11.0 Resource Protection

11.1 Ecological Protection

JW Wilde, KJ Cranna, JE Grzyb, JJ Nugent, JA Pottmeyer

Ecological monitoring is performed on the Hanford Site to collect and track data needed to ensure compliance with an array of environmental laws, regulations, and policies governing DOE activities. Ecological monitoring data provide baseline information about the plants, animals, and habitat under DOE stewardship at Hanford required for decision-making under NEPA and CERCLA.

The *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (CLUP; DOE/EIS-0222-F) evaluated the impacts associated with future land-use planning at the Hanford Site. The purpose of this land-use plan and its implementing procedures is to facilitate decision-making about the site's uses and facilities over at least the next 50 years. The DOE decision to adopt the CLUP seeks to balance continuing land-use needs at Hanford with the preservation of important ecological and cultural values of the site and supporting future access and economic development in the area.

The *Hanford Site Biological Resources Management Plan* (BRMP; DOE/RL-96-32) is identified by the CLUP as the primary implementation control for managing and protecting natural resources on the Hanford Site. According to the CLUP, the BRMP:

> provides a mechanism for ensuring compliance with laws protecting biological resources; provides a framework for ensuring that appropriate biological resource goals, objectives, and tools are in place to make DOE an effective steward of the Hanford biological resources; and implements an ecosystem management approach for biological resources on the Site. The [BRMP]† provides a comprehensive direction that specifies DOE biological resource policies, goals, and objectives.

DOE places priority on monitoring those plant and animal species or habitats with specific regulatory protections or requirements; that are rare and/or declining (federal or state listed endangered, threatened, or sensitive species); or are of significant interest to federal, state, or tribal governments or the public. The BRMP ranks wildlife species and habitats (Levels 0–5), providing a graded approach to monitoring biological resources based on the level of concern for each resource.

Ecological monitoring and ecological compliance support the Hanford Site's waste management and environmental restoration mission through the following activities:

- Ensuring the Hanford Site's operational compliance with laws and regulations including the Endangered Species Act of 1973 (16 U.S.C. 1531), *Bald and Golden Eagle Protection Act* (16 U.S.C. 668–668c), and MBTA of 1918 (16 U.S.C. 703) as well as compliance with executive orders, DOE orders, and DOE resource management guidance
- Providing data for environmental impact and ecological risk assessments

†The CLUP document uses a different acronym (BRMaP, in place of BRMP used here) for abbreviating the *Hanford Site Biological Resource Management Plan* document.

- Providing information and maps of the distribution and condition of biological resources at the Hanford Site
- Supporting Hanford Site land-use planning and stewardship.

Hanford Site ecological monitoring activities provide information useful to the Hanford Site natural resource stakeholders and the public on the status of some of the site's most highly valued biological resources. Population level surveys are conducted to monitor fish, wildlife, and plants and are used to develop baseline information and monitor any changes resulting from Hanford Site operations. Population data collection and analysis are integrated with data from environmental surveillance monitoring of biotic and abiotic media, and analytical results are used to characterize any potential risk or impact to the biota.

11.1.1 Rare Plants

Plant populations monitored at the Hanford Site include taxa classified by the Washington State Natural Heritage Program as endangered, threatened, or sensitive species and those listed as Review Group 1 (i.e., taxa in need of additional fieldwork before status can be determined). In 2015, two separate monitoring efforts occurred on the DOE managed portion of the Hanford Site. Upland plants of conservation concern were inventoried concurrently with an effort to map Hanford Site plant communities, and a focused survey of gray cryptantha (*Cryptantha leucophaea*) was led by Washington Rare Care and Conservation (Rare Care) with participation by botanists/ecologists representing Rare Care, the Washington State Natural Heritage Program, the U.S. Bureau of Land Management, and DOE.

Species canvassed as part of the study of rare upland plant species at Hanford included the following:

Cespitose evening primrose (*Oenothera cespitosa*), Washington (WA) State Sensitive
Columbia milk-vetch (*Astragalus columbianus*), Federal Species of Concern, WA State Sensitive
Dwarf evening-primrose (*Eremothera pygmaea*), WA State Sensitive
Gray cryptantha (*Cryptantha leucophaea*), Federal Species of Concern, WA State Sensitive
Great Basin gilia (*Aliciella leptomaria*), WA State Threatened
Piper's daisy (*Erigeron piperianus*), WA State Sensitive
Rosy pussypaws (*Calyptridium roseum*), WA State Threatened
Small-flowered evening-primrose (*Eremothera minor*), WA State Sensitive
Spreading pygmyleaf (*Loeflingia squarrosa* var. *squarrosa*), WA State Threatened
Suksdorf's monkeyflower (*Erythranthe suksdorfii*), WA State Sensitive
Thompson's sandwort (*Eremogone franklinii* var. *thompsonii*), WA State Sensitive
Yellow or sand wildrye (*Leymus flavescens*), WA State Review Group 1

In May 2015, Rare Care partnered with the U.S. Bureau of Land Management to locate the remaining occurrences of gray cryptantha in Washington State that had not been monitored for the previous 5 years. This effort included the survey of gray cryptantha populations at Hanford described in this section. Rare Care found that 26% of the known population occurrences in Washington State could not be relocated and 26% had fewer than 50 individuals. In total, populations appear to have declined by 75% or more at 30% of the occurrences (Rare Care 2015). Overall, roughly 6,200 individual plants of gray cryptanatha were observed at the Hanford site over the monitoring period. Of those plants, approximately 98% were in bloom and 2% were vegetative. Plant "skeletons" or senescing plants were not included in the tally and were seen infrequently. Because of the extent of the Hanford Dune fields (roughly 2,820 ac) and the scattered nature of the gray cryptantha populations, it is likely that not all populations within the dune fields were found.

Each year, seed collections are made from populations of rare native plants across Washington State. In June 2015, a month after completion of the survey described above, personnel from Rare Care and BLM returned to the Hanford Site to collect gray cryptantha seed following Rare Care protocols. The findings were also surveyed by MSA Radiological Control Technicians prior to being removed from the Hanford Site. Additional details from these surveys are included in the FY 2015 monitoring report currently or shortly available at http://www.hanford.gov/page.cfm/EcologicalMonitoring.

11.1.2 Fish and Wildlife Monitoring

This section provides inventory, monitoring, and survey information for fish and wildlife evaluated at the Hanford Site during 2015. This information is provided in context with historical data and trend information. Historically, three fish and wildlife species on the Hanford Site have been monitored annually: fall Chinook salmon (*Oncorhynchus tshawytscha*), steelhead (*Oncorhynchus mykiss*), and bald eagles (*Haliaeetus leucocephalus*). These species are either protected by federal or state laws and regulations or are of special interest to the public and stakeholders. Monitoring consisted of estimating numbers of fall Chinook salmon redds, surveying for steelhead redds, and assessing bald eagle nesting and night roosting activity because the species have the potential to be impacted by Hanford Site operations. Yearly monitoring provides occurrence and distribution data to ensure their protection from Hanford Site operations. Additional annual monitoring efforts included nesting raptors and migratory birds. Each calendar year, additional species specific monitoring are performed based on stakeholder interest, legal requirements, resource status, BRMP resource level and data needs. In addition to the aforementioned annual projects, CY 2015 monitoring also included Townsend's ground squirrel, burrowing owl, Hanford reptiles, black-tailed jackrabbits, and American badger. The sections below provide summaries of the monitoring results; the detailed monitoring reports are currently or shortly available at http://www.hanford.gov/page.cfm/EcologicalMonitoring.

11.1.2.1 Fall Chinook Salmon

Commonly referred to as king salmon, Chinook are the largest Pacific salmon (Myers et al. 1998; Netboy 1958). Adult fall Chinook salmon destined for the Hanford Reach enter the Columbia River in late summer and spawn in the fall. Females fan out nests or redds in suitable gravel substrate and deposit eggs in a pocket while males simultaneously extrude milt to fertilize the eggs. Redds are readily identifiable during this time and appear as clean swept gravel patches amidst darker undisturbed substrate covered by algae (periphyton).

The population of fall Chinook salmon that spawns in the Hanford Reach of the Columbia River is the largest run remaining in the Pacific Northwest and has regional ecological and cultural significance, and economic importance that reaches areas downstream on the Columbia River and along the Pacific Ocean as far as southeast Alaska (Dauble and Watson 1997). These fall Chinook salmon have been vital in efforts to preserve and restore other depleted Chinook salmon stocks in the Columbia Basin (Anglin et al. 2006). Aerial counts of fall Chinook salmon redds have been conducted since 1948 at Hanford to provide an index of relative abundance among spawning areas and years (Wagner, Lindsey, and Nugent 2012; Wagner, Nugent, and Lindsey 2013; Lindsey and Nugent 2014; Nugent and Wilde 2015). The counts are also used to document the onset of spawning, locate spawning areas, and determine intervals of peak spawning activity. These data also allow for planning to avoid impacts such as disturbance or siltation to redds from Hanford Site activities. Understanding the location and abundance of spawning is a critical part of the management of this important population. The information collected during the aerial surveys, which are the focus of this report,

is vitally important for the implementation of the Hanford Reach Fall Chinook Protection Program (USACE 2006). Prior to 2011, the Hanford Reach was divided into 11 sections that were maintained in the current monitoring campaign. In 2011, eight additional sections (100-B/C, 100-K, 100-N, 100-D, 100-H, 100-F, the dunes, and 300 Area) were defined to better monitor the abundance and distribution of fall Chinook redds in areas of potential upwelling of contaminated groundwater. The original 11 sections and the newer eight sections are not mutually exclusive areas; they simply represent different divisions of the Hanford Reach.

In 2015, three aerial surveys were completed along the length of the Hanford Reach (October 19, November 2, and November 16). Table 11.1 summarizes the results of visual aerial surveys for fall Chinook salmon redds in the originally defined 11 sections. The results for the same surveys, organized into the eight operational areas are shown in Table 11.2. The peak annual redd count for 2015 (20,678) was certainly the highest count since 1948 and well exceeds the previous 10-year average (8,813; Figure 11.1). Additional information detailing the 2015 monitoring effort is available at http://www.hanford.gov/page.cfm/EcologicalMonitoring.

Table 11.1. Summary of Fall Chinook Visual Aerial Redd Counts for CY 2015 Aerial Surveys in the Hanford Reach of the Columbia River

Area	Description	10/19/15	11/02/15	11/16/15	Maximum Count
0	Islands 17–21 (Richland)	0	0	0	0
1	Islands 11–16	4	581	1,193	1,193
1a	Savage Island/Hanford Slough	0	0	0	0
2	Islands 8–10	18	1,320	3,145	3,145
3	Near Island 7	1	535	800	800
4	Island 6 (lower half)	5	1,630	2,315	2,315
5	Island 4, 5, and upper 6	13	1,550	2,540	2,540
6	Near Island 3	5	320	1,100	1,100
7	Near Island 2	12	1,400	1,900	1,900
8	Near Island 1	0	400	1,000	1,000
8a	Upstream of Island 1 to Coyote Rapids	0	0	15	15
9	Near Coyote Rapids	15	215	750	750
9a	Upstream of Coyote Rapids to China Bar	0	71	230	230
China Bar	China Bar/Midway	3	400	1,500	1,500
10	Near Vernita Bar	10	3,250	4,175	4,175
11	Upstream of Vernita Bar to Priest Rapids Dam	0	10	15	15
	Total	**86**	**11,682**	**20,678**	**20,678**

Table 11.2. Summary of Fall Chinook Visual Aerial Redd Counts for CY 2015 Aerial Surveys by Operational Area Sub-sections

Sub-area	10/19/15	11/02/15	11/16/15	Maximum Count
300 Area	0	0	0	0
Dunes	0	0	0	0
100F	1	535	800	800
100H	13	1,550	2,540	2,540
100D	0	400	1,000	1,000
100N	0	0	15	15
100K	0	0	0	0
100BC	15	215	750	750
Total	**29**	**2,700**	**5,105**	**5,105**

Figure 11.1. Visual Hanford Reach Fall Chinook Salmon Redd Counts 1948 to 2015

11.1.2.2 Steelhead

Steelhead use the Hanford Reach for rearing as juveniles, as a migratory corridor for juveniles and adults, and for spawning as adults. Currently, upper Columbia summer-run steelhead are federally listed as threatened under the *Endangered Species Act of 1973* in 16 U.S.C. 1531 and as a state candidate in Washington. Because of their listing status and importance to recreational and tribal fisheries, steelhead were selected for monitoring under this program.

Steelhead build nests termed "redds" in gravel or cobble substrate and spawn in the spring; the steelhead fry emerge from the gravel later that same spring. Adult steelhead generally use smaller tributary habitat and substrate; however, adult steelhead will spawn in larger mainstream rivers with suitable habitat, such as the Columbia River. Suitable spawning conditions within the Hanford Reach, occur between February and early June, with peak spawning in mid-May (Eldred 1970; Watson 1973; PNL-5371).

Aerial surveys for steelhead redds are conducted on the Hanford Reach in the spring of each year to identify potential spawning areas and timing as well as to provide an annual index of relative abundance among spawning areas. The surveys document any change in the status of steelhead spawning in the Hanford Reach and could help plan project activities to avoid redds, if any are identified. Similar to the methods used to document fall Chinook salmon spawning, the survey area is divided into 11 sections, with the number of redds being totaled by section. Eight additional sub-sections (100-B/C, 100-K, 100-N, 100-D, 100-H, 100-F, the dunes, and 300 Area) were added in 2012 to monitor the abundance and distribution of steelhead redds in areas of potential upwelling of contaminated groundwater. The original 11 sections and the newer 8 sections are not mutually exclusive areas; they simply represent different divisions of the Hanford Reach area. Because few redds have been counted in recent years, after the first aerial survey in which redds are observed, a follow-up boat survey is conducted to verify redds seen from the air.

Three steelhead aerial redd count surveys were completed along the length of the Hanford Reach during the 2015 spawning season. The first survey was performed on April 7, the second survey on May 6, and the third survey on May 21. No steelhead redds were observed on April 7 but were observed on May 6 and

May 21. A boat survey on May 11 confirmed redds seen from the air on May 6. A maximum count of 43 steelhead redds were recorded in 2015, the most redds recorded in the Hanford Reach of the Columbia River since 1998 when 75 redds were documented (Dauble 1998; DOE/RL-2000-27). Table 11.3 describes the counts performed by survey area for each flight. The maximum count describes the highest number of redds documented in a survey area within a single flight. Table 11.4 shows the number of redds occurring within the newer defined sub-sections, coinciding with areas of potential upwelling of contaminated groundwater.

Table 11.3. Summary of Steelhead Redd Counts for the 2015 Aerial Surveys in the Hanford Reach of the Columbia River

Area	Description	4/7/15	5/6/15	5/21/15	Maximum Count
0	Islands 17–21 (Richland)	0	0	0	0
1	Islands 11–16	0	15	7	15
1a	Savage Island/Hanford Slough	0	0	0	0
2	Islands 8–10	0	6	6	6
3	Near Island 7	0	0	0	0
4	Island 6 (lower half)	0	7	16	16
5	Island 4, 5, and upper 6	0	0	6	6
6	Near Island 3	0	0	0	0
7	Near Island 2	0	0	0	0
8	Near Island 1	0	0	0	0
8a	Upstream of Island 1 to Coyote Rapids	0	0	0	0
9	Near Coyote Rapids	0	0	0	0
9a	Upstream of Coyote Rapids to China Bar	0	0	0	0
China Bar	China Bar/Midway	0	0	0	0
10	Near Vernita Bar	0	0	0	0
11	Upstream of Vernita Bar to Priest Rapids Dam	0	0	0	0
	Total	**0**	**28**	**35**	**43**

Table 11.4. Summary of Steelhead Redd Counts by Sub-areas Adjacent to Hanford Site Operations for the 2015 Aerial Surveys in the Hanford Reach of the Columbia River

Sub-area	4/7/15	5/6/15	5/21/15	Maximum Count
300 Area	0	0	0	0
Dunes	0	0	0	0
100F	0	0	0	0
100H	0	0	6	6
100D	0	0	0	0
100N	0	0	0	0
100K	0	0	0	0
100BC	0	0	0	0
Total	**0**	**0**	**6**	**6**

Lower than normal flows in late April and early May were likely the reason for the increase in steelhead redds detected. It is unclear whether the higher number of redds detected was due to increased spawning in the reach or to better conditions for observation during 2015. Past records of elevated numbers of steelhead redds in the Hanford Reach also coincided with low flow periods during the spawning season. It is assumed, although it has not been quantified, that more high-quality spawning habitat occurs at lower flow levels. Additional information detailing the 2015 monitoring effort is available at http://www.hanford.gov/page.cfm/EcologicalMonitoring.

11.1.2.3 Bald Eagle

Bald eagles were removed from the federal endangered and threatened species list in July 2007 and were down-listed by the WDFW from threatened to sensitive in January 2008. Federal laws, including the *Bald and Golden Eagle Protection Act of 1940* (16 U.S.C. 668–668c) and the *Migratory Bird Treaty Act of 1918*, still provide protection for eagles, their nest trees, and communal night roosts. DOE/RL-94-150 sets temporal and spatial restrictions on Hanford Site work activities to protect eagles and their habitats in accordance with current federal and state guidelines. Under the plan, communal night roosts and nest sites are protected with a 0.25-mi (400-m) buffer zone. Night roost buffers are enforced from November 15 until March 15, and nest exclusion buffers are maintained until nest abandonment or fledging of young, whichever is later. Work-related access into roost areas is allowed between 10 a.m. and 2 p.m. after notification to Hanford Site Ecological Compliance staff members.

Monitoring bald eagles is essential to maintaining current biological information about their abundance and distribution on the Hanford Site, ensuring compliance with protection regulations and informing future protection and management efforts and decisions. As of early April 2016, 226 night roost, three boat, and eight nest surveys were conducted. WDFW defines a communal or night roost as "a tree or a group of trees in which at least three eagles roost for at least two nights and during more than one year." Night roost surveys were conducted at dusk from 10 minutes prior to sunset until dark. Night roost surveys were conducted weekly at 12 locations between mid-November 2015 and mid-March 2016 with the exception of the week of December 21, 2015 when staff visited only the locations that had yet to qualify as a roost for the 2015-16 season under the WDFW definition described above.

As noted above, the entire Hanford Reach was surveyed by boat three times during the 2015-16 season (mid-December, mid-January, and late February). Boat surveys are used to determine the number, age class, and distribution of eagles present on the Hanford Reach (Figure 11.2). Boat surveys also are used to identify additional potential night roosts and nest sites and to identify the primary foraging areas along the Hanford Reach. The maximum count of 136 bald eagles on the Hanford Reach for the 2015-16 season (on December 15, 2015) was less than the record maximum count of 141 documented during the 2014-15 season, but remains much higher than the historic average maximum count of 25 eagles (1961 to 2013). This was most likely a result of the record number of adult fall Chinook salmon spawning in the Hanford Reach in recent years. Spawned-out salmon carcasses that accumulate along the Hanford Reach provide bald eagles their primary food source. During 2015-16 boat surveys, adult eagles were observed sitting on nests at both the BPA sub-station tower location (near the Upstream of Wooded Island nest that was occupied during the 2012-13 to 2014-15 seasons) and the White Bluffs Peninsula (on February 16, 2016).

Nest site surveys were conducted in two locations: White Bluffs Peninsula and BPA sub-station utility tower. Sites were monitored for nesting activities (e.g., a pair defending the nest from other eagles, nest tending, and pair bonding behaviors). As of April 4, 2016, eagles appeared to be using both the peninsula and sub-station tower nests. The areas are posted with signs to ensure that no vehicular traffic approaches the nests within 0.25 mi (400 m) as required by DOE/RL-94-150. MSA staff members will continue to monitor the nests to determine the outcome of the nesting attempts. Additional information detailing the 2015-16 monitoring effort is available at http://www.hanford.gov/page.cfm/EcologicalMonitoring.

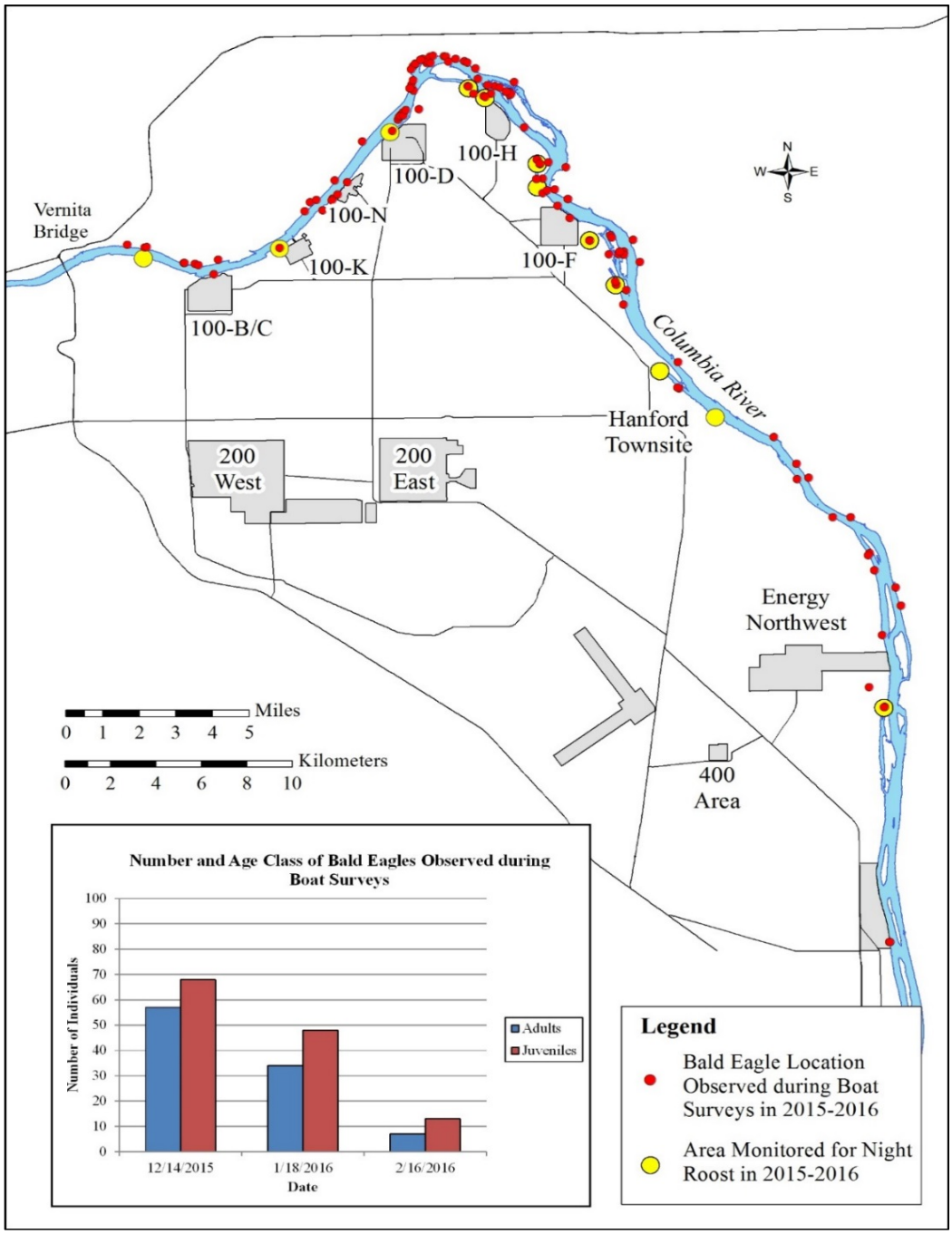

Figure 11.2. Bald Eagle Boat Survey Results for the 2015-16 Season

11.1.2.4 Raptor Nest Monitoring

The Hanford Site supports a large and diverse community of raptorial birds (PNL-3212), with 26 species of raptors observed on the Hanford Site. Thirteen raptor species have been recorded nesting on the Hanford Site, including eight species of diurnal raptors and five species of owls (Table 11.5), and several of which are on federal and state endangered and threatened species lists. The ferruginous hawk is a Washington state-listed threatened species, and the bald eagle is a Washington state sensitive species and a federal species of concern. The burrowing owl (*Athene cunicularia*) is a Washington state candidate species, and the Swainson's hawk (*Buteo swainsoni*), prairie falcon (*Falco mexicanus*), and osprey (*Pandion haliaetus*)

are all Washington state monitored species. Raptor species on the Hanford Site are also afforded protection under the MBTA (16 U.S.C. 703). Because of the status of these species and their protection under the MBTA, DOE-RL documents and protects nest locations to avoid disturbance during the nesting season and tracks populations over time to determine potential impacts of Hanford operations on these species. Common ravens also nest on the Hanford Site, and although they are not considered raptors, they perform a similar ecological role.

Table 11.5. Nest Substrates Used by Raptors and Ravens in 2015 on DOE-RL Managed Lands of the Hanford Site

Species	Tree	Cliff	Transmission Tower	Utility Pole	Electrical Substation	Nest Platform	Communications Tower	Building	Irrigation Pipe	Mammal Burrow	Artificial Burrow	Total
Ferruginous hawk			4									4
Swainson's hawk	19		1									20
Red-tailed hawk	3		3					1				7
Prairie falcon		3										3
American kestrel	4											4
Bald eagle	1											1
Osprey						3						3
Great horned owl	3							2				5
Long-eared owl	2											2
Burrowing owl*									3	3	5	11
Common raven†	14	1	37	7	1		1	1				62
Total	**46**	**4**	**45**	**7**	**1**	**3**	**1**	**4**	**3**	**3**	**5**	**122**

*Burrowing owls were recorded in separate monitoring effort (Wilde et al. 2016).
†Common ravens are technically not raptors but occupy a similar ecological niche and are protected under the MBTA.

Nest surveys for raptors and ravens were conducted on DOE-managed lands, including central Hanford, McGee Ranch/Riverlands, the dunes, and southern shoreline of the Columbia River. Nests were located using vehicular and foot surveys. Nest searches occurred in late May and early June when all species occupy nesting territories. Survey methods used in 2015 were consistent with the methods used in 2012 through 2014 (Nugent, Lindsey, and Malin 2013; Nugent, Lindsey, and Wilde 2014; Nugent et al. 2015).

A total of 122 nest sites were recorded in 2015 (Table 11.5). A second bald eagle nest was built on the White Bluffs peninsula, but its continued occupancy and success could not be determined. Of the 11 burrowing owl nests observed, 10 of these were found during a separate burrowing owl monitoring effort (Wilde, Cranna, and Nugent 2016), and one nest site was detected during a vegetation mapping survey. From the 62 common raven nests observed, two of these were removed from utility poles by Integrated Biological Control because they were deemed fire hazards. Nest substrates used by raptors and ravens on DOE-RL managed lands are shown in Table 11.5. All raptor and raven nest sites located in 2015 are displayed in Figure 11.3. A comparison of the number of raptor and raven nest sites located during 2012 to 2015 is presented in Figure 11.4.

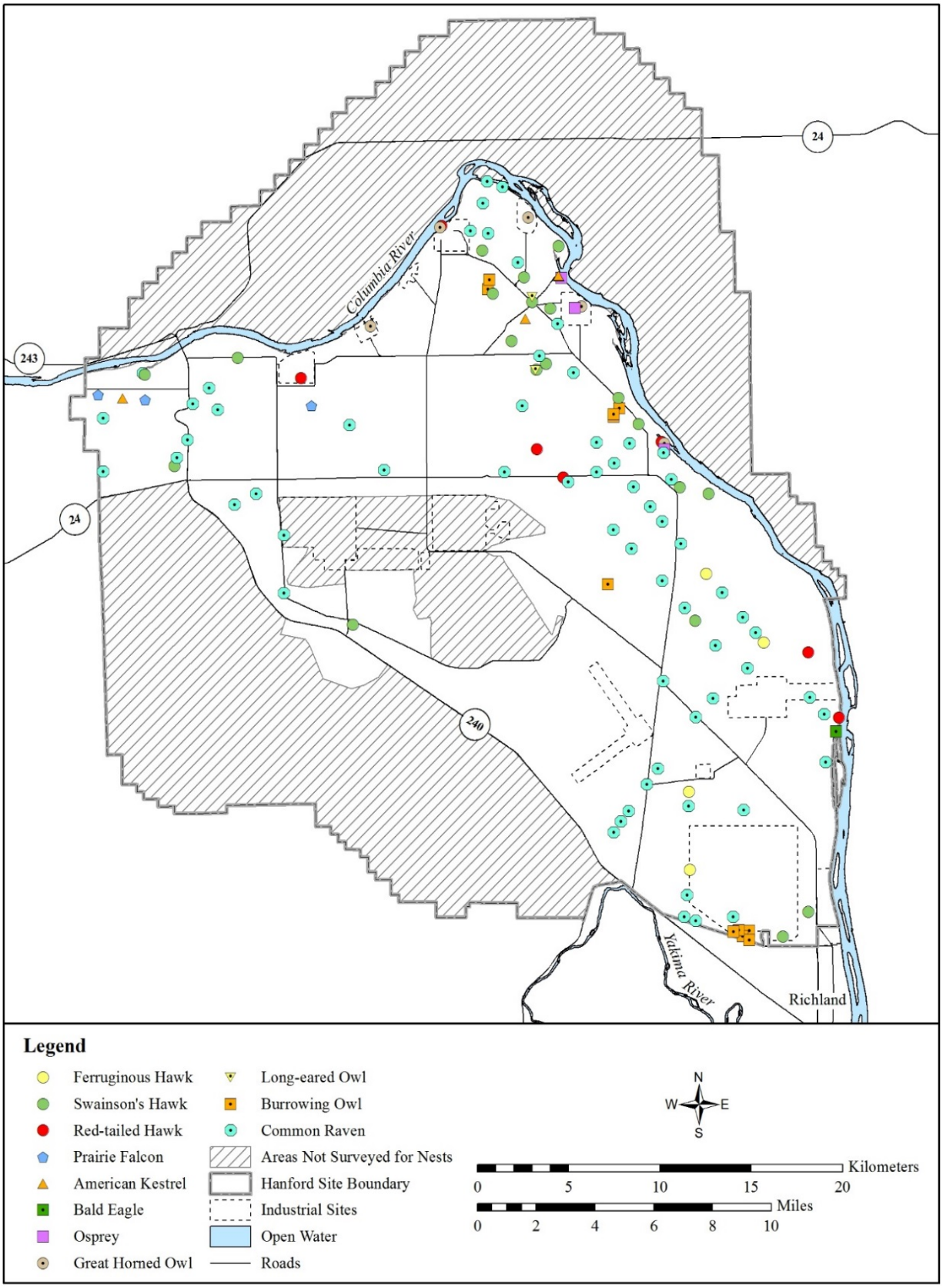

Figure 11.3. Raptor and Common Raven Nests Located on DOE-RL Managed Lands of the Hanford Site in 2015

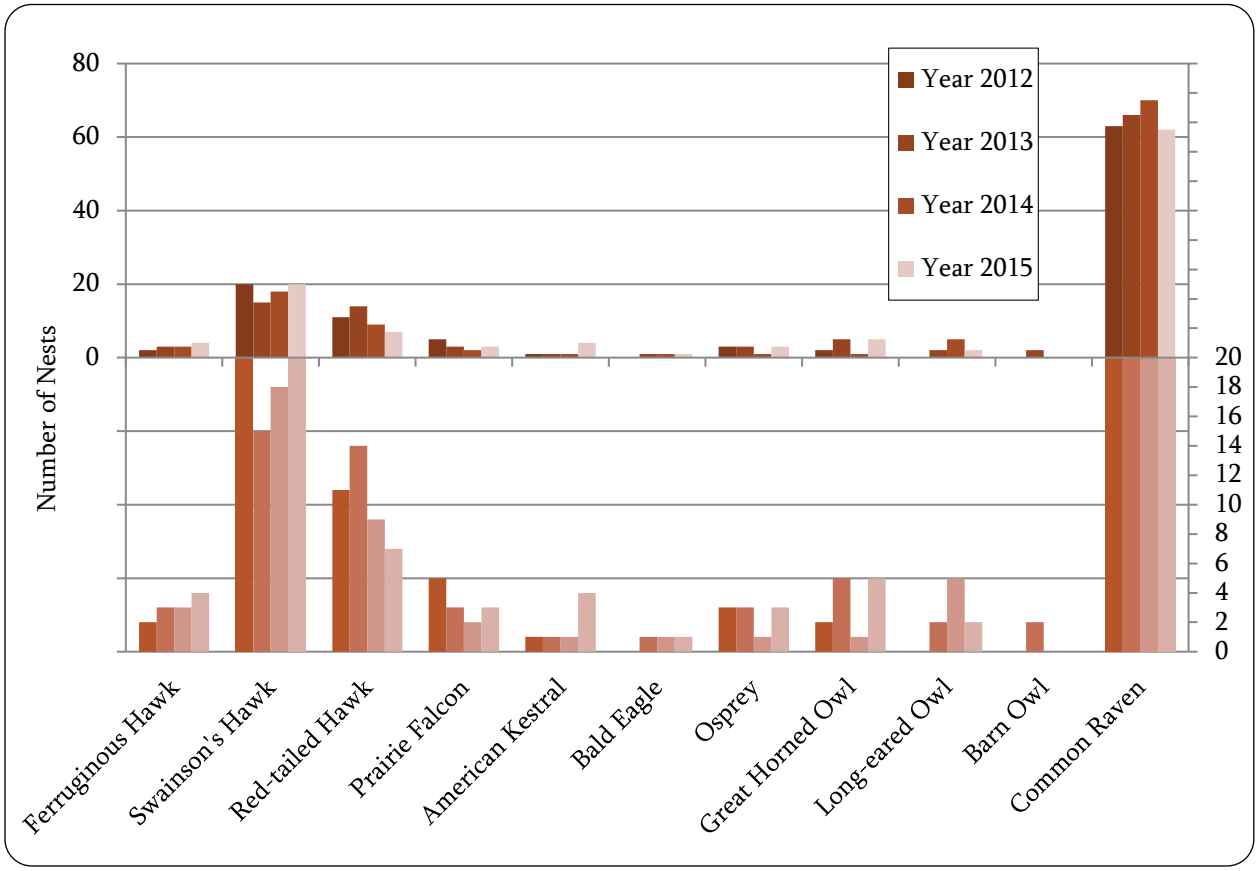

Figure 11.4. Number of Raptor and Raven Nest Sites Located on Hanford Site DOE-RL Managed Lands, 2012–2015

The first known successful bald eagle nest was documented on the Hanford Site upstream of Wooded Island in 2013; the nest site was successful again in 2014 and 2015 (Cranna et al. 2015a; Cranna et al. 2015b). A second bald eagle nest was constructed on the White Bluffs peninsula in 2015, but its continued occupancy and success could not be determined due to its location being obscured by foliage later in the season. On June 5, surveyors performing a roadside breeding bird survey observed a juvenile bald eagle in the nest tree; however, it was unclear whether this was a young bird from the nest (Cranna et al. 2015b).

Ferruginous hawks occupied four nest sites on the Hanford Site in 2015, up slightly from two to three nests observed in 2012 through 2014. Twenty Swainson's hawk nests were found in 2015, which was similar to the past 3 years (20 in 2012; 15 in 2013; 18 in 2014). These numbers were within the range (9 to 23 nests) found in the survey area in the last 42 years. The number of red-tailed hawk nests located in 2015 (7) was fewer than observed in the past 3 years (11 in 2012; 14 in 2013; 9 in 2014) and is at the lower end of the range found in the survey area during the past 42 years (7 to 19 nests).

Three prairie falcon nests were found in 2015, which was similar to the past 3 years (five in 2012; three in 2013; two in 2014). American kestrel nest site numbers are expected to be much greater than the four nests located during this survey. As secondary cavity nesters, American kestrels have many opportunities (holes and crevices on trees, cliffs, buildings, and other structures) for nesting on the Hanford Site but are difficult to detect during a survey of this type.

Three osprey nests were located on the Hanford Site in 2015; all nests were situated on nest platforms. These numbers were similar to the past 3 years (three in 2012; three in 2013; one in 2014).

Five great horned owl nests were found on the Hanford Site in 2015; the number of great horned owl nests has ranged from one to seven a year in the survey area in the past 42 years. Two long-eared owl nests were located in 2015; a range of one to six long-eared owl nests in a year have been observed in the survey area in the last 42 years. Barn owl nest numbers have always been infrequent on the Hanford Site. No barn owl nests were detected in 2015, although a single barn owl was seen in the Hanford Townsite on May 27. No barn owl nests were observed in 2012, two in 2013, and none in 2014. No short-eared owl nests were detected during 2012 to 2015. Short-eared owls rarely nest on the Hanford Site.

A separate monitoring effort for burrowing owls was conducted in 2015 (Wilde, Cranna, and Nugent 2016). The scope of the owl monitoring effort in 2015 was to document the status of known active burrows. Eighteen active burrows were located constituting 11 active burrowing owl nest sites. Eleven burrowing owl nest sites were also found in 2014, though neither year likely represents a complete number for the Hanford Site.

Sixty-two common raven nest sites were detected on the Hanford Site in 2015. This number was a decrease from a high of 70 nest sites in 2014. Until 2015, nesting common ravens had been increasing steadily on the Hanford Site with 70 nests in 2014, 66 in 2013, and 63 in 2012 compared to 45 nests in 2005 (PNNL-SA-46396) and 9 to 11 nests located on the entire Hanford Site each year (PNL-2754) from 1975 to 1978. Additional information detailing the 2015 monitoring effort is or will be available at http://www.hanford.gov/page.cfm/EcologicalMonitoring.

11.1.2.5 Hanford Bird Surveys

The Hanford Site contains a wide expanse of bird habitat such as basalt outcrops, riparian streams and springs, shrub-steppe on slopes and plains, sand dunes and blowouts, and abandoned fields or disturbed areas. The large size of the site provides habitat for shrub-steppe birds that are entirely dependent on large expanses of sagebrush or areas with native grasses in the understory. In the majority of the Columbia Basin, human activities such as farming, urbanization, and industrial development have greatly decreased the amount of natural sagebrush-grass habitat and disturbance-free riparian zones that many endemic birds require for survival. Ultimately, these actions have caused a decrease in a number of shrub-steppe bird populations; some, such as the greater sage grouse (*Centrocercus urophasianus*), have been locally extirpated. Several sagebrush-steppe-dependent species such as the sagebrush sparrow (*Artemisiospiza nevadensis*), sage thrasher (*Oreoscoptes montanus*), and loggerhead shrike (*Lanius ludovicianus*) are currently listed by WDFW as candidate species and have the potential to be listed as threatened or endangered federally. In addition, the Hanford Site and surrounding area provide refuge for 17 state-listed species, including numerous birds: ferruginous hawks, state threatened; American white pelican (*Pelecanus erythrorhynchos*), state endangered; and bald eagle, state sensitive and a federal species of concern.

Ecological monitoring staff conduct roadside surveys to monitor changes in species richness and relative abundance of shrub-steppe birds over time and in response to various types of land-use changes. In 2015, roadside surveys were performed on March 10, 13, 19, and 26; May 28; June 5 and 19; and September 2, 23, 24, and 25. Four Hanford routes (Figure 11.5) were surveyed three times each in 2015. The survey timing corresponded with pre-breeding, breeding, and fall migration surveys. The 12 surveys documented over 3300 individual birds. The surveys performed during breeding season documented 1227 individuals similar to the 1,264 and 1,332 individuals counted during the similar period in 2013 and 2014, respectively. A total of 52 bird species were documented during the breeding season surveys, higher than

the 47 of 2013 and nearly the same richness as the 51 species recorded in similar 2014 breeding season surveys. The breeding season identified the largest richness of species (52) to 43 in pre-breeding survey and 37 during migration survey.

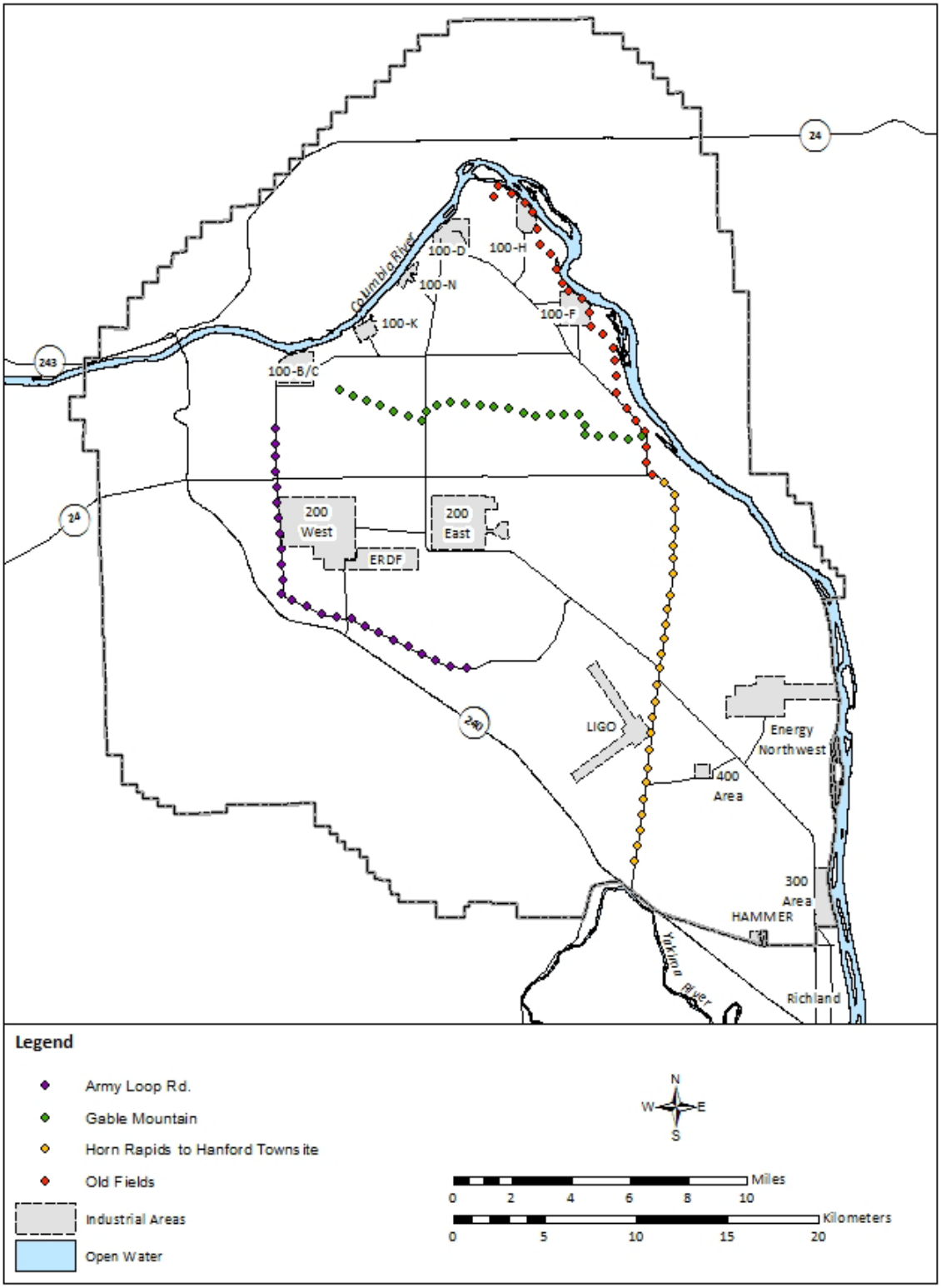

Figure 11.5. Roadside Bird Survey Routes

The Old Fields survey route had the highest species diversity, and the Army Loop Road survey route had the lowest species diversity (Table 11.6). The western meadowlark (*Sturnella neglecta*) was the most abundant species documented along all routes. Surveys documented 885 western meadowlarks, 26.34% of all individuals counted.

Table 11.6. Species Richness and Abundance During 2015 Roadside Bird Surveys

Route Name	Number of Surveys Performed	Number of Species	Abundance
Army Loop Road	3	19	649
Gable Mountain	3	23	551
Horn Rapids to Townsite	3	21	662
Old Fields	3	62	1498
Total	**12**	**68***	**3360**

*Unique species identified

The second most abundant species counted, the horned lark (*Eremophila alpestris*), had 809 individuals (24.08%) of birds surveyed. Western meadowlarks were counted on 245 survey points (81.67%), and the horned lark was documented on 218 survey points (72.67%). These two species were counted at nearly three times as many survey points as any other species documented in 2015, with the third most survey points being 76 of the common raven.

The Hanford bird monitoring program documents the presence, abundance, and distribution of species of concern on the Hanford Site. Both the USFWS and the WDFW maintain lists of species that are of management concern because populations or habitat availability are limited. In Washington, those listings include (in order of least to greatest concern) state candidate, state sensitive, state threatened, and state endangered. The WDFW also maintains a list of state monitor species, a group of birds not considered species of concern but for which status and distribution data are documented. There are currently no avian species listed as federally threatened or endangered on the Hanford Site, although several are considered federal species of concern in eastern Washington. Six state-listed species were recorded on the Hanford Site in the 2015 surveys: American white pelican, state endangered; ferruginous hawk, state threatened; bald eagle state sensitive; loggerhead shrike, state candidate; and sagebrush sparrow, state candidate. Additional information detailing migratory bird monitoring efforts is available at http://www.hanford.gov/page.cfm/ecologicalmonitoring.

11.1.2.6 Ground Squirrel Habitat Analysis

The Townsend's ground squirrel (*Urocitellus townsendii*) is listed as a state candidate (WDFW 2012). Ground squirrels are important to the shrub-steppe ecosystem for many reasons. They serve as a food source for many mammals such as badgers and coyotes and fall prey to predatory birds such as hawks, falcons, and owls. The ground squirrel diet consists of a variety of foods including seeds, which contributes to native plant seed dispersal. The process of digging burrows helps to aerate the soil and provides burrows for other species, including burrowing owls (Sato 2012). Their decline is due to the loss of suitable habitat and isolation of their communities through fragmentation as well as control programs involving poisoning and shooting that were widely practiced in the past (WDFW 2012).

Ground squirrels are underground for much of the year for hibernation and estivation, making it essential to monitor during the correct time frame. The ground squirrels' lifecycle consists of several seasonal components. During mid- to late January, squirrels emerge from their burrows after hibernation. They spend the next month breeding, followed by gestation and rearing of young. The young ground squirrels

are active outside the burrow beginning in mid-April. The squirrels then go dormant again in late May to late June, entering a type of torpor called estivation that is used to avoid the hot and dry portion of the year (WDFW 2012). After estivation, ground squirrels may spend late September and October foraging in preparation for hibernation; thus, the crucial window to observe and monitor these mammals is between late January after hibernation and before late May when estivation begins. These months are the longest active period for the squirrels and thus are the best time for monitoring. Ground squirrels breed and rear young during this time, and age determination is easier because the juveniles are significantly smaller than adults. Protective maternal alarm calls are also used during this period of months, maximizing the likelihood of detecting occupied colonies.

The goal for 2015 was to develop a habitat suitability model for the Townsend's ground squirrel on the Hanford Site that can be used by managers and planners to make informed decisions regarding strategies and management actions such as mitigation, restoration, and habitat improvements. Habitat suitability models delineate important habitats on the Hanford Site to assess the impacts of proposed Hanford Site activities during ecological compliance reviews as well as provide focus areas for more efficient monitoring in the future. Habitat suitability models assess the quality of habitat for a species within a study area based on known and assumed habitat associations for several different factors which, specific to this model, were soil, land cover, slope, and distance to roads, railroads, and power transmission lines. Classifications of each factor were ranked and assigned a suitability value from 0.00 (unsuitable habitat) to 1.00 (optimal habitat). Rankings were based primarily on the model developed for the Washington Connected Landscapes Project's analysis specific to the Columbia Plateau Ecoregion (Washington WHCWG 2012), with the exception of soil and land cover. The Hanford Site data layers for these factors are of a much finer resolution and contain many more classifications; therefore, these factors were ranked using a literature review and the results of soil and vegetation characterization that was performed at each of the occupied sites. ArcGIS software was used to combine raster layers for each factor and produce a final suitability map resulting in a suitability score for each pixel. All raster layers used or developed were 5 m resolution. The extent of the model encompasses central Hanford and the ALE Reserve to assess connectivity with the surrounding areas.

An example of the model output is illustrated in Figure 11.6, which shows the areas on the Hanford Site (and the ALE reserve) with a habitat suitability score of ≥0.90. The resulting map shows 83 polygons within the DOE managed portion of the Hanford Site, mostly found near Highway 240 adjacent to the ALE Reserve as well as some areas in the northern portion of the site and ranges from less than 1 ha to 1858 ha. Four out of the five currently occupied sites fall within these areas. Mean size was 99 ha and the total area for all 83 polygons was 8175 ha (10% of the total area of Hanford). Additional information detailing Townsend's monitoring efforts is available at http://www.hanford.gov/page.cfm/ecologicalmonitoring

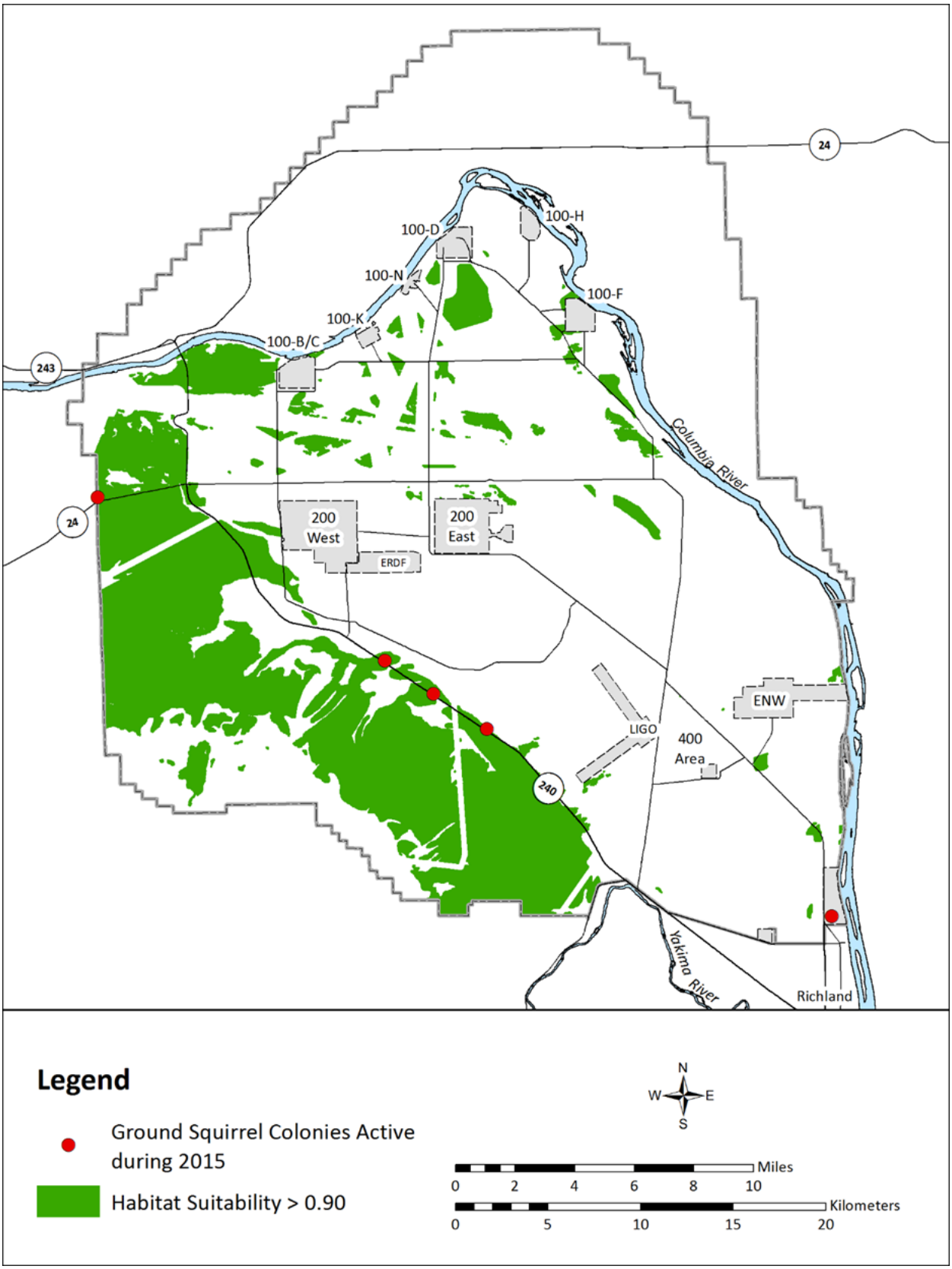

Figure 11.6. DOE-managed Portion of the Hanford Site and ALE Reserve with Habitat Suitability Score >0.90

11.1.2.7 Hanford Reptile Monitoring

The Hanford Site contains remnants of native Washington State shrub-steppe habitat that are relatively untouched by agriculture and large-scale development. These native habitats within the site are likely to support a refuge for many species of reptiles. Of the species documented or presumed to occur on the Hanford Site (Table 11.7), the WDFW currently lists both the sagebrush lizard (*Sceloporus graciosus*) and the striped whipsnake (*Masticophis taeniatus*) as candidates for listing as threatened or endangered. The striped whipsnake is also federally listed as a species of concern. The night snake (*Hypsiglena torquata*), racer (*Coluber constrictor*), and short-horned lizard (*Phrynosoma douglasii*) are all listed as monitored species by WDFW. Relatively few studies of reptiles have been conducted on the Hanford Site and most have been small in scale or observational in nature.

Table 11.7. Federal and State Status of Reptile Species Predicted and Documented to Occur on the Hanford Site

Species	Predicted	Documented	Status	
			Federal	State
Painted turtle (*Chrysemys picta*)	Yes	Yes		
Short-horned lizard (*Phrynosoma douglassii*)	Yes	Yes		Monitored
Sagebrush lizard (*Sceloporus graciosus*)	Yes	Yes	Species of Concern	Candidate
Side-blotched lizard (*Uta stansburiana*)	Yes	Yes		
Common garter snake (*Thamnophis sirtalis*)	Yes	Yes		
Western terrestrial garter snake (*Thamnophis elegans*)	Yes	Yes		
Gopher snake (*Pituophis catenifer*)	Yes	Yes		
Racer (*Coluber constrictor*)	Yes	Yes		Monitored
Nightsnake (*Hypsiglena torquata*)	Yes	Yes		Monitored
Striped whipsnake (*Masticophis taeniatus*)	Yes	Yes		Candidate
Ringneck snake (*Diadophis punctatus*)	Yes	No		
Western rattlesnake (*Crotalus viridis*)	Yes	Yes		

Of the three lizard species found on the Hanford Site, the side-blotched lizard (*Uta stansburiana*) is the most frequently observed and occurs in most native upland habitats. Sagebrush lizards are also found on Hanford and generally occupy habitats where some shrub cover is available. The short-horned lizard is relatively uncommon on the Hanford Site. Most of the snakes commonly occur in upland habitats only, including the racer (*Coluber constrictor*) and gopher snake (*Pituophis melanoleucus*). The western rattlesnake (*Crotalus viridis*) is often found in or near basalt outcrops on Hanford or along the Columbia River, while the striped whipsnake and nightsnake also occur in uplands but have rarely been encountered on the site. The common garter snake (*Thamnophis sirtalis*) prefers riparian habitats. The painted turtle (*Chrysemys picta*) is the only turtle known to occur on the Hanford Site.

Reptiles are ectothermic, meaning their bodies take on the temperature of their surroundings. As a result, they are unable to remain active during temperature conditions that are too hot or too cold. Reptiles must seek refuge to avoid temperature extremes. During the winter months, reptiles seek out underground refugia known as hibernacula. These locations have specialized temperature, humidity, and airflow conditions that allow reptiles to survive without becoming frozen during the winter months.

In this area, snakes typically seek out hibernacula in mid-October and remain inside until mid-April. Upon emergence, snakes will typically spend 2–3 weeks around the den prior to dispersing to feeding ranges, though some species remain nearby longer for breeding and egg laying (Larsen 1997). Hibernacula locations are readily identifiable during the emergence period from the presence of snakes at the openings.

South-central Washington lizards become active in March or April and are seen less frequently as temperatures drop, though some lizards are observed basking in the open on warm days in fall and winter.

Sixteen 8 km transects were surveyed from June to September in 2015 (Figure 11.7). Surveyors noted all reptile species encountered and the general habitat type where each observation occurred. A total of 513 observations were documented during the visual encounter surveys: 343 (~66%) were side-blotched lizards, 160 (~31%) unidentified lizards, 13 (~3%) sagebrush lizards, and two were snakes (one racer and one unidentified). No short-horned lizards were observed during the transect surveys; however, two were observed in 2015 by biologists performing other natural resource surveys. Additional information detailing reptile monitoring efforts is available at http://www.hanford.gov/page.cfm/ecologicalmonitoring.

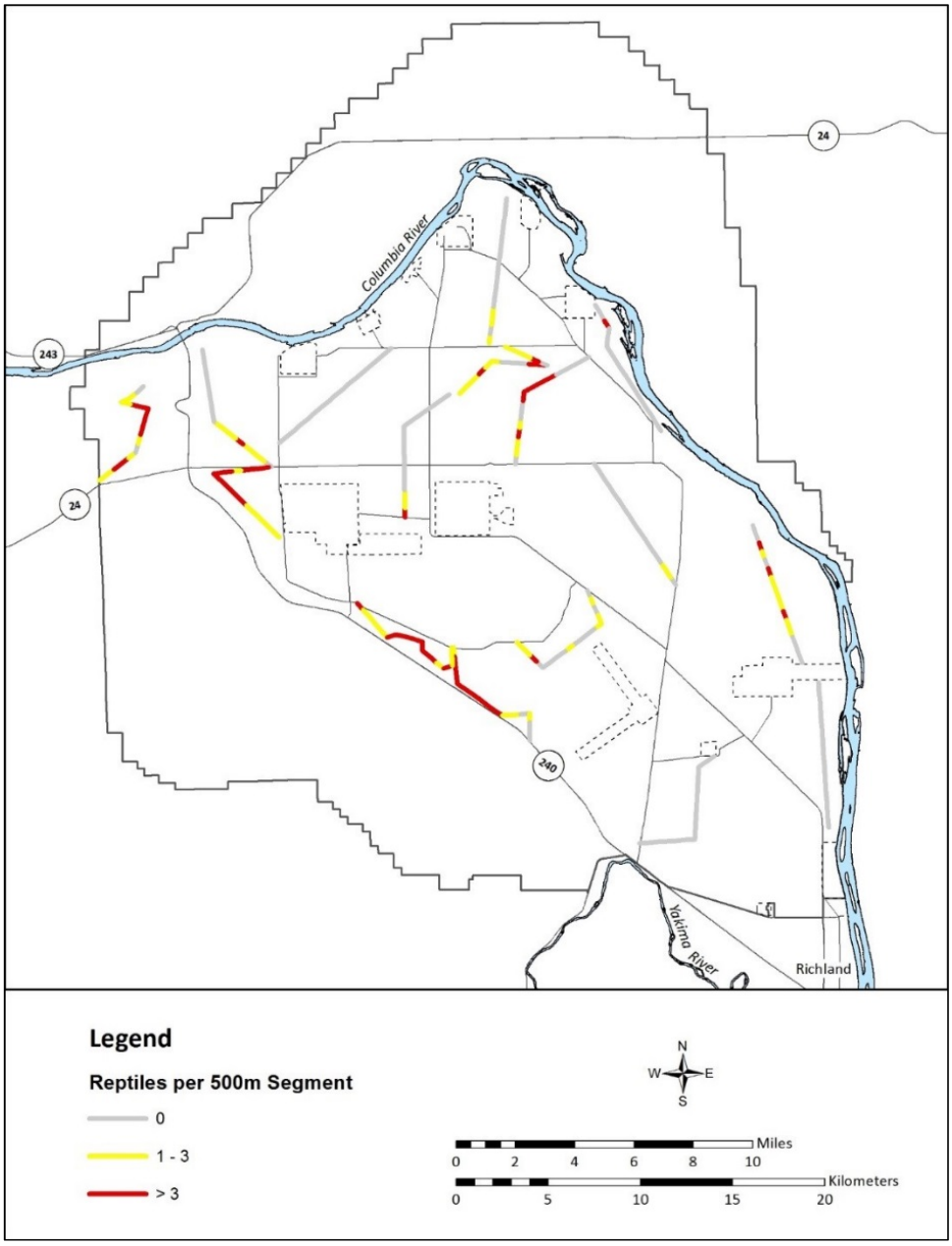

Figure 11.7. Number of Reptiles Observed per 500-m Segment in 2015 Reptile Visual Encounter Transects

11.1.2.8 Burrowing Owls

The burrowing owl is classified as a WDFW candidate species and is considered a USFWS species of concern in eastern Washington. Burrowing owls are also protected under the MBTA. From a decline in Washington State and throughout their historic range (Conway and Pardieck 2006; WDFW 2012), burrowing owl populations and burrow locations are of concern locally to both DOE and USFWS. Burrowing owl population monitoring contributes to the management and protection of the species, maintenance and management of site-wide biological diversity, and assists with proper impact assessment of Hanford Site projects, many of which include ground surface impacts with activities such as grubbing, excavating, burning, off-road driving, compacting, and leveling. Without documentation of current owl burrow locations, it is difficult to protect them.

A total of 97 historical burrow locations were visited to determine the current status of burrowing owls on the Hanford Site. One new location found during other work was visited as well for a total of 98 burrow locations surveyed. To avoid interfering with breeding of the owl populations, surveys were performed in May. At this point in the season, most of the burrows are occupied with eggs, or the owlets have hatched but are not matured enough to resemble adults. Later in the season, the young may temporarily occupy nearby burrows, which could result in an over-estimation of burrow occupation. Field team members determined if a burrow was active by looking for owls in the burrow or the presence of castings, feces, feathers and/or footprints at the opening of the burrow. Brief scans of the surrounding area for additional burrows were made at each location. All newly discovered burrows were documented with GPS and added to the Hanford Site burrow list. Monitoring of the historic burrows during 2015 found a total of 18 active burrows, 6 natural (3 anthropogenic and 3 mammalian origin), and 12 artificial (Figure 11.8).

Staff members assisted the USFWS collect burrowing owls at the artificial burrow at the HAMMER Emergency Vehicle Operations Course (EVOC). USFWS was attempting to retrieve tracking devices placed on owls in previous year, document previously banded owls, and band any new or hatchling/fledgling owls. The burrow survey discussed above was performed prior to trapping to identify active burrows and clusters being used by owls. This preliminary survey increased the trapping success rates because traps were placed only at active burrows. Traps were double entry swing door style. Staff members retrieved owls from traps, determined the sex and age of the owls, and banded each owl with an identification band before the bird was released.

A total of 12 owls were captured at five nest areas (Figure 11.9), no geolocators were recovered. Six owls were hatch-year birds, the other eight were after-hatch year (likely breeding adults): three males and five females. Two captured owls – one male and one female – were already banded previously. Both owls had bands placed on them from previous captures at EVOC. All other owls were banded on the left leg for hatch-year and right leg for after-hatch year.

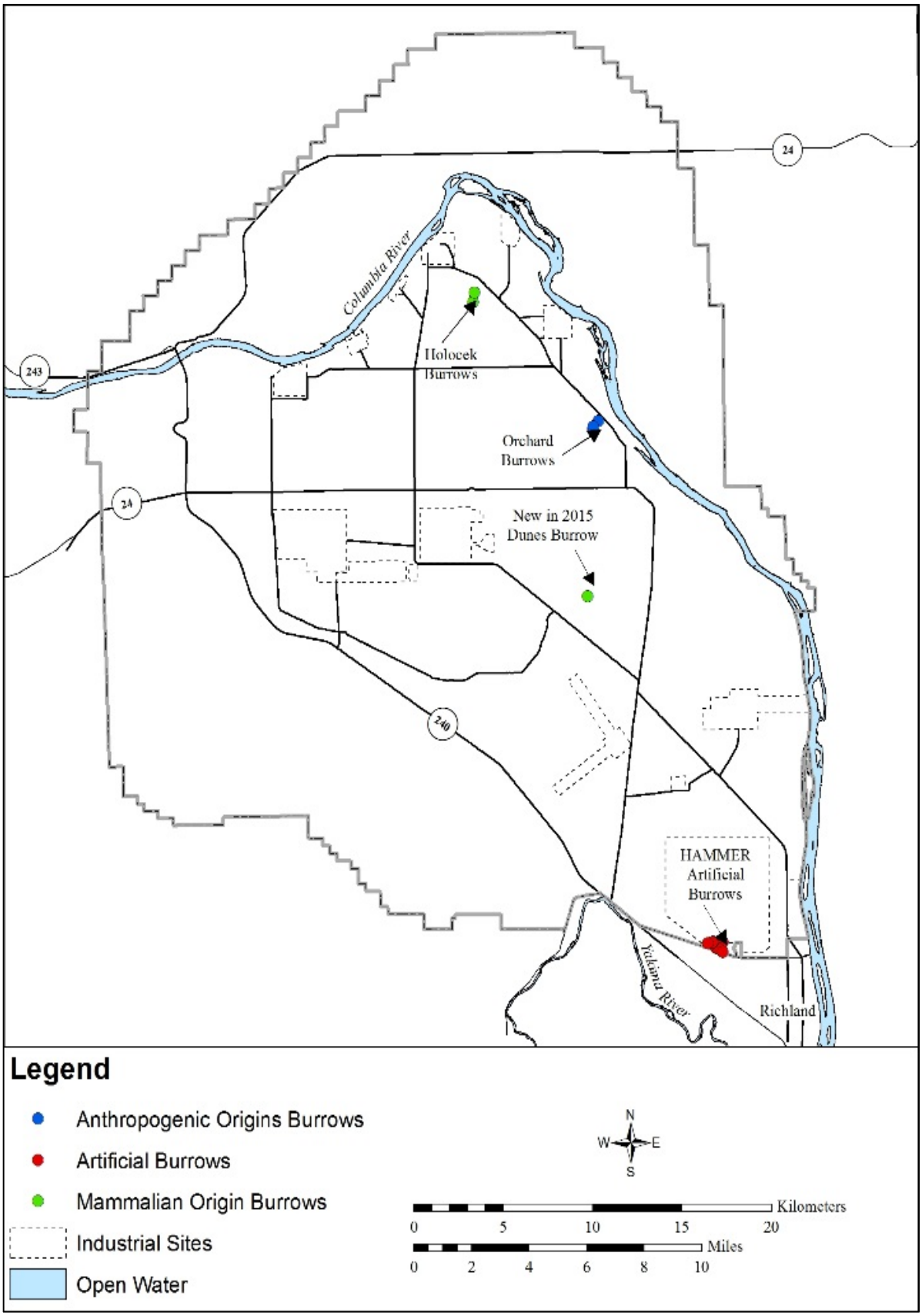

Figure 11.8. Active Burrowing Owl Burrows Documented During 2015 Surveys

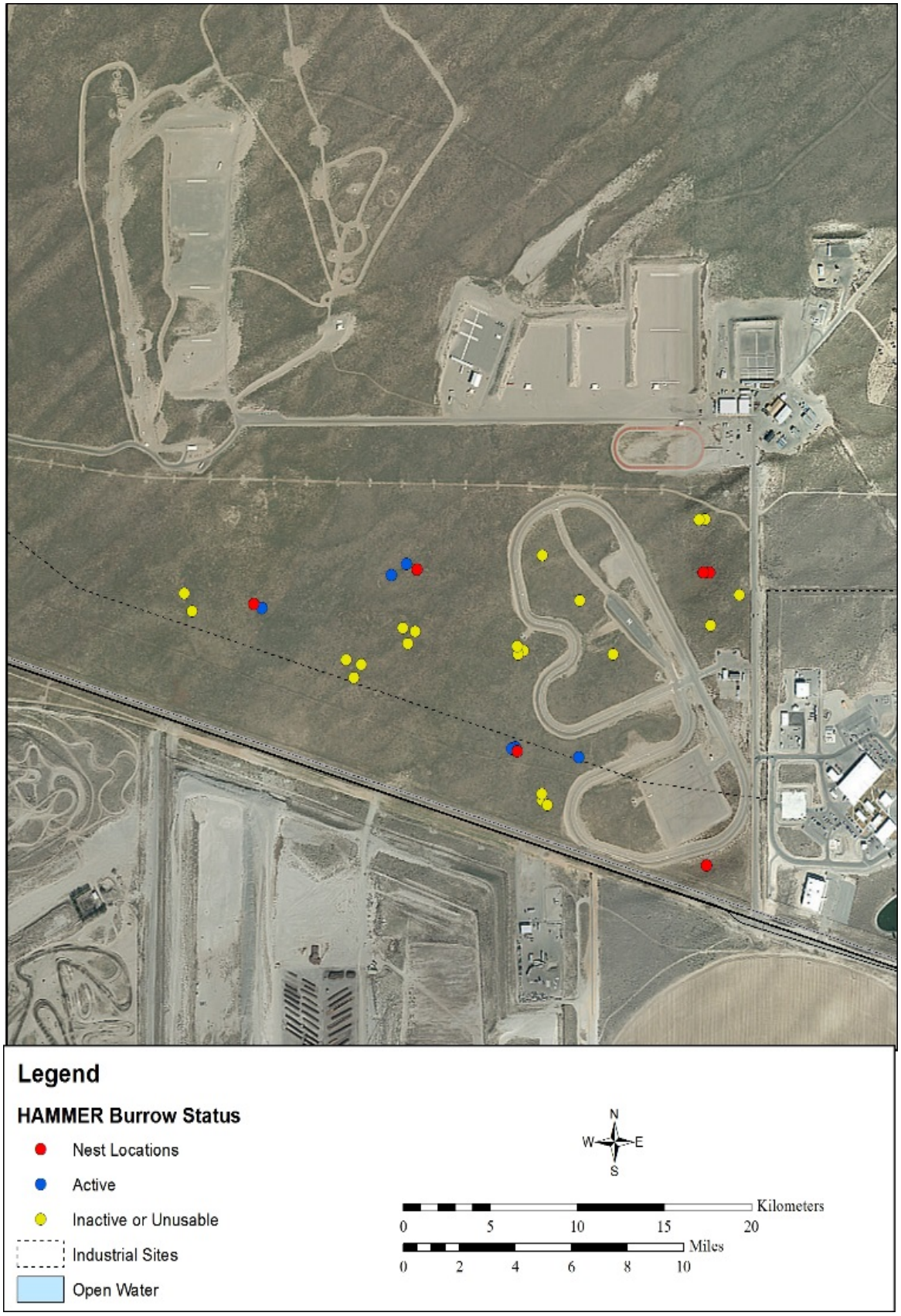

Figure 11.9. HAMMER Burrow Status During 2015 Surveys and Banding

11.1.2.9 Jackrabbits

Evidence suggests that both black- and white-tailed jackrabbits (*L. townsendii*) were historically abundant in Washington (Ferguson and Atamian 2012). Jackrabbit populations are declining across Washington State due to the loss and fragmentation of native shrub-steppe habitat. Currently, both the black- and white-tailed jackrabbit are candidates for listing as threatened and endangered. In recent years, jackrabbits have been infrequently observed on the Hanford Site, potentially indicating population declines, though other factors such as natural population cycles may be occurring. To understand the extent and causes of possible decline and to implement means to protect the species, it is imperative to collect population status and distribution data before jackrabbits disappear completely from the Hanford Site.

Black-tailed jackrabbits play an important role in the ecosystem, serving as a food source for large mammalian and avian predators, including the coyote (*Canis latrans*), golden eagle (*Aquila chrysaetos*), and the state-listed threatened ferruginous hawk (*Buteo regalis*). Increasing the understanding of jackrabbits on the Hanford Site could benefit both common and sensitive predator species. Jackrabbits do not migrate long distances or go into a hibernation or estivation period. They also rarely use underground burrows or dens (Best 1996); thus, the highly localized and active nature of jackrabbits provides surveying opportunities throughout the year.

Black-tailed jackrabbits prefer sagebrush-dominated habitats in Washington (PNL-8942) but will also use rabbitbrush (*Ericameria nauseosa* and *Chrysothamnus viscidiflorus*) and antelope bitterbrush (*Purshia tridentata*) communities. Although they prefer grass-dominated habitats typically found at higher elevations in Eastern Washington, white-tailed jackrabbits have been observed on the ALE Reserve, the DOE-RL managed portion of the Hanford Site consists of habitat more commonly associated with black-tailed jackrabbits. A combination of daytime walking transects and nighttime driving transects were conducted on the Hanford Site in FY 2012 (Wilde, Lindsey, and Nugent 2012); other recent studies on central Hanford consisted of driving surveys (The Nature Conservancy 1999). Although jackrabbits were detected using these methods, data did not provide the information necessary to address distribution and abundance of jackrabbits on the Hanford Site; therefore, monitoring for FYs 2013–15 focused on the black-tailed jackrabbit on the DOE-RL managed portion of the Hanford Site using motion-activated trail cameras (Lindsey et al. 2014; Grzyb, Nugent, and Wilde 2016).

The entire central Hanford Site was divided into a mesh of hexagonal survey areas measuring 1 km^2 (0.39 mi^2) using a Geographic Information System (GIS). Hexagonal sample area size was based on the approximate size of a jackrabbit home range, reported between 0.02 km^2 and 1 km^2 (0.01 to 0.39 mi^2) and >0.5 km^2 (>0.19 mi^2) on the Hanford Site (Major 1993). The upper limit of the home range size was selected for this project so that a rabbit observed in one transect is assumed not to be present, and therefore not detectible, in any adjacent hexagon. This process provided a more coarse scale map of jackrabbit distribution and allowed for a larger portion of the Hanford Site to be surveyed per-unit effort. Trail cameras were used to document definitively the presence of jackrabbits within each hexagonal survey area.

A total of 820 1-km^2 hexagons were identified across the DOE-RL managed portion of the Hanford Site. Surveying every hexagon would have been prohibitively time consuming, so initial camera setup locations were determined based on the presence of activity center termed a "core area," defined as locations with high levels of visibly detectible jackrabbit activity such as active trails and fresh scat. Jackrabbits were confirmed at core areas using the cameras, and all adjacent hexagons were monitored using the camera

setup. If any hexagons adjacent to the original core areas were found to contain jackrabbits based on camera-trap observations, then the search area was expanded to include all hexagons adjacent to the newly discovered active hexagon. Monitoring with trail cameras began February 2, 2013, and the last camera trap was retrieved on July 13, 2015. The data summarized are a comprehensive catalogue for all data gathered from the study's first camera deployment through July 13, 2015. During this time, 4334 jackrabbit images were captured on the remote cameras, with a total of 257 hexagons successfully surveyed. Jackrabbits were detected within 72 of the hexagons surveyed (Figure 11.10).

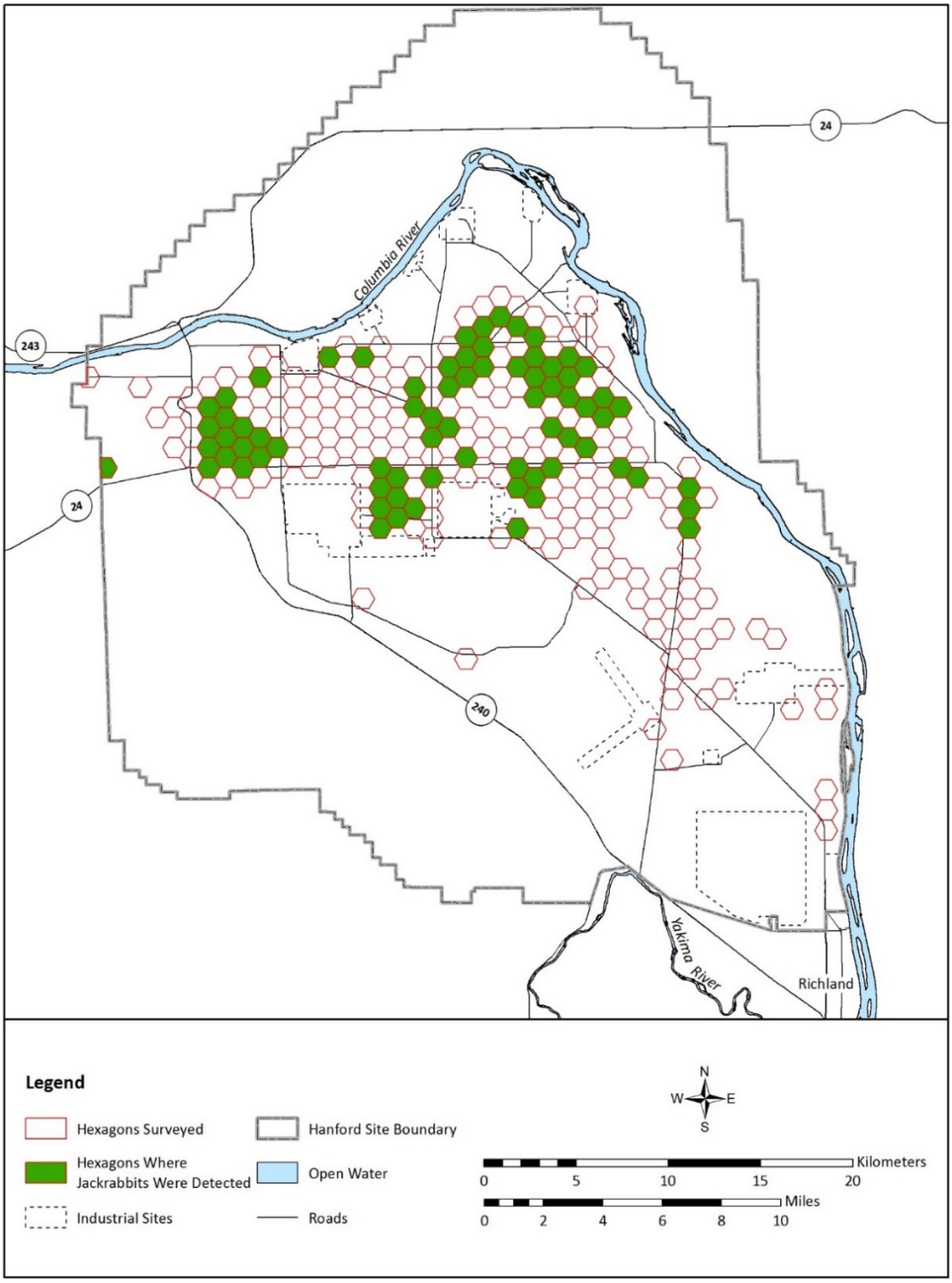

Figure 11.10. Hexagons Surveyed for Black-tailed Jackrabbits

All locations where jackrabbits were observed on the Hanford Site while setting trail cameras, driving, or performing other surveys were recorded. These occurrences included flushed individuals and road kill observations. Locations were recorded using a GPS, or the approximate location was marked on a map by the observer and later digitized into electronically to capture coordinates. All locations were stored and mapped using GIS.

The status of the black-tailed jackrabbit population on the Hanford Site was largely unknown at the start of this project. Until official documented surveys commenced, jackrabbit data consisted of occasional, isolated sightings. The data generated by this project begin to show the status and distribution of black-tailed jackrabbits across the DOE-RL managed portion of the Hanford Site. This knowledge provides a foundation of where habitat conservation efforts can be focused while site cleanup continues. Additional information detailing jackrabbit monitoring efforts is available at http://www.hanford.gov/page.cfm/ecologicalmonitoring

11.1.2.10 American Badger

The BRMP ranks wildlife species and habitats (Levels 0–5), providing a graded approach to monitoring biological resources based on the level of concern for each resource. The American badger (*Taxidea taxus*) is ranked at Level 2, a potential species of concern according to the BRMP (DOE/RL-96-32). The WDFW lists the American badger as a state monitored species, meaning that it requires management, survey, or data emphasis. No previous monitoring efforts have been completed for badgers on the Hanford Site; therefore, no concrete evidence exists regarding their relative abundance or habitat distribution. The monitoring data will be useful for determining the badger's selected habitat characteristics and the level of connectivity between active badger-occupied areas. If unconnected populations are determined to be present, these will be considered opportunities to restore connectivity for badgers and sagebrush species who utilize these areas on the Hanford Site.

The entire central Hanford Site was divided into hexagonal transects 6 km² in size. Transect size was based on the approximate size of a female badger home range in eastern Washington. Thus, a badger observed in one transect is not assumed to be present, and therefore not detectible, in any adjacent hexagon. Trail cameras were used to document the presence of badgers definitively within each hexagonal area. A total of 134 hexagons were designated for this project.

In total, 44 hexagons were monitored with trail cameras between April 2 and November 11, 2015. Thus far, cameras have been deployed for 587 nights, with a total number of three confirmed American badger sightings. Starting on April 21, 2013, all incidental observations and their respective locations were recorded. Currently, 13 of the 14 incidental observations have occurred in late winter and early spring. While they do not hibernate, badgers are much less active during the winter months, spending most of the time underground conserving energy. It is possible that these observations indicate the time of year when reliant food sources become available for badgers on the Hanford Site after the cold winter months. Staff members often take to the field, traversing vast remote areas of the Hanford Site while conducting field research. To maximize gathering additional data, staff members recorded badger activity while hiking 5-mile long transects during the 2015 reptile monitoring (Section 11.1.2.7 of this report). The number of badger diggings (both burrows and holes) were recorded.

The status of the American badger population on the Hanford Site was largely unknown at the start of this project. Until official documented surveys commenced, badger data consisted of occasional, isolated

sightings. The data in this report begin to show the status and distribution of badgers across the DOE-RL managed portion of the Hanford Site as seen in a distribution map of all recorded data to date (Figure 11.11). The data in this report aids in the identification of high-value areas for shrub-steppe connectivity restoration. Collectively, the information contained in this monitoring report will be useful during site development planning to minimize potential project-related impacts to badgers, sagebrush obligate species, and other species of concern who utilize similar habitats and corridors on the Hanford Site. Habitat surveys in areas occupied and unoccupied by badgers greatly contribute to the understanding of badger habitat requirements. Additional information detailing American badger monitoring efforts is available at http://www.hanford.gov/page.cfm/ecologicalmonitoring.

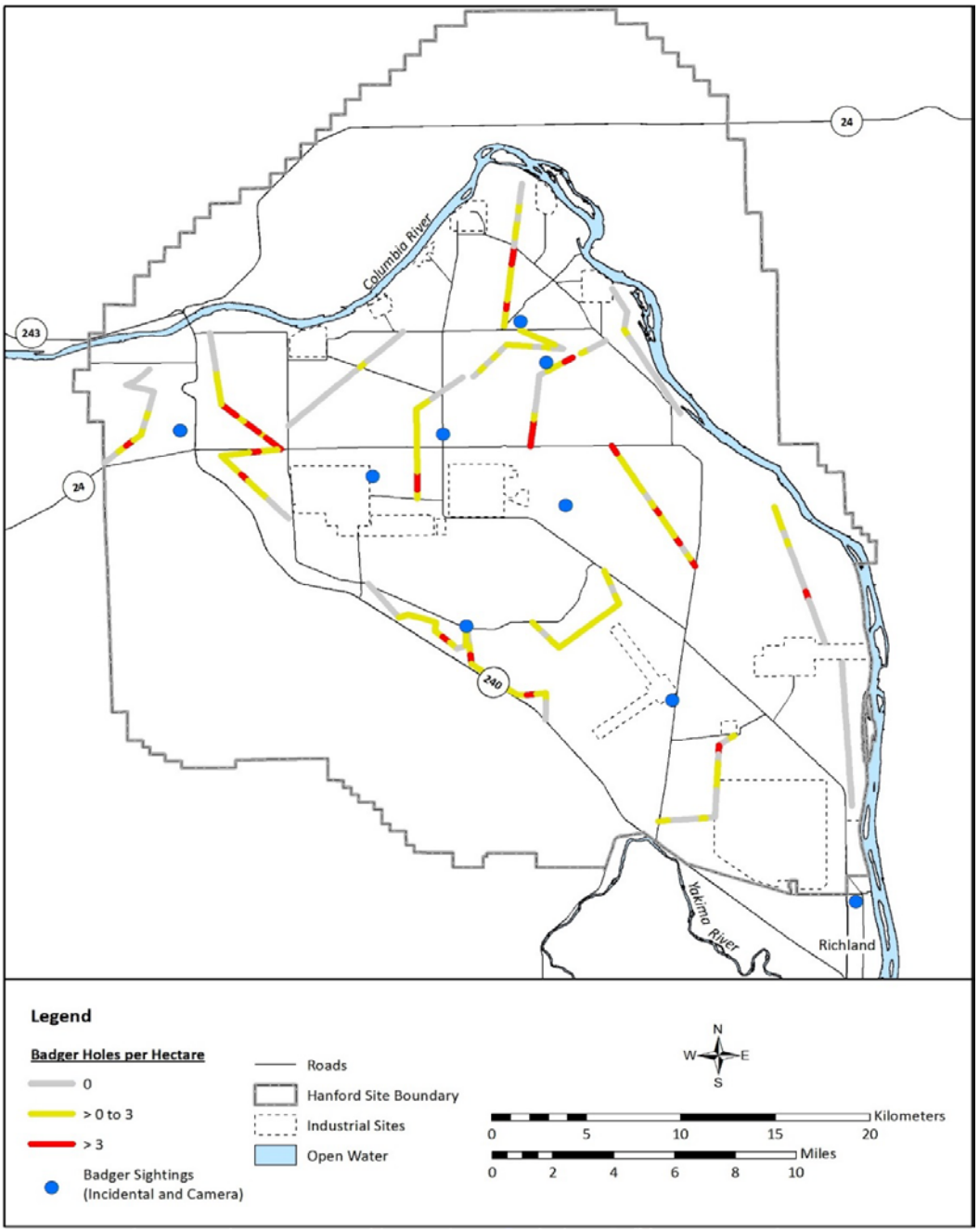

Figure 11.11. Distribution Map Containing All Badger Data to Date

11.2 Endangered and Threatened Species

JA Pottmeyer

This section describes federal and state endangered and threatened species, candidate or sensitive plant and animal species, and other species of concern potentially found at the Hanford Site. Endangered species are those in danger of extinction within all or a significant portion of their range. Threatened species are those likely to become endangered in the near future. Sensitive species are species that are vulnerable or declining and could become endangered or threatened without active management or removal of threats. The federal list of endangered and threatened species is maintained by the USFWS in 50 CFR 17.11, "Endangered and Threatened Wildlife" and 50 CFR 17.12, "Endangered and Threatened Plants." The Washington Natural Heritage Program (WNHP 2014) and WDFW (WDFW 2016) maintain state lists.

The purposes of the *Endangered Species Act of 1973* (16 U.S.C. 1531, as amended) are to: 1) provide a means to conserve critical ecosystems; 2) provide a program for the conservation of endangered and threatened species; and 3) ensure appropriate steps are taken to achieve the purposes of the treaties and conventions established under the Act. Washington State regulations also list species as endangered and threatened, but such a listing does not carry the protection of the federal Endangered Species Act. The National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NOAA 2015) has the responsibility for federal listing of anadromous fish (i.e., fish that require both saltwater and freshwater to complete a lifecycle). The USFWS is responsible for all other federally listed species at the Hanford Site. Table 11.8 lists the federal species of plants and animals that occur or potentially occur on the Hanford Site and are listed as endangered, threatened, sensitive, or candidate by either the federal or state government.

Table 11.8. Federal and State Endangered, Threatened, Sensitive, and Candidate Species

Species	Status* Federal	State
Plants		
Annual sandwort (*Minuartia pusilla* var. *pusilla*)		Sensitive
Awned halfchaff sedge (*Lipocarpha aristulata*)		Threatened
Beaked spike-rush (*Eleocharis rostellata*)		Sensitive
Canadian St. John's wort (*Hypericum majus*)		Sensitive
Columbia milkvetch (*Astragalus columbianus*)	Species of concern	Sensitive
Columbia yellowcress (*Rorippa columbiae*)	Species of concern	Threatened
Coyote tobacco (*Nicotiana attenuata*)		Sensitive
Desert dodder (*Cuscuta denticulata*)		Threatened
Dwarf evening primrose (*Eremothera pygmaea*)		Sensitive
Geyer's milkvetch (*Astragalus geyeri* var. *geyeri*)		Threatened
Grand redstem (*Ammannia robusta*)		Threatened
Gray cryptantha (*Cryptantha leucophaea*)	Species of concern	Sensitive
Great Basin gilia (*Aliciella leptomeria*)		Threatened
Hairy bugseed (*Corispermum villosum*)		Sensitive
Hoover's desert parsley (*Lomatium tuberosum*)	Species of concern	Sensitive
Loeflingia (*Loeflingia squarrosa*)		Threatened
Lowland toothcup (*Rotala ramosior*)		Threatened
Miner's candle (*Cryptantha scoparia*)		Sensitive
Piper's daisy (*Erigeron piperianus*)		Sensitive
Rosy pussypaws (*Cistanthe rosea*)		Threatened
Small-flower evening-primrose (*Eremothera minor*)		Sensitive
Snake River cryptantha (*Cryptantha spiculifera*)		Sensitive
Snowball cactus (*Pediocactus nigrispinus*)		Sensitive
Suksdorf's monkey flower (*Erythranthe suksdorfii*)		Sensitive

Table 11.8. Federal and State Endangered, Threatened, Sensitive, and Candidate Species

Species	Status* Federal	State
Thompson's sandwort (*Eremogone franklinii* var. *thompsonii*)		Sensitive
Tufted evening-primrose (*Oenothera cespitosa* ssp. *cespitosa*)		Sensitive
Umtanum desert buckwheat (*Eriogonum codium*)	Threatened	Endangered
White Bluffs bladderpod (*Physaria douglasii* ssp. *tuplashensis*)	Threatened	Threatened
White eatonella (*Eatonella nivea*)		Threatened
Mollusks		
California floater (*Anodonta californiensis*)		Candidate
Columbia pebblesnail (*Fluminicola columbiana*)		Candidate
Shortface lanx (*Fisherola nuttalli*)		Candidate
Insects		
Columbia clubtail (dragonfly; *Gomphus lynnae*)		Candidate
Columbia River tiger beetle (*Cicindela columbica*)†		Candidate
Silver-bordered fritillary (*Boloria selene atrocostalis*)		Candidate
Fish		
Bull trout (*Salvelinus confluentus*)‡	Threatened	Candidate
Chinook salmon (upper Columbia spring-run; *Oncorhynchus tshawytscha*)	Endangered	Candidate
Leopard dace (*Rhinichthys falcatus*)‡		Candidate
Mountain sucker (*Catostomus platyrhynchus*)‡		Candidate
River lamprey (*Lampetra ayresi*)‡	Species of concern	Candidate
Steelhead (upper Columbia; *Oncorhynchus mykiss*)	Threatened	Candidate
Birds		
American white pelican (*Pelecanus erythrorhynchos*)		Endangered
Bald eagle (*Haliaeetus leucocephalus*)	Species of concern	Sensitive
Burrowing owl (*Athene cunicularia*)		Candidate
Clark's grebe (*Aechmophorus clarkii*)		Candidate
Common loon (*Gavia immer*)		Sensitive
Ferruginous hawk (*Buteo regalis*)		Threatened
Flammulated owl (*Otus flammeolus*)‡		Candidate
Golden eagle (*Aquila chrysaetos*)		Candidate
Greater sage grouse (*Centrocercus urophasianus*)		Threatened
Lewis's woodpecker‡ (*Melanerpes lewis*)‡		Candidate
Loggerhead shrike (*Lanius ludovicianus*)		Candidate
Northern goshawk‡ (*Accipiter gentilis*)‡		Candidate
Peregrine falcon (*Falco peregrinus*)	Species of concern	Sensitive
Sagebrush sparrow (*Artemisiospiza nevadensis*)		Candidate
Sage thrasher (*Oreoscoptes montanus*)		Candidate
Sandhill crane (*Grus canadensis*)		Endangered
Western grebe (*Aechmophorus occidentalis*)		Candidate
Amphibians and Reptiles		
Sagebrush lizard (*Sceloporus graciosus*)		Candidate
Striped whipsnake (*Masticophis taeniatus*)		Candidate
Western toad (*Bufo boreas*)		Candidate
Mammals		
Black-tailed jackrabbit (*Lepus californicus*)		Candidate
Merriam's shrew (*Sorex merriami*)		Candidate
Townsend's ground squirrel (*Urocitellus townsendii*)		Candidate
Washington ground squirrel (*Urocitellus washingtoni*)‡	Candidate	Candidate
White-tailed jackrabbit (*Lepus townsendii*)		Candidate

*Endangered=Species in danger of extinction within all or a significant portion of its range; Threatened=Species likely to become endangered in the near future; Candidate=Species believed to qualify for threatened or endangered species status but for which listing proposals have not been prepared; Sensitive=Taxa vulnerable or declining that could become endangered or threatened without active management or removal of threats; Species of concern=Not currently listed or candidates under the Endangered Species Act of 1973 but of conservation concern within specific USFWS regions.

†Probable but not observed on the Hanford Site.

‡Reported but seldom observed on the Hanford Site.

Two federally listed fish species, spring-run Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*O. mykiss*), are known to occur regularly in the Hanford Reach of the Columbia River. One additional fish species, bull trout (*Salvelinus confluentus*), was recorded at the Hanford Site, but scientists believe this species is transient. Two plant species, Umtanum desert buckwheat (*Eriogonum codium*) and White Bluffs bladderpod (*Physaria douglasii* ssp. *tuplashensis*), were listed as threatened under the federal *Endangered Species Act* in April 2013; the rule was reaffirmed and made effective later that year (78 FR 23984). No other plants or animals known to occur on the Hanford Site are currently on the federal list of endangered and threatened species (50 CFR 17), but one mammal species (Washington ground squirrel) is currently a candidate for federal listing. In addition, 12 plant species and 4 bird species have been listed as either endangered or threatened by Washington State. Numerous additional species of animals and plants are listed as candidate or sensitive species by Washington State. There are 33 state-level sensitive and candidate species of animals and 17 sensitive plant species occurring or potentially occurring on the Hanford Site.

Washington State officials maintain additional lower level lists of species, including a monitor list for animals (WDFW 2016) and review and watch lists for plants (WNHP 2014). Species on the state monitor, watch, and review lists are not considered species of concern but are monitored for status and distribution (Table 11.9). These species are managed as needed by the state to prevent them from becoming endangered, threatened, or sensitive, and an abundance of these species may be indicative of an ecosystem with relatively high native diversity. Approximately 50 state monitor list animal species occur or potentially occur on the Hanford Site (Table 11.9), along with 24 watch or review list plant species (Table 11.10).

Table 11.9. Washington State Monitored Animal Species

Species	Species
Birds	**Insects**
Arctic tern (*Sterna paradisaea*)*	Juba skipper (*Hesperia juba*)
Ash-throated flycatcher (*Myiarchus cinerascens*)*	Nevada skipper (*Hesperia nevada*)
Black tern (*Chlidonias niger*)*	Pasco pearl crescent (*Phyciodes tharos pascoensis*)
Black-crowned night-heron (*Nycticorax nycticorax*)	Persius' duskywing (*Erynnis persius*)
Black-necked stilt (*Himantopus mexicanus*)	Purplish copper (*Lycaena helloides*)
Bobolink (*Dolichonyx oryzivorus*)*	Ruddy copper (*Lycaena rubida perkinsorum*)
Caspian tern (*Sterna caspia*)	Viceroy (*Limenitis archippus lahontani*)
Forster's tern (*Sterna forsteri*)	**Amphibians and Reptiles**
Grasshopper sparrow (*Ammodramus savannarum*)	Night snake (*Hypsiglena torquata*)
Gray flycatcher (*Empidonax wrightii*)	Racer (*Coluber constrictor*)
Great blue heron (*Ardea herodias*)	Short-horned lizard (*Phrynosoma douglasii*)
Great egret (*Ardea alba*)	Tiger salamander (*Ambystoma tigrinum*)
Gyrfalcon (*Falco rusticolus*)*	Woodhouse's toad (*Anaxyrus woodhousii*)
Horned grebe (*Podiceps auritus*)	**Mollusks**
Lesser goldfinch (*Spinus psaltria*)	Oregon floater (*Anodonta oregonensis*)
Long-billed curlew (*Numenius americanus*)	Western floater (*Anodonta kennerlyi*)
Osprey (*Pandion haliaetus*)	Western pearlshell (*Margaritifera falcata*)
Prairie falcon (*Falco mexicanus*)	Winged floater (*Anodonta nuttalliana*)
Red-necked grebe (*Podiceps grisegena*)*	**Mammals**
Snowy owl (*Nyctea scandiaca*)	American badger (*Taxidea taxus*)
Swainson's hawk (*Buteo swainsoni*)	Canyon bat (*Parastrellus hesperus*)
Turkey vulture (*Cathartes aura*)*	Long-legged myotis (*Myotis volans*)†
Western bluebird (*Sialia mexicana*)	Northern grasshopper mouse (*Onychomys leucogaster*)
Fish	Pallid bat (*Antrozous pallidus*)
Pacific lamprey (*Lampetra tridentata*)†	Sagebrush vole (*Lemmiscus curtatus*)
Paiute sculpin (*Cottus beldingi*)	Western small-footed myotis (*Myotis ciliolabrum*)†
Reticulate sculpin (*Cottus perplexus*)	
Sand roller (*Percopsis transmontana*)	

*Reported but seldom observed on the Hanford Site; †Federal species of concern.

Table 11.10. Hanford Site Washington State Review and Watch List Plant Species

Species	State Listing*
Annual paintbrush (*Castilleja exilis*)	Watch List
Basalt milkvetch (*Astragalus conjunctus* var. *rickardii*)	Watch List
Bristly combseed (*Pectocarya setosa*)	Watch List
Chaffweed (*Anagallis minima*)	Watch List
Columbia River mugwort (*Artemisia lindleyana*)	Watch List
Crouching milkvetch (*Astragalus succumbens*)	Watch List
False pimpernel (*Lindernia dubia* var. *anagallidea*)	Watch List
Giant helleborine (*Epipactis gigantea*)	Watch List
Kittitas larkspur (*Delphinium multiplex*)	Watch List
Medic milkvetch (*Astragalus speirocarpus*)	Watch List
Pigmy-weed (*Crassula aquatica*)	Watch List
Porcupine sedge (*Carex hystericina*)	Watch List
Robinson's onion (*Allium robinsonii*)	Watch List
Rosy balsamroot (*Balsamorhiza rosea*)	Watch List
Scilla onion (*Allium scilloides*)	Watch List
Shining flatsedge (*Cyperus bipartitus*)	Watch List
Shy gilly-flower (*Gilia inconspicua*)	Review Group 1
Small-flowered nama (*Nama densum* var. *parviflorum*)	Watch List
Smooth cliffbrake (*Pellaea glabella* var. *simplex*)	Watch List
Smooth willowherb (*Epilobium campestre*)	Review Group
Southern mudwort (*Limosella acaulis*)	Watch List
Stalked-pod milkvetch (*Astragalus sclerocarpus*)	Watch List
Vanilla grass (*Anthoxanthum hirtum*)	Review Group 1
Winged combseed (*Pectocarya penicillata*)	Watch List

*Watch List: Taxa of conservation concern but more abundant and/or less threatened than previously assumed. Review Group 1: Taxa for which currently there are insufficient data available to support listing as threatened, endangered, or sensitive.

11.3 Cultural and Historic Resource Protection

CD Currie, AP Fergusson, KM Mendez

Cultural and historic resources protection on the Hanford Site is conducted under the direction of the DOE-RL Cultural Resources Program to ensure site compliance with federal cultural resources laws and regulations (Section 2.5). Program activities in 2015 included the following:

- Performed Cultural Resource Reviews for federal undertakings conducted at the Hanford Site in accordance with Section 106 of the NHPA (16 U.S.C. 470) and NEPA (42 U.S.C. 4321 et seq.);
- Monitored site conditions to ensure important cultural resources are protected;
- Maintained a database of cultural resources site records, project records, and regional ethno-history;
- Maintained archaeological and historical collections;
- Identified and evaluated new cultural resources to ensure they are appropriately managed;
- Consulted with Native American Tribes and other stakeholders to gather input on the identification, documentation, and management of cultural resources important to them.

DOE-RL's Cultural Resources Program personnel oversee all cultural resource activities at the Hanford Site. Project-specific NHPA Section 106 compliance work scope in 2015 was performed by staff archaeologists from MSA and WCH.

The DOE-RL Cultural Resources Program also schedules monthly meetings with archaeological staff from Hanford Site contractors (MSA and WCH) to discuss and resolve issues relating to Cultural Resources Management (including survey procedures, site testing, site evaluation, consultations with external parties, etc.), with the objective of establishing and maintaining consistency among contractors.

11.3.1 Cultural Resources Reviews

Pursuant to the NEPA, and Section 106 of the *National Historic Preservation Act of 1966*, DOE-RL conducts cultural resources reviews of federal undertakings at the Hanford Site. The Section 106 regulations are also addressed as ARAR (Section 121[d]) under the CERCLA, requiring remedial actions to identify and take into account the effects of activities on historic properties included on or eligible for inclusion on the National Register of Historic Places (NRHP; National Register). NHPA Section 106 cultural resource reviews ensure that important cultural resources are identified and effects to those resources are evaluated prior to project initiation so that mitigation measures can be conducted, if necessary.

In 2015, Hanford Site archaeologists completed 103 NHPA Section 106 cultural resource reviews, which included the following:

- Twenty-three undertakings in 2015 that had the potential to affect cultural resources, which included efforts to identify cultural resources that might be affected by project activity, an assessment of potential impacts, and the development of mitigation measures, if necessary‡;
  - Nine were identified as *No Historic Properties Affected;*
  - Eleven were determined to have *No Adverse Effects* to historic properties;
  - Three projects were identified as having *Adverse Effects* requiring mitigation measures as documented in a resulting project-specific Memoradum of Agreement. Adverse effects were avoided by taking specific actions to minimize impacts, including avoidance, following treatment plan guidelines, and archaeological monitoring.
- Twenty-seven projects that affected historic buildings but did not involve ground disturbance and were determined exempt by Hanford Site archaeologists after meeting the DOE-approved historic buildings programmatic agreement (DOE/RL-96-77) exemption criteria following an initial review;
- Fifty-four projects that had been reviewed for effects to cultural resources under previous NHPA Section 106 reviews (Previously Reviewed Project Analyses Reviewed Project Analysis);
- Ten projects were reviewed and completed by Hanford Site archaeologists under an emergency declaration (Post Reviews) in accordance with Section 5.1.1 of the *Hanford Cultural Resources Management Plan* (DOE/RL-98-10).

A total of 4,645.13 ac (1.879.81 ha) of new ground was surveyed for cultural resources from NHPA Section 106 project specific surveys. In addition, some undertakings required NRHP (36 CFR 60) eligibility evaluations. Most projects cleared under these expedited reviews occurred in the 200 Areas of the Hanford Site (Figure 11.12).

‡This number does not reflect all full cultural resources reviews initiated in 2015. Additional reviews were initiated in 2015 but completed in 2016 and are not included in this report.

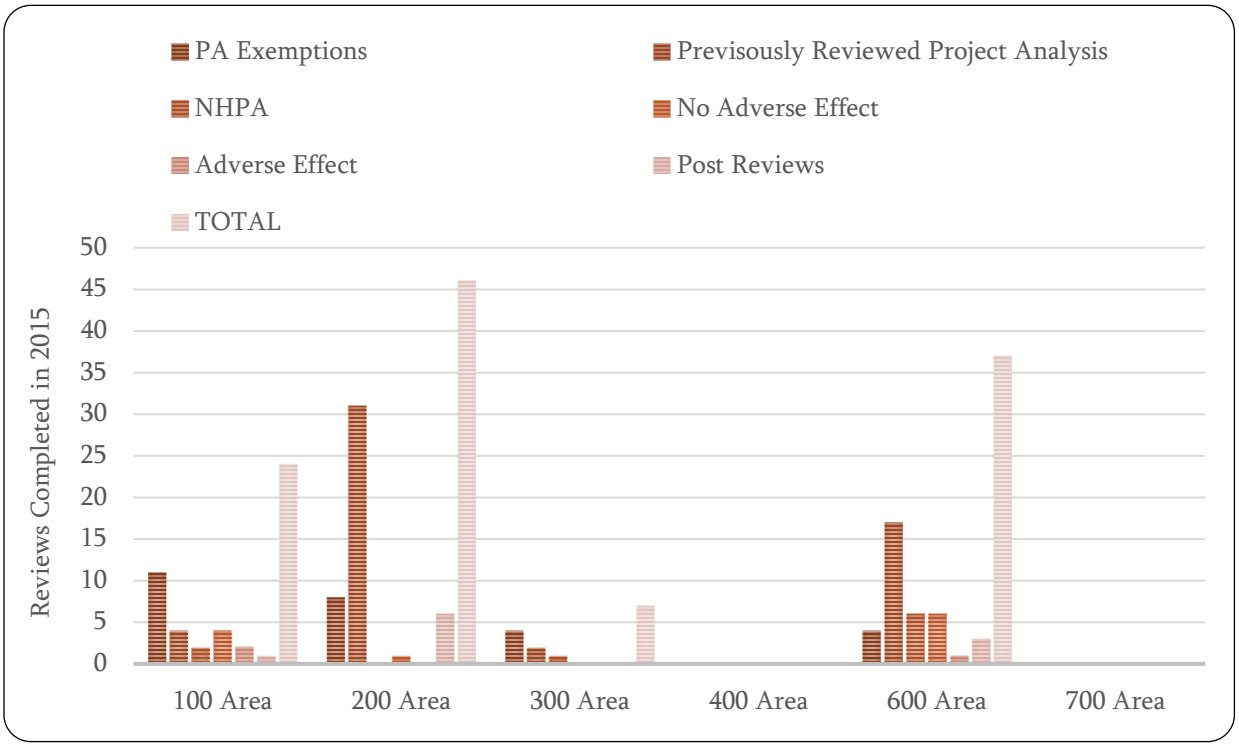

Figure 11.12. Hanford Site National Historic Preservation Act Section 106 Reviews by Area

11.3.2 Cultural Resources Protections and Section 110 Activities

To ensure protection of cultural and historic resources located on the Hanford Site, monitoring activities are conducted to comply with Section 110 of the NHPA (16 U.S.C. 470) and the Archaeological Resources Protection Act (16 U.S.C. 470) formed

> to secure, for the present and future benefit of the American people, the protection of archaeological resources and sites which are on public lands and Indian lands, and to foster increased cooperation and exchange of information between governmental authorities, the professional archaeological community, and private individuals (Sec. 2(4)(b)).

A monitoring program has been in place since 1989 to assess weathering and erosion effects and/or unauthorized excavation and collection of significant cultural resources on the Hanford Site. Activities include on-site inspections to monitor site conditions, assess impacts, and identify protective measures, if necessary.

In 2015, eight pre-contact archaeological sites were monitored under the Section 110 Site Conditions Monitoring program. Site visits are conducted with the participation of tribal cultural resources personnel. In addition, the Section 110 program was adjusted to ensure compliance with applicable regulations. A work plan was established that will ensure all components of Section 110 are addressed, including identification, nomination, and protection of historic properties. A five-year plan was established that, if implemented, will allow all sites included in the monitoring program to be evaluated for National Register eligibility by 2020. The changes made to the monitoring program will ensure that site condition monitoring is completed in a comprehensive and efficient manner that can be helpful in making resource management decisions.

11.3.2.1 Identification and Evaluation Activities

Identification and evaluation activities are performed to comply with Sections 106 and 110 of the NHPA. In 2015, approximately 500 ac (202 ha) of new ground was surveyed for cultural resources under the Section 110 program. Two new archaeological sites and one new isolate were recorded during this survey effort. Also in 2015, 27 new archaeological sites were recorded, and 60 new isolated finds were located (Table 11.11). National Register evaluations have not been completed on the newly discovered sites. Archaeological site forms for three previously recorded archaeological sites were updated, of which two were previously determined eligible for the National Register and one was not evaluated. Thirteen archaeological sites were determined eligible to the National Register for sites recorded in previous reviews. Ten archaeological sites recorded in previous years were determined not eligible. No Historic Property Inventory Forms (HPIF) were completed during the reporting period for components of Hanford's built environment.

Table 11.11. Sites and Isolates Recorded or Updated

2015	Eligible	Not Eligible	Unevaluated	Total
Site updates	2	0	1	**3**
New sites	0	0	31	**31**
New isolates	0	0	62	**62**
Historic Property Inventory Form	0	0	0	**0**
Total	**2**	**0**	**94**	**96**

11.3.2.2 Data and Artifact Collections Management

In 2014, the Cultural Resources Program transitioned to a paperless record keeping system, a process that continued in 2015. The Hanford Site Section 106 database tracks all cultural resource reviews conducted on the Hanford Site. The Section 106 database tracks dates, actions, letters, and results of the cultural resource reviews. Once a project is complete, it is closed out in the database and accessioned into the MSA digital archives for use by all Hanford Site Cultural Resource contractors and other interested researchers. Maintenance of these files is essential to the completion of all cultural resource compliance activities conducted on the Hanford Site.

In 2015, 138 new projects were opened, with pertinent information entered as acquired into the Section 106 database, and 165§ projects were closed out after data entry was complete, with a digital copy of the project documentation added to the digital archive.

The cultural resources GIS database contains cultural resource data collected from Hanford Site contractors, including new archaeological surveys completed as part of Section 106 work, newly recorded, and updated archaeological site locations, and contextual information describing the survey or site. All Hanford Site contractors use the GIS database for literature reviews, cultural resource compliance reporting, and documentation, and research by DOE-approved users. As part of ongoing database management in 2015, a total of 17 polygons delineating completed archaeological surveys were added to the Hanford Site Survey Master shapefiles (map file), and three new archaeological sites/isolates, together with associated spatial and contextual information, were added to the GIS Archaeological Site and Isolate

§This number is larger than the number of projects opened because projects from previous years were closed during 2015.

database. Spatial and contextual information for three archaeological sites/isolates were updated in this database based on information gathered during recent re-visits to these locations.

Largely due to excavations conducted as mitigation for adverse effects on archaeological sites, the Cultural and Historic Resources Program manages a collection of artifacts relating to the Native American settlement of the area within the mid-Columbia Basin that would become the Hanford Site. Similarly, a small collection of artifacts that mark the pre-1943 Euro-American settlement of the Priest Rapids Valley, later designated as the Hanford Site, is also maintained. These artifacts are stored at the Washington State University Tri-Cities Campus, Central Information Center, which maintains a climate controlled, restricted access facility. The forms and reports that document the excavations and interpret these sites also are held by the Cultural and Historic Resources Program. No new artifacts were added to either the prehistoric or the pre-Hanford collections in 2015.

11.3.3 Cultural Resources Consultations and Public Involvement

DOE conducts formal consultations with the Washington State Historic Preservation Officer (SHPO) within the DAHP, Native American tribes, and other interested parties for cultural resource reviews to comply with Section 106 of the NHPA and NEPA (Section 2.1.4). DOE-RL consulted with the Washington SHPO and Native American tribes on all 24 projects that required a full review because of their potential to affect cultural resources within the project area.

DOE Cultural Resources Program staff members held nine meetings in 2015 with Tribal Cultural Resources staff members from the Nez Perce Tribe, CTUIR, Confederated Tribes and Bands of Yakama Nation, and Wanapum. Discussions focused on the cultural resource reviews completed and initiated in 2015; proposed undertakings within traditional cultural property (TCP) boundaries and view sheds; and approaches to protecting threatened archaeological sites and places containing Native American human remains.

11.4 Collection Management and Curation

MC Petrich-Guy

The Hanford Collection comprises artifacts from the Manhattan Project and Cold War era obtained in compliance with DOE/RL-96-77, *Programmatic Agreement Among the U.S. Department of Energy, Richland Operations Office, the Advisory Council on Historic Preservation, and the Washington State Historic Preservation Office for the Maintenance, Deactivation, Alteration, and Demolition of the Built Environment on the Hanford Site, Washington*. This programmatic agreement directs DOE-RL to identify and preserve any artifacts that may have value as interpretive or educational exhibits within national, state, or local museums. During 2015, 70 artifacts were picked up from Hanford Site facilities and delivered to the 4732-A Artifact Staging Facility, leaving 26 (3.5%) of the 743 tagged artifacts scheduled for collection between 2016 and 2048.

Figure 11.13. Archives Storage Area at WSU-TC

The MSA Curation Services program awarded a subcontract to Washington State University Tri-Cities (WSU-TC) to provide professional curatorial and archival services for the management, conservation, and interpretation of the Hanford Collection consisting of artifacts and multimedia relating to the Manhattan Project and Cold War Era (Figure 11.13). With its local, national, and international ties to scholars and researchers, WSU-TC uniquely satisfied one of the principal objectives of DOE-RL to gather, preserve, and make the Hanford Collection broadly available to students and the public. In addition to public outreach and education, WSU-TC will also provide a repository for the collection that meets the requirements of 36 CFR 79, "Curation of Federally-Owned and Administered Archaeological Collections," including protecting these resources from theft, fire, breakage, or deterioration.

The transition of the Hanford Collection to the WSU-TC facility began in July 2015. During 2015, 40% of the Collection was moved from the artifact staging facility on the Hanford Site to the WSU-TC Consolidated Information Center curation facility. Prior to being moved move off site, Collection items were screened for residual radioactivity above allowable limits (DOE O 458.1) and controlled or classified materials to determine whether items could be released to the public. The remaining 60% of the collection is scheduled for transition during 2016.