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Hanford Site Steelhead Redd Monitoring Report for Calendar Year 2013

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-09RL14728

P.O. Box 650
Richland, Washington 99352

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Hanford Site Steelhead Redd Monitoring Report for Calendar Year 2013

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Mission Support Alliance

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1.0 Introduction

The U.S. Department of Energy, Richland Operations Office (DOE-RL) conducts ecological monitoring 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 provides baseline information about the plants, animals, and habitat under DOE stewardship at Hanford required for decision-making under the *National Environmental Policy Act* (NEPA) and *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA). In addition, ecological monitoring helps ensure that DOE, its contractors and other entities conducting activities on the Hanford Site are in compliance with the *Hanford Site Comprehensive Land Use Plan* (DOE/EIS-0222-F). DOE-RL places priority on monitoring those plant and animal species or habitats with specific regulatory protections or requirements; or that are rare and/or declining (federal or state listed endangered, threatened, or sensitive species); or of significant interest to federal, state, or tribal governments or the public.

A prized recreational fishery exists for Steelhead throughout the Pacific Northwest, and steelhead constitute a primary component of tribal fisheries in the Columbia Basin. Steelhead use the Hanford Reach for rearing as juveniles, as a migratory corridor as both juveniles and adults, and for spawning as adults. Upper Columbia Summer-run Steelhead potentially use the Hanford Reach and are currently listed as threatened under the *Endangered Species Act of 1973* (ESA). Because of their ESA listing status and importance to recreational and tribal fisheries, steelhead were selected for monitoring by the Mission Support Alliance (MSA) Public Safety and Resource Protection Program (PSRP).

On August 18, 1997, Upper Columbia Summer-run Steelhead were listed as endangered under the ESA, with an effective date of October 17, 1997 (62 FR 43937). This status was upgraded to threatened on January 5, 2006; reinstated to endangered status per U.S. District Court decision in June 2007; and upgraded to threatened per U.S. District Court order in June 2009. National Oceanic and Atmospheric Administration (NOAA) Fisheries issued results of a five-year review on August 15, 2011, and concluded that this species should remain listed as threatened (76 FR 50447). Steelhead covered under this listing include all naturally spawned anadromous *Oncorhynchus mykiss* (steelhead) populations and their progeny below natural and man-made impassable barriers in streams in the Columbia River Basin upstream from the Yakima River, Washington, to the U.S.-Canada border. Also covered are artificial propagation programs: the Wenatchee River, Wells Hatchery (in the Methow and Okanogan Rivers), Winthrop National Fish Hatchery, Omak Creek, and the Ringold steelhead hatchery programs. Critical habitat for this Evolutionarily Significant Unit (ESU) within the Hanford Site includes the entire Hanford Reach of the Columbia River (65 FR 7764, and 70 FR 52630).

Steelhead are the anadromous (sea-run) form of the rainbow trout. Steelhead migrate from their natal streams to the ocean as juveniles and return to their natal streams as mature adults to spawn. They can survive spawning (iteroparity) whereas all pacific salmon die after spawning (semelparity). Although steelhead can survive spawning to spawn a second time, the repeat spawning rate in the state of Washington is low (4 to 15 percent [Wydoski and Whitney 1979]). In addition, adults encounter four

mainstem Columbia River dams on their way to and from the Hanford Reach; therefore, repeat spawning in the Hanford Reach by a significant number of steelhead is unlikely.

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 utilize smaller tributary habitat and substrate than Chinook salmon but will spawn in larger mainstem rivers, such as the Columbia, where suitable habitat exists. In Idaho's Clearwater and Salmon Rivers, the preferred gravel size for nesting was 1.3 to 10.2 cm (0.5 to 4 in), water depth 0.2 to 1.5 m (0.75 to 5 ft), and water velocity 0.70 to 0.76 m/s (2.3 to 2.5 ft/s); these habitat conditions are available within the Hanford Reach (Orcutt 1968, DOE/RL-2000-27). In 2007, steelhead spawning habitat suitability surveys were conducted at multiple sites contained within three key contaminant plumes resulting from Hanford Site operations (Stables and Tiller 2007). Habitat suitability was assessed based upon depth, velocity, substrate size, and substrate embeddedness. Eleven of the 72 sites surveyed were found to be entirely suitable to support steelhead spawning at the flows present during the time of the surveys.

Steelhead occur in the Hanford Reach all year; however, most adults move into the Reach from August to November, peaking in September (Watson 1973; PNL-5371, DOE/RL-2000-27). Most steelhead that enter the Hanford Reach hold in the immediate vicinity for 6 to 8 months. A limited tagging study in 1967 found adults migrated near shorelines at depths less than 3 meters (m) (10 feet)(Coutant 1973, DOE/RL-2000-27).

Spawning within the Hanford Reach would likely occur between February and early June, with peak spawning in mid-May (Eldred 1970; Watson 1973; PNL-5371, DOE/RL-2000-27). Little is known about the quality and quantity of steelhead spawning, rearing, and adult holding habitat in the Hanford Reach. Watson (1973) estimated that from 1962 to 1971, an annual average of 35,000 steelhead that passed McNary Dam did not pass Priest Rapids Dam on the Columbia River or Ice Harbor Dam on the Snake River (DOE/RL-2000-27). He estimated that 10,000 of these fish were potential spawners in the Hanford Reach, after taking into account reductions due to migration into the Yakima and Walla Walla Rivers, sport catch, and natural mortality. Counts from 1977 to 1996 indicated an average of 20,000 steelhead that annually passed McNary Dam but did not pass Ice Harbor or Priest Rapids dams, and approximately 9,000 of these could potentially spawn in the Hanford Reach (DOE/RL-2000-27).

Gray and Dauble (1976) provide other evidence of steelhead spawning (DOE/RL-2000-27). They collected gravid and ripe females in late April and early May and collected spent males in August within the Hanford Reach. However, information on the quantity and location of steelhead spawning is uncertain because aerial surveys of steelhead spawning are often hampered by highly turbid spring runoff that obscures visibility. Historical information on steelhead spawning was from the late 1960s and early 1970s during unusually low flow conditions (39 to 78 thousand cubic feet per second (kcfs), normal average flow is ~120 kcfs). Key spawning areas reported from aerial surveys conducted in 1968 and 1970 included Vernita Bar, Coyote Rapids, Locke Island, 100-F islands, and Ringold (Tony Eldred, personal communication with D. R. Geist PNNL 9-28-89). A total of 220 redds were counted in 1968 and 95 in 1970; total steelhead spawning was estimated by Eldred to be approximately 2,200 to 25,000 in

1968 and 950 to 7,800 in 1970. Fickeisen et al. (1980) indicated steelhead likely spawned at Vernita Bar, Coyote Rapids, Locke Island, and Ringold. An aerial survey conducted on April 30, 1998, identified up to 75 redds in the Hanford Reach, with the area from Wooded Island to Ringold having 14 redds and the 100-F Area islands having 61 (Dauble 1998, DOE/RL-2000-27).

Recent documentation of steelhead spawning in the Hanford Reach is rare. A comprehensive study was conducted in spring 1999 to survey likely spawning areas near Locke Island, but no steelhead redds were found (PNNL-13055). In the spring of 2005, the 100-N Area shoreline was investigated by aerial and boat surveys to search for spawning areas (PNNL-SA-75348). Results of these surveys showed only limited spawning near the Ringold Hatchery Creek (near United States Geological Survey (USGS) River Mile 355) in certain years. One verified steelhead redd was found near the 300 Area in spring 2003, and surveys in the spring of 2005 identified a single location where steelhead redds occurred downstream of Ringold at Island 15 (PNNL-SA-75348). Aerial steelhead redd counts were conducted during years 2007 through 2009, but only a single redd was observed in 2008, which was located near the upper portion of Locke Island. Aerial surveys conducted during 2012 along the entire length of the Hanford Reach detected no steelhead redds (HNF-53665).

Aerial surveys for steelhead redds are conducted on 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. Although few redds have been counted in recent years, the surveys would document any change in the status of steelhead spawning in the Hanford Reach and would help plan project activities to avoid redds, if any are identified.

2.0 Methods

Aerial surveys of steelhead redds were conducted in 11 areas of the Hanford Reach (Figure 1), with the number of redds being totaled by section, consistent with past survey efforts and the historical database. Eight additional sub-sections (100-B/C, 100-K, 100-N, 100-D, 100-H, 100-F, Dunes, and 300 Areas) were added to better monitor the abundance and distribution of steelhead redds in areas of potentially contaminated groundwater upwelling of (Figure 2). Subsections were delineated based on the presence of contaminated groundwater plumes adjacent to the Columbia River along the Hanford Site (DOE/RL-2011-119). This change to the historical monitoring technique provides additional spatial resolution to the survey information, but does not impede the summing of redd counts in the original areas, still allowing collected data to be directly comparable to historical records.

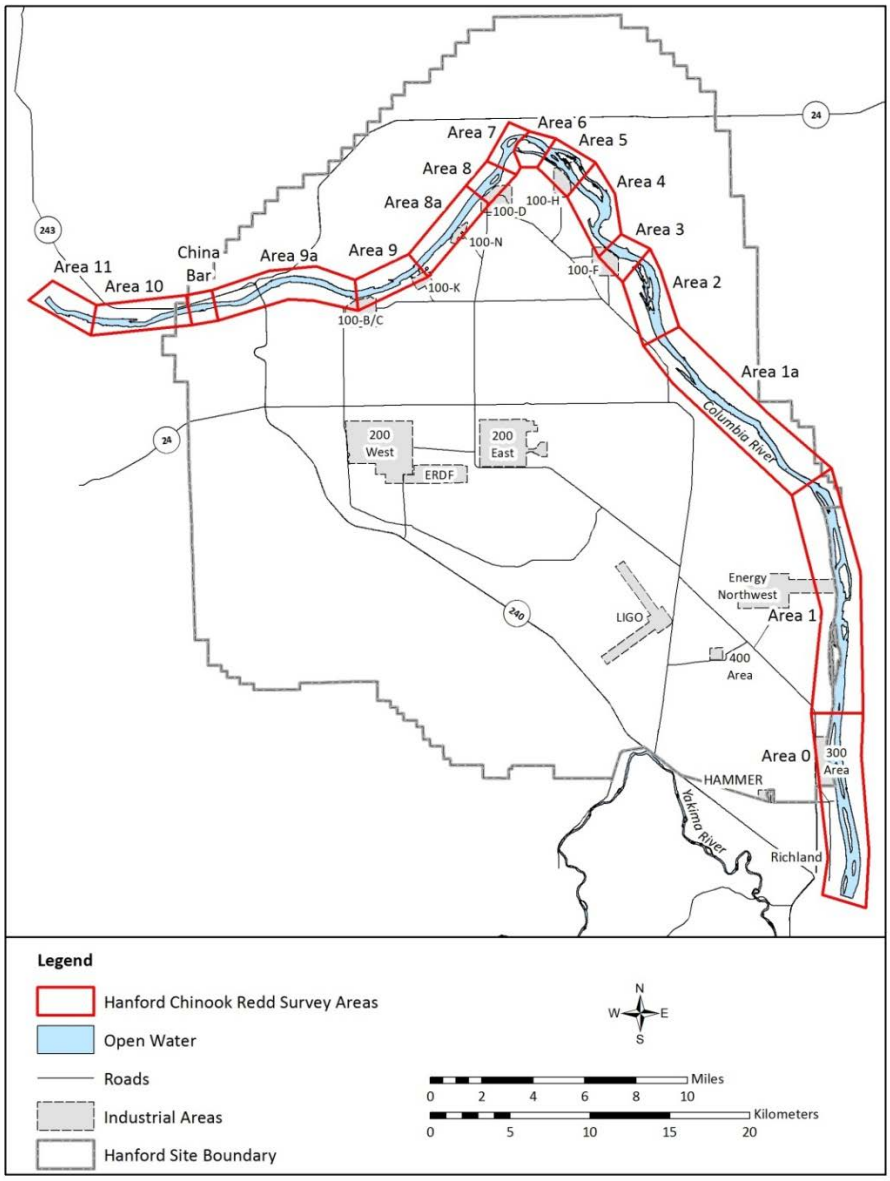

Figure 1. Aerial Survey Areas for Steelhead Redds Used Historically and in 2013

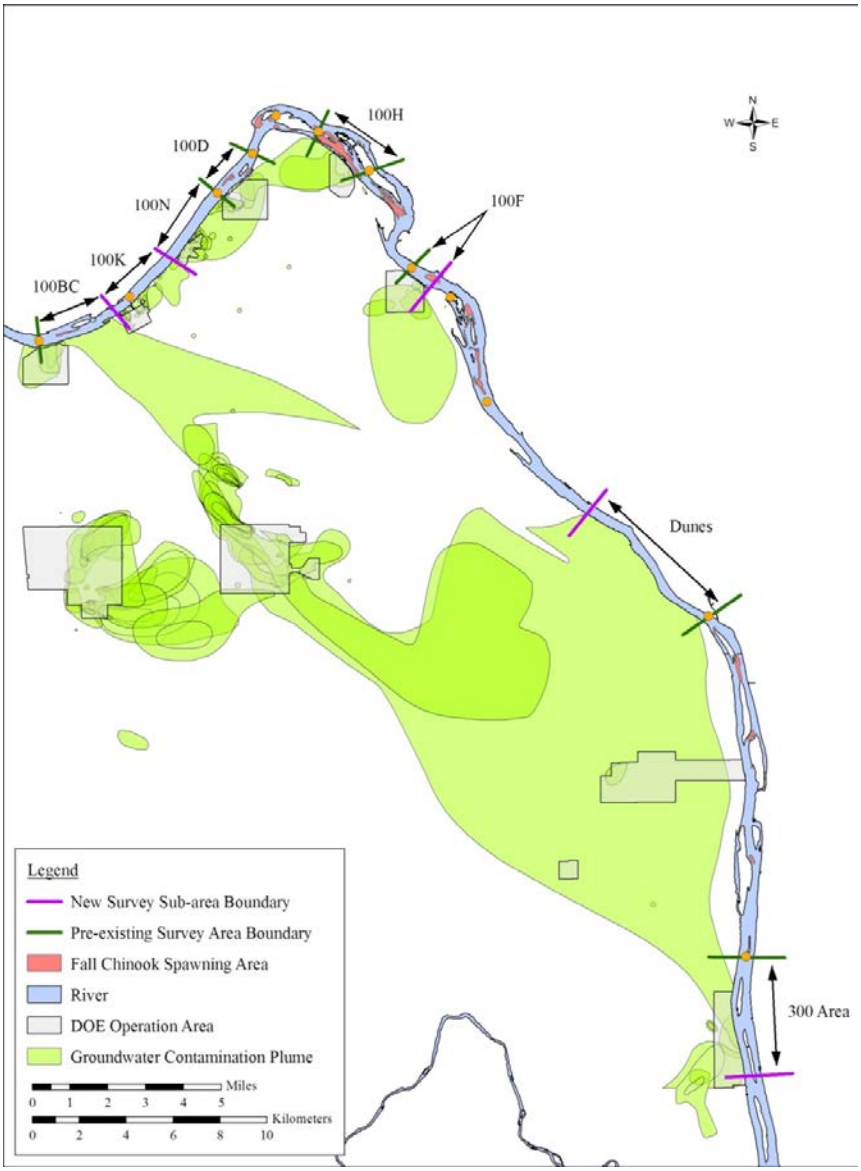

Figure 2. Survey Sub-areas where Groundwater Upwelling May Contain Contamination from the Hanford Site

The primary physical factors influencing the accuracy of aerial counts includes depth of water over the redds and water clarity. Wind action, available light, orientation of the river, and direction of the current can also affect visibility. Because it is seldom possible to view all redds from the air, these counts provide an index of relative abundance and distribution of steelhead spawning in the Hanford Reach of the Columbia River.

Survey flight altitudes ranged from approximately 244 to 366 m (800 to 1200 ft) with air speeds of 120 to 161 km (75 to 100 miles) per hour. Redds, when observed, were counted individually. Flight cancellation could occasionally be necessary due to either adverse weather conditions (i.e., wind, fog, or low clouds) or excessively high river flows. Excessively high flows resulting from spring run-off can flood areas typically characterized by terrestrial vegetation and lacking steelhead spawning habitat, and leave

previously usable habitat with flows too swift for spawning and too deep to be observed from the air. Sustained flows in excess of 160 kcfs were considered too high to survey.

Redd count surveys began near Richland at Nelson Island and ended at Priest Rapids Dam. Flights were normally conducted near noon with the intent to bracket the highest angle of the sun for optimum viewing conditions. Observers wore polarized glasses as necessary to reduce glare. Any redds observed were documented by survey area on large format printed maps.

If redds were identified during aerial surveys, follow-up surveys were conducted from a boat to confirm the presence of steelhead redds. The suspected redds identified from the air were also located from a boat to confirm their status as newly formed steelhead redds.

3.0 Results

Two aerial surveys were completed along the length of the Hanford Reach during the 2013 survey season, which is consistent with historical levels of effort. The first survey was performed on March 28 and the second and final survey was completed on May 12. Higher than average river flows prevailed through the first half of April and much of May (Figure 3), which hampered the survey effort.

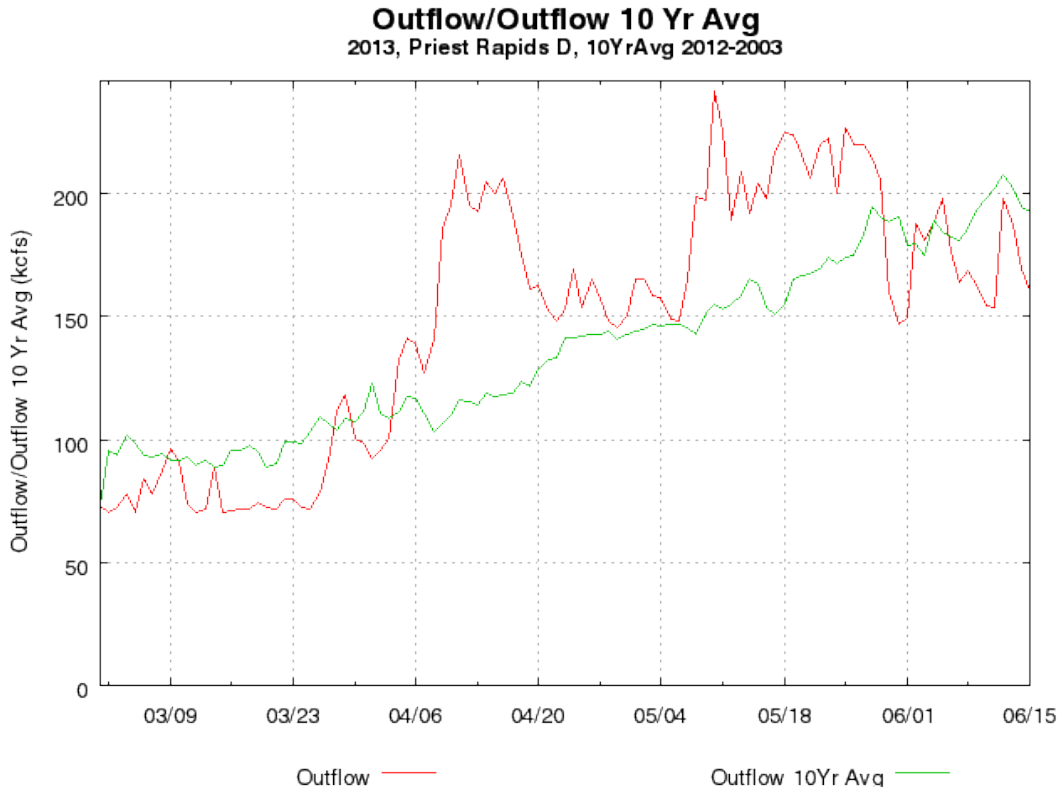

Figure 3. Daily Average Priest Rapids Dam Outflow March 1, 2012 through June 15, 2013 Compared to 10-Year Average

Source: Columbia River Dart (http://www.cbr.washington.edu/dart/dart.html).

The first 2013 steelhead redd aerial survey was conducted on March 28, 2013. Wind was light and viewing conditions were excellent. River discharge changes at Priest Rapids Dam translate through the Hanford Reach in approximately eight hours. Discharge from Priest Rapids Dam for the eight hours prior to the survey ranged from 101 to 120 kcfs. Two suspected redd clusters containing a total of 6 redds (2 near Coyote Rapids and 4 near the top of Homestead Island [Island 13]) were identified during the aerial survey (Figure 4). Because steelhead redds are rarely sighted on the Hanford Reach, per monitoring protocols, a boat survey was conducted the following day (March 29) in an effort to validate the aerial observations. The boat-based survey began at approximately 0900 hours and concluded at approximately 1400 hours. Discharge from Priest Rapids Dam for the eight hours prior to the boat-based survey ranged from 101 to 132 kcfs. The bare patches observed on a gravel bar near Coyote Rapids during the aerial flight were determined not to be steelhead redds, but were two high spots that had recently been dewatered causing submerged periphyton that had been growing on the rocks to desiccate or freeze during a recent low water period. Consequently, the dead periphyton on the rock surfaces made the substrate within the two areas appear disturbed. One of the four suspected steelhead redds observed near the tip of Homestead Island (Island 13) was also located by the boat-based field team and verified to be a recently established redd. The substrate present in the vicinity of the verified redd was generally smaller than substrates used by fall Chinook and more suitable to steelhead spawning (Tiller and Stables 2008). Consistent with the aerial observations, other bare gravel patches were observed in close proximity to the verified redd during the boat survey, but these could not be conclusively determined to be redds because viewing conditions were hampered by the depth of water and swift current present. As such, all four redds counted from the aircraft were considered to be valid due to their close proximity to one another (Table 1). No redds were observed within areas adjacent to Hanford Site operations.

The second 2013 steelhead redd aerial survey was conducted on May 12. Discharge from Priest Rapids Dam for the eight hours prior to the survey ranged from 150 to 203 kcfs. Because discharge changes at Priest Rapids Dam take approximately eight hours to translate from the top to the bottom of the Hanford Reach, good viewing conditions were found to be present throughout most of the survey area. This was due to the flow reduction (<160 kcfs) from the previous night persisting at all locations downstream of Vernita Bar. Areas from Vernita Bar upstream were found to be unsuitable for surveying due to high water. Wind was light throughout the survey. No redds were observed in the survey area.

Table 1 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 2 shows the number of redds occurring within the newly defined sub-sections, coinciding with areas of potential upwelling of contaminated groundwater. No steelhead redds were observed in areas of potentially contaminated groundwater upwelling in 2013.

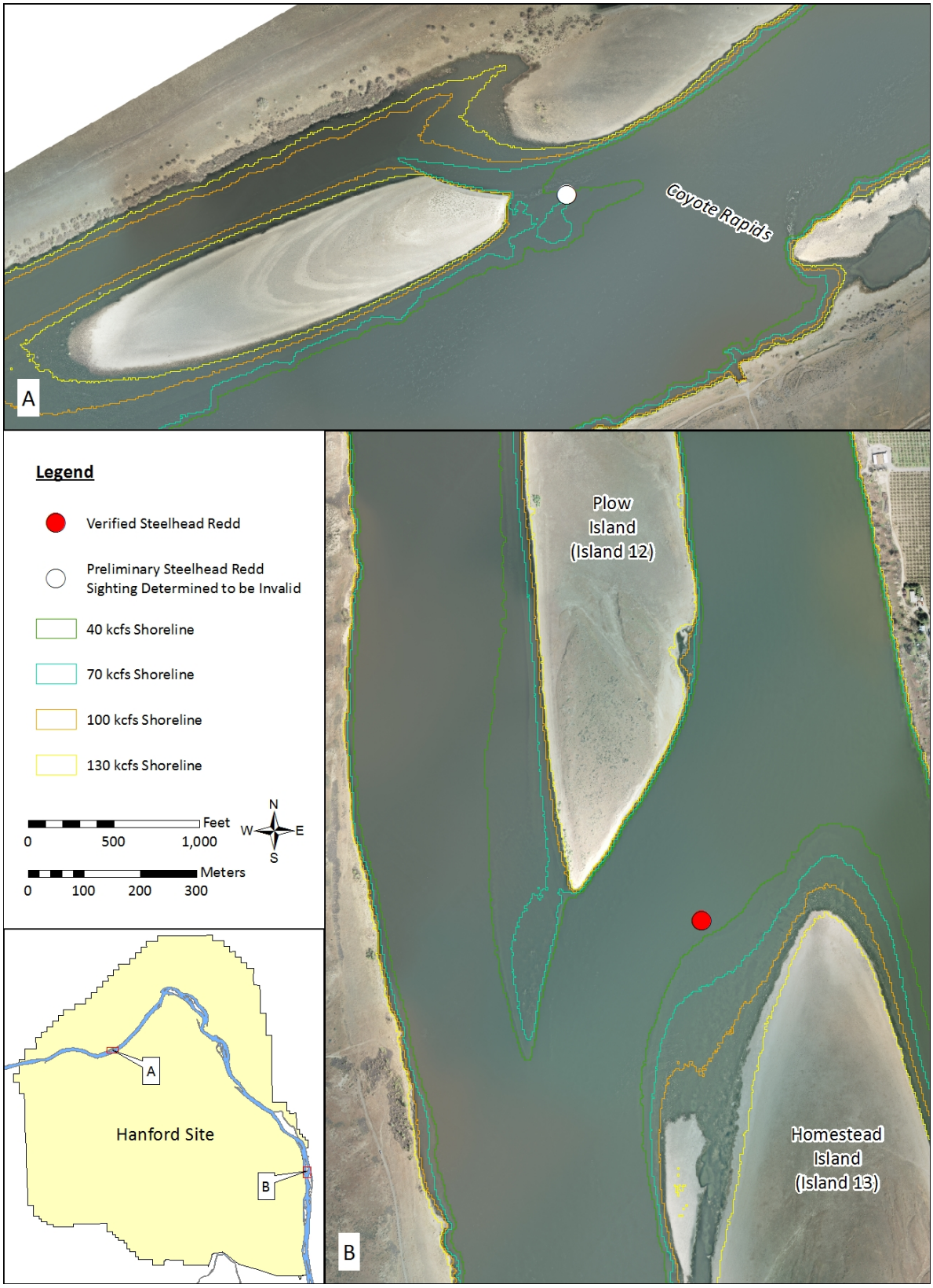

Figure 4. Locations of Preliminary and Verified Steelhead Redds from 2013

Table 1. Summary of Steelhead Redd Counts for the 2013 Aerial Surveys in the Hanford Reach, Columbia River

Area	Description	3/28/2013	5/12/2013	Maximum Count
0	Islands 17-21 (Richland)	0	0	0
1	Islands 11-16	4	0	4
2	Islands 8-10	0	0	0
3	Near Island 7	0	0	0
4	Island 6 (lower half)	0	0	0
5	Island 4, 5 and upper 6	0	0	0
6	Near Island 3	0	0	0
7	Near Island 2	0	0	0
8	Near Island 1	0	0	0
9	Near Coyote Rapids	0	0	0
	Midway (China Bar)	0	0	0
10	Near Vernita Bar	0	N/A	0
11	Near Priest Rapids Dam	0	N/A	0
	TOTAL	**4**	**0**	**4**

Table 2. Summary of Steelhead Redd Counts for the 2013 Aerial Surveys by Potentially Contaminated Groundwater Upwelling Sub-sections.

Hanford Site Sub-Areas	3/28/2013	5/12/2013	Maximum Count
300 Area	0	0	0
Dunes	0	0	0
100-F	0	0	0
100-H	0	0	0
100-D	0	0	0
100-N	0	0	0
100-K	0	0	0
100-B/C	0	0	0
TOTAL	**0**	**0**	**0**

4.0 Discussion

Aerial counts of steelhead redds have been conducted in the Hanford Reach since 1998. Prior to 2012, the surveys were performed by the Pacific Northwest National Laboratory (PNNL). Beginning in 2012, the surveys have been conducted by MSA as part of the PSRP program. Because long term trends in both redd abundance and distribution are important monitoring components, several steps were taken to ensure compatibility and consistency with past efforts. These included reviewing and adopting past monitoring protocols, coordination/training with former redd count personnel, using maps detailing the entire survey reach as well as all historical sub-areas and spawning sites, both as in-flight guidance

documents and as field data recording forms, and using the same air service, airplane, and pilots that were used in previous years.

Although steelhead redds have seldom been observed in the Hanford Reach in recent years, the March 28 and 29, 2013, observations support past evidence that limited steelhead spawning does occur in the Hanford Reach. The location of these redds within close (less than 1.5 miles) proximity to the Ringold Hatchery effluent may indicate that the fish that spawned in this area may have been hatchery strays or possibly natural origin fish attracted by the effluent. Validation of steelhead redds by boat-based field survey immediately following the aerial survey sightings was useful because field teams were able to distinguish actual steelhead redds from other hydraulic anomalies which could have been mistakenly identified as redds from the air. Confirming potential redd sites from a boat proved to be challenging, but was greatly aided by aerial photos taken and site locations sketched and detailed on hard copy maps during the aerial flight. It should be noted that Columbia River flows had been relatively stable (~70-75 kcfs) throughout mid-March, but began to increase on March 28, with the advent of the spring freshet. Relatively stable river levels are believed to be an important factor for steelhead spawning because their selection of suitable spawning habitat is based on water depths (less than 2 meters (7 feet)) as well as substrate sizes and water velocity (Stables and Tiller 2008).

As was the case in 2012, old fall Chinook redds were still visible throughout the Hanford Reach during the first spring 2013 aerial survey (HNF-53665). In general, old fall Chinook redds were less distinct (more periphyton growth over rock surfaces), far more numerous, and placed in deeper water than were the steelhead redds. This is well past the six week redd life, the period after which redds are indiscernible from the surrounding substrate, expected for fall Chinook salmon redds. The large number and size of the redds, presence in historic fall Chinook salmon spawning areas, as well as the complete lack of adult fish observed in the vicinity distinguished these as fall Chinook salmon redds rather than steelhead redds. In areas where steelhead and fall Chinook salmon spawning habitat features may overlap, steelhead spawning on top of or in close proximity to fall Chinook salmon redds would be extremely difficult to distinguish from still readily visible fall Chinook salmon redds. The presence of adult steelhead would be necessary to distinguish them. Under the conditions just described, verification of steelhead redds absent of spawning adults would require closer inspection via boat, submersible camera, or diver.

Consistent with recent-year survey results, few steelhead redds were observed in the Hanford Reach in 2013. Dauble (1998) counted 75 redds in the spring of 1998; but the 2013 observations suggest that these could have been fall Chinook salmon redds and not steelhead redds. Rising river flows in 1998 precluded ground-truth verification of the spring redd sightings. Orcutt et al. (1968) identified preferred steelhead spawning gravel size, water depth and water velocity in Idaho's Clearwater and Salmon Rivers, and habitat features with these same characteristics are available in the Hanford Reach (DOE/RL-2000-27). It should be noted that steelhead in the Columbia River Basin are often classified as either A-run or B-run. Steelhead in the Hanford Reach and Upper Columbia Basin are all A-run while the Snake River Basin contains both A-run and B-run steelhead. A-run steelhead occur throughout the steelhead-bearing streams of the Snake River Basin; B-run steelhead are thought to be produced only in

the Clearwater, Middle Fork Salmon, and South Fork Salmon Rivers (IDFG 1994). B-run steelhead are larger than A-run steelhead and would therefore be better suited to spawning in mainstem habitats. While the habitat features identified by Orcutt et al. (1968) may be available in the Hanford Reach, they may not be suitable for smaller A-run steelhead.

Watson (1973) estimated that from 1962 to 1971, an average of 10,000 steelhead were potentially available to spawn in the Hanford Reach, this estimate was based upon dam counts uncorrected for fallback. During a two year evaluation, Wagner (1990) and Wagner and Hillson (1991) counted several thousand pre-spawn adult steelhead falling back through the juvenile collection system at McNary Dam (5,721 from September 15 through November 30, 1990, and 11,512 from March 25 through December 15, 1991) and these fallbacks were not accounted for in the upstream passage data. In addition, the fallback statistics for 1990 and 1991 only include steelhead that were intercepted by the juvenile bypass screening system and do not include steelhead that may have passed either: 1) under the screens and through the turbines; 2) over the spillways during periods of spill; 3) through the navigation locks; or 4) through the turbine intakes outside of the time period when the screening system was in place. All of these factors potentially inflate adult passage estimates. Because thousands of adult steelhead fall back at McNary Dam, it is difficult to accurately estimate how many, if any, are actually available to spawn in the Hanford Reach.

High spring flows and hampered steelhead redd count surveys notwithstanding, if significant steelhead spawning does occur in the Hanford Reach, we would expect to find sub-yearling and pre-smolt juveniles (i.e., young-of-the-year). Gray and Dauble (1976) reported that young-of-the-year steelhead were not collected by small mesh beach seines in areas of the Hanford Reach during the time of the year when steelhead juveniles should have been present. Other studies have failed to collect young-of-the-year steelhead (Dauble et al. 1989, Wagner et al. 1997, Hoffarth et al. 1998, Nugent et al. 1999 and 2000). In June 2001, four wild steelhead fry were collected from an entrapment pool near Wooded Island for the first time during the fifth year of an on-going fry stranding study (Nugent et al. 2002). The absence of young-of-the-year steelhead, even in cases where juvenile fish of all species residing in the Hanford Reach were targeted during the summer months when steelhead fry would have been present (Wagner et al. 1997, Hoffarth et al. 1998, Nugent et al. 1999 and 2000) supports the conclusion that there is very little steelhead spawning occurring in the Hanford Reach.

While the data discussed above strongly suggests that very little steelhead spawning occurs in the Hanford Reach, the observations of small numbers of steelhead redds and fry confirm that some steelhead spawning does in fact take place. Furthermore, because the population of natural origin steelhead inhabiting the upper Columbia River has been reduced to the point of listing under the ESA, the number of steelhead spawning in the Hanford Reach may be low at present but will likely increase as recovery actions are successfully implemented. Monitoring should continue to document any changes, and to ensure that Hanford Site activities do not adversely affect the recovery of these fish.

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