as potential sage sparrow habitat based on the model output, the final map also includes the effect of constructing the ERDF.

Actual occupancy by sage sparrows of areas depicted in Figure D.20 also may depend on landscape effects (Knick and Rotenberry 1995) not examined by the geostatistical model. Knick and Rotenberry found that habitat usage by sage sparrows depended on the patch size of shrub-steppe habitats and the spatial similarity of the habitat within the patch (i.e., how homogeneous the patch is). Their results suggest that fragmentation of the shrub-steppe adversely affects the presence of sage sparrows (as well as other shrub-obligate species). The application of Figure D.20 at the landscape level is to recognize the detrimental effects of fragmentation and to manage the remaining late-successional communities in a manner that minimizes additional fragmentation or even reverses it. Moreover, if further impacts to the shrub-steppe are unavoidable, their spatial occurrence should be directed away from the largest patches of remaining late-successional shrub-steppe.

Although Figure D.20 is intended to help steer site-wide development plans away from late-successional sagebrush-steppe, and by doing so reduce both impacts to biological resources and compensatory mitigation costs, habitat quality models also may be necessary to apply at a smaller scale such as in determining both appropriate site selection for individual projects and any mitigation costs. For individual projects, it may be appropriate to consider a threshold value for the amount of habitat loss that is allowed before it is necessary to consider compensatory mitigation. A possible approach is to base such a threshold value on the breeding territory size of a sage sparrow pair.

For sage sparrows, territory size is positively related to reproductive success (Petersen and Best 1987). Males occupy non-overlapping singing territories; however, foraging areas may overlap (Wiens et al. 1985; see also Petersen and Best 1987). Rich (1980b) reported that territory size changed in size and shape both daily and seasonally as breeding progressed; however, once established, Petersen and Best (1987) reported that territories remained fixed throughout the breeding season. The size of the territory may depend on habitat features; thus, sage sparrow territories tend to be larger in habitats that include spinescent shrubs (i.e., spiny hopsage) compared with pure sagebrush habitats (Wiens et al. 1985).

The ability to detect the effects of habitat differences on territory size are complicated, however, by the effects of differences in population density. Although at low population densities sage sparrows may select for optimal habitat conditions, at high densities (when a minimal acceptable territory size may be reached) individuals may be forced to occupy habitats with suboptimal conditions (Wiens et al. 1985). Finally, sage sparrows seem to possess an adaptive behavior that expresses itself as a shift in the location of the territory with each breeding season. The behavior seems to be directed at achieving an increase in territory size (Petersen and Best 1987).

Documented sage sparrow territory sizes range from around 0.4 ha (1 acre) (Petersen and Best 1987) to about 7.1 ha (17.5 acres) (Rich 1980b). Data collected specifically at Hanford on the ALE Unit depict plot means that range from 0.65 ha (1.6 acres) (mean of nine territories) to 1.57 ha (3.9 acres) (mean of 6 territories) (Wiens et al. 1985). Relative to data from other geographic locations, the ALE Unit data correspond to territory sizes that occur under high population densities (Wiens et al. 1985, their Figure 3). Based on the preceding discussion, 0.5 ha (1.2 acres) seems to be a reasonable, conservative estimate of the minimum territory size that may be expected to occur for a sage sparrow at Hanford.

D.2.3 Plant Communities

D.2.3.1 Protection of Washington's Natural Heritage: The Natural Heritage Program

Unaltered ecosystems are highly evolved, interactive associations of abiotic and biotic components. These associations cannot be duplicated artificially. Moreover, they represent storehouses of natural diversity. Examples of these complex ecological systems may be invaluable to future generations in

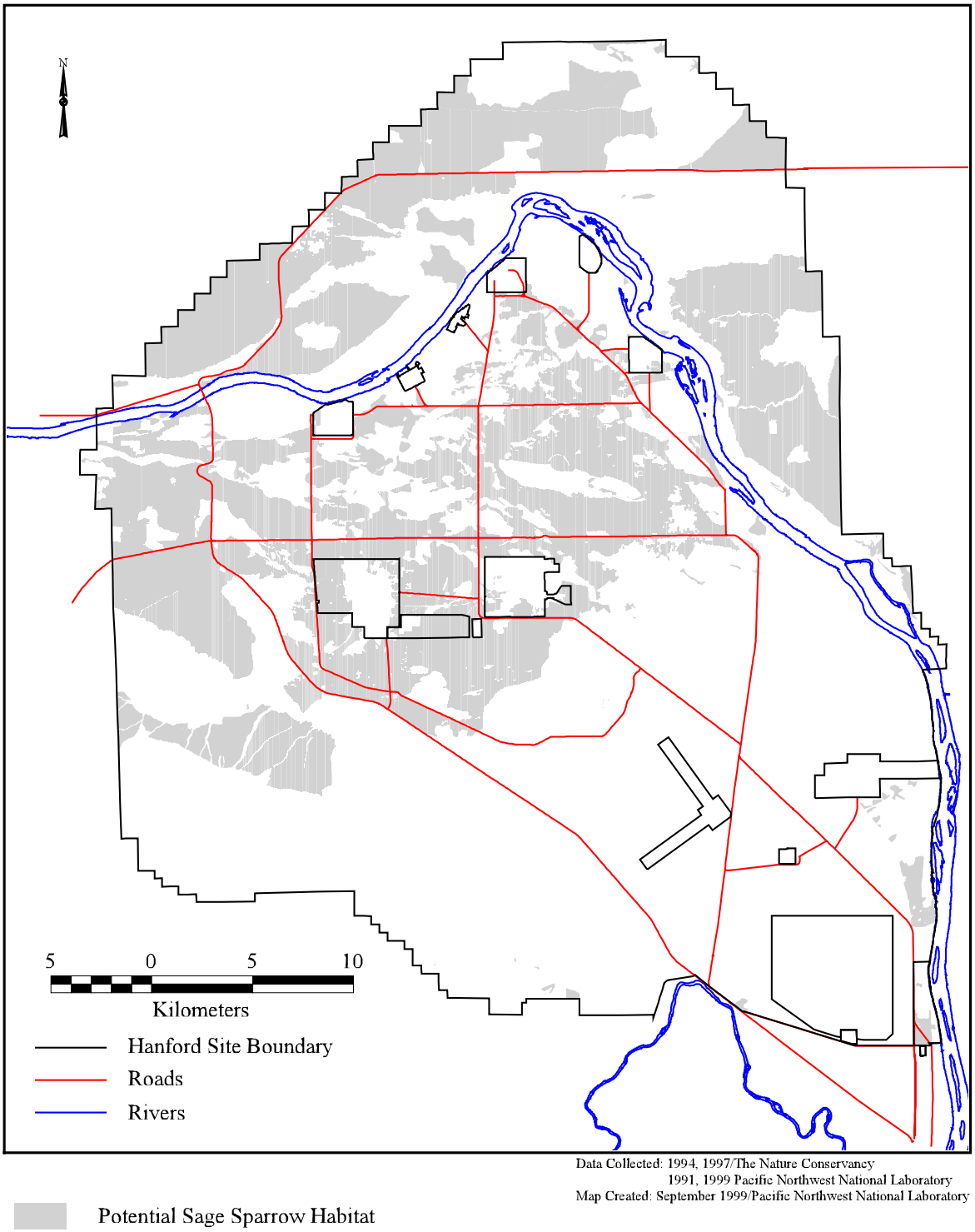


Figure D.20 Areas of Potential Usage by Sage Sparrows Based on a Modeling of Habitat Association

ways that presently cannot be foreseen (WDNR 1995). In 1972, the Washington State Legislature recognized the need to preserve such areas and passed the Natural Area Preserves Act [Chapter 79.70 Revised Code of Washington (RCW)]. The legislature declared: "It is, therefore, the public policy of the State of Washington to secure for the people of present and future generations the benefit of an enduring resource of natural areas" (RCW 79.70.010). The act authorized the WDNR to cooperate with federal and other governmental agencies to establish and manage natural areas. Federal counterparts to the state system of managed natural areas include Research Natural Areas (such as the ALE Unit) and Areas of Critical Environmental Concern (managed by the Bureau of Land Management). Washington State law (i.e., RCW 79.70) and regulations (Washington Administrative Code 332–60) enable registration of federal natural areas as components of the statewide Natural Area System (WDNR 1995).

A 1981 amendment to the Natural Area Preserves Act established the Natural Heritage Program within WDNR. Part of this program's mandate was to establish a classification scheme for the state's natural heritage resources (i.e., the state's natural diversity) and to provide assistance in the selection and nomination of areas for the protection of their qualifying resources (WDNR 1995).

D.2.3.2 Ecological Significance of Element Occurrences

Washington's natural diversity consists of thousands of plant and animal species that interact with each other and their physical environment. Faced with such numbers, a systematic approach is needed to inventory and protect the state's natural diversity. The technique used by WDNR's Natural Heritage Program is to classify Washington's natural diversity into elements. As defined in the Natural Heritage Plan, an element is a basic unit of Washington's biologic and geologic environment identified as a needed component of a system of natural areas. An element is an entire ecological system, such as a plant community or a wetland ecosystem, that includes the common plants and animals of that system (WDNR 1995).

Elements are evaluated for their present condition and ability to persist over time. Additionally, their ecological quality, diversity, and viability are compared with other occurrences of the element to determine which occurrence(s) provides the best representation of the element. There also is a site analysis that considers the ability of the location containing the element to both provide protection against human-induced disturbances and to enable management, either actively or passively, that maintains the element (or natural processes) through time. By tracking the location and quality of the various occurrences of a particular element, the Natural Heritage Program can assess the significance of a given occurrence relative to other occurrences in the state or region.

Because it is a more efficient use of public and private lands and funds to select sites with multiple elements, selection of a natural area favors those sites containing multiple elements. Many federal agencies use WDNR's approach for selecting natural areas (WDNR 1995).

Elements also are ranked in regard to their priority for receiving protection based on the element's rarity (regionally as well as state), the degree of threat to which the element is exposed to within Washington, and the adequacy of protection for the element by existing land management (WDNR 1995). The evaluation of protection adequacy also considers whether currently protected element occurrences are adequate representatives of an element. Based on these guidelines WDNR assigns one of three priority rankings to each terrestrial, wetland, or aquatic ecosystem element. Priority designations are as follows:

- Priority 1: elements in the greatest jeopardy of being destroyed or degraded, with few occurrences in natural condition and little or no protection in existing natural areas
- Priority 2: elements in an intermediate level of jeopardy, with few occurrences in natural condition, and little or no protection in existing natural areas
- Priority 3: elements not in immediate jeopardy, with varying numbers of occurrences in natural condition, and some protection in existing natural area.

D.2.3.3 Element Occurrences on the Hanford Site

In 1994, TNC evaluated for the ALE Unit and Wahluke Unit each occurrence of a plant community type considered by the Natural Heritage Program

to be an element (TNC 1995). Each element was evaluated as to its condition, size, and proximity to disturbance vectors such as roads, power lines, off-road vehicle trails, or livestock grazing. Three factors formed the basis for the condition evaluation: (1) the degree of invasion by non-native plant species; (2) the composition of the community as compared with descriptions by Daubenmire (1970), the Natural Heritage Program, or other occurrences of the same element; and (3) the degree of soil disturbance and amount of microbiotic crust cover. The Nature Conservancy identified as potential element occurrences (i.e., a high-quality representative of a native plant community type) only those occurrences that met high-quality standards associated with the evaluation factors described above. The Natural Heritage Program subsequently reviewed the TNC evaluation results and made the final determination as to which occurrences qualified as element occurrences.[12]

The Nature Conservancy conducted additional field work along the south shore of the Hanford Reach during 1995. They identified six potential element occurrences of low elevation riparian wetlands (Salstrom and Easterly 1995). The Natural Heritage Program subsequently determined that all six qualified as element occurrences.[13] Based on field work conducted in 1996, Natural Heritage Program staff added an additional six element occurrences of the big sagebrush/Sandberg's bluegrass plant community type. This community type is not yet identified in the Natural Heritage Plan (WDNR 1995), but it is intended to be added to the next addition of the plan.[14]

The results of the 1994, 1995, and 1997 TNC evaluations and Natural Heritage Program reviews and 1996 field work are summarized pictorially in Figure D.21. The map is a reclassification of the appropriate portions of the Figure D.1 land cover classes. Because identification of an element is based on the potential plant community type (i.e., the plant composition that represents a last stage of succession), some of the qualifying seral communities identified in Figure D.1 are reclassified in Figure D.21 on this basis. Data on Natural Heritage Program priority ranking, number of occurrences, and area totals for each plant community type are summarized in Table D.3. The six low-elevation riparian wetland element occurrences, which occurred along the south shore of the Hanford Reach, are not included in Table D.3. Currently, only approximate locational information (shown in Figure D.21) is available for these element occurrences. Area information will be added at a later date.

A total of 38 separate terrestrial plant communities, representing 17 elements recognized by the Natural Heritage Program qualified as element occurrences. The 17 elements constitute about 40% of all the terrestrial elements found in the Columbia Basin Province of Washington (WDNR 1995).[15] Only three elements are common to both the ALE Unit and the Wahluke Unit. This indicates that, to protect the full range of element diversity, both the ALE Unit and the Wahluke Unit must be considered. The element occurrences occupy about 18,280 ha (45,170 acres) of the ALE Unit and about 6,290 ha (15,540 acres) of the Wahluke Unit. The large sizes and excellent conditions of the big sagebrush/bluebunch wheatgrass community (ALE Unit) and the bitterbrush/Indian ricegrass sand dune complex (Wahluke Unit) are especially noteworthy (TNC 1995).

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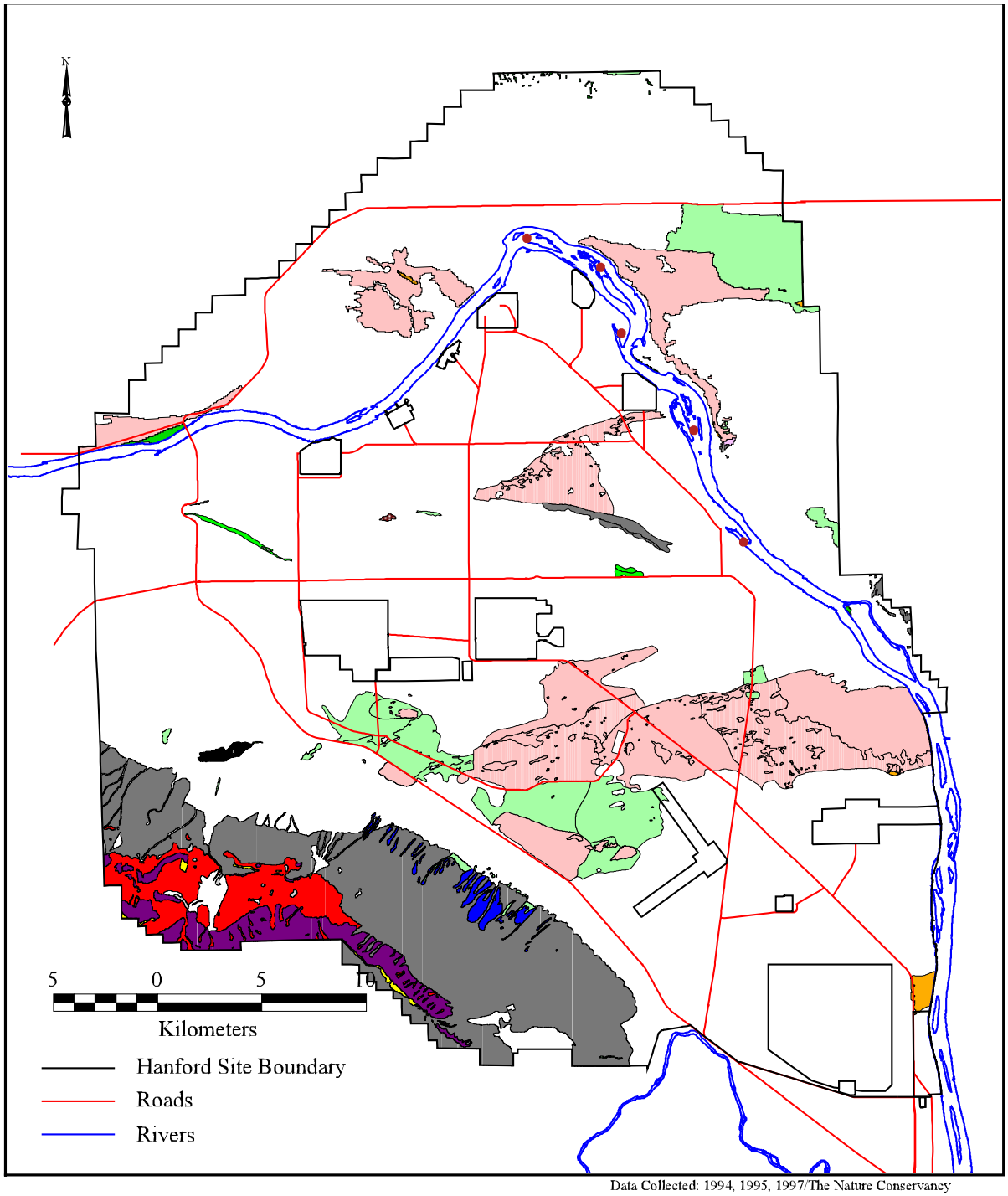
12 TNC (1995) identified 38 potential element occurrences; however, the Natural Heritage Program determined that six of these did not qualify as element occurrences because of inadequate ecological condition and/or size [Letter from M. Sheehan, Washington Natural Heritage Program, Washington Department of Natural Resources to L. Cadwell (PNNL), dated February 27, 1996.]

13 Although the Natural Heritage Program recognized all six occurrences, the areal extent accepted was smaller than that indicated in Salstrom and Easterly (1995) [Letter from C. Chappell, Washington Natural Heritage Program, Washington Department of Natural Resources to L. Cadwell (PNNL), dated May 31, 1996]. Because the element occurrences are connected to nearby cover types through hydrology and fluvial processes, the Natural Heritage Program recommended, however, the protection of the entire original areas mapped as element occurrences by Salstrom and Easterly (1995) to protect the integrity of the element occurrences.

14 Letter from C. Chappell, Washington Natural Heritage Program, Washington Department of Natural Resources to L. Cadwell (PNNL), dated August 6, 1996. Letter from M. Sheehan, Washington Natural Heritage Program, Washington Department of Natural Resources to L. Cadwell (PNNL), dated February 27, 1996.

15 The boundaries of the Columbia Basin Province as described in WDNR (1995) mostly encompasses the Washington portion of the Columbia Basin Ecoregion.



Data Collected: 1994, 1995, 1997/The Nature Conservancy
1996/Washington Natural Heritage Program
Map Created: August 1999/Pacific Northwest National Laboratory

● Approximate locations of low elevation riparian wetlands along the Hanford Reach

Figure D.21 Washington State Natural Heritage Program Element Occurrences on the Hanford Site Exclusive of the Upland Portions of the Central Core (Map)

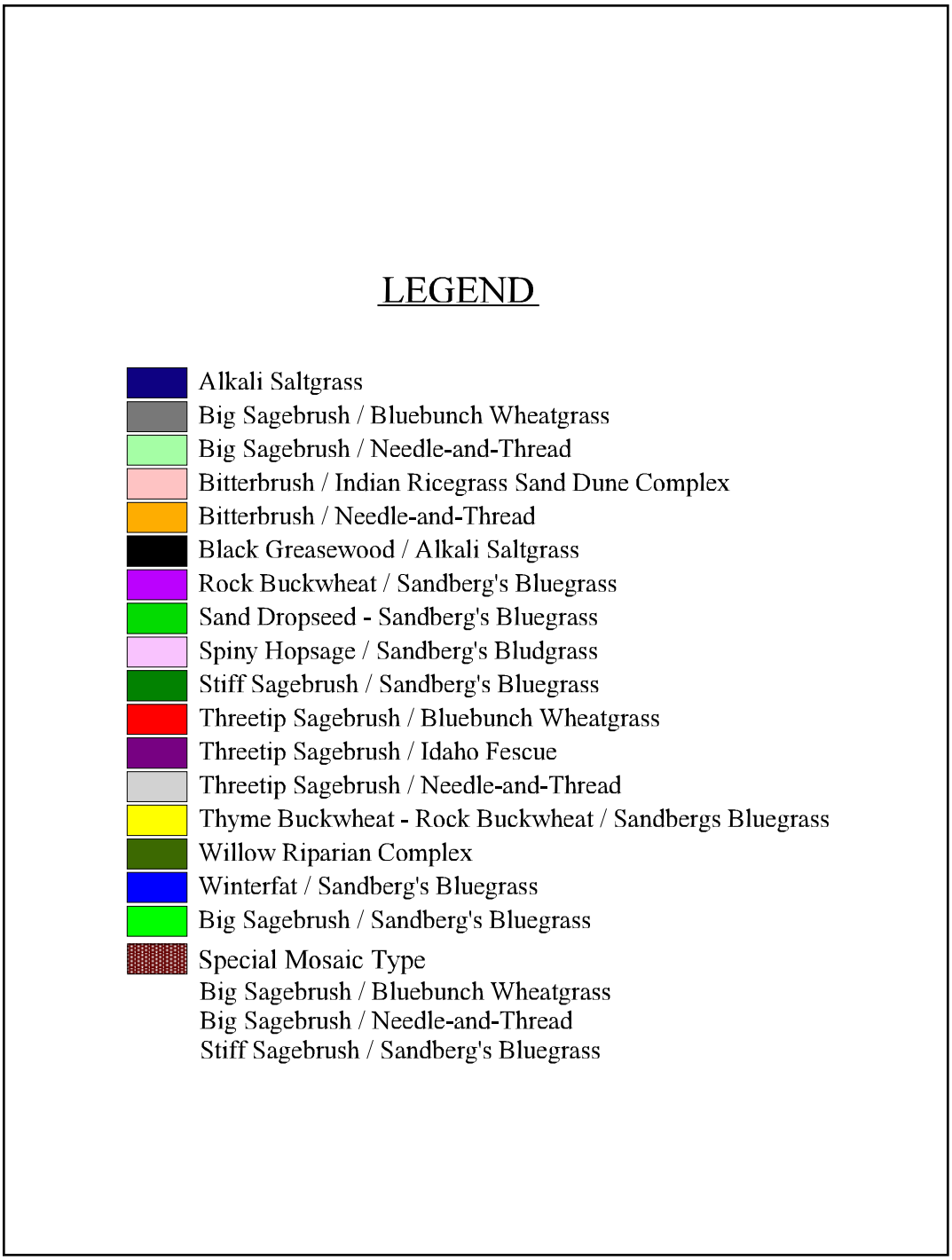


Figure D.21 Washington State Natural Heritage Program Element Occurrences on the Hanford Site Exclusive of the Upland Portions of the Central Core (Legend)

Table D.3 Potential Plant Community Types of the Hanford Site that had at Least One Qualifying Element Occurrence (EO)

Potential Plant Community Type	Total Acreage on the Hanford Site (acres/ha)	WNHP Protection Priority Status*	Number of EOs on the ALE Reserve	Total Acreage Qualifying as EOs on the ALE Reserve (acres/ha)	Number of EOs on the North Slope	Total Acreage Qualifying as EOs on the North Slope (acres/ha)	Number of EOs on Central Hanford[(a)]	Total Acreage Qualifying as EOs on Central Hanford (acres/ha)[(a)]
Alkali saltgrass	6/3	1	0	0	1	6/3	0	0
Big sagebrush/bluebunch wheatgrass	37,384/15,129	2	1	28,714/11,622	2	163/66	1	665/269
Big sagebrush/needle-and-thread	84,701/34,278	1	1	245/99	3	5330/2156	2	8133/3291
Big sagebrush/Sandberg's bluegrass	43,060/17,426	3	5	3669/1485	1	1223/495	2	322/130
Bitterbrush/Indian ricegrass dune complex	34,379/13,913	1	0	0	3	8433/3413	3	20,993/8496
Bitterbrush/needle-and-thread	1384/560	1	0	0	3	63/25	1	349/141
Black greasewood/alkali saltgrass	299/122	1	1	299/122	0	0	0	0
Rock buckwheat/ Sandberg's bluegrass[(b)]	126/51	ap	2	126/51	0	0	0	0
Sand dropseed/ Sandberg's bluegrass	4332/1753	2	0	0	3	225/90	0	0
Spiny hopsage/ Sandberg's bluegrass	2713/1098	3	0	0	2	37/15	0	0
Stiff sagebrush/ Sandberg's bluegrass	144/58	3	0	0	1	74/30	0	10/4
Threetip sagebrush/ bluebunch wheatgrass	6227/2520	2	2	6059/2451	0	0	0	0
Threetip sagebrush/Idaho fescue	4703/1903	2	1	4703/1903	0	0	0	0
Threetip sagebrush/ needle-and-thread	116/45	1	1	116/45	0	0	0	0
Thyme buckwheat/ Sandberg's bluegrass[(b)]	124/50	2	2	124/50	0	0	0	0
Willow riparian complex	61/25	1	2	24/10	0	0	0	0
Winterfat/Sandberg's bluegrass	1164/471	3	1	1092/443	0	0	0	0
Total	220,923/89,405	—	19	45,171/18,281	19	15,554/6293	10	30,472/12,331

*Washington Natural Heritage Program (WNHP) Protection Priority Status (WDNR 1995): **ap**—adequately protected.
Priority 1—Elements in the greatest jeopardy of being destroyed or degraded, limited distribution in Washington and few occurrences in natural condition, and little or no representation in existing natural areas or other protected areas.
Priority 2—Elements at an intermediate level of jeopardy, regional distribution in Washington and few occurrences in natural condition, and little or no representation in existing natural areas or protected areas (may receive some *de facto* protection in other managed areas).
Priority 3—Elements not in immediate jeopardy but are still significant components of the state's natural heritage, regional distribution in Washington, and varying numbers of occurrences in natural condition, and may be partially represented in existing natural areas (or, if not in natural areas, are in areas that provide *de facto* protection).
(a) The tally for the number of element occurrences per potential plant community type includes instances when a type contributed solely to an element occurrence plus when it was the largest type (by acreage) within a mosaic of multiple potential plant community types, each of which qualified as an element occurrence. Total acreage per potential plant community type also includes the percentage amount contributed by a type when it qualified as an element occurrence as part of a mosaic. See text for additional details.
(b) Rock and thyme buckwheat mostly occurred together. Where they occurred together, the total area occupied was split equally between the two shrub community types.

D.2.3.4 Use of Designated Natural Areas to Manage Hanford's Element Occurrences

In 1971, the ALE Unit was designated the Rattlesnake Hills Research Natural Area as a result of an interagency federal cooperative agreement (PNL 1993). It constitutes the single largest tract in the federal RNA system for Oregon and Washington (Franklin et al. 1972; Rickard 1972). Research Natural Areas preserve plant communities and other natural features primarily for scientific and educational purposes. In short, RNAs provide: (1) baseline areas against which to compare the effects of human activities in similar environments, (2) sites for study of natural processes in undisturbed ecosystems, and (3) gene pool preserves for plant and animal species, especially species of concern (Franklin et al. 1972). Because of their purpose and protection status, federal RNAs can be important components of Washington State's Natural Area System (WDNR 1995).

Prior to the 1994 TNC surveys, Washington's Natural Heritage Plan (WDNR 1995) had identified the presence of six types of terrestrial (i.e., plant community) element occurrences and two types of wetland and aquatic ecosystem element occurrences (see section on rare habitats in D.3.2) on the ALE Unit. The TNC study identified the presence of five new types of terrestrial element occurrences on the ALE Unit (TNC 1995).[16] Natural Heritage Program surveys during 1996 added one more. Moreover, the number and extent of the ALE Unit element occurrences are now mapped (Figures D.17 and D.21) and their condition documented.

Because the ALE Unit already is administered as a RNA, the element occurrences, new and old, are considered to exist under a high degree of protection (WDNR 1995). Such protection is not necessarily the case for the newly identified element occurrences on the Wahluke Unit. Current management practices and administrative designations on the Wahluke Unit may require revision to appropriately protect the 19 occurrences of nine elements on the Wahluke Unit as natural areas. Appropriate management strategies are discussed in Sections 7.3 and 7.4.

D.2.4 Administrative Areas

Some areas of the Hanford Site have administrative designations that establish the perpetuation of biological resources values, among other values, as at least one of their top priorities (Figure D.22). These are no impact zones or at least areas within which adverse impacts to biological resources of concern (i.e., levels III and IV) should be fully mitigated.

As an RNA, the ALE Unit is managed primarily for its scientific and educational values insofar as these values relate to the ALE Unit's role as perhaps the best remnant of the shrub-steppe ecosystem in the Columbia Basin Ecoregion. Access to the ALE Unit is restricted if the purposes are not compatible with the primary management goals. As a natural area, management emphasis for the ALE Unit must be on maintaining (or enabling to change naturally) the native biotic composition and natural ecological processes that presently exist. To accomplish this, even mitigation (or buffering) of human-induced changes adjacent to the ALE Unit may need to be considered.

The Saddle Mountain Unit and the Wahluke Unit are managed primarily for their wildlife and habitat values. Access to the national refuge is restricted; whereas, regulated public access is allowed on the Wahluke Unit. The documented presence of numerous plant community element occurrences and rare plant populations (TNC 1995) may necessitate some changes in management approach for these areas.

D.2.5 Species of Concern

In this section, detailed biological and regulatory information is provided at the level of the individual species. The information provided includes: (1) federal and state listing status, (2) WDNR Natural Heritage Program or WDFW Priority Species status, (3) state and global rarity data, (4) whether the species is endemic to the ecoregion, (5) distribution within the ecoregion, (6) habitat association, (7) Hanford relative abundance, (8) and the resource level of concern to which the species is assigned to at Hanford.

[16] One plant community type previously identified in the Heritage Plan, spiny hopsage/Sandberg's bluegrass, was not identified on the ALE Unit by TNC but is present on the Wahluke Unit and more than likely within the central core. See text for additional discussion.

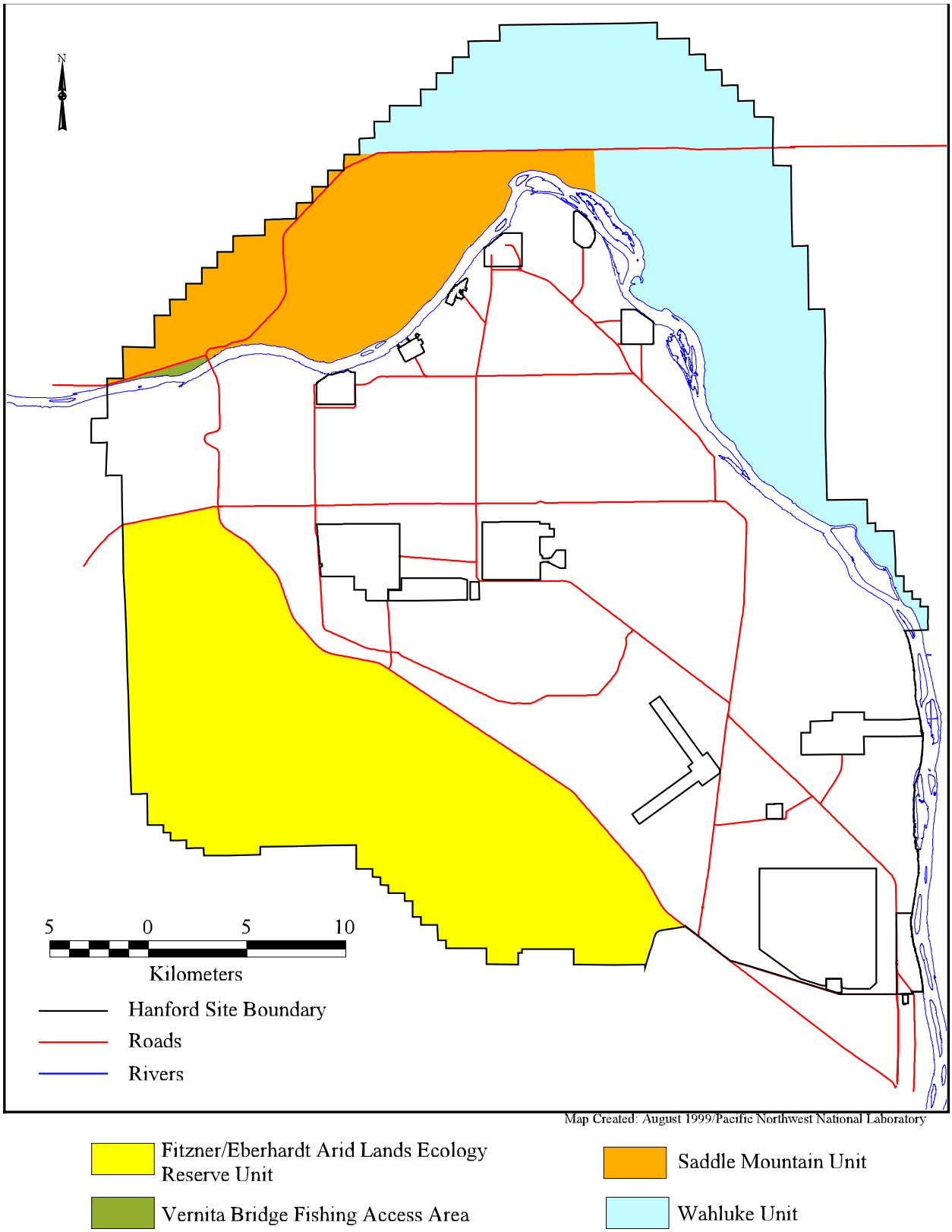


Figure D.22 Administratively Designated Areas of Hanford Within Which Protection of Biological Resource Values is a Priority Consideration

Because the Columbia Basin Ecoregion constitutes the relevant ecological boundary for assessing the significance of and impacts to species of concern, information relative to each species for Oregon is provided when available to supplement the Washington data. For some taxa or specific species, the information is not as complete. In general, however, the tabular information that follows represents the best information available.

Species data are provided first by taxa. Additional tabular information includes culturally and ecologically important species not otherwise identified as species of concern. Finally, information is provided on species recently discovered at Hanford that are either new to science, new to Washington, or new to Hanford. For the first two new species categories, federal and/or state listing statuses still need to be determined. To facilitate review of the tabular information, this section begins by providing definitions of federal and state listing and priority species categories, protection priorities, and rarity statuses. This information is common to many of the tables. By providing it in one place, the need to repeat the information for each table is avoided.

D.2.5.1 Common Reference Information for Species of Concern Data Tables

Federally Listed and Federal Candidate Species: References

U.S. Fish and Wildlife Service. August 20, 1994. Endangered and Threatened Wildlife and Plants. 50 CFR 17.11 and 17.12.

U.S. Fish and Wildlife Service. February 28, 1996. Endangered and Threatened Wildlife and Plants; Review of Plant and Animal Taxa that are Candidates for Listing as Endangered or Threatened Species. 61 FR 7595–7613.

www.fws.gov/r9endspp/endspp.html

Federally Listed and Federal Candidate Species: Category Definitions

Endangered - a species that is likely to become extinct throughout all or a significant portion of its range.

Threatened - a species that is likely to become endangered in the foreseeable future.

Proposed - a species for which a proposed rule to list as endangered or threatened has been published in the Federal Register.

Candidate (previously defined as candidate category 1) **-** a species for which there is sufficient information on biological vulnerability and threat(s) to support issuance of a proposed rule to list it as endangered or threatened but issuance of the proposed rule is precluded (i.e., by other listing activity or lack of funding).

Added definition for the purposes of BRMaP:

Former Candidate - a species previously proposed for listing (whether or not a proposed rule was ever published in the Federal Register) or a species for which information at one time indicated that proposing to list it as endangered or threatened was possibly appropriate, but for which sufficient information on biological vulnerability and threat(s) were not available to support a proposed rule to list.

Washington State Listed, Candidate, and Monitor Species: References

Plants

Washington Department of Natural Resources. 1994. Endangered, Threatened & Sensitive Vascular Plants of Washington. Washington Department of Natural Resources, Washington Natural Heritage Program, Olympia, Washington.

www.wa.gov/dnr/
www.wa.gov/wdfw/hab/phspage.htm

Animals

Washington Department of Wildlife. 1994. Species of Special Concern in Washington. Washington Department of Wildlife, Olympia, Washington, as amended by a listing and candidate notice update by the now Washington Department of Fish and Wildlife, dated April 2, 1996.

www.wa.gov/wdfw

Washington State Listed, Candidate, and Monitor Species: Category Definitions

Plants

Endangered - a species that is likely to become extinct throughout all or a significant portion of its range within the state.

Threatened - a species that is likely to become endangered in the foreseeable future.

Sensitive - a species that is likely to become endangered or threatened in a significant portion of its range within the state.

Review 1 - a species in need of additional field work before a status can be assigned.

Review 2 - a species with unresolved taxonomic questions.

Watch List Species - a species more abundant and/or less threatened in Washington than previously assumed.

Animals

Endangered - wildlife species native to the state of Washington that are seriously threatened with extinction throughout all or a significant portion of its range within the state.

Threatened - wildlife species native to the state of Washington that are likely to become endangered in the foreseeable future throughout significant portions of their ranges within the state without cooperative management or the removal of threats.

Sensitive - wildlife species native to the state of Washington that are vulnerable or declining and are likely to become endangered or threatened throughout significant portions of their ranges within the state without cooperative management or the removal of threats.

Candidate - wildlife species that are under review by the Washington Department of Wildlife for possible listing as endangered, threatened, or sensitive.

Monitor - Wildlife species native to the state of Washington that:

1 - were at one time classified as endangered, threatened, or sensitive

2 - require habitat that has limited availability during some portion of its life cycle

3 - are indicators of environmental quality

4 - require further field investigations to determine population status

5 - have unresolved taxonomy which may bear upon their status classification

6 - may be competing with and impacting other species of concern

7 - have significant popular appeal.

Washington State Species Protection Priorities: References

Plants

Washington Department of Natural Resources. 1995. State of Washington Natural Heritage Plan: 1993/1995 Update. Washington Department of Natural Resources, Washington Natural Heritage Program, Olympia, Washington.

Animals

Washington Department of Fish and Wildlife. 1996. Priority Habitats and Species List. Washington Department of Fish and Wildlife, Habitat Program, Olympia, Washington.

Washington State Species Protection Priorities: Category Definitions

Plants

Priority 1 - These taxa are in danger of becoming extinct throughout their ranges. These taxa's populations are at critically low levels or their habitats are degraded or depleted to a significant degree. These taxa are the highest priorities for preservation.

Priority 2 - These taxa will become endangered in Washington if factors contributing to their population decline or habitat degradation or loss continue. These taxa area high priorities for preservation efforts.

Priority 3 - These taxa are vulnerable or declining and could become endangered or threatened in the state without active management or removal of threats. These taxa should be important in the analysis of potential preserve sites.

Animals

Criterion 1 (State Listed and Candidate Species) - State listed species are those native fish and wildlife species legally designated as Endangered (WAC 232-12-014), Threatened (WAC 32-12-011), or Sensitive (WAC 232-12-011). State Candidate species are those fish and wildlife species that will be reviewed by the department (POL-M-6001) for possible listing as endangered, threatened, or sensitive according to the process and criteria defined in

WAC 232-12-297. Federal candidate species are evaluated individually to determine their status in Washington and whether inclusion as a priority species is justified.

Criterion 2 (Vulnerable Aggregations) - Vulnerable aggregations include those species or groups of animals susceptible to significant population declines, within a specific area or statewide, by virtue of their inclination to aggregate. Examples include heron rookeries, seabird concentrations, marine mammal haulouts, shellfish beds, and fish spawning and rearing areas.

Criterion 3 (Species of Recreational, Commercial, and/or Tribal Importance) - Native and non-native fish and wildlife species of recreational or commercial importance and recognized species used for tribal ceremonial and subsistence purposes that are vulnerable to habitat loss or degradation.

Oregon State Listed, Sensitive, and Candidate Species: References

Plants

Oregon Department of Agriculture. 1995. Oregon Administrative Rules 603, Division 73. Plants: Endangered, Threatened, and Candidate Species. Oregon Department of Agriculture, Salem, Oregon.

Animals

Oregon Department of Fish and Wildlife. 1993. State List of Sensitive Species. Oregon Department of Fish and Wildlife, Portland, Oregon.

Oregon Department of Fish and Wildlife. 1994. Oregon Administrative Rules (635–100–125): State List of Threatened and Endangered Species. Oregon Department of Fish and Wildlife, Portland, Oregon.

Oregon Department of Fish and Wildlife. 1994. Oregon Administrative Rules (635–100–100): Definition of Terms. Oregon Department of Fish and Wildlife Portland, Oregon.

Oregon State Listed, Sensitive, and Candidate Species: Category Definitions

Plants

Endangered - a species that is likely to become extinct throughout all or a significant portion of its range within the state**.**

Threatened - a species that is likely to become endangered in the foreseeable future.

Candidate - a species under review for listing as endangered or threatened.

Animals

Endangered - a species that is likely to become extinct throughout all or a significant portion of its range within the state.

Threatened - a species that is likely to become endangered in the foreseeable future.

Sensitive species are divided into the following categories:

Sensitive/critical - a species for which listing as threatened or endangered is pending or one for which listing as threatened or endangered may be appropriate if conservation actions are not taken.

Sensitive/vulnerable - a species for which listing as threatened or endangered is not believed to be imminent and can be avoided through continued or expanded use of adequate protective measures and monitoring.

Sensitive/peripheral and sensitive/naturally rare (considered one category) - a species whose Oregon populations are on the edge of their range and which had low population numbers historically in Oregon because of naturally limiting factors, respectively.

Sensitive/undetermined status - a species whose status is unclear and for which scientific study is required before its status can be determined.

Global and State Rarity Status: References

Plants

Washington Department of Natural Resources. 1994. Endangered, Threatened & Sensitive Vascular Plants of Washington. Washington Department of Natural Resources, Washington Natural Heritage Program, Olympia, Washington.

The Nature Conservancy of Oregon. 1995. Oregon Natural Heritage Program, Rare Plant and Animal Data Base. The Nature Conservancy, Portland, Oregon.

Animals

Washington Department of Natural Resources. 1995. Washington National Heritage Information System. Washington Department of Natural Resources, Washington Natural Heritage Program, Olympia, Washington.

The Nature Conservancy of Oregon. 1995. Oregon Natural Heritage Program, Rare Plant and Animal Data Base. The Nature Conservancy, Portland, Oregon.

Global and State Rarity Status: Category Definitions

Plants

G - indicator of global, i.e., rangewide, status.

T - indicator of status of infraspecific taxa, always used in conjunction with a global rank.

S - indicator of state status (for both Washington and Oregon):

1 - critically imperiled because of extreme rarity or because it is particularly vulnerable to extinction or extirpation, typically 5 or fewer occurrences

2 - imperiled because of rarity or because it is vulnerable to extinction or extirpation, typically 6 to 20 occurrences

3 - either very rare and local throughout its range or found locally (even abundantly) in a restricted range, typically 21 to 100 occurrences

4 - apparently secure, typically more than 100 occurrences

5 - demonstrably widespread, abundant and secure.

X - presumed extinct or extirpated.

H - historically known with the expectation that it may be rediscovered.

U - status uncertain, additional information is needed.

SR - reported from the state but without persuasive documentation.

SRF - reported falsely (in error) from the state, but the error persists in the literature.

? - indicates uncertainty about the assigned rank.

Q - indicates uncertainty about the taxonomic status.

Note: Washington State references were used to assign global rarity status in each of the species of concern data tables.

Animals

G - indicator of global, i.e., rangewide, status, always followed by another character.

T - a global rank for subspecific taxa.

S - indicator of state status:

1 - extremely rare, typically 5 or fewer estimated occurrences in the state, or only a few remaining individuals, may be especially vulnerable to extirpation

2 - very rare, typically between 5 and 20 estimated occurrences, or with many individuals in fewer occurrences, often susceptible to becoming extirpated

3 - rare to uncommon, typically 20 to 100 estimated occurrences, may have fewer occurrences but with a large number of individuals in some populations, may be susceptible to large-scale disturbances

4 - common, apparently secure under present conditions, typically 100 or more estimated occurrences, but may be fewer with many large populations, may be restricted to only a portion of the state, usually not susceptible to immediate threats

5 - very common, demonstrably secure under present conditions.

X - apparently extinct or extirpated.

H - historically known from the state, but not verified for an extended period, usually 15 years.

U - status uncertain, often because of low search effort or cryptic nature of the element, uncertainty spans a range of 4 to 5 ranks as defined above.

R - reported from the state, but without persuasive documentation that would provide a basis for either accepting or rejecting (e.g., misidentified specimen) the report.

SRF - reported falsely (in error) from the state, but the error persists in the literature.

A - accidental (occurring only once or a few times) or casual (occurring more regularly although not every year) in state; a few of these species (typically long-distance migrants such as some birds, butterflies, and cetaceans) may have even bred on one or more of the occasions when they were recorded.

E - exotic (introduced through human actions) in the state.

P - likely to occur or to have occurred (but having not been previously documented) in the state.

Z - not of significant conservation concern in the state, although the taxon is native and appears regularly in the state for a reason other than being exotic (E) or accidental/casual (A) or absent.

Q - a qualifying "Q" with a global rank indicates that a taxonomic question concerning the taxon exists.

C - a qualifying "C" with a GH or GX rank indicates that the taxon is extant in captivity or cultivation, although it is not known to still exist in nature.

? - indicates uncertainty about the assigned rank.

Note: Washington State references were used to assign global rarity status in each of the species of concern data tables. For those tables that lack an Oregon State rarity status, a state rarity status was not assigned for those species by the Oregon Natural Heritage Program.

D.2.5.2 Plants

Legal protections for species of concern differ between plant and animals. Although legal protections for federally listed or proposed plant species, insofar as they address plants found on federal property, are similar to that for animals, protection is limited on non-federal lands (i.e., state and private) to situations in which either federal funding or the requirement for a federal permit is involved. Legal protection for state-listed species in Washington is even more limited. There are no state of Washington laws that specifically recognize endangered or threatened plants or afford them any protection on any lands; however, WDNR's Natural Heritage Program does identify and track the status of species deserving of such status (WDNR 1994).

Table D.4 provides information about plant species of concern potentially found on or near the Hanford Site. There are currently no federal endangered, threatened, or proposed species, or species that are currently candidates for listing found at Hanford. Nineteen species, however, have been documented to be present on Hanford that are either sensitive, threatened, or endangered in the state of Washington (TNC 1996). Five of these species are federally listed by the USFWS as species of concern in the Columbia River Basin Ecoregion.

Figure D.23 shows approximate locations of subpopulations and populations of the plant species of concern that have been entered so far into the Ecosystem Monitoring Project's data base (see Table 4.2 for Level III species categories). Data are a combination of both TNC survey (J. Soll, correspondence and digital data, 1995, 1996, and 1998) and recent Ecosystem Monitoring Project survey results (recent survey information is reported in Cadwell 1994 and 1995). Location data were acquired either by GPS or by digitizing locations originally recorded on USGS topographic maps. All 1994 and earlier data are shown.

Figure D.23 is not intended to represent all areas where plant species of concern may be present; rather, the figure shows only general locations where the presence of individual plant subpopulations or populations have been documented. Even areas that have been surveyed potentially could contain other plant species of concern; for example, certain rare annual and/or early flowering plants that are sensitive to the drought conditions that were present during the early part of 1994 may have been missed during the TNC surveys (TNC 1995). Those areas searched by TNC during 1994, 1995, and 1997 are depicted in TNC (1995; Figure 4), Caplow and Beck 1996 (Figure 3), and Hall (1998), respectively. These reports also can be referenced for more detail about specific species.

Table D.15 provides information on newly identified plant species or varieties at Hanford. In total, survey results indicate that the Hanford Reach, ALE Unit, Gable Mountain and vicinity, and Umtanum Ridge all contain significant numbers of populations of Level III plant species of concern (Figure D.23). Much of the central core of Hanford still remains to be surveyed for plant species of concern. It is

Table D.4 Plant Species of Concern Potentially Found on or Near the Hanford Site

Scientific Name	Common Name	Federal Status[a]	Washington State Status (Priority Ranking as Applicable)[a]	Oregon State Status[a]	Global and Washington State Rarity Status[a]	Endemism[b]	Oregon State Rarity Status[a]	Washington/ [Oregon] Distribution by County[b,c]	Habitat Association on Hanford[d]	Hanford Abundance[e]	Resource Level of Concern at Hanford[f]
Allium robinsonii	Robinson's onion		Watch				SX	[GI, MO, SH, UM]	Shrub-steppe	Uncommon	II
Allium scillioides	Squill onion		Watch						Shrub-steppe	Uncommon	II
Ammannia robusts	Grand redstem		Review 1		G5			Most state	Riparian	Uncommon	
Arenaria franklinii var. *thompsonii*	Thompson's sandwort		Review 2	Candidate	G4 THQ, SRF	Regional	SH	BE, GR [GI]	Sand/shrub-steppe	Uncommon	II
Artemisia campestris borealis var. *wormskioldii*	Northern wormwood	Former candidate	Endangered, (1)	Endangered	G5 T1, S1	Regional	SX	GR, KL [SH]	Rocky riparian	Undocumented[g]	III
Artemisia lindleyana	Columbia River mugwort		Watch						Riparian	Common	II
Astragalus arrectus	Palouse milkvetch		Sensitive, (3)		G2G3, S2	Regional		Columbia Basin: CH, (GR), (KTS), KL, LI, WHI	Shrub-steppe	Not recently documented[h]	III
Astragalus columbianus	Columbia milkvetch	Former candidate	Threatened, (2)		G2, S2	Local		Southcentral WA: BE, KTS, YA	Shrub-steppe	Rare	III
Astragalus conjunctus var *rickardii*	Basalt milkvetch		Review 1						Shrub-steppe	Uncommon	II
Astragalus geyeri	Geyer's milkvetch		Sensitive, (3)		G5, S1?	Disjunct		GR	White Bluffs	Rare	III
Astragalus sclerocarpus	Stalked-pod milkvetch		Watch						Sand/shrub-steppe	Common	II
Astragalus speirocarpus	Medick milkvetch		Watch						Drainages/ shrub-steppe	Undocumented	II
Astragalus succumbens	Crouching milkvetch		Watch						Shrub-steppe	Uncommon	II
Balsamorhiza rosea	Rosy balsamroot		Watch				SH	[UM]	Rattlesnake Ridge	Common	II
Calyptridium roseum	Rosy pussypaws		Sensitive		G5, S1				Shrub-steppe	Rare	III

Table D.4 Plant Species of Concern Potentially Found on or Near the Hanford Site (continued)

Scientific Name	Common Name	Federal Status[a]	Washington State Status (Priority Ranking as Applicable)[a]	Oregon State Status[a]	Global and Washington State Rarity Status[a]	Endemism[b]	Oregon State Rarity Status[a]	Washington/ [Oregon] Distribution by County[b,c]	Habitat Association on Hanford[d]	Hanford Abundance[e]	Resource Level of Concern at Hanford[f]
Camissonia minor	Smallflower evening-primrose		Review 1		G4				Shrub-steppe	Rare	
Camissonia (=Oenothera) pygmaea	Dwarf evening-primrose		Threatened, (2)		G3, S1S2			Scattered: BE, DO, FR, GR	Sand/shrub-steppe	Rare	III
Carex densa	Dense sedge		Sensitive, (3)		G5, S1	Peripheral		(BE), (CK), WAH, (YA)	Riparian	Undocumented[i]	III
Castilleja exilis	Smallflower annual paintbrush		Review 1		G5				Shrub-steppe	Rare	
Centunculus minimus	Chaffweed		Review 1		G5					Rare	
Cirsium brevifolium	Palouse thistle		Review 1						Shrub-steppe	Undocumented	I
Collinsia sparsiflora var. *bruceae*	Few-flowered collinsia		Sensitive, (3)		G4T4, S1S2	Peripheral		KL, (SKA)	Riparian	Undocumented[j]	III
Cryptantha spiculifera	Snake River cryptantha		Sensitive		G3G4, S2	Peripheral		(AD), CH, FR, GR, KL, LI, OK, SP	Bluffs	Rare	III
Cryptantha leucophaea	Gray cryptantha		Sensitive, (3)		G2G3, S2S3		SH	Scattered: western Columbia Basin - BE, DO, FR, GR, KTS, WW, YA [GI]	Sand	Uncommon	III
Cryptantha scoparia	Miner's candle		Review 1		C4				Shrub-steppe	Rare	
Cuscuta denticulata	Desert dodder		Sensitive		G4, S1	Disjunct		BE	Shrub-steppe	Rare	III
Cyperus bipartitus (=C. rivularis)	Shining flatsedge		Sensitive, (3)		G5, S2	Peripheral		(AS), BE, GR, KI, KTS, KL, (WHI), YA	Columbia River, riparian	Uncommon	III
Eatonella nivea	White eatonella		Threatened, (2)		G4, S1	Disjunct		GR, KTS	Sand/shrub-steppe	Rare	III
Erigeron piperianus	Piper's daisy		Sensitive, (3)		G2, S2	Regional		Columbia Basin: AD, BE, FR, GR, KTS, KL, YA	Disturbances/ sand/shrub-steppe	Uncommon	III

Table D.4 Plant Species of Concern Potentially Found on or Near the Hanford Site (continued)

Scientific Name	Common Name	Federal Status[a]	Washington State Status (Priority Ranking as Applicable)[a]	Oregon State Status[a]	Global and Washington State Rarity Status[a]	Endemism[b]	Oregon State Rarity Status[a]	Washington/ [Oregon] Distribution by County[b,c]	Habitat Association on Hanford[d]	Hanford Abundance[e]	Resource Level of Concern at Hanford[f]
Eriogonum codium	Umtanum desert buckwheat		Endangered		G1, S1			BE	Shrub-steppe	Rare	III
Gilia leptomeria	Great Basin gilia		Review 1		G5				Shrub-steppe	Rare	
Hypericum majus	Canadian St. John's-wort		Sensitive		G5, S1?			Scattered: KI, PO, SKT	Riparian	Rare	III
Lesquerella tuplashensis	White Bluffs bladderpod		Endangered		G1, S1			FR	Shrub-steppe	Uncommon	III
Limosella acaulis	Southern mudwort		Sensitive, (3)		G5Q, S2	Disjunct		BE, CH, GR, KTS, WAH, WHA, YA	Columbia River, riparian	Uncommon	III
Lindernia dubia var. *anagallidea*	False pimpernel		Review 2		G5T4, S3			BE, CK, (KL), MA	Columbia River, riparian	Uncommon	III
Lipocarpha aristulata	Awned halfchaff sedge		Review 1		G5				Riparian	Uncommon	
Loeflingia squarrosa var *squarrosa*	Loeflingia		Threatened		G5T4, S1				Riparian	Rare	III
Lomatium tuberosum	Hoover's desert parsley	Former candidate	Threatened, (2)		G2, S2	Local		BE, GR, KTS, YA	Umtanum Ridge, talus	Rare	III
Mimulus suksdorfii	Suksdorf's monkey-flower		Sensitive, (3)		G4, S2	Peripheral		CH, GR, (KTS), (KL), (YA), BE	Sand/shrub-steppe	Rare	III
Nama densum var. *parviflorum*	Small-flowered nama		Review 1		G5T5				Shrub-steppe	Uncommon	
Nicotiana attenuata	Coyote tobacco		Sensitive, (3)		G4, S2			Scattered: BE, (CH), DO, FR, GR, (KTS), KL, YA	Gravel washes	Rare[h]	III
Oenothera caespitosa	Desert evening-primrose		Sensitive, (3)		G4, S1?	Peripheral		KTS, YA	Riparian/ islands/ uplands	Rare	III
Pectocarya linearis var. *penicillata*	Winged combseed		Review 1		G5				Shrub-steppe	Uncommon	
Pectocarya setosa	Bristly combseed		Sensitive, (3)		G5, S2	Peripheral		(CH), GR, YA	Sand/shrub-steppe	Rare	III

Table D.4 Plant Species of Concern Potentially Found on or Near the Hanford Site (continued)

Scientific Name	Common Name	Federal Status[a]	Washington State Status (Priority Ranking as Applicable)[a]	Oregon State Status[a]	Global and Washington State Rarity Status[a]	Endemism[b]	Oregon State Rarity Status[a]	Washington/ [Oregon] Distribution by County[b,c]	Habitat Association on Hanford[d]	Hanford Abundance[e]	Resource Level of Concern at Hanford[f]
Pellaea glabella var. *slimpex*	Smooth cliffbrake		Watch						Umtanum Ridge, moist canyons	Rare	II
Penstemon eriantherus var. *whitedii*	Fuzzy beardtongue		Monitor 3						White Bluffs	Rare	I
Rorippa columbiae	Columbia yellowcress	Former candidate	Endangered, (1)	Candidate	G3, S2		S3	Scattered: BE, GR, (KL), SKA [UM]	Columbia River, riparian	Common	III
Rotala ramosior	Lowland toothcup		Review 1		G5				Riparian	Uncommon	

(a) See Section D.2.5.1 for references and category definitions. Global and state rarity statuses are separated by a comma in the table.
(b) Endemism categories and county distributions from WDNR (1994). Endemism: local = a taxon restricted to a very small geographic area or specialized habitats within a somewhat larger geographical area; Regional = a taxon inhabiting a relatively large geographical area ranging from a mountain range to the Pacific Northwest; Disjunct = a taxon whose population(s) in Washington is widely separated from the main continuous populations; Peripheral = a taxon approaching the geographical limits of its continuous range in Washington. County abbreviations: AD = Adams; AS = Asotin; BE = Benton; CH = Chelan; CK = Clark; DO = Douglas; FR = Franklin; GR = Grant; KI = King; KTS = Kittitas; KL = Klickitat; LI = Lincoln; MA = Mason; OK = Okanogan; PO= Pond Oreille; SKT = Skagit; SKA = Skamania; SP = Spokane; WAH = Wahkiakum; WW = Walla Walla; WHI = Whitman; YA = Yakima. (County names or abbreviations in parentheses indicate that the taxon was historically collected in that county or that it has been reported from that county but its occurrence is unverified or questionable. In both cases, recent, verifiable information regarding the taxon's occurrence in the county in question is lacking.)
(c) County distributions are from The Nature Conservancy of Oregon. 1995. Oregon Natural Heritage Program, Rare Plant and Animal Data Base. The Nature Conservancy, Portland, Oregon. County abbreviations: GI = Gilliam; MO = Morrow; SH = Sherman; UM = Umatilla.
(d) Hanford Biological Resources Laboratory and Ecosystem Monitoring Project data bases maintained by Pacific Northwest National Laboratory.
(e) Abundance categories developed and applied by M. Sackschewsky and W. Rickard from Pacific Northwest National Laboratory (pers. comm. 1995). Abundant = commonly found throughout the Hanford Site in diverse habitat types; Common = commonly found throughout appropriate, specific habitats; Uncommon = found only in some of the specific, appropriate habitats; Rare = only known from one to several locations on the Hanford Site; Undocumented/Not recently documented = has been historically reported from the Hanford Site, or is known to occur near the Hanford Site, but its present occurrence on the Site is unsubstantiated or doubtful.
(f) See Section 4.3 for definitions of resource levels of concern. Each level corresponds to a different set of management actions that are required to be taken in regard to those species included for consideration at that level. A particular species is defined by its association with one specific level of management concern.
(g) Known to occur within 25 km of the Hanford Site; however, recent surveys have not documented its occurrence on Hanford (see Cadwell 1994 for areas surveyed).
(h) Previously reported from Rattlesnake Hills (Sackschewsky et al. 1992); however, its presence has not been confirmed by recent surveys.
(i) Previously reported from the 100 Areas (Sackschewsky et al. 1992); however, it was probably misidentified (Sackschewsky pers. comm. 1995) and recent surveys have not documented its occurrence.
(j) Previously reported from Rattlesnake Hills (Sackschewsky et al. 1992); however, it was probably misidentified (Sackschewsky pers. comm. 1995) and recent surveys have not documented its occurrence.

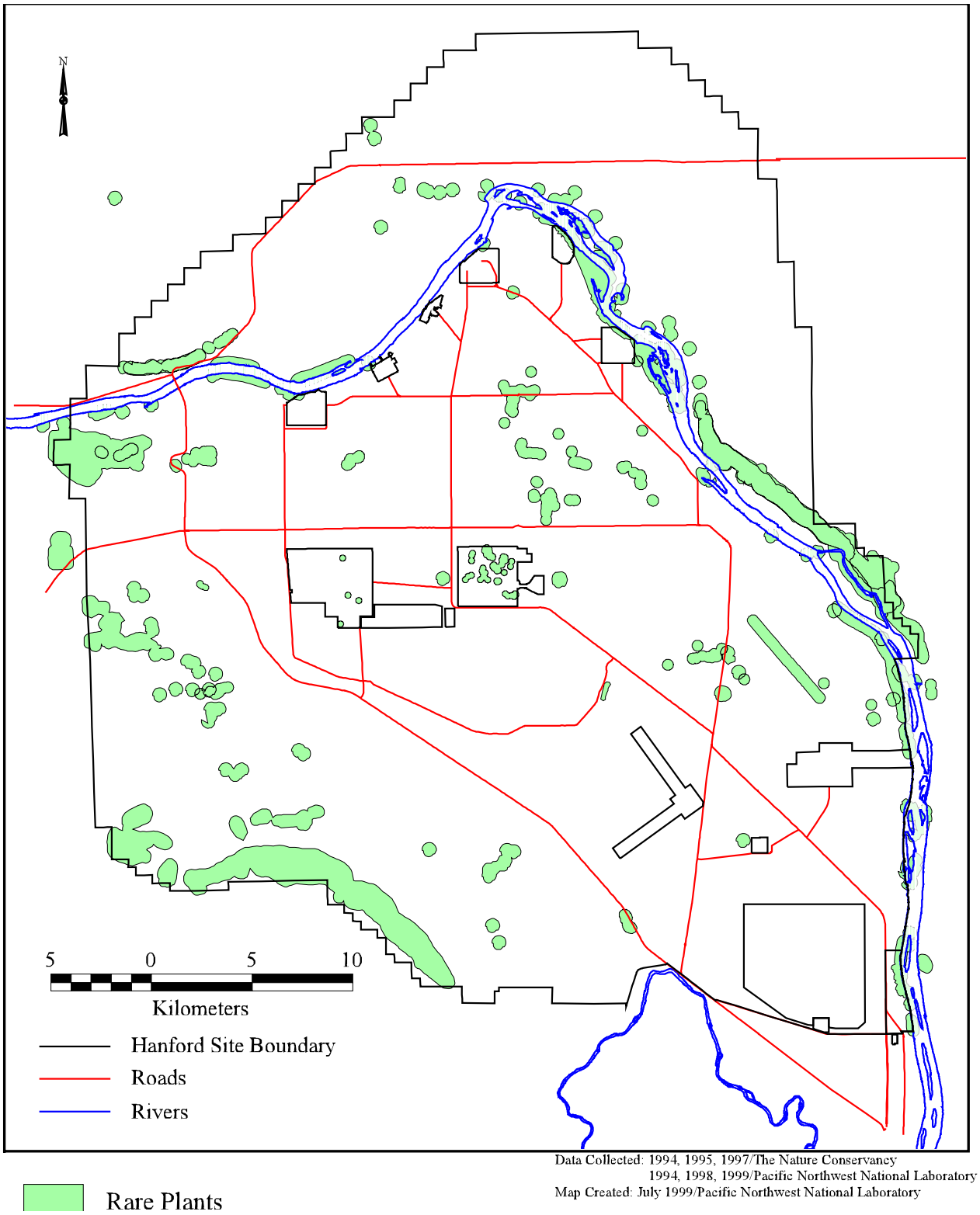


Figure D.23 Approximate Locations of Level III Plant Species of Concern

probable that the Hanford Dune Field, for example, contains plant species of concern (TNC 1995). Islands within the Hanford Reach also deserve survey attention. Plant species of concern are best protected by protecting locations in which they occur or could potentially occur. In large measure this can be accomplished by protecting areas that contain intact native plant communities.

D.2.5.3 Invertebrates

Partial surveys for invertebrate species of concern have been accomplished within the last few years at the Hanford Site. Information on terrestrial invertebrates at Hanford is summarized in Table D.5. The most recent distribution information on terrestrial invertebrate species of concern is a result of TNC survey work (TNC 1995, 1996, 1998, and 1999).

Insect survey work, other than for butterflies and moths, occurred mostly on the ALE Unit. Insect diversity is high with over 1,000 taxa identified so far, which is probably less than 10% of the total present (TNC 1996). Hanford's insect diversity is directly related to the extent and diversity of native habitat. Few insect pest species were collected on the ALE Unit, which would be another indication of its relatively undisturbed status (TNC 1996).

Umtanum Ridge and the shorelines of the Hanford Reach have been identified previously, because of their butterfly diversity, to be of particular importance for Washington butterfly conservation (Pyle 1989). Results from the TNC surveys indicate Rattlesnake Ridge also supports a fauna, similar to Umtanum Ridge, of uncommon butterflies (TNC 1995). Specific information on the butterfly and moth surveys can be found in Ensor (1996). Ensor also includes a map of areas searched (Ensor 1996; Figure 1).

A spring area on Umtanum Ridge also contains an endemic land snail not known from any other location (Frest and Johannes 1993). Information on this species is provided later in this section as is information on other new invertebrate species (all insects) recently discovered at Hanford. This list can be expected to grow as inventory work continues on the Hanford Site.

Information on aquatic invertebrates at Hanford is summarized in Table D.6. Aquatic invertebrate species of concern are currently limited to those found in the Hanford Reach. Detailed ecological and distributional information about the shortface lanx (*Fisherola nuttalli*) and Columbia pebblesnail (*Fluminicola columbiana*) in the Columbia River Basin can be found in Neitzel and Frest (1993). Little information is available on the ecology of the California floater (*Anodonta californiensis*).

Frest and Johannes (1993) speculated that the relatively sparse nature of Hanford's mollusc fauna (both freshwater forms and land snails) was due to the presence of only a few streams in a large area that possessed few continuous or seasonal connections. Moreover, they also speculated that the human modification of the spring/stream systems during the early part of the twentieth century may have caused certain species to be extirpated from the Hanford Site.

D.2.5.4 Fish

Gray and Dauble (1977) identify 43 species of fish as occurring within the Hanford Reach of the Columbia River. Five of these species are species of concern (Table D.7). One additional species not identified by Gray and Dauble (i.e., bull trout, *Salvelinus confluentus*) and two stocks of another species (i.e., spring/summer and fall runs of the Snake River chinook salmon, *(Oncorhynchus tshawytsch*), for which there is a related Columbia River stock (i.e., fall chinook salmon that spawn in the Hanford Reach), also are species of concern; however, they are rare migrants to the Hanford Reach (Table D.7). Management of fish species of concern within the Hanford Reach requires additional work on specific habitat requirements. The habitat association information provided in Table D.7, for those species that have specific habitat requirements identified, could still benefit from additional empirical information.

D.2.5.5 Amphibians and Reptiles

There are no comprehensive accounts of amphibians and reptiles at Hanford and their distribution and abundance are poorly understood (Fitzner and Gray 1991). Compared with more mesic areas (for amphibians) and xeric areas (such as the desert southwest of the U.S. for reptiles), the herpetofauna of Hanford is generally depauperate. Five species of concern occur on the Hanford Site (Table D.8). All species can be found in the upland shrub-steppe habitat; however, Woodhouse's toad (*Bufo woodhousii*) is generally found near water. The striped whipsnake (*Masticophis taeniatus*) is at the northern

Table D.5 Terrestrial Invertebrate Species of Concern Potentially Found on or Near the Hanford Site

Scientific Name	Common Name	Federal Status[a]	Washington State Status[a]	WDWF Priority Species (Criterion)[a]	Global and Washington State Rarity Status[a]	Habitat Association and Hanford Abundance[b]	Resource Level of Concern at Hanford[c]
Boloria (=Clossiana) selene atrocostalis	Silver-bordered fritillary		Candidate	YES (1)	G5, S3	Wetlands (1)	III
Callophrys sheridanii neoperplexa	Canyon green hairstreak		Monitor	NO	S5, S?	Shrub-steppe (2)	II
Cicindela columbica	Columbia River tiger beetle		Candidate	YES (1)	G2, S1	Riparian (3)	III
Harkenclenus titus immaculosus	Coral hairstreak		Monitor	NO		Upland areas (4)	II
Hesperia juba	Juba Skipper		Monitor	NO	G5, S?	Upland areas (5)	II
Hesperia nevada	Nevada skipper		Monitor	NO	G4G5, S?	Upland areas (6)	II
Limenitis (=Basilarchia) archippus lahontani	Nevada viceroy	Former candidate	Monitor	NO	G5, S?	Canyonlands (7)	II
Lycaena (= Epidemia) helloides	Purplish copper		Monitor	NO	G5, S?	River/stream bottoms (8)	II
Lycaena (= Chalceria) rubida perkinsorum	Perkins' copper		Monitor	NO	G5, S?	Shrub-steppe (9)	II
Mitoura siva	Juniper hairstreak		Candidate	YES (1)	G4, S?	Shrub-steppe (10)	III
Ochlodes sylvanoides bonnevilla	Bonneville skipper		Monitor	NO	G5, S?	Shrub-steppe (11)	II
Phyciodes tharos pascoensis	Pasco crescent		Monitor	NO	G5	Wetlands (12)	II

(a) See Section D.2.5.1 for references and category definitions. Global and state rarity statuses are separated by a comma in the table.
(b) Habitat associations obtained from the Hanford Biological Resources Laboratory and Ecosystem Monitoring Project data bases maintained by Pacific Northwest National Laboratory, unless otherwise noted. These Hanford abundance categories are: rare, uncommon, and common, and their definitions, were adapted from Landeen et al. (1992) and applied by Lee Rogers (pers. comm. 1995) to these species based on incidental observations made during ecological studies conducted by the Ecology Group at Pacific Northwest National Laboratory. Rare = present in appropriate habitat only in small numbers, seldom observed; Uncommon = usually present in appropriate habitat but not always observed; Common = often observed in appropriate habitat.
1 = Moist meadows and bogs, near woodlands, sometimes wet meadows among plains or sagelands. Likely not present on the Hanford Site. Has not been collected on the Hanford Site to date.
2 = Sagebrush habitat in desert canyons. Rare on Hanford Site. Collected on the ALE Reserve (Ensor 1996).
3 = Known only from sandy beach areas along the Snake and Columbia Rivers and their tributaries. Has not been collected on the Hanford Site to date, but may occur there.
4 = Mountain canyons, scrubby and wooded areas, and brushy clearings. Has not been collected on the Hanford Site to date, but may occur there.
5 = Collected on the ALE Reserve in Snively Canyon and on the North Slope (Ensor 1996). The abundance of this species on the Hanford Site is unknown.
6 = High sagelands and forest edges, alpine slopes and high meadowland. Rare, on the Hanford Site it is known only from Rattlesnake Mountain. Collected on the ALE Reserve in Snifely Canyon (Ensor 1996).
7 = Areas bordering canyon creeks, streams, and rivers. It is seldom found far from its favorite food plans, willow and cottonwood. Common, on the Hanford Site it is usually found in association with willows. Collected on the ALE Reserve in Snively Canyon and on the North Slope (Ensor 1996).
8 = Mostly lowlands. Collected on the ALE Reserve in Snively Canyon and on the North Slope (Ensor 1996). The abundance of this species on the Hanford Site is unknown.
9 = Open dry areas, sagebrush, sandy watercourses, moderate to high elevations. Favors edges of meadows or streams in sagebrush associations. Uncommon on the Hanford Site. It is known from Rattlesnake Mountain and the North Slope (Ensor 1996).
10 = Arid lands, open scrubby woodland, rocky outcrops, and canyons. On Hanford it would most likely be found in dunes. Has not been collected on the Hanford Site to date, but may be present.
11 = Desert areas of the Northwest in scrub, on ridges, along roadsides, and in sagebrush. Common on Hanford.
12 = Moist meadows, moist fields, valley bottoms and streamsides. Likely not present on the Hanford Site. Has not been collected on the Hanford Site to date.
(c) See Section 4.3 for definitions of resource levels of concern. Each level corresponds to a different set of management actions that are required to be taken in regard to those species included for consideration at that level. A particular species is defined by its association with one specific level of management concern.

Table D.6 Aquatic Invertebrate Species of Concern Potentially Found Within or Near the Hanford Reach

Scientific Name	Common Name	Federal Status[a]	Washington State Status[a]	WDFW Priority Species (Criterion)[a]	Global and Washington State Rarity Status[a]	Oregon State Rarity Status[a]	Habitat Association[b]	Hanford Abundance[c]	Resource Level of Concern at Hanford[d]
Anodonta californiensis	California floater	Former candidate	Candidate	YES (1)	G4, S?		Lentic areas of the Columbia River[e]	Undocumented	III
Fisherola nuttalli	Shortface lanx	Former candidate	Candidate	YES (1)	G1G3, S2	S2?	Rapids edges or likely to be found in any area of the Hanford Reach that is not dewatered or subject to siltation	Common	III
Fluminicola columbiana	Columbia pebblesnail	Former candidate	Candidate	YES (1)	GU, S2	S?	Rapids edges or likely to be found in any area of the Hanford Reach that is not dewatered or subject to siltation	Rare	III

(a) See Section D.2.5.1 for references and category definitions. Global and state rarity statuses are separated by a comma in the table.
(b) Taken from Neitzel and Frest (1993) as modified by Duane Neitzel (pers. comm. 1996), unless otherwise noted.
(c) The abundance category, common, and its definition were adapted from Landeen et al. (1992) and applied by Dennis Dauble (pers. comm. 1995) to these species based on prior surveys and scientific studies conducted by the Ecology Group at Pacific Northwest National Laboratory. Common = often observed in appropriate habitat. The category rare was assigned by Duane Neitzel (pers. comm. 1996). Rare = only 1-2% of the Hanford Reach *Fluminicola* are *F. columbiana*.
(d) See Section 4.3 for definitions of resource levels of concern. Each level corresponds to a different set of management actions that are required to be taken in regard to those species included for consideration at that level. A particular species is defined by its association with one specific level of management concern.
(e) Dennis Dauble (pers. comm. 1996).

Table D.7 Fish Species of Concern Potentially Found Within or Near the Hanford Reach

Scientific Name	Common Name	Federal Status[a]	Washington State Status[a]	WDFW Priority Species (Criterion)[a]	Oregon State Status[a]	Global and Washington State Rarity Status[a]	Oregon State Rarity Status[a]	Habitat Association	Hanford Abundance[b]	Resource Level of Concern at Hanford[c]
Catostomus platyrhynchus	Mountain sucker		Monitor	NO		G5, S?		Mountain streams[d]	Rare	II
Cottus beldingi	Piute sculpin		Monitor	NO		G5, S?		Riffle areas of slight to moderate gradient streams[d]	Common	II
Cottus perplexus	Reticulate sculpin		Monitor	NO		G4, S?		Pools and riffles of generally small streams[d]	Uncommon	II
Lampetra ayresi	River lamprey	Former candidate		NO				Riverine[d]	Rare	I
Oncorhynchus tshawytscha	Snake River Chinook Salmon (Spring/Summer and Fall)	Endangered		NO	Threatened	G5, S?		Free-flowing portions of large rivers[e]	Rare	IV
Percopsis transmontana	Sand roller		Monitor	NO		G4, S?		Shallow, sandy flats and quiet backwater areas[f]	Uncommon	II
Salvelinus confluentus	Bull trout	Candidate		YES (2, 3)		G3, S?	S3	Pool areas of streams[d]	Accidental	III
Oncorhynchus tshawytscha	Upper Columbia River Chinook Salmon (Spring)	Endangered	Candidate	YES	Not applicable	G5, S?		Tributaries of large rivers	Rare	IV
Oncorhynchus mykiss	Upper Columbia River Steelhead	Endangered	Candidate	YES	Not applicable	G5, S?		Tributaries of large rivers	Rare	IV
Oncorhynchus mykiss	Middle Columbia River Steelhead	Threatened	Candidate	YES	Not listed	G5, S?		Tributaries of large rivers	Rare	IV
Oncorhynchus mykiss	Snake River Steelhead	Threatened	Candidate	YES	Not listed	G5, S?		Tributaries of large rivers	Rare	IV

(a) See Section D.2.5.1 for references and category definitions. Global and state rarity statuses are separated by a comma in the table.
(b) These categories: accidental, rare, uncommon, and common, and their definitions were adapted from Landeen et al. (1992) and applied by Dennis Dauble (pers. comm. 1995) to these species based on prior surveys and scientific studies conducted by the Ecology Group at Pacific Northwest National Laboratory. Accidental = appears very infrequently and well outside its normal range; Rare = present in appropriate habitat only in small numbers, seldom observed; Uncommon = usually present in appropriate habitat but not always observed; Common = often observed in appropriate habitat.
(c) See Section 4.3 for definitions of resource levels of concern. Each level corresponds to a different set of management actions that are required to be taken in regard to those species included for consideration at that level. A particular species is defined by its association with one specific level of management concern.
(d) Habitat associations are from Wydoski and Whitney (1979). The bull trout habitat association is based on that of the Dolly Varden (Salvelinus malma) to which it is closely related. For the Piute sculpin, slight to moderate gradient streams refers to streams of less than 1.8% gradient but generally greater than 6 m (about 20 ft) wide; conversely, the reticulate sculpin is generally found in streams less than 6 m wide (Wydoski and Whitney 1979).
(e) Habitat association is from Downs et al. (1993). Juvenile salmon occupy backwater sloughs and shoreline embayments.
(f) Sand rollers show an apparent diel behavior in their habitat selection (Gray and Dauble 1976). They are present on sandy bottoms at night (Gray and Dauble 1976) and in quiet backwaters during the day (Wydoski and Whitney 1979).

Table D.8 Herpetofaunal Species of Concern Potentially Found on or Near the Hanford Site

Scientific Name	Common Name	Federal Status[a]	Washington State Status[a]	WDFW Priority Species (Criterion)[a]	Global and Washington State Rarity Status[a]	Endemism[b]	Habitat Association[c]	Hanford Abundance[d]	Resource Level of Concern at Hanford[e]
Bufo woodhousii	Woodhouse's toad		Monitor	NO	G5, S3	Peripheral	Shrub-steppe, R	Common	II
Hypsiglena torquata	Night snake		Monitor	NO	G5, S4	Peripheral	Shrub-steppe, BS	Uncommon	II
Masticophis taeniatus	Striped whipsnake		Candidate	YES (1)	G5, S1	Peripheral	Shrub-steppe	Rare	III
Pituophis melanoleucus (=catenifer) catenifer	Pacific gopher snake		Monitor	NO	G5T5, S?	Peripheral	Shrub-steppe	Abundant	II
Sceloporus graciosus graciosus	Northern sagebrush lizard	Former candidate		NO	G5, S?	Peripheral	Shrub-steppe, S	Common	I

(a) See Section D.2.5.1 for references and category definitions. Global and state rarity statuses are separated by a comma in the table.
(b) None are endemics (Nussbaum et al. 1983); they seem to be relatively recent invaders from the south.
(c) General association with shrub-steppe is based on Hanford Biological Resources Laboratory and Ecosystem Monitoring Project data bases maintained by Pacific Northwest National Laboratory. More specific habitat associations (i.e., BS = basalt outcroppings, R = riparian, S = sandy areas) are from Fitzner and Gray (1991).
(d) The abundance categories: rare, uncommon, common, and abundant were obtained from Fitzner and Gray (1991), however, definitions of common and uncommon were adapted from Landeen et al. (1992), as these authors provide more complete definitions. The "abundant" category is defined here. Rare = present in appropriate habitat only in small numbers; seldom seen or heard. Uncommon = usually present in appropriate habitat but not always seen. Common = often seen in appropriate habitat. Abundant = very often seen or heard in appropriate habitat. Hallock (1995) reported the abundance category designations the same as did Fitzner and Gray (1991) with one exception. She identifies the gopher snake as common.
(e) See Section 4.3 for definitions of resource levels of concern. Each level corresponds to a different set of management actions that are required to be taken in regard to those species included for consideration at that level. A particular species is defined by its association with one specific level of management concern.

extent of its range; however, it has been recorded from the Vantage area (Nussbaum et al. 1983) and after a long period without observation, it was reported on Hanford in 1996 west of State Highway 24 (B. Tiller, pers. comm., 1996).

D.2.5.6 Birds

Three types of information are provided for avian species of concern. First, Table D.9 provides information similar to what has been provided for other taxa in earlier tables. The species listed include all year-round resident avian species of concern plus migratory birds (as identified in the list of migratory bird species at 50 CFR 10.13) that either breed or winter at Hanford or pass through but are federally listed or candidates for listing. Second, for the same species included in Table D.9, Table D.10 provides ecological information on each species: occurrence, preferred habitat, and Hanford abundance. Third, Table D.11 provides information on the temporal occurrence of migratory birds at Hanford for all migratory birds that breed at Hanford or, for migratory species that do not breed at Hanford, are otherwise species of concern. By knowing when species tend to arrive and leave the Hanford Site, and when the sensitive periods of their life cycle (such as nesting) occur, activities at Hanford can be better planned to avoid impacts to these species.

Because most of the bird species that constitute Hanford's characteristic avifauna are migratory, direct impacts to these species potentially can occur away from Hanford (e.g., on the wintering area) as well as when they are present on Hanford. Indirect impacts, however, such as losses of habitat, can occur at any time of year at Hanford. Many species have a strong fidelity to return to the same location at which breeding was previously successful; however, breeding locations for other species can be dynamic. Excessive losses of appropriate habitat eventually can be detrimental to the persistence of populations at Hanford; however, specific habitat association and complete distribution information is lacking for many avian species of concern at Hanford.

Although detailed habitat requirements for individual species may be lacking, Smith (1994) was able to construct large-scale habitat association models for bird species breeding in eastern Washington (principally within the Columbia Basin Ecoregion but also including the Methow and Okanogan Valleys) that could be used to predict species richness centers throughout the area. He addressed only those species associated with upland habitats; that is, shrub- or meadow-steppe. Smith predicted species richness for five different categories:

1. species for which 80% of their Washington breeding range was within the eastern Washington study area (20 species)
2. species that nest principally in sagebrush (*Artemisia*) (six species)
3. species that nest principally in grassland areas within the shrub-steppe (nine species) (i.e., areas not dominated by tall shrubs)
4. species of concern (10 species; a subset of species that included those species with small or declining populations in eastern Washington)
5. species that are steppe obligates, either to sagebrush or to grassland areas within the shrub-steppe (21 species).

For all categories, Hanford ranked as one of the highest centers of predicted species richness (Smith 1994).

The preceding discussion illustrates the importance of Hanford for maintaining viable populations of shrub-steppe-dependent birds within the Columbia Basin Ecoregion, especially for sagebrush obligate species such as the sage sparrow. Although specific sighting information is important to establish usage of particular habitats by specific species (and within industrial areas to indicate what potential impacts to species of concern a Site activity may cause), not all areas have been surveyed and usage can be dynamic. The approach taken in this management plan to address most avian species of concern is to identify the distribution and extent of the habitat most likely used by those species. Thus, conservation of most individual avian species of concern can be accomplished by conserving the habitats identified in Figure D.12, the Hanford habitats of concern.

Because of their listing status and because they are most vulnerable to impact at fixed locations, the ferruginous hawk (*Buteo regalis*) and bald eagle (*Haliaeetus leucocephalus*) require management focused on their individual requirements. As a response to the potential for impacts to federally and state listed species and federal candidate species

Table D.9 Avian Species of Concern Potentially Found on or Near the Hanford Site - Status

Common Name	Federal Status[a]	Washington State Status[a]	WDFW Priority Species (Criterion)[a]	Oregon State Status[a]	Species Identified by Federal Regulation as Migratory[b]	Global and Washington State Rarity Status[a]	Oregon State Rarity Status[a]	Resource Level of Concern at Hanford[c]	Comments[d]
Aleutian Canada Goose	Threatened	Endangered	NO (see comments)	Endangered	M	G5T2, SZN		IV	Listing status applies to just this subspecies of the Canada goose. The subspecies is not separately identified as a priority species by WDFW.[a]
American Avocet			YES (2)		M	G5, S4B, SZN		II	Resident breeder
American Bittern			NO		M	G4, S4N, S4B		II	Resident breeder
American Coot			NO		M	G5, S5B, S5N		II	Resident breeder
American Crow			NO		M	G5, S5		II	Resident breeder
American Kestrel			NO		M	G5, S5B, S5N		II	Resident breeder
American Robin			NO		M	G5, S5B, S5N		II	Resident breeder
American White Pelican		Endangered	YES (1,2)	Sensitive/ vulnerable	M	G3, S1B, S2N		III	Oregon State status applies only to breeding populations.[a] Although observed in significant numbers on Hanford since 1990, no breeding/nesting activity has been recorded. Recently documented as having bred in the Wallula Gap area.[e]
American Wigeon			YES (2,3)		M	G5, S4B, S5N		II	Priority species criteria refers only to significant waterfowl breeding areas and to regular-large concentrations in winter of Family Anatidae.[a] Winter resident.
Arctic Tern		Monitor	YES (2)		M	G5, S2B, SZN		II	Priority species criteria refers only to breeding populations.[a] Observed during October.
Ash-throated Flycatcher		Monitor	NO		M	G5, S2B, SZN		II	Erratic occurrences on Hanford. Usually observed in June and September.
Bald Eagle	Threatened	Threatened	YES (1)	Threatened	M	G4, S3S4B, S4N	S3	IV	Nesting attempted; no successful reproduction recorded. Some night roost and potential nest locations require buffer zones to minimize disturbance[f]
Bank Swallow			NO	Sensitive/ undetermined status	M	G5, S4B, SZN		II	Regularly breeds on Hanford

Table D.9 Avian Species of Concern Potentially Found on or Near the Hanford Site - Status (continued)

Common Name	Federal Status[a]	Washington State Status[a]	WDFW Priority Species (Criterion)[a]	Oregon State Status[a]	Species Identified by Federal Regulation as Migratory[b]	Global and Washington State Rarity Status[a]	Oregon State Rarity Status[a]	Resource Level of Concern at Hanford[c]	Comments[d]
Barn Owl			NO		M	G5, S4		II	Resident breeder
Barn Swallow			NO		M	G5, S5B, S5N		II	Resident breeder
Barred Owl		Monitor	NO		M	G5, S5		II	Not believed to breed on Hanford. Apparently makes two short stops in April and September.
Barrow's Goldeneye			YES (2,3)	Sensitive/ peripheral or naturally rare	M	G5, S4B, S4N		II	Winter resident. Oregon State status applies only to breeding populations.[a]
Belted Kingfisher			NO		M	G5, S5		II	Resident breeder
Bewick's Wren			NO		M	G5, S5		II	Resident breeder
Black Tern	Former candidate	Monitor	YES (2)		M	G4, S4B, SZN		II	Priority species criteria refers only to breeding populations.[a] Not believed to breed on Hanford. Observed on Site from May-June and August-September.
Black-billed Magpie			NO		M	G5, S5		II	Resident breeder
Black-crowned Night Heron		Monitor	YES (2)		M	G5, S3B, S3N		II	Landeen et al. (1992) and Fitzner and Gray (1991) report this species as being present year round. Ennor (1991) reports arrival and departure dates of August and March, respectively. Observed breeding on islands across from 300 Area in 1994 and 1995.
Black-headed Grosbeak			NO		M	G5, S5B, SZN		II	Resident breeder
Black-necked Stilt		Monitor	YES (2)		M	G5, S3B, S3N		II	Priority species criteria refers only to breeding populations.[a] Observed from April-May and in August
Black-throated Sparrow			NO	Sensitive/ peripheral or naturally rare	M			II	Erratic occurrences on Hanford

Table D.9 Avian Species of Concern Potentially Found on or Near the Hanford Site - Status (continued)

Common Name	Federal Status[a]	Washington State Status[a]	WDFW Priority Species (Criterion)[a]	Oregon State Status[a]	Species Identified by Federal Regulation as Migratory[b]	Global and Washington State Rarity Status[a]	Oregon State Rarity Status[a]	Resource Level of Concern at Hanford[c]	Comments[d]
Brewer's Blackbird			NO		M	G5, S5		II	Resident breeder
Brewer's Sparrow			NO		M	G4, S4B, SZN		II	Resident breeder
Brown-headed Cowbird			NO		M	G5, S5B, S4N		II	Resident breeder
Bufflehead			YES (2,3)	Sensitive/ peripheral or naturally rare	M	G5, SZB, S5N		II	Winter resident. Oregon State status applies only to breeding populations.[a]
Bullock's (formerly Northern) Oriole			NO		M	G5, S4S5B, SZN		II	Resident breeder
Burrowing Owl	Former candidate	Candidate	YES (1)	Sensitive/ critical	M	G4, S3B, SZN	S?	III	Habitat also includes weedy fields of non-native annuals/areas recovering from fire/ other disturbance.[g]
California Gull			NO		M	G5, S4B, S5N		II	Resident breeder
Canada Goose			YES (2,3)		M	G5, S5B, S5N		II	Priority species criteria refer only to significant waterfowl breeding areas and regular-large concentrations in winter of Family Anatidae, excluding Canada geese in urban areas.[a] Resident breeding population plus separate wintering population.
Caspian Tern		Monitor	YES (2)		M	G5, S4S5B, SZN		II	Priority species criteria refers only to breeding populations.[a]
Clark's Grebe		Monitor	YES (2)		M	G5, S2B, SZN		II	Priority species criteria refers only to breeding populations.[a] Observed in fall (October).
Cliff Swallow			NO		M	G5, S5B, SZN		II	Resident breeder
Common Goldeneye			YES (2,3)		M	G5, SA, S5N		II	Winter resident

Table D.9 Avian Species of Concern Potentially Found on or Near the Hanford Site - Status (continued)

Common Name	Federal Status[a]	Washington State Status[a]	WDFW Priority Species (Criterion)[a]	Oregon State Status[a]	Species Identified by Federal Regulation as Migratory[b]	Global and Washington State Rarity Status[a]	Oregon State Rarity Status[a]	Resource Level of Concern at Hanford[c]	Comments[d]
Common Loon		Candidate	YES (1,2)		M	G5, S2B, S5N		III	Some present fall/winter; others resident year-round. Rare breeder on Site (two sightings of juveniles in the last 10 years).[e]
Common Merganser			YES (2,3)		M	G5, S4B, S5N		II	Priority species criteria refer only to significant waterfowl breeding areas and to regular-large concentrations in winter of Family Anatidae.[a] Resident breeder
Common Nighthawk			NO		M	G5, S4B, SZN		II	Spring/summer breeder
Eastern Kingbird			NO		M	G5, S4S5B, SZN		II	Spring/summer breeder
Common Poorwill			NO		M	G5, S4B, SZN		II	Spring/summer breeder
Common Raven			NO		M	G5, S5		II	Resident breeder
Dark-eyed Junco			NO		M	G5, S5B, S5N		II	Winter resident
Ferruginous Hawk	Former candidate	Threatened	YES (1)	Sensitive/ critical	M	G4, S2B, SZN	S3	III	Resident breeder. Habitat also includes dry upper slopes of ALE[g] canyons. Nest locations require buffer zones to minimize disturbance.[h]
Flammulated Owl		Candidate	YES (1)	Sensitive/ critical	M	G4, S3B, SZN		III	Observed during March
Forster's Tern		Monitor	YES (2)		M	G5, S3B?, SZN		II	Priority species criteria refers only to breeding populations.[a]
Franklin's Gull			NO	Sensitive/ peripheral or naturally rare	M	G5, SZN		II	

Table D.9 Avian Species of Concern Potentially Found on or Near the Hanford Site - Status (continued)

Common Name	Federal Status [a]	Washington State Status [a]	WDFW Priority Species (Criterion) [a]	Oregon State Status [a]	Species Identified by Federal Regulation as Migratory [b]	Global and Washington State Rarity Status [a]	Oregon State Rarity Status [a]	Resource Level of Concern at Hanford [c]	Comments [d]
Golden Eagle		Candidate	YES (1)		M	G4, S3B, S3N		III	May reside year-round in Tri-Cities;[g] occasionally seen on Hanford year-round.[g,i] Also observed in native bunchgrass areas recovering from fire/other disturbance, and on Rattlesnake/Saddle Mountain.[g]
Grasshopper Sparrow		Monitor	NO	Sensitive/ undetermined status	M	G5, S3B, SZN		II	Spring/summer breeder. Observed on ALE using native bunchgrass areas, weedy fields of non-native annuals, and areas recovering from fire/other disturbance.[g]
Great Blue Heron		Monitor	YES (2)		M	G5, S4S5		II	Regularly nests on the Hanford Site
Great Egret		Monitor	NO	Sensitive/ undetermined status	M	G5, S3B, SZN		II	Present from April to May/August to September. Rare breeder. Observed nesting with Great Blue Heron colony once or twice in the late 1980s.[j] See Fitzner and Gray (1991).
Great-horned Owl			NO		M	G5, S5		II	Resident breeder
Gyrfalcon		Monitor	NO		M	G5, S2N		II	Winter sighting. No recent records.
Harlequin Duck			YES (2,3)	Sensitive/ peripheral or naturally rare	M	G4, S3		II	Oregon State status applies only to breeding populations.[a]
Horned Grebe		Monitor	YES (2)	Sensitive/ peripheral or naturally rare	M	G5, S3B, S5N		II	Priority species criteria refers only to breeding populations.[a] Oregon State status applies only to breeding populations.[a]
Horned Lark			NO		M	G5, S5B, S5N		II	Resident breeder
House Finch			NO		M	G5, S5		II	Resident breeder
Killdeer			YES (2)		M	G5, S5B, S5N		II	Spring-summer breeder
Lark Sparrow					M	G5, S4B, SZN		II	Spring-summer breeder
Lazuli Bunting			NO		M	G5, S5B, SZN		II	Spring-summer breeder

Table D.9 Avian Species of Concern Potentially Found on or Near the Hanford Site - Status (continued)

Common Name	Federal Status[a]	Washington State Status[a]	WDFW Priority Species (Criterion) [a]	Oregon State Status[a]	Species Identified by Federal Regulation as Migratory[b]	Global and Washington State Rarity Status[a]	Oregon State Rarity Status[a]	Resource Level of Concern at Hanford[c]	Comments[d]
Lewis' Woodpecker		Candidate	NO	Sensitive/ critical	M	G4, S3B, SZN	S3, S4	III	Present late April to May/mid-August to mid-October. Observed in ALE riparian areas.[g]
Loggerhead Shrike	Former candidate	Candidate	YES (1)	Sensitive/ undetermined status	M	G4G5, S3B, SZN		III	Some year-round residents; others migrate. Observed in native bunchgrass areas, weedy fields of non-native annuals, areas recovering from fire/other disturbance, ALE riparian areas on ALE.[g]
Long-billed Curlew	Former candidate	Monitor	YES (3)		M	G5, S2B, S2N		II	Also observed in native bunchgrass areas, weedy fields with non-native annuals, and areas recovering from fire/other disturbance.[g] Spring/summer breeder.
Mallard			YES (2,3)		M	G5, S5B, S5N		II	Resident breeder
Marsh Wren			NO		M	G5, S4N, S5B		II	Resident breeder
Merlin		Candidate	YES (1)		M	G4, S3B, S4N		III	A few recent sightings in winter.[j]
Mourning Dove			NO		M	G5, S5B, S5N		II	Spring-summer breeder
Northern Flicker			NO		M	G5, S5		II	Resident breeder
Northern Goshawk	Former candidate	Candidate	YES (1)	Sensitive/ critical	M	G4, S3B, S3N		III	A few recent sightings.[j]
Northern Harrier			NO		M	G5, S4B, S4S5N		II	Resident breeder
Northern Shrike			NO		M	G5, S4N		II	Winter resident
Olive-sided Flycatcher	Former candidate		NO		M	G5, S4S5B, SZN		II	
Oregon Vesper Sparrow		Monitor	NO	Sensitive/ undetermined status	M	G5TU, S2S3B, SZN		II	Common in bluebunch wheatgrass on Rattlesnake Mountain where it regularly breeds.
Osprey		Monitor	YES (3)		M	G5, S4B, SZN		II	Present during September to October/April to May.
Peregrine Falcon	Endangered	Endangered	YES (1)	Endangered	M	G4, S1B, S3N	S1	IV	Present late November to January

Table D.9 Avian Species of Concern Potentially Found on or Near the Hanford Site - Status (continued)

Common Name	Federal Status [a]	Washington State Status [a]	WDFW Priority Species (Criterion) [a]	Oregon State Status[a]	Species Identified by Federal Regulation as Migratory [b]	Global and Washington State Rarity Status [a]	Oregon State Rarity Status [a]	Resource Level of Concern at Hanford [c]	Comments [d]
Prairie Falcon		Monitor	YES (3)		M	G5, S3B, S3N		II	Also observed in bunchgrass areas, weedy fields of non-native annuals, areas recovering from fire/other disturbance, Rattlesnake Mountain/Saddle Mountain, rivers, and dry upper slopes of ALE canyons.[g] Resident breeder.
Red-necked Grebe		Monitor	YES (3)	Sensitive/ critical	M	G5, S3B, S5N		II	Priority species criteria refers only to breeding populations.[a] Oregon State status applies only to breeding populations.[a]
Red-tailed Hawk			NO		M	G5, S5B, S5N		II	Resident breeder
Red-winged Blackbird			NO		M	G5, S5B, S5N		II	Spring/summer breeder
Ring-billed Gull			NO		M	G5, S5B, S5N		II	Spring/summer breeder
Rock Wren			NO		M	G5, S5B, SZN		II	Spring/summer breeder
Sage Grouse	Former candidate	Candidate	YES (1,3)	Sensitive/ vulnerable		G5, S3		III	
Sage Sparrow		Candidate	YES (1)		M	G5, S3B, SZN		III	Habitat also includes dry upper slopes of ALE canyons.[g]
Sage Thrasher		Candidate	YES (1)		M	G5, S3B, SZN		III	Habitat also includes ALE riparian areas.[g]
Sandhill Crane		Endangered	YES (1)	Sensitive/ vulnerable	M	G5, S1B, S3N		III	Early March-May/mid-September/early November. Habitat also includes Rattlesnake/ Saddle Mountain.[g] Rarely lands on Site.
Say's Phoebe			NO		M	G5, S5B, SZN		II	Spring/summer breeder
Sharp-tailed Grouse	Former candidate	Monitor	YES (1,3)			G4, S2	S?	II	Possibly present on ALE in early 1970s. Not documented on Hanford since then.[k]
Snowy Egret			NO	Sensitive/ vulnerable	M	G5, SZN		II	Oregon State status applies only to breeding populations.[a]
Snowy Owl		Monitor	NO		M	G5, S3N		II	

Table D.9 Avian Species of Concern Potentially Found on or Near the Hanford Site - Status (continued)

Common Name	Federal Status [a]	Washington State Status [a]	WDFW Priority Species (Criterion) [a]	Oregon State Status[a]	Species Identified by Federal Regulation as Migratory [b]	Global and Washington State Rarity Status [a]	Oregon State Rarity Status [a]	Resource Level of Concern at Hanford [c]	Comments [d]
Prairie Falcon		Monitor	YES (3)		M	G5, S3B, S3N		II	Also observed in bunchgrass areas, weedy fields of non-native annuals, areas recovering from fire/other disturbance, Rattlesnake Mountain/Saddle Mountain, rivers, and dry upper slopes of ALE canyons.[g] Resident breeder.
Red-necked Grebe		Monitor	YES (3)	Sensitive/ critical	M	G5, S3B, S5N		II	Priority species criteria refers only to breeding populations.[a] Oregon State status applies only to breeding populations.[a]
Red-tailed Hawk			NO		M	G5, S5B, S5N		II	Resident breeder
Red-winged Blackbird			NO		M	G5, S5B, S5N		II	Spring/summer breeder
Ring-billed Gull			NO		M	G5, S5B, S5N		II	Spring/summer breeder
Rock Wren			NO		M	G5, S5B, SZN		II	Spring/summer breeder
Sage Grouse	Former candidate	Candidate	YES (1,3)	Sensitive/ vulnerable		G5, S3		III	
Sage Sparrow		Candidate	YES (1)		M	G5, S3B, SZN		III	Habitat also includes dry upper slopes of ALE canyons.[g]
Sage Thrasher		Candidate	YES (1)		M	G5, S3B, SZN		III	Habitat also includes ALE riparian areas.[g]
Sandhill Crane		Endangered	YES (1)	Sensitive/ vulnerable	M	G5, S1B, S3N		III	Early March-May/mid-September/early November. Habitat also includes Rattlesnake/ Saddle Mountain.[g] Rarely lands on Site.
Say's Phoebe			NO		M	G5, S5B, SZN		II	Spring/summer breeder
Sharp-tailed Grouse	Former candidate	Monitor	YES (1,3)			G4, S2	S?	II	Possibly present on ALE in early 1970s. Not documented on Hanford since then.[k]
Snowy Egret			NO	Sensitive/ vulnerable	M	G5, SZN		II	Oregon State status applies only to breeding populations.[a]
Snowy Owl		Monitor	NO		M	G5, S3N		II	

Table D.9 Avian Species of Concern Potentially Found on or Near the Hanford Site - Status (continued)

Common Name	Federal Status [a]	Washington State Status [a]	WDFW Priority Species (Criterion) [a]	Oregon State Status[a]	Species Identified by Federal Regulation as Migratory [b]	Global and Washington State Rarity Status [a]	Oregon State Rarity Status [a]	Resource Level of Concern at Hanford [c]	Comments [d]
Song Sparrow			NO		M	G5, S5B, S5N		II	Resident breeder
Spotted (formerly Rufous-sided) Towhee			NO		M	G5, S5B, S5N		II	Spring/summer breeder
Swainson's Hawk	Former candidate	Monitor	NO	Sensitive/ vulnerable	M	G4, S3B, SZN	S3	III	Resident breeder. Also observed in native bunchgrass, weedy fields of non-native annuals, areas recovering from fire/other disturbance, and riparian areas.[g]
Tricolored Blackbird			NO	Sensitive/ peripheral or naturally rare	M		S2	II	Erratic occurrence on Hanford. Normally breeds from southern Oregon to Baja California.
Turkey Vulture		Monitor	NO		M	G5, S4B, SZN		II	Habitat also includes Rattlesnake/Saddle Mountain.[g]
Western Bluebird		Monitor	YES (3)	Sensitive/ vulnerable	M	G5, S3B, SZN		II	Migrant observed on Rattlesnake Mountain.[g]
Western Grebe		Monitor	YES (2)		M	G5, S3B, S5N		II	Priority species criteria refers only to breeding populations.[a] Primarily a winter resident/rare in summer.
Western Kingbird			NO		M	G5, S5B, SZN		II	Resident breeder
Western Meadowlark			NO		M	G5, S5B, S5N		II	Resident breeder
White-crowned Sparrow			NO		M	G5, S5B, S5N		II	Winter resident
Willow Flycatcher	Former candidate		NO		M	G5, S5B, SZN		II	

Table D.9 Avian Species of Concern Potentially Found on or Near the Hanford Site - Status (continued)

Common Name	Federal Status [a]	Washington State Status[a]	WDFW Priority Species (Criterion) [a]	Oregon State Status[a]	Species Identified by Federal Regulation as Migratory [b]	Global and Washington State Rarity Status [a]	Oregon State Rarity Status [a]	Resource Level of Concern at Hanford [c]	Comments [d]
Yellow-headed Blackbird			NO		M	G5, S5B, S4N		II	Resident breeder
Yellow-rumped Warbler			NO		M	G5, S5B, S4N		II	Winter resident.

(a) See Section D.3.5.1 for references and definitions. Global and state rarity statuses separated by commas. Often two state rarity statuses are listed. For long-distance migratory species whose non-breeding status may be different from breeding status; B and N indicate the status.
(b) 50 CFR 10.13. 1990. List of Migratory Bird Species. M = federally-listed migratory bird; no notation = not listed as federally protected migratory bird.
(c) See Section 3.3 for definitions. Each level corresponds to a set of management actions required for species at that level. A particular species is defined by its association with one specific level of management concern.
(d) Hanford Biological Resources Laboratory and Ecosystem Monitoring Project data bases maintained by Pacific Northwest National Laboratory. Comments from these sources, unless otherwise stated.
(e) Breeding information from Lisa Fitzner (pers. comm. 1996).
(f) Day and nighttime bald eagle buffers around roosts: 800 m for activities within line of sight of visible roosts, 400 m for activities out of line of sight. Bald eagle buffers around perches: none at this time, other than those recommended above for night roosts that are used for perching/resting during the day. All buffer requirements from Fitzner and Weiss (1994).
(g) Additional habitat use information from The Nature Conservancy (1995).
(h) Ferruginous hawk buffers around nests are 1.0 km (Fitzner et al. 1994).
(i) Based on Landeen et al. (1992).
(j) Breeding and sighting information from William Rickard (pers. comm. 1996).
(k) Sighting information from John Rotenberry (pers. comm. 1995).

Table D.10 Avian Species of Concern Potentially Found on or Near the Hanford Site - Ecology

Common Name	Occurrence[a]					Preferred Habitat[b]							Hanford Abundance[a]				
	YR	SP	SU	F	W	FW	PG	RC	RT	SD	SM	WM	C	U	R	A	AC
Aleutian Canada Goose				●	●	●			●								●
American Avocet		●	●	●							●		●				
American Bittern		●	●	●		●					●				●		
American Coot	●					●					●					●	
American Crow	●						●		●							●	
American Kestrel	●						●		●	●		●				●	
American Robin	●						●		●							●	
American White Pelican	●					●					●		●				
American Wigeon		●		●	●	●					●	●					●
Arctic Tern				●		●					●						
Ash-throated Flycatcher		●		●					●						●		
Bald Eagle				●	●	●			●				●				
Bank Swallow		●	●	●		●					●					●	
Barn Owl	●								●				●				
Barn Swallow		●	●	●			●		●		●					●	
Barred Owl		●		●					●			●					●
Barrow's Goldeneye					●	●									●		
Belted Kingfisher	●								●					●			
Bewick's Wren	●								●					●			
Black Tern		●		●		●					●			●			
Black-billed Magpie	●						●		●	●						●	
Black-crowned Night Heron	●					●			●		●			●			
Black-headed Grosbeak		●	●	●					●					●			
Black-necked Stilt		●				●			●								●
Black-throated Sparrow		●								●						●	
Brewer's Blackbird		●	●	●			●		●			●	●				
Brewer's Sparrow		●	●	●						●			●				
Brown-headed Cowbird		●	●	●			●		●					●			
Bufflehead		●		●	●	●										●	
Bullock's (formerly Northern) Oriole		●	●	●			●		●				●				
Burrowing Owl	●									●						●	
California Gull		●	●	●		●					●					●	
Canada Goose	●					●					●	●	●				
Caspian Tern		●	●			●					●				●		

Table D.10 Avian Species of Concern Potentially Found on or Near the Hanford Site - Ecology (continued)

Common Name	Occurrence[a]					Preferred Habitat[b]							Hanford Abundance[a]				
	YR	SP	SU	F	W	FW	PG	RC	RT	SD	SM	WM	C	U	R	A	AC
Clark's Grebe				●		●			●						●		
Cliff Swallow		●	●	●			●		●		●					●	
Common Goldeneye		●		●	●	●										●	
Common Loon	●					●								●			
Common Merganser	●					●										●	
Common Nighthawk			●	●			●			●		●				●	
Common Poorwill		●	●	●					●					●			
Common Raven	●								●	●		●				●	
Dark-eyed Junco		●		●	●		●		●			●				●	
Eastern Kingbird		●	●	●					●							●	
Ferruginous Hawk		●	●	●		●		●		●				●			
Flammulated Owl		●							●	●							●
Forster's Tern		●	●	●		●					●			●			
Franklin's Gull		●	●	●		●					●				●		
Golden Eagle	●							●	●	●				●			
Grasshopper Sparrow		●	●							●				●			
Great Blue Heron	●					●			●		●					●	
Great Egret		●	●			●			●		●				●		
Great-horned Owl	●						●		●				●				
Gyrfalcon				●	●			●	●	●		●					●
Harlequin Duck		●				●											●
Horned Grebe		●		●	●				●					●			
Horned Lark	●									●		●				●	
House Finch	●						●		●					●			
Killdeer	●						●				●	●				●	
Lark Sparrow		●	●	●			●		●	●			●				
Lazuli Bunting		●	●	●			●		●	●				●			
Lewis' Woodpecker		●	●	●			●		●						●		
Loggerhead Shrike	●						●		●	●			●				
Long-billed Curlew		●	●							●	●	●	●				
Mallard	●										●	●				●	
Marsh Wren	●										●					●	
Merlin		●		●	●		●		●	●					●		
Mourning Dove	●						●		●			●				●	
Northern Flicker	●						●		●				●				

Table D.10 Avian Species of Concern Potentially Found on or Near the Hanford Site - Ecology (continued)

Common Name	Occurrence					Preferred Habitat							Hanford Abundance				
	YR	SP	SU	F	W	FW	PG	RC	RT	SD	SM	WM	C	U	R	A	AC
Northern Goshawk				●	●				●	●				●			
Northern Harrier	●								●		●	●	●				
Northern Shrike		●		●	●									●			
Olive-sided Flycatcher		●	●				●		●	●					●		
Oregon Vesper Sparrow		●	●	●						●			●				
Osprey		●		●		●			●		●			●			
Peregrine Falcon				●	●	●		●	●	●							●
Prairie Falcon	●							●	●	●					●		
Red-necked Grebe				●*		●								●			
Red-tailed Hawk	●								●	●			●				
Red-winged Blackbird		●	●	●			●		●		●	●				●	
Ring-billed Gull	●					●	●				●	●				●	
Rock Wren		●	●	●				●								●	
Sage Grouse	●									●					●		
Sage Sparrow		●	●							●			●				
Sage Thrasher		●	●	●						●					●		
Sandhill Crane		●		●								●		●			
Say's Phoebe		●	●	●			●			●		●		●			
Sharp-tailed Grouse																	
Snowy Egret		●		●					●		●	●			●		
Snowy Owl					●				●	●		●					
Song Sparrow	●								●			●				●	
Spotted (formerly Rufous-sided) Towhee		●	●	●			●		●					●			
Swainson's Hawk		●	●	●					●	●			●				
Tricolored Blackbird		●							●								●
Turkey Vulture			●						●	●		●					●
Western Bluebird		●		●			●		●	●					●		
Western Grebe		●		●	●	●			●					●			
Western Kingbird		●	●	●			●		●							●	
Western Meadowlark	●						●			●		●				●	
Western Wood-pewee																	
Yellow-headed Blackbird		●	●	●			●				●	●	●				
Yellow-rumped Warbler																	

YR = year-round
SP = spring
SU = summer
F = fall
W = winter

FW = freshwater, rivers, lakes, ponds, sloughs; PG = parks, gardens, urban habitats; RC = rocky cliffs, talus slopes, rimrock areas; RT = riparian thickets, woodlands, orchards; SD = sagebrush desert or steppe; SM = sandy shores, mudflats, cattail marshes; WM = wet meadows, fields, fencerows, roadsides.

C = common
U = uncommon
R = rare
A = abundant
AC = accidental

(a) Fitzner and Gray (1991). In some instances, Ennor (1991) is used to supplement Fitzner and Gray (1991). Although these species were determined to be present on the Hanford Site using Ennor (1991), the definitions of occurrence [and/or abundance; see footnote (c) below] are generally according to Fitzner and Gray (1991). Additional sources, used only infrequently, are from the Hanford Biological Resources Laboratory and Ecosystem Monitoring Project data bases, Landeen et al. (1992), and Stephen Weiss (pers. comm. 1996).
(b) Preferred habitats are from Ennor (1991). Additional sources, used only infrequently, are from the Hanford Biological Resources Laboratory and Ecosystem Monitoring Project data bases, TNC (1995), and Stephen Weiss (pers. comm. 1996).
(c) Abundance categories were obtained from Fitzner and Gray (1991); however, definitions of rare, uncommon, and common were adapted from Landeen et al. (1992) as these authors provide more complete definitions. The "accidental" category was obtained from Landeen et al. (1992). Accidental = appears very infrequently and well outside its normal range; Rare = present in appropriate habitat only in small numbers, seldom seen or heard; Uncommon = usually present in appropriate habitat but not always seen or heard; Common = often seen or heard in appropriate habitat; Abundant = very often seen or heard in appropriate habitat. Additional sources, used only infrequently, are from the Hanford Biological Resources Laboratory and Ecosystem Monitoring Project data bases, Ennor (1991), and Landeen et al. (1992).
(d) Possibly present on ALE in early 1970s. Not documented on Hanford since then (John Rotenberry, pers. comm. 1995). Farrand (1988) indicates that the sharp-tailed grouse is widespread but not conspicuous in grasslands, brush, and woodland edges.

Table D.11 Migratory Birds: Resident Breeders and Listed (or Candidates for Listing) Non-Residents - Temporal Distribution on the Hanford Site

Species	Migration Period/ Arrival[a]	Nesting Period[a]	Fledging Period[a]	Migration Period/ Departure[a]	Comments
Aleutian Canada Goose	September			February	Accidental migrant observed during fall/winter
American Avocet	Summer[b]			Fall[b]	
American Bittern	Spring[b]			Fall[b]	Resident breeder
American Coot					Resident breeder. Present year-round.
American Crow					Resident breeder. Present year-round.
American Kestrel					Resident breeder. Present year-round.
American Robin					Resident breeder. Present year-round.
American White Pelican					Resident year-round. Although this species has been observed on Hanford for the past 7 years, no breeding/nesting activity has been recorded.
Arctic Tern					Observed during October
Ash-throated Flycatcher					Observed during June and September
Bald Eagle	October (late)			April (early)	Nesting has been attempted, but no successful reproduction has been recorded.
Bank Swallow	April (mid)	May-June	June-July	September (mid)	Breeds on Hanford[b]
Barn Owl					Resident breeder. Present year-round.
Barn Swallow	Summer[b]			Fall[b]	
Barred Owl					Not believed to breed on Hanford. Apparently makes two short stops, one in April and one in September.[c]
Barrow's Goldeneye	November (mid)			April (mid)	Winter Resident
Belted Kingfisher					Resident breeder. Present year-round.
Bewick's Wren					Resident breeder. Present year-round.
Black Tern					Not believed to breed on Hanford. Present during two periods, May to June and August to September.
Black-billed Magpie					Resident breeder. Present year-round.

Table D.11 Migratory Birds: Resident Breeders and Listed (or Candidates for Listing) Non-Residents - Temporal Distribution on the Hanford Site (continued)

Species	Migration Period/ Arrival[a]	Nesting Period[a]	Fledging Period[a]	Migration Period/ Departure[a]	Comments
Black-crowned Night Heron	April (mid)	April-May	June-July	September (mid)	Notwithstanding these arrival and departure dates from Ennor (1991), Ennor and Fitzner and Gray (1991) report this species as being present year-round. Nests on island #18 across from 300 Area.
Black-headed Grosbeak	Summer[b]			Fall[b]	
Black-necked Stilt					Accidental migrant[d] observed from April to May and August.
Black-throated Sparrow					Accidental migrant. Otherwise present in small numbers along the White Bluffs in the summer of 1994.[e]
Brewer's Blackbird	Summer[b]			Fall[b]	
Brewer's Sparrow	Summer[b]			Fall[b]	
Brown-headed Cowbird	Summer[b]			Fall[b]	
Bufflehead	October (mid)			May (mid)	Winter Resident
Bullock's (formerly Northern) Oriole	Summer[b]			Fall[b]	
Burrowing Owl	March	April-May	June-July	September (early)	Notwithstanding the arrival and departure dates, some are present on Hanford year-round.
California Gull	Summer[b]			Fall[b]	
Canada Goose					Resident breeder. Present year-round.
Caspian Tern	April (early)			September (early)	Nests both upstream and downstream from the Hanford Reach, but not within the Hanford Reach.
Clark's Grebe	October				Migrant observed during fall
Cliff Swallow	Summer[b]			Fall[b]	
Common Loon					Some migrate and are present during fall-winter; some are resident year-round.
Common Merganser					Resident breeder. Present year-round.
Common Nighthawk	Summer[b]			Fall[b]	
Common Poorwill	Summer[b]			Fall[b]	
Common Raven					Resident breeder. Present year-round.
Eastern Kingbird	Summer[b]			Fall[b]	

Table D.11 Migratory Birds: Resident Breeders and Listed (or Candidates for Listing) Non-Residents - Temporal Distribution on the Hanford Site (continued)

Species	Migration Period/ Arrival[a]	Nesting Period[a]	Fledging Period[a]	Migration Period/ Departure[a]	Comments
Ferruginous Hawk	February (late)	April-June		October	Resident breeder
Flammulated Owl	March				Observed during March
Forster's Tern	April (early)	May-June	July-August	October (mid)	Nests on islands in the Columbia River.
Franklin's Gull					Present during spring, summer, and fall.[b]
Golden Eagle					Year round resident,[b,c] although the ECAP[a] reports it as a migrant arriving in October and leaving in March.
Grasshopper Sparrow	May (mid)	May-June	June-July	July (mid)	Resident during spring and summer
Great Blue Heron		April-May	May-June		Resident
Great Egret					Present during two periods, April to May and August to September. Bred south of 100-F Area in 1986.[b]
Great-horned Owl					Resident breeder. Present year-round.
Gyrfalcon					Accidental during winter[c,d]
Harlequin Duck					Observed in Spring (accidental)
Horned Grebe	September (late)			May (early)	
Horned Lark					Resident breeder. Present year-round.
House Finch					Resident breeder. Present year-round.
Killdeer					Resident breeder. Present year-round.
Lark Sparrow	Spring[b]			Fall[b]	
Lazuli Bunting	Summer[b]			Fall[b]	
Lewis' Woodpecker					Present during two periods, April(late)-May/August(mid)-October(mid).
Little Willow Flycatcher					Present during spring in May and June and during the fall in September.[b]
Loggerhead Shrike	March (early)	March (late)-July	May (early)	September	Some are year-round residents.
Long-billed Curlew	March (mid)	April		September (mid)	
Mallard					Resident breeder. Present year-round.

Table D.11 Migratory Birds: Resident Breeders and Listed (or Candidates for Listing) Non-Residents - Temporal Distribution on the Hanford Site (continued)

Species	Migration Period/ Arrival[(a)]	Nesting Period[(a)]	Fledging Period[(a)]	Migration Period/ Departure[(a)]	Comments
Marsh Wren					Resident breeder. Present year-round.
Merlin	September (late)			March (late)	
Mourning Dove					Resident breeder. Present year-round.
Northern Flicker					Resident breeder. Present year-round.
Northern Goshawk	October			March	
Northern Harrier					Resident breeder. Present year-round.
Olive-sided Flycatcher					Migrant that is present during two periods, May and August to September.
Oregon Vesper Sparrow	April (mid)	April-June	June-July	September	
Osprey					Present during two periods, September to October and April to May.
Peregrine Falcon	November (late)			January	
Prairie Falcon		April (mid)-May (early)	June (mid)-July (late)		Resident year-round
Red-necked Grebe	October (early)			December (mid)	
Red-tailed Hawk		April (early)-April (late)	July (mid)-August (mid)		Resident year-round
Red-winged Blackbird	Spring[(b)]			Fall[(b)]	Resident breeder
Ring-billed Gull					Resident breeder. Present year-round.
Rock Wren	Summer[(b)]			Fall[(b)]	
Sage Grouse					Rare with no known breeding populations on the Hanford Site.
Sage Sparrow	February (mid)	March-June		August (mid)	
Sage Thrasher	April	May		December	
Sandhill Crane					Present during two periods, March (early) to May and September (mid) to November (early). Rarely lands on Site.
Say's Phoebe	Summer[(b)]			Fall[(b)]	

Table D.11 Migratory Birds: Resident Breeders and Listed (or Candidates for Listing) Non-Residents - Temporal Distribution on the Hanford Site (continued)

Species	Migration Period/ Arrival[a]	Nesting Period[a]	Fledging Period[a]	Migration Period/ Departure[a]	Comments
Snowy Egret					Present during two periods, May to June and September, but no known breeding populations.
Snowy Owl	November (mid)			March (early)	Accidental.
Song Sparrow					Resident breeder. Present year-round.
Spotted (formerly Rufous-sided) Towhee	Summer[b]			Fall[b]	
Swainson's Hawk	April (early)	April (mid)-July (mid)	July (mid)-August (mid)	September (mid - late)	
Tricolored Blackbird					More likely to occur to the south in Oregon.
Turkey Vulture					Accidental migrant usually observed in summer.[b]
Western Bluebird					Occasional migrant during fall and spring, but breeds elsewhere.
Western Grebe	September			June	Primarily a winter resident, but occasionally present throughout the summer.
Western Kingbird	Summer[b]			Fall[b]	
Western Meadowlark					Resident breeder. Present year-round.
Western Wood-pewee	Spring			Fall	
Yellow-headed Blackbird	Summer[b]			Fall[b]	

(a) Arrival, Nesting, Fledging, and Departure periods/dates were obtained from the Ecological Compliance Assessment Project data base maintained by Pacific Northwest National Laboratory, unless otherwise indicated.
(b) Fitzner and Gray (1991).
(c) Ennor (1991).
(d) Landeen et al. (1992).
(e) TNC (1995).

that could occur during CERCLA[17] site characterization and cleanup, Westinghouse Hanford Company established guidelines that if followed would minimize potential impacts to these species [(Fitzner et al. 1994; although both ferruginous hawks and bald eagles are addressed in this document, bald eagle protection requirements that resulted via consultation with the USFWS under the Endangered Species Act (ESA) are officially documented in Fitzner and Weiss (1994)].

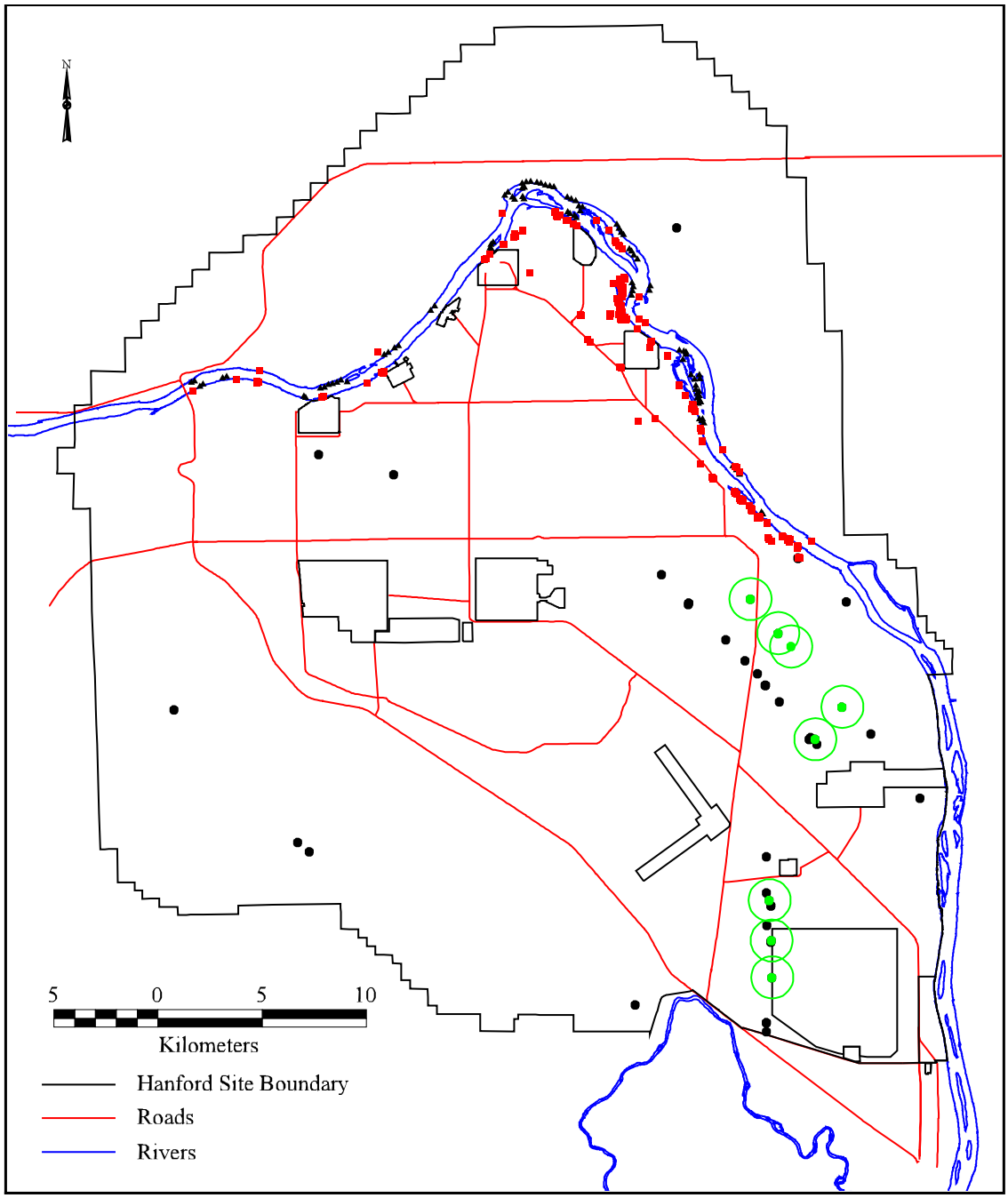
The nesting population of ferruginous hawks at Hanford represents roughly 20–25% of the breeding population in Washington State (Downs et al. 1993; Fitzner et al. 1994). At Hanford most of these hawks nest on transmission towers isolated from human activities (Fitzner et al. 1994), which may reflect more the hawk's preference to avoid any close association with humans and not necessarily a nest substrate preference. To avoid disturbing nesting ferruginous hawks, Fitzner et al. (1994) recommended avoidance of nest locations from March 1 through August 1 with a buffer distance of 1 km. Figure D.24 shows the locations of historic (i.e., 1977–1993) ferruginous hawk nest sites (data from PNNL's Ecosystem Monitoring Project data base). The circle radius represents the 1-km buffer zone around the nest site. Active or potentially active nest sites (i.e., historical nest sites should be avoided after March 1 until it is certain a particular location will not be used for nesting that breeding season) should be avoided as described above. Impacts to nest substrates that occur during the non-breeding season should be appropriately mitigated (e.g., if a historic nest platform is removed, an artificial platform should be erected elsewhere).

Bald eagles are legally protected under the ESA. The Hanford Site's *Bald Eagle Site Management Plan* (Fitzner and Weiss 1994) fulfills requirements under the ESA for eagle protection as well as meeting the intent of the Washington Administrative Code 232–12–292 that addresses bald eagle habitat protection rules.[17] Although unsuccessful nesting attempts have occurred, bald eagles primarily use the Hanford Site as a wintering area with an average of slightly over 40 eagles using the Site each year since the mid-1980s (Fitzner and Weiss 1994). Areas to be protected include foraging, perching, and night roosting locations. Buffer zones are required by the *Bald Eagle Site Management Plan* specifically for one of the attempted nest sites and for six primary night roosting areas. Perching, secondary roosting, and foraging locations are to be evaluated on a case by case basis. Perch locations can either be in trees or on the ground; whereas, roost locations are all in trees. Primary night roosts are used communally (i.e., by several eagles at a time). Foraging areas tend to correspond with major concentrations of ground perch locations.

Bald eagle ground perch and tree perch and/or secondary night roost tree locations are shown in Figure D.24. No buffer zones are specified for these locations; however, these areas generally should be avoided if eagles are present (during the period November 15 to March 15). These locations were categorized and recorded by Eisner (1991). Observations were made during 1986–1987 and locations recorded via GPS during 1991. The categories of use in Figure D.24 are a reclassification of the data in Eisner's Appendix C (1991).

The *Bald Eagle Site Management Plan* (Fitzner and Weiss 1994) specifies six primary night roost locations. All these locations require buffer zones to preclude disturbance of eagles or their roosting habitat. Additionally, three locations at which eagles have attempted nesting are identified. One of these locations currently requires a buffer zone. (The other two locations are not considered likely candidates for future eagle nesting attempts but will be monitored to determine if buffer zones will be necessary.) Figure D.25 shows the seven locations that require a disturbance buffer plus the locations of two other potential nest locations. With one exception, the buffer zone size is an 800-m radius circle around each location. As this is a line-of-sight-based requirement (Fitzner and Weiss 1994), this assumes each roost/nest location is visible from this distance from all points of the compass. The exception is the roost location at 100 K. Here, the buffer zone does not extend northeast beyond the fenceline between the roost and 100 K Area (the fence is within 100 m of the roost) (Fitzner and Weiss 1994). (This change in the buffer zone is not shown in Figure D.25.) The relaxation of the buffer

[17] The USFWS concurred through informal consultation pursuant to Section 7(a)(2) of the ESA that Department of Energy activities that are carried out consistent with the Hanford Site's Bald Eagle Site Management Plan are "not likely to adversely affect" the bald eagle [Potential impacts to the peregrine falcon also were addressed by this statement.].



Data Collected: 1986-87/Pacific Northwest National Laboratory (eagle perches)
1977-99/Pacific Northwest National Laboratory (hawk nests)
Map Created: July 1999/Pacific Northwest National Laboratory

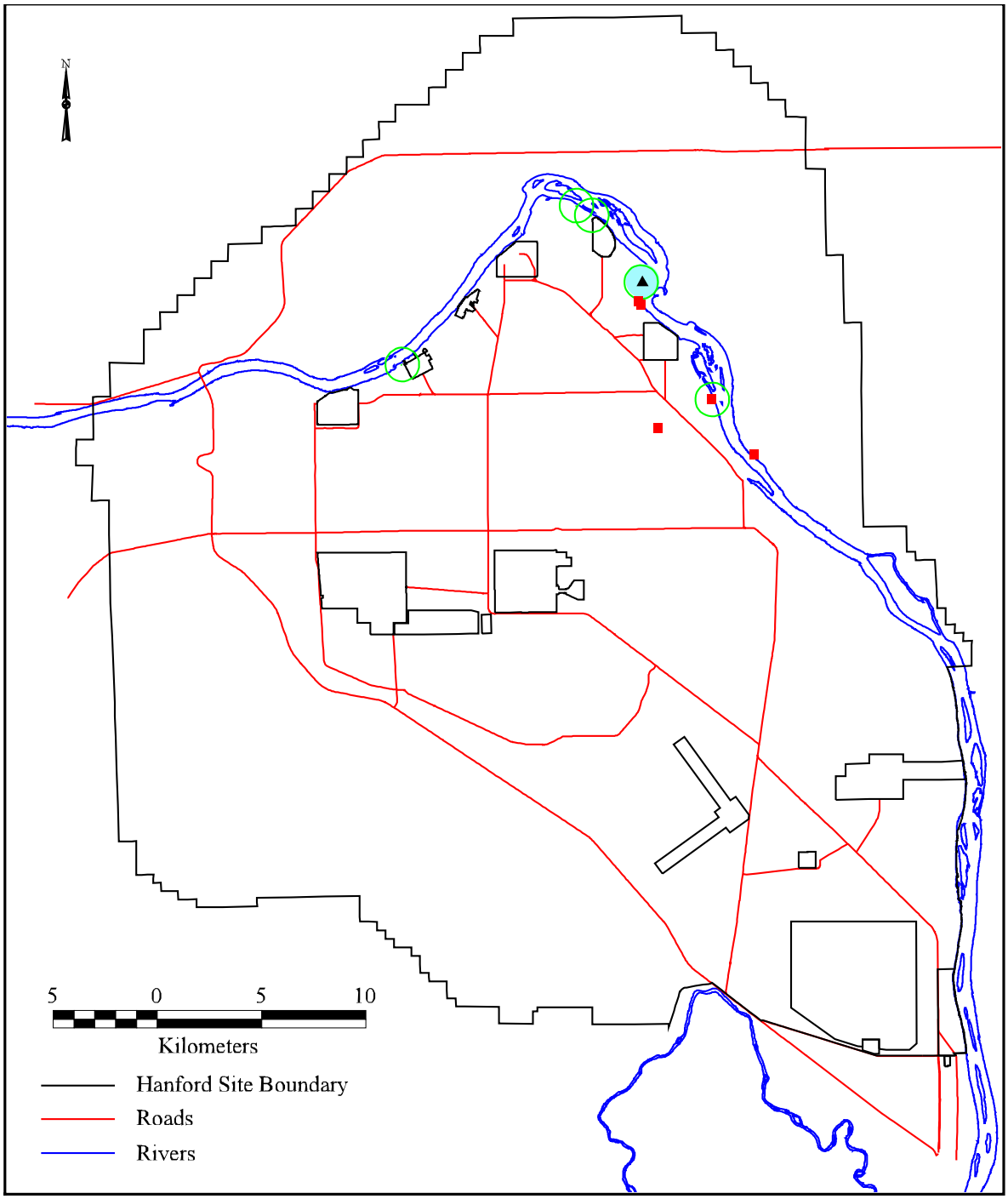
1999 Ferruginous Hawk Nest Locations with 1 km Buffer

Historic Ferruginous Hawk Nest Locations

Bald Eagle Tree Perch and/or Secondary Night Roost Tree Locations

Bald Eagle Ground Perch Locations

Figure D.24 Historic Ferruginous Hawk Nest Locations and Bald Eagle Perch and Secondary Night Roost Locations



Data Collected: 1986-99/Pacific Northwest National Laboratory
Map Created: July 1999/Pacific Northwest National Laboratory

▲ 1999 Bald Eagle Nest Location with Exclusion Zone

■ Bald Eagle Nesting Attempts (1991-1998)

○ Bald Eagle Primary Night Roosts with Exclusion Zone

Figure D.25 Bald Eagle Potential Nest and Primary Night Roost Locations

zone requirements for this location is based on previous experience with the type of human activities that have occurred near the roost location and the seeming lack of a disturbance effect on the eagles. Provided the scale of activities remains consistent with those identified in Fitzner and Weiss (1994), the relaxation is allowed. Activities that could create a larger scale disturbance will require additional consultation with USFWS prior to the activity being allowed to occur (Fitzner and Weiss 1994).

To avoid direct impacts to the eagles themselves, the buffer zones have temporal limits of November 15 to March 15 for the primary night roosts and January 1 to August 15 for nest locations (the actual duration of the latter timeframe is dependent on whether birds continue the nesting cycle instead of abandoning the site; Fitzner and Weiss 1994). Although a variety of activities, precluded when eagles are present, can occur outside these temporal limits, permission to conduct activities within buffer zones does not extend to activities that would result in modifications to the habitat (at all times of the year). Activities that could result in adverse impacts to buffer zone habitat that may affect eagle usage (to include direct removal of vegetation or application of herbecides that causes vegetation mortality) or activities that could result in losses of potential nest trees or perch/roost trees require additional consultation with the USFWS (Fitzner and Weiss 1994).

D.2.5.7 Mammals

Forty species of mammals have been documented at Hanford at one time or another since its inception as a federal facility (Fitzner and Gray 1991). Some species, such as the pygmy rabbit (*Brachylagus idahoensis*), may be extirpated. Additional species have ranges that extend to the vicinity of the Hanford Site; therefore, it is possible that some of these species may be present on Hanford in suitable habitat. At present, there are 13 mammal species of concern that are potentially found on or near Hanford (Table D.12). Seven of these species are bat species, four of which have yet to be documented at Hanford. Two species, the Washington ground squirrel (*Spermophilus washingtoni*) and Ord's kangaroo rat (*Dipodomys ordii*), though not yet documented on Hanford, may be present, especially on the North Slope. The pygmy rabbit has not been observed on Hanford since the early 1980s (Fitzner and Gray 1991). Although suitable habitat is present, recent searches for pygmy rabbits on Hanford have not resulted in any positive indication that rabbits are present (Cadwell 1994). The remainder of the species listed in Table D.12 [sagebrush vole (*Lagurus curtatus*), northern grasshopper mouse (*Onychomys leucogaster*), and Merriam's shrew (*Sorex merriami*)] all occur on Hanford and are characteristic shrub-steppe species (Rickard et al. 1988).

D.2.5.8 Non-Taxonomic Species Category: Recreationally/Commercially Important Species

Not all species that are important to be considered from a resource management perspective are addressed under a narrowly defined concept of species of concern. Some species that are important culturally (either recreationally, commercially, or to Native Americans) or ecologically as harbingers of environmental change deserve management attention at least at the level of status monitoring.

Table D.13 provides a tentative list of recreationally/commercially important species for the Hanford Site. The list is by no means complete and is intended to be dynamic. The current table is composed mainly of species identified by WDFW as important recreational and/or commercial species (WDFW 1996). One of the other two species on the list, the fall chinook salmon (*Oncorhynchus tshawytscha*), is of vital cultural importance to Native Americans as well as of regional and national significance. Its cultural standing and regional/national significance make the fall chinook salmon a Level IV resource, despite the fact the particular stock that uses the Hanford Reach to spawn is unlisted. All other species listed in Table D.13 are considered Level I resources. Recreationally/commercially important species that are otherwise identified in the taxa-specific, species of concern tables are not repeated in Table D.13.

Historically, fall chinook salmon spawned in the mainstem Columbia River from near The Dalles, Oregon, to the Pend Oreille River in Idaho; however, today the Hanford Reach of the Columbia River is the only significant mainstem spawning habitat remaining for upriver bright stocks of fall chinook salmon (Dauble and Watson 1990). The relative contribution of these upriver bright stocks to fall chinook salmon runs in the Columbia River increased from about 24% of the total in the early 1980s to 50–60% of the total in the 1990s; these

Table D.12 Mammal Species of Concern Potentially Found on or Near the Hanford Site

Scientific Name	Common Name	Federal Status[a]	Washington State Status[a]	WDFW Priority Species (Criterion)[a]	Oregon State Status[a]	Global and Washington State Rarity Status[a]	Oregon State Rarity Status[a,b]	Habitat Association
Antrozus pallidus	Pallid bat		Monitor	YES (2)	Sensitive/ vulnerable	G5, S3		A, C[e]
Brachylagus (=Sylvilagus) idahoensis	Pygmy rabbit	Former candidate	Endangered	YES (1)	Sensitive/ vulnerable	G5, S1		Dense stands of big sagebrush[f]
Spermophilus (=Citellus) washingtoni	Washington ground squirrel		Monitor	YES (1)	Sensitive/ critical	G2, S2	S2	Shrub- and meadow-steppe[h]
Dipodomys ordii	Ord's Kangaroo rat		Monitor	NO		G5, S?		Sandy soils in arid and semi-arid habitats[i]
Lagurus (=Lemmiscus) curtatus	Sagebrush vole		Monitor	NO		G5, S?		SS, R[j]
Myotis ciliolabrum (split from M. leibii)	Small-footed myotis	Former candidate	Monitor	YES (2)		G5, S?		C[e]
Myotis evotis	Long-eared myotis		Monitor	YES (2)		G5, S3		C, S[e]
Myotis thysanodes	Fringed myotis	Former candidate	Monitor	YES (2)	Sensitive/ vulnerable	G5T2, S?		C, A[e]
Myotis volans	Long-legged myotis	Former candidate	Monitor	YES (2)		G5, S3		A, S[e]
Myotis yumanensis	Yuma myotis	Former candidate		YES (2)		G5, S?		A, S[e]
Onychomys leucogaster	Northern grasshopper mouse		Monitor	NO		G5, S?		SS[j]
Plecotus townsendii pallescens	Pale Townsend's big-eared bat	Former candidate		YES (1, 2)	Sensitive/ critical			C, A, S[e]
Sorex merriami	Merriam's shrew		Candidate	YES (1)		G5, S3		SS[j]

(a) See Section D.3.5.1 for references and definitions. Global and state rarity statuses are separated by a comma in the table.
(b) Oregon distribution of the Washington ground squirrel by county: Gilliam, Morrow, and Umatilla counties. Data from the The Nature Conservancy of Oregon. 1995. Oregon Natural Heritage Program, Rare Plant, and Animal Database. The Nature Conservancy, Portland, Washington.
(c) The abundance categories: common and uncommon, were obtained from Fitzner and Gray (1991); however, definitions of common and uncommon were adapted from Landeen et al. (1992) as these authors provide more complete definitions. Common = often seen in appropriate habitat; Uncommon = usually present in appropriate habitat but not always seen. Rickard et al. (1988) identifies the northern grasshopper mouse as never very abundant.
(d) See section 3.3 for definitions of resource levels of concern. Each level corresponds to a different set of management actions that are required to be taken in regard to those species included for consideration at that level. A particular species is defined by its association with one specific level of management concern.
(e) Habitat associations are as follows (WDW 1993): A = anthropogenic (buildings); C = cliffs (may include talus); S = snags, cavities, or under bark; T = tree, roosts on tree and relies on camouflage.
(f) A complete description of pygmy rabbit habitat requirements is provided in WDFW (1995).
(g) Fitzner and Gray (1991) reported a population of pygmy rabbits on ALE prior to 1984 but indicated there have been no sitings since. Some recent surveys been conducted at Hanford to ascertain whether pygmy rabbits are present (Cadwell 1994). To date, there is no evidence of the presence of pygmy rabbits on Hanford.
(h) Although Washington ground squirrels may be associated with sagebrush, Betts (1990) found them in areas with little or no shrub cover and high herbaceous cover. There are no known records of the Washington ground squirrel on the Hanford Site; however, Washington ground squirrels are found near Hanford in Franklin, Adams, and Grant Counties (Betts 1990).
(i) Habitat association information is from Burt and Grossenheider (1976). Fitzner and Gray (1991) have not documented the Ord's kangaroo rat as occurring on the Hanford Site; however, its potential range extends to southcentral Washington (Burt and Grossenheider 1976).
(j) Habitat associations are from Fitzner and Gray (1991) and Rickard et al. (1988): SS = shrub-steppe; R = riparian. The sagebrush vole has a close association with big sagebrush (Rickard 1960). On Hanford, capture results by O'Farrell (1972, 1975) recorded sagebrush voles from only the big sagebrush/bluebunch wheatgrass association; whereas O'Farrell (1975) captured northern grasshopper mice only within the big sagebrush/Sandberg's bluegrass association (the latter is at lower elevations and contains sandier soil than the former). Gano and Rickard (1982), however, reported capturing northern grasshopper mice within a bitterbrush community that also contained sandy soils. Merriam's shrew is generally associated with drier habitats than most shrews and seems to be found in habitat where sagebrush voles are located; however, Wunder et al. (1994) found them to be most abundant within high elevation threetip sagebrush (*Artemisia tripartita*) sites on the Yakima Training Center.
(k) One population has been observed in the Process Pipe Tunnel between the 190-DR Warehouse and the 105-DR Reactor (Becker 1993).

Table D.13 Recreationally/Commercially Important Species Potentially Found on or Near the Hanford Site

Scientific Name	Common Name	WDFW Priority Species (Criterion)[a]	Distribution and/or Habitat Association on Hanford[b]	Hanford Abundance[b]
Birds				
Alectoris chukar	Chukar	Yes (3)	Upper elevations	Abundant
Phasianus colchicus	Ring-necked pheasant	Yes (3)	Riparian areas	Abundant
Mammals				
Lepus townsendii	White-tailed jackrabbit	Yes (3)	Upper elevations of ALE	Uncommon
Mustela vison	Mink	Yes (3)	Riparian along Columbia River	Uncommon
Cervus elaphus nelsoni	Rocky Mountain elk	Yes (3)	ALE	Common
Odocoileus hemionus hemionus	Rocky Mountain mule deer	Yes (3)	Entire Site	Common
Fish				
Acipenser transmontanus	White sturgeon	Yes (2,3)	Main channel/deep pools Columbia River	Abundant year-round
Ictalurus punctatus	Channel catfish	Yes (3)	Slack areas near the upper portion of McNary Pool	Common in spring and summer
Oncorhynchus tshawytscha	Fall chinook salmon	Yes (2,3)	Life-stage dependent: redds are located in the main channel of the Hanford Reach; juveniles use the whole Columbia River	Abundant
Oncorhynchus kisutch	Coho salmon	Yes (2,3)	Main channel Columbia River	Uncommon
Oncorhynchus mykiss	Rainbow trout/steelhead	Yes (3)	Main channel Columbia River	Abundant spring through fall
Oncorhynchus nerka	Sockeye salmon	Yes (2,3)	Main channel Columbia River	Juveniles common spring and adults common summer
Micropterus salmoides	Largemouth bass	Yes (3)	Sloughs of the Hanford Reach	Common
Micropterus dolomieui	Smallmouth bass	Yes (3)	Sloughs of the Hanford Reach	Abundant
Stizostedion vitreum	Walleye	Yes (3)	Main channel Columbia River	Common

(a) WDFW (1996). See Section D.2.5.1 for definition of criteria.
(b) All habitat association, distribution, and abundance information for birds and mammals are from Fitzner and Gray (1991). Habitat association, distribution, and abundance information for fish were provided by Dennis Dauble (pers. comm. 1995) and were based on prior surveys and scientific studies conducted by the Ecology Group at Pacific Northwest National Laboratory.

stocks also have contributed to a higher percentage of the commercial, tribal, and sport fishing catch since 1980 (Dauble and Watson 1990; NPS 1994).

Aerial counts of fall chinook salmon redds (as the gravel nests are termed) have been conducted since 1948 at Hanford to provide an index of relative abundance among spawning areas and years. Redd counts peaked during 1987 at 8630 redds (Dauble and Watson 1990). Counts have fluctuated since that time with the latest count 5619 redds in 1994 (Cadwell 1995). Redd counts are minimum estimates of nest building as redds that occur in deeper water are not counted during aerial surveys (Dauble and Watson 1990; NPS 1994). For a 41 year record, redd counts from the Vernita Bar and Upper Locke Island areas averaged 33% and 25% of the total, respectively (Dauble and Watson 1990). Figure D.26 shows the general locations of the major fall chinook salmon spawning areas within the Hanford Reach. These locations were digitized from aerial photos that were taken on November 13, 1991, major spawning areas and patched onto the USGS river map. The depicted locations differ slightly from those shown in Dauble and Watson (1990: Figure 3.1). Areas 4–7 of Dauble and Watson are shown on Figure D.26 as one continuous area concentrated near Locke Island. Area 1 of Dauble and Watson is subdivided into four areas on Figure D.26.

D.2.5.9 Non-Taxonomic Species Category: Ecologically Important Species

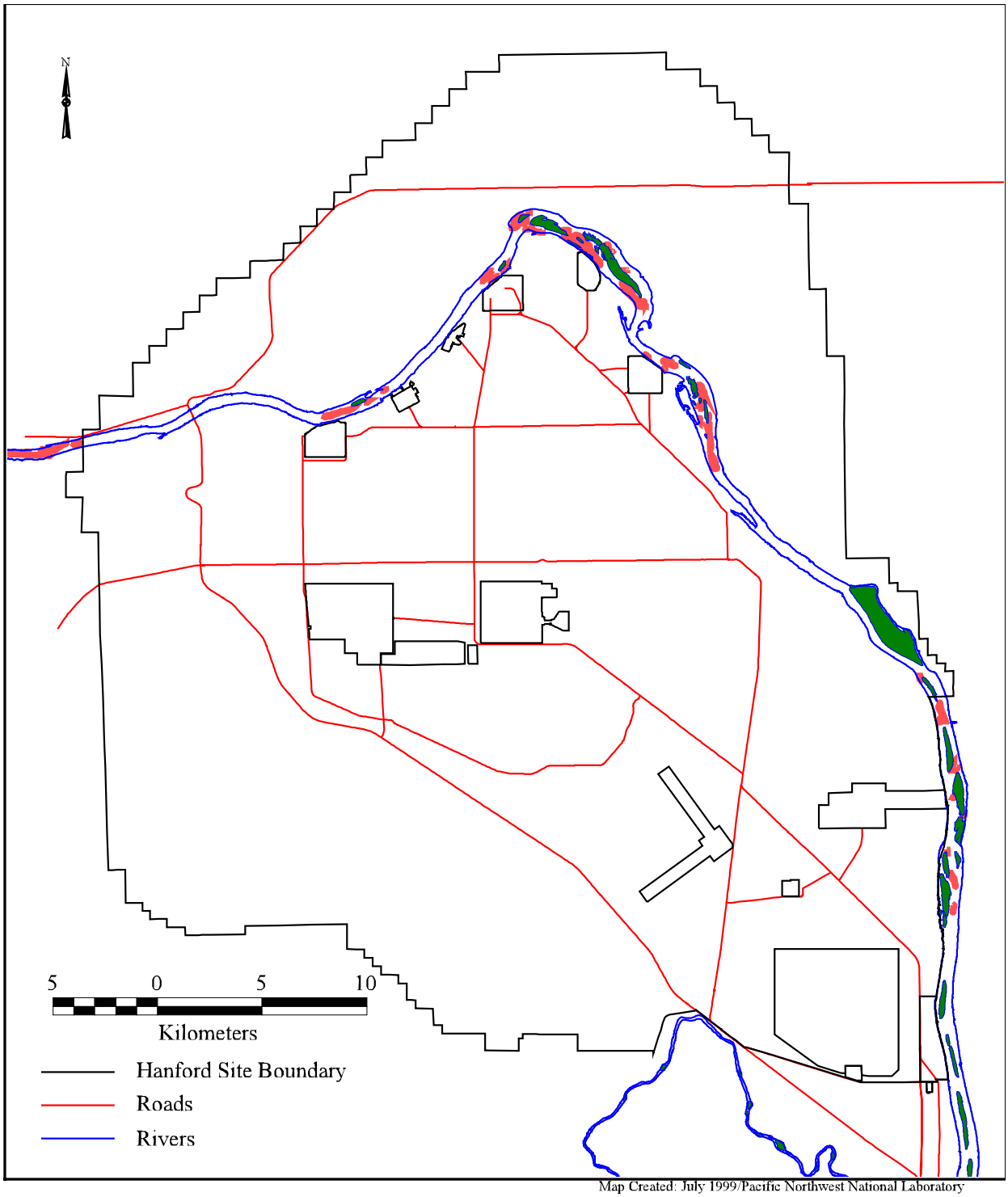
Sometimes it is the responses of the more ubiquitous species to environmental change that best serve as the indicators of ecological stress. Those species that are characteristic of a particular habitat and are typically relatively abundant in that habitat can be readily used as monitors of change. Table D.14 provides an initial list of such ecologically important species. A more definitive list of species/taxa will be developed in concurrence with the development of the monitoring strategy for the Hanford Site. In general, species monitoring will be accomplished in conjunction with data collection that characterizes and monitors changes in habitats of concern on Hanford. All the species/taxa identified in Table D.14 are considered Level I resources (i.e., require status monitoring). Other ecologically important species, that are also species of concern, are included in the tables that address specific taxa and are not generally repeated here. (The bird species listed, because each also qualifies as a federally-recognized migratory bird, are an exception.)

Table D.14 lists relatively abundant or widely distributed species/taxa that are proposed for monitoring in the following four general habitat classes on the Hanford Site: shrub-steppe, desert streams, the riparian corridor along the Hanford Reach, and the aquatic environment of the Hanford Reach. In general, these species/taxa were selected because of their ubiquity in the specified habitat and their position in the food chain. For example, long-term declines in species at the base of the food chain or at the top of the food chain are likely to be indicative of a decline in the overall health of the specified habitat. Brief descriptions in regard to the basis for selecting the species identified in Table D.14 are provided by habitat class in the paragraphs that follow.

Darkling beetles (family Tenebrionidae) are among the most conspicuous of the ground-dwelling insects at Hanford (Rickard et al. 1988). Their abundance varies according to season of the year, habitat, and microclimate; generally, their abundance is greater in warmer and drier locations and in areas dominated by native vegetation (Rogers et al. 1988). Thus, changes in the abundance or species composition of darkling beetles may well be an indicator of change within shrub-steppe communities. Species likely to be particularly good indicators of shrub-steppe condition include *Eleodes hispilabris*, *E. obscura*, *E. nigrina*, *E. granulata*, *E. humeralis*, *Eusattus muricatus*, *Stenomorpha puncticollis*, and *Philolithus densicollis*.

The ecological role of darkling beetles is closely tied to their particular life stage. Larval populations are primarily detritivores and live in the litter layer near the soil surface. Their feeding activities help to cycle nutrients between the plant and soil components. Adults also feed primarily on detritus, though some species will feed on green plant material. The adults also are an important component in the diets of a variety of predatory mammals that range in size from the grasshopper mouse (*Onychomys leucogaster*) to the coyote (*Canis latrans*). They also may serve as prey for a variety of the raptorial bird species that occupy the shrub-steppe.

The Great Basin pocket mouse (*Perognathus parvus*) is granivorous. This species is widely distributed and abundant across the entire shrub-steppe of the



Fall Chinook Salmon Redd Areas

Columbia River Islands

Figure D.26 Fall Chinook Spawning Areas

Table D.14 Initial List of Ecologically Important Species Found on the Hanford Site

Habitat Class/Location/Scientific Name or Taxonomic Group	Common Name or Taxonomic Group
Shrub-Steppe	
Invertebrates	
Tenebrionidae spp.	Darkling beetles
Reptiles	
Uta stansburiana	Side-blotched lizard
Birds	
Circus cyaneus	Northern harrier
Mammals	
Perognathus parvus	Great Basin pocket mouse
Desert Streams (and associated Springs)	
Dry Creek (Rattlesnake Spring)	
Invertebrates	
Baetis spp.	Mayfly
Simulium spp.	Black fly
Amphibians	
Scaphiopus intermontanus	Great Basin spadefoot toad larvae
Snively Creek (Snively and Lower Snively Springs)	
Invertebrates	
Amphipoda	Scuds
Baetis spp.	Mayfly
Simulium spp.	Black fly
Riparian Habitat along Hanford Reach	
Birds	
Bubo virginianus	Great horned owl
Falco sparverius	American kestrel
Tyrannus tyrannus	Eastern kingbird
Mammals	
Sylvilagus nuttalli	Nuttall's cottontail
Aquatic (Hanford Reach)	
Invertebrates	
Chironomidae spp.	Midge fly
Pacifasticus leniusculus	Crayfish
Hydropsyche spp.	Caddisfly
Fish	
Catostomus macrocheilus	Largescale sucker

Hanford Site. Densities of this species are higher in shrub-grass habitats where native bunchgrasses are more prevalent than in cheatgrass (*Bromus tectorum*) monocultures (Brandt and Rickard 1994). The pocket mouse also has a higher survival rate in shrub-dominated stands than it does in cheatgrass-dominated stands (Brandt and Rickard 1994; Gano and Rickard 1982). Thus, changes in numbers of the Great Basin pocket mouse would likely be indicative of changes in the species composition of shrub-steppe plant communities and would also likely be reflected in changes in population numbers of the many raptors on Site, such as the northern harrier (*Circus cyaneus*), for which the pocket mouse represents a significant prey item. The northern harrier is a year-round resident of Hanford and is common over the entire Site.

The side-blotched lizard (*Uta stansburiana*) is abundant and widely distributed at low elevations (Rickard 1968) across Hanford. It is likely a major prey item of snakes and raptors on Site.

Black fly (*Simulium* spp.) and mayfly (*Baetis* spp.) larvae are predominately detritivores. These genera are the most abundant of the benthic insects in both of the ALE Unit upland stream systems (Gaines et al. 1992). Adult black flies and mayflies provide an important food source for insectivorous birds (C. Cushing, pers. comm., 1995). Amphipods are omnivorous and are numerous only in Snively Spring (Gaines et al. 1992). Amphipods are eaten by carnivorous insect larvae, such as the dragonfly and damselfly. Adult dragonflies and damselflies also constitute an important prey base for insectivorous birds (C. Cushing, pers. comm., 1995).

Great Basin spadefoot (*Scaphiopus intermontanus*) larvae are numerous only in Dry Creek. These larvae are significant consumers of primary productivity and detritus.

Nuttall's cottontail (*Sylvilagus nuttalli*) is ubiquitous and abundant in the riparian corridor of the Hanford Reach and is an important food source for the great horned owl (*Bubo virginianus*) and American kestrel (*Falco sparverius*). The great horned owl and kestrel are also ubiquitous and abundant in the riparian corridor and forage nocturnally and diurnally, respectively. Kestrels use nest boxes, which would greatly facilitate study of this species. The eastern kingbird (*Tyrannus tyrannus*) is insectivorous and is also ubiquitous and abundant throughout the riparian corridor (W. Rickard, pers. comm., 1995).

Caddisflies (*Hydropsyche* spp.) are abundant in the main channel and shorelines of the Hanford Reach of the Columbia River. Caddisflies require flowing water and thus occur much less frequently in slough and backwater areas. Midge flies of the family Chironomidae are a common detritivore of the Hanford Reach. Both caddisflies and midges are an important food source for carnivorous fish, such as whitefish (*Prosopium williamsonii*), juvenile salmonids, and smallmouth bass (*Micropterus dolomieui*). Adult caddisflies are important prey for insectivorous birds. Crayfish (*Pacifasticus leniusculus*) are scavengers and commonly occur in the main channel of the Hanford Reach where the substratum is open enough to provide cover. Crayfish are an important prey base for white sturgeon (*Acipenser transmontanus*), largemouth bass (*Micropterus salmoides*), and smallmouth bass (C. Cushing, pers. comm., 1995). The largescale sucker (*Catostomas macrocheilus*) consumes periphyton, aquatic insect larvae, and detritus (Dauble 1986). The species is abundant and present year-round in the Hanford Reach.

D.2.5.10 Species New to Science, New to Washington State, or New to Hanford

As a result of mainly the TNC biodiversity surveys of 1994 (TNC 1995) 1995 (TNC 1996), and 1997 (TNC 1998, 1999), several species new to science, new to Washington State, or new to the Hanford Site have been discovered recently. The taxa affected are plants and invertebrates (with two exceptions, the rest of the latter are insects). Tables D.15 (plants) and D.16 (invertebrates) provide summary information on these new species. Species new to Hanford are listed only if they have some current status recognition as a species of concern at the state or federal level (i.e., monitor, sensitive, candidate, etc.). Except for the species that are new to Hanford, all other species in Tables D.15 and D.16 have not received a final determination as to what resource level of concern they should be assigned. This must await a determination of their listing status at the federal and/or state level. A conservative approach to their management will help preclude adverse impacts to species that may be eligible for federal and/or state listing.

Because the biodiversity inventories of the Hanford Site are not complete, there is still the possibility that many more species await discovery at Hanford.

Table D.15 Plant Species New to Science, New to Washington State, or New to the Hanford Site

Scientific Name	Common Name	Federal Status	Washington State Status[b]	Habitat Association	Location on Hanford	Global and Washington State Rarity Status[b]	Hanford Abundance
Plant Species (Variety) New to Science							
Astragalus conjunctus var. *rickardii*	Basalt milkvetch	Undetermined	Review 1	Bunchgrass areas within big sagebrush/bluebunch wheatgrass and threetip sagebrush/Idaho fescue plant communities	Rattlesnake Mountain	Undetermined	Uncommon
Eriogonum coduim	Umtanum desert buckwheat	Undetermined	Endangered	Exposed rocky sites in big sagebrush/bluebunch wheatgrass	Umtanum Ridge	G1, S1	Rare
Lesquerella tuplashensis	White Bluffs bladderpod	Undetermined	Endangered	Big sagebrush/Sandberg's bluegrass - Indian ricegrass	White Bluffs	G1, S1	Uncommon
Plant Species (Variety) New to Washington State							
Calyptridium rosea	Calyptridium		Sensitive	Big sagebrush/Sandberg's bluegrass	Gable Mountain area	G5, S1	Rare
Gilia leptomeria	Gilia		Review 1	Big sagebrush/Sandberg's bluegrass	Gable Mountain, Vernita Bluffs, and Umtanum Ridge	G5	Rare
Loeflingia squarrosa var. *squarrosa*	Loeflingia		Threatened	Big sagebrush/Sandberg's bluegrass	Gable Mountain area	G514, S1	Rare
Plant Species New to Hanford							
Mimulus suksdorfii	Suksdorf's monkey-flower		Sensitive	Sand/Shrub-steppe	Gable Mountain area	G4, S2	Rare

(a) Table information is from TNC (1995, 1996, 1998, and 1999). Species new to science, new to Washington, or new to the Hanford Site were located on Hanford by The Nature Conservancy (TNC) during its biodiversity inventory of the Fitzner/Eberhardt Arid Lands Ecology Reserve, Wahluke Unit, and central core of Hanford during 1994, 1995, and 1997. Information on epithets, federal and state statuses, locations on Hanford, global and state rarity statuses, and more specific habitat association data will be added to this table when such information becomes available. In most cases, species new to science, new to Washington, or new to the Hanford Site were collected in relatively small numbers at relatively few locations. Thus, most are considered rare.
(b) See Section D.3.5.1 for references and category definitions. Global and state rarity statuses are separated by a comma in the table.

Table D.16 Insect Species New to Science, New to Washington State, or New to the Hanford Site

Order	Family	Genus Identity only or Complete Species Epithet	No. New Species or Subspecies/ Common Name	Federal Status[a]	Washington State Status[a]	Habitat Association	Global and Washington State Rarity Status[a]	Hanford Abundance
Insect Species New to Science[b]								
Coleoptera (beetles)	Scarabaeidae	*Glaresis*	1 new species	Undetermined	Undetermined	Shrub-steppe		Rare
Diptera (flies)	Asilidae	*Efferia*	2 new species	Undetermined	Undetermined	Shrub-steppe		Rare
Homoptera (leafhoppers)	Cicindellidae	*Aceratagallia*	3 new subspecies	Undetermined	Undetermined	Shrub-steppe		Rare
Homoptera (leafhoppers)	Cicindellidae	*Auridius*	1 new subspecies	Undetermined	Undetermined	Shrub-steppe		Rare
Homoptera (leafhoppers)	Cicindellidae	*Errhomus*	1 new subspecies	Undetermined	Undetermined	Shrub-steppe		Rare
Hymenoptera (ants, bees, and wasps)	Andrenidae	*Andrena*	1 new species	Undetermined	Undetermined	Shrub-steppe		Rare
Hymenoptera (ants, bees, and wasps)	Andrenidae	*Perdita*	2 new species	Undetermined	Undetermined	Shrub-steppe		Rare
Hymenoptera (ants, bees, and wasps)	Colletidae	*Colletes*	1 new species	Undetermined	Undetermined	Shrub-steppe		Rare
Mollusc Species New to Science[c]								
Pulmonata	Polygyridae	*Cryptomastix*	1 new species			Areas surrounding springs and basalt talus		Rare
Arthropod Species New to Washington[b,d]								
Hymenoptera	Torymidae	*Diomerus zabriskiei*	Tormids		Undetermined	Shrub-steppe		Rare
Hymenoptera	Torymidae	*Monodontomerus viridiscapus*	Tormids		Undetermined	Shrub-steppe		Rare
Hymenoptera	Torymidae	*Pseuderimerus mayetiolae*	Tormids		Undetermined	Shrub-steppe		Rare

Table D.16 Insect Species New to Science, New to Washington State, or New to the Hanford Site (continued)

Order	Family	Genus Identity only or Complete Species Epithet	No. New Species or Subspecies/ Common Name	Federal Status[a]	Washington State Status[a]	Habitat Association	Global and Washington State Rarity Status[a]	Hanford Abundance
Arthropod Species New to Washington[b,d] (continued)								
Hymenoptera (continued)	Torymidae	*Pseudotorymus lazulellus*	Tormids		Undetermined	Shrub-steppe		Rare
Hymenoptera	Torymidae	*Torymus aeneoscapus*	Tormids		Undetermined	Shrub-steppe		Rare
Hymenoptera	Torymidae	*Torymus capillaceus albitarsis*	Tormids		Undetermined	Shrub-steppe		Rare
Hymenoptera	Torymidae	*Torymus kinseyi*	Tormids		Undetermined	Shrub-steppe		Rare
Hymenoptera	Torymidae	*Zaglyptonotus schwarzi*	Tormids		Undetermined	Shrub-steppe		Rare
Podocopida	Cyprididae	*Stenocypris bolieki*	Seed shrimp			Spring/stream		Undetermined
Insect Species New to Hanford[b]								
Lepidoptera (butterflies and moths)	Nymphalidae	*Cercyonis pegala ariane*	Large wood nymph	Former candidate		Shrub-steppe	G5	Rare
Lepidoptera (butterflies and moths)	Hesperiidae	*Hesperia juba*	Juba skipper		Monitor	Upland areas[e]	G5, S?	Rare
Lepidoptera (butterflies and moths)	Hesperiidae	*Hesperia nevada*	Nevada skipper		Monitor	Shrub-steppe	G4G5, S?	Rare
Lepidoptera (butterflies and moths)	Hesperiidae	*Ochlodes sylvanoides bonnevilla*	Bonneville skipper		Monitor	Shrub-steppe	G5, S?	Rare

(a) See Section D.3.5.1 for references and category definitions. Global and state rarity statuses are separated by a comma.
(b) Unless otherwise indicated, table information is from Jonathon Soll (Correspondence and personal communication in regard to preliminary findings about insects by The Nature Conservancy of Washington from its 1994 and 1995 biodiversity inventories of the Hanford Site, 1995). Insect species new to science, new to Washington, or new to the Hanford Site were located on Hanford by The Nature Conservancy (TNC) during its biodiversity inventories of the Fitzner/Eberhardt Arid Lands Ecology Reserve Unit and Wahluke Unit during 1994 and 1995. Information epithets, federal and state statuses, global and Washington state rarity statuses, locations on Hanford, and more specific habitat association data will be added to this table when such information becomes available. Insect species new to science, new to Washington, or new to the Hanford Site were collected in relatively small numbers at relatively few locations. Thus, all these are considered rare.
(c) One new species of the genus *Cryptomastix* has been located on the Hanford Site (Frest and Johannes 1993). This new species is endemic to Hanford and is known from only one spring area on Umtanum Ridge.
(d) Information on *Stenocypris bolieki* is from Colbert Cushing (pers. comm., 1996).
(e) Collected in 1994 on the Fitzner/Eberhardt Arid Lands Ecology Reserve Unit in Snively Canyon and on the Wahluke Unit (TNC 1995).

Even already collected material may yield additional species new to science. For insects especially, specimens collected in 1994 or 1995 have not been fully evaluated taxonomically. A finding of several additional species new to science can be expected once taxonomic evaluations are complete. For now, the species listed in Tables D.15 and D.16 provide another indication of the uniqueness of Hanford's flora and fauna, as well a demonstration that the maintenance of high levels of native biodiversity relies on healthy, native ecosystems.

D.2.5.11 Summary of Federally and Washington/Oregon State Listed and Candidate Species

Table D.17 provides a summary of the federal and Washington/Oregon State listing or candidate status for species potentially found on or near the Hanford Site. Also included in the table is information on the abundance of the particular species at Hanford.

As indicated by Table D.17, there are three federally endangered, two federally threatened, and one federal candidate species that potentially are found on or near the Hanford Site. Steelhead trout and bald eagle are common (Figure D.27 shows steelhead trout spawning areas, which are also depicted in the composite map of Level IV habitats of concern [Figure 4.6]). The other four species are either rare or accidental visitors to the Site. There are seven state of Washington endangered species potentially found on or near the Hanford Site. Two of these, the American white pelican (*Pelecanus erythrorhynchos*) and Columbia yellowcress (*Rorippa columbiae*), are common to the Site; the remainder are either undocumented [i.e., northern wormwood (*Artemisia campestris borealis* var. *wormskioldii*)], extirpated (i.e., pygmy rabbit), accidental [i.e., Aleutian canada goose (*Branta canadensis leucopareia*) and peregrine falcon (*Falco peregrinus*)], or uncommon migrant visitors [i.e., sandhill crane (*Grus canadensis*)]. There are six Washington State threatened species at Hanford; four of these are rarely found plants. The other two threatened species are the bald eagle and ferruginous hawk. In contrast to the preceding relatively low numbers, there are 13 Washington State sensitive plant species (nine of which have been recently documented to be present on Site) and 19 Washington State candidate animal species (only three of which have never been documented on Site or in the Hanford Reach) that are potentially found on or near Hanford.

Table D.17 reflects recent USFWS changes to federal candidate species designations and definitions.[18] Previously, species contained in candidate categories 1 and 2 were considered candidates for listing. Category 1 candidate species were those taxa the USFWS had sufficient information on biological vulnerability and threat(s) to support a proposed rule to list but listing was precluded by other USFWS priorities or funding limitations. Category 2 candidate species were those taxa that USFWS information indicated that proposing to list was possibly appropriate, but for which sufficient data on biological vulnerability and threat were not currently available to support proposed rules. By its February 28, 1996, actions the USFWS discontinued the use of the category 2 candidate designation (and category 3 as well). Previous category 2 species are no longer considered candidate species by the USFWS. Also, in a separate but parallel action the USFWS reevaluated the status of many of the former category 1 species. Ninety six of these species, among them a Hanford resident species—Columbia milkvetch (*Astragalus columbianus*), were removed from candidate status either because they were already extinct, had unresolved taxonomic questions, were more widespread than previously thought, or had insufficient information on file to justify issuing a proposed rule (61 FR 7457).

Only those former category 1 species not removed from the candidate list by the separate action described above are now considered by USFWS to be candidate species (61 FR 7595). The Hanford Site retains one federal candidate species—the bull trout, an occasional but accidental visitor to the Hanford Reach. Before the current action by USFWS, there were three category 1 and 23 category 2 candidate species potentially found on or near the Hanford Site. In accompanying press releases to the *Federal Register* notices, the USFWS indicated it remains concerned about many of the

[18] U.S. Fish and Wildlife Service. February 28, 1996. Endangered and Threatened Wildlife and Plants; Review of Plant and Animal Taxa that are Candidates for Listing as Endangered or Threatened Species. 61 FR 7595. U.S. Fish and Wildlife Service. February 28, 1996. Endangered and Threatened Species; Notice of Reclassification of 96 Candidate Taxa. 61 FR 7457.

Table D.17 Summary of Listing and Candidate Status Information for Species Potentially Found on or Near the Hanford Site

Scientific Name	Common Name	Federal Status[(a)]	Washington (Oregon) State Status[(a)]	Hanford Abundance[(b)]
Plants				
Arenaria franklinii var. *thompsonii*	Thompson's sandwort		(Candidate)	Uncommon
Artemisia campestris borealis var. *wormskioldii*	Northern wormwood	Former candidate	Endangered (endangered)	Undocumented
Astragalus arrectus	Palouse milkvetch		Sensitive	Not recently documented
Astragalus columbianus	Columbia milkvetch	Former candidate	Threatened	Rare
Astragalus geyeri	Geyer's milkvetch		Sensitive	Rare
Camissonia (=Oenothera) pygmaea	Dwarf evening-primrose		Threatened	Rare
Carex densa	Dense sedge		Sensitive	Undocumented
Collinsia sparsiflora var. *bruceae*	Few-flowered collinsia		Sensitive	Undocumented
Cryptantha leucophaea	Gray cryptantha		Sensitive	Uncommon
Cyperus bipartitus (=C. rivularis)	Shining flatsedge		Sensitive	Uncommon
Eatonella nivea	White eatonella		Threatened	Rare
Erigeron piperianus	Piper's daisy		Sensitive	Uncommon
Limosella acaulis	Southern mudwort		Sensitive	Uncommon
Lindernia dubia var. anagallidea	False pimpernel		Sensitive	Uncommon
Lomatium tuberosum	Hoover's desert parsley	Former candidate	Threatened	Rare
Mimulus suksdorfii	Suksdorf's monkey-flower		Sensitive	Rare
Nicotiana attenuata	Coyote tobacco		Sensitive	Not recently documented
Oenothera cespitosa	Dwarf evening-primrose		Sensitive	Rare
Pectocarya setosa	Bristly combseed		Sensitive	Rare

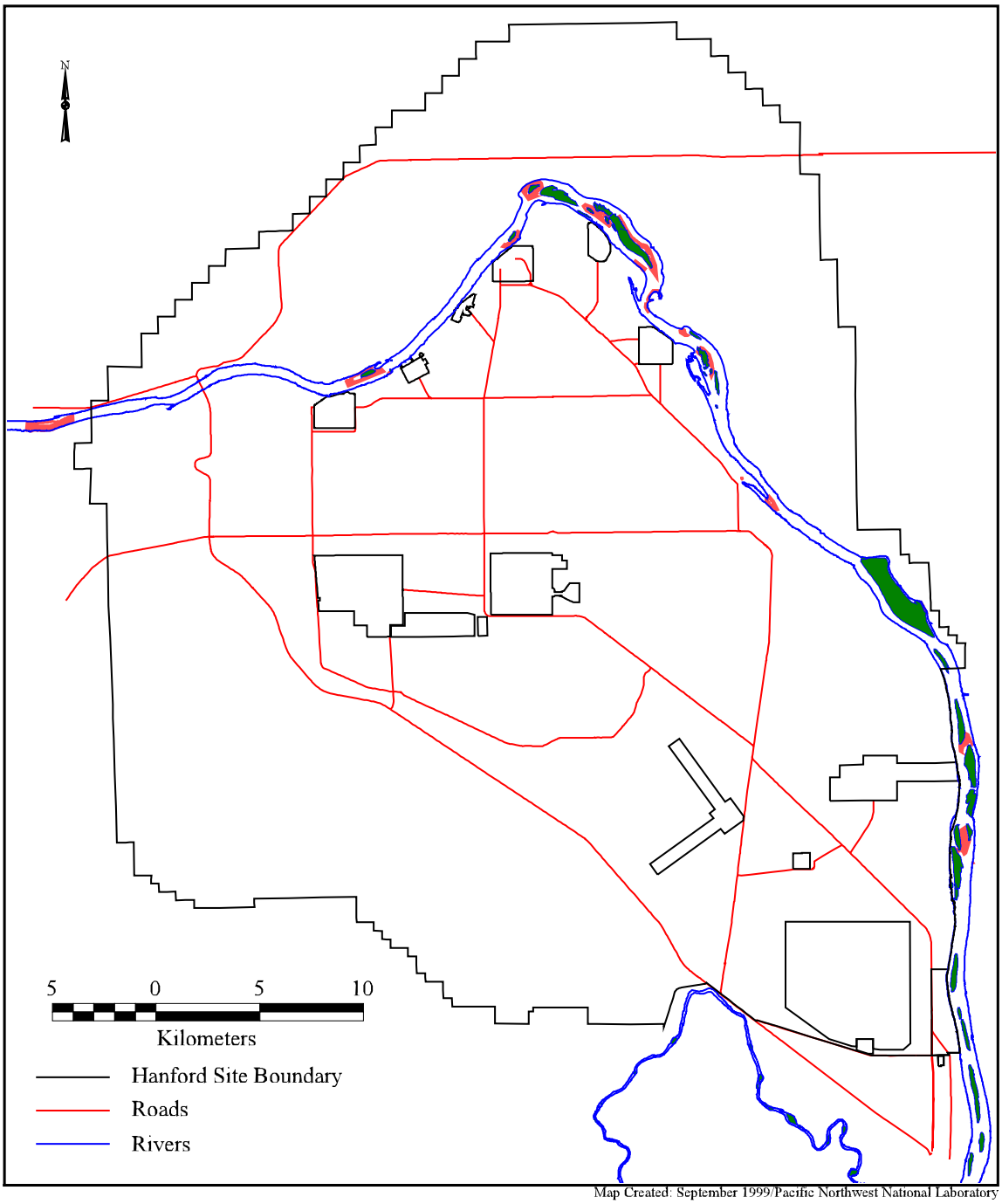
Table D.17 Summary of Listing and Candidate Status Information for Species Potentially Found on or Near the Hanford Site (continued)

Scientific Name	Common Name	Federal Status[a]	Washington (Oregon) State Status[a]	Hanford Abundance[b]
Rorippa columbiae	Columbia yellowcress	Former candidate	Endangered (candidate)	Common
Terrestrial Invertebrates				
Boloria (=Clossiana) selene atrocostalis	Silver-bordered fritillary		Candidate	Undocumented
Cicindela columbica	Columbia River tiger beetle		Candidate	Undocumented
Mitoura siva	Juniper hairstreak		Candidate	Undocumented
Aquatic Invertebrates				
Fisherola nuttalli	Shortface lanx	Former candidate	Candidate	Common
Fluminicola columbiana	Columbia pebblesnail	Former candidate	Candidate	Rare
Fish				
Oncorhynchus mykiss	Upper Columbia River steelhead trout	Endangered	Candidate	Common
Oncorhynchus tshawytscha	Snake River chinook salmon (spring/summer and fall)	Endangered		Rare
Salvelinus confluentus	Bull trout	Candidate		Accidental
Reptiles				
Masticophis taeniatus (=catenifer) catenifer	Striped whipsnake		Candidate	Rare
Birds				
Accipiter gentilis	Northern goshawk	Former candidate	Candidate (sensitive/critical)	Uncommon
Amphispiza belli	Sage sparrow		Candidate	Common
Aquila chrysaetos	Golden eagle		Candidate	Uncommon
Athene cunicularia	Burrowing owl	Former candidate	Candidate (sensitive/critical)	Abundant
Branta canadensis leucopareia	Aleutian canada goose	Threatened	Endangered (endangered)	Accidental
Buteo regalis	Ferruginous hawk	Former candidate	Threatened (sensitive/critical)	Uncommon

Table D.17 Summary of Listing and Candidate Status Information for Species Potentially Found on or Near the Hanford Site (continued)

Scientific Name	Common Name	Federal Status[(a)]	Washington (Oregon) State Status[(a)]	Hanford Abundance[(b)]
Buteo swainsoni	Swainson's hawk	Former candidate	Candidate (sensitive/vulnerable)	Common
Centrocercus urophasianus	Sage grouse	Former candidate	Candidate (sensitive/vulnerable)	Rare
Falco peregrinus	Peregrine falcon	Endangered	Endangered (endangered)	Accidental
Gavia immer	Common loon		Candidate	Uncommon
Grus canadensis	Sandhill crane		Endangered (sensitive/vulnerable)	Uncommon
Haliaeetus leucocephalus	Bald eagle	Threatened	Threatened (threatened)	Common
Lanius ludovicianus	Loggerhead shrike	Former candidate	Candidate (sensitive/ undetermined status)	Common
Melanerpes lewis	Lewis' woodpecker		Candidate (sensitive/critical)	Rare
Oreoscoptes montanus	Sage thrasher		Candidate	Rare
Otus flammeolus	Flammulated owl		Candidate (sensitive/critical)	Accidental
Pelecanus erythrorhynchos	American white pelican		Endangered (sensitive/vulnerable)	Common
Sialia mexicana	Western bluebird		Candidate (sensitive/vulnerable)	Rare
Mammals				
Brachylagus (=Sylvilagus) idahoensis	Pygmy rabbit	Former candidate	Endangered (sensitive/vulnerable)	Extirpated
Spermophilus (=Citellus) washingtoni	Washington ground squirrel		Monitor (sensitive/critical)	Undocumented
Plecotus townsendii pallescens	Pale Townsend's big-eared bat	Former candidate	(sensitive/critical)	Undocumented
Sorex merriami	Merriam's shrew		Candidate	Uncommon

(a) See Section D.3.5.1 for listing and candidate category definitions.
(b) See species of concern data tables for each taxa for references for abundance data.



Upper Columbia River Steelhead Redd Areas

Columbia River Islands

Figure D.27 Steelhead Spawning Areas

former category 2 species.[19] Additionally, part of its rationale for discontinuing the category 2 list was that it duplicated species status tracking efforts by state fish and wildlife agencies and Natural Heritage Programs. The USFWS intends to continue to work with the states and others (e.g., TNC) to gather information about the former category 2 species and to continue to assess their conservation status.[20]

Conservation actions for federal candidate and other species of concern are often the most effective and least expensive means for conserving species. Actions taken now can preclude future listings. The BRMaP will retain information on the former federal candidate species. Many, but not all, of these species are identified in Table D.17. Many of the former federal candidate species are identified by the states of Washington and/or Oregon as species of concern at a candidate level or above. The state listings now take on additional conservation importance in the aftermath of the USFWS action. Additionally, state Natural Heritage Program and TNC data bases can be expected to now take on greater importance as sources of information for determining the status of a particular species of concern.

D.2.5.12 Relationship of Species of Concern Categories to WDFW Priority Species Criteria

A priority species is a fish or wildlife species that requires protective measures and/or management guidelines to ensure its perpetuation (WDFW 1996). The WDFW's Habitat Program establishes three criteria by which a fish or wildlife species will be considered a priority species in the state of Washington (see Section D.2.5.1 for definitions). In addition to these criteria, a further constraint on designating a species a priority species is that species are often considered a priority only within known limiting habitats (e.g., breeding areas) or within areas that support a relatively high number of individuals (e.g., regular large concentrations) (WDFW 1996). These "priority areas" are identified for each priority species (WDFW 1996).

To address the state of Washington's interest in priority fish and wildlife species that occur at Hanford, the different priority species criteria have been matched in BRMaP with a corresponding resource level of concern. The results are depicted in Table D.18.

With two exceptions, all species that are known to occur on Hanford and are identified as a priority species in WDFW (1996) have been accounted for in either Level I, II, or III. Two species, the bald eagle and peregrine falcon, are identified as Level IV resources because of their federal listing status. The WDFW criteria do not directly address federal endangered or threatened status and leave the significance of federal candidate status open to interpretation on a species by species basis (WDFW 1996; see definition of Criterion 1 in Section D.2.5.1). Because DOE-RL is part of a federal agency, it is incumbent on them to address federal status more directly than does WDFW. Thus, the definition of Criterion 1 (state listed and candidate species) best matches up with level III and not with Level IV, which elevates the management importance of federal threatened and endangered species relative to state threatened and endangered species (see Table 3.2).

Many of the Criterion 2 species that WDFW lists and that frequent Hanford are also migratory birds. Because BRMaP identifies migratory birds as Level II resources (Table 3.2), Criterion 2 (vulnerable aggregations) matches best with Level II. Several species of bats and several food fish also

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[19] U.S. Fish and Wildlife Service news release and question and answer sheets in regard to candidate species, dated February 27, 1996.

[20] At the level of their individual state office, the USFWS is now tracking many of the former category 2 candidate species, as well as some of those former category 1 species that had their status recently reevaluated and were not retained in the new candidate list, as "species of concern" (L. Propp, pers. comm., 1996). The conversation standing of these species is still of concern to the Service; however, status information is needed. No regional or national species of concern lists are being maintained; each state office maintains its own list. Washington has two species of concern lists: one for east of the crest Cascade Range and one for west of the crest. The eastern list, issued May 2, 1996, includes all of the former candidate species listed in Table D.17 with the exception of the shortface lanx. Additionally, 11 other former candidate species that are potentially found on or near the Hanford Site, but which are not identified as either listed species or candidates for listing by the state of Washington, are not tracked by the USFWS as species of concern. Thus, a total of 25 species that potentially occur at Hanford are not identified by USFWS as species of concern.

Table D.18 Relationship Between BRMaP's Resource Levels of Concern and WDFW's Priority Species Criteria

BRMaP Resource Level of Concern	WDFW Priority Species Criteria
I	Criterion 3
II	Criterion 2
III	Criterion 1
IV	N/A

are identified as priority species under Criterion 2. Because the bat species, with one exception, also are identified as state monitor species (Level II, see Table 3.2), Criterion 2 again matches best with Level II. The pale Townsend's big-eared bat subspecies (*Plecotus townsendii pallescens*) is not yet on WDFW's species of special concern list; however, the species is identified as sensitive/critical by Oregon. The subspecies is identified as a Level III resource. The fish species also are identified under Criterion 3 (species of recreational, commercial, and/or tribal importance). Other than the fall chinook salmon (Level IV), these species are retained at Level I because their prioritization by WDFW is based on their role as food fish.

Most remaining Criterion 3 species that WDFW lists (not including those species listed under multiple criteria) are identified in WDFW (1996) as game species. Moreover, many of these species are non-native, introduced species. Therefore, for those species present on Hanford that qualify as priority species under only Criterion 3, resource level of concern I is the best match for establishing an appropriate degree of management attention.

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