Klamath Hydroelectric Project
FERC Project No. 2082

Klamath Hydroelectric Settlement Agreement
Interim Measure 7
J.C. Boyle Gravel Monitoring Report
2014-2015

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December 2015

KLAMATH HYDROELECTERIC PROJECT SETTLEMENT AGREEMENT
INTERIM MEASURE 7
J.C. BOYLE 2014-2015 GRAVEL MONITORING REPORT

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1 INTRODUCTION

1.1 PROJECT DESCRIPTION

PacifiCorp owns and operates the Klamath Hydroelectric Project (Project), located on the upper Klamath River in Klamath County (south-central Oregon) and Siskiyou County (north-central California). The Project has five dams on the Klamath River-Keno, J.C. Boyle, Copco 1, Copco 2, and Iron Gate; and one dam on the Fish Creek tributary. The Link River dam is owned by the U.S. Bureau of Reclamation. A map of the Project area is shown below (Figure 1.1-1).

Figure 1.1-1. Location map.

1.2 BACKGROUND

On February 18, 2010, the United States, the States of California and Oregon, PacifiCorp, Tribes, and a number of other stakeholder groups signed the Klamath Hydroelectric Settlement Agreement (KHSA). The KHSA includes provisions and detailed actions for the interim

operation of PacifiCorp's dams and mitigation activities prior to removal of the dams or the termination of the KHSA. One of the measures, titled Interim Measure 7: J.C. Boyle Gravel Placement and/or Habitat Enhancement, requires habitat restoration in the J.C. Boyle bypass and peaking reaches.

As described in Interim Measure 7 of the KHSA, PacifiCorp is to provide funding annually for the planning, permitting, and implementation of gravel placement and habitat enhancement projects, including related monitoring, in the Klamath River above Copco Reservoir and below J.C. Boyle dam. The key objective of this measure is to place suitable gravels in the J.C. Boyle bypass and peaking reaches for resident trout and potential future salmon spawning and ecological restoration purposes. The full text of Interim Measure 7 is included below.

Interim Measure 7: J.C. Boyle Gravel Placement and/or Habitat Enhancement

> Beginning on the Effective Date and continuing through decommissioning of the J.C. Boyle Facility, PacifiCorp shall provide funding of $150,000 per year, subject to adjustment for inflation as set forth in Section 6.1.5 of the Settlement, for the planning, permitting, and implementation of gravel placement or habitat enhancement projects, including related monitoring, in the Klamath River above Copco Reservoir.
>
> Within 90 days of the Effective Date, PacifiCorp, in consultation with the IMIC, shall establish and initiate a process for identifying such projects to the Committee, and, upon approval of a project by the Committee, issuing a contract or providing funding to a third party approved by the Committee for implementation of the project.
>
> The objective of this Interim Measure is to place suitable gravels in the J.C. Boyle bypass and peaking reach using a passive approach before high flow periods, or to provide for other habitat enhancement providing equivalent fishery benefits in the Klamath River above Copco Reservoir. Projects undertaken before the Secretarial Determination shall be located outside the FERC project boundary.

Interim Measure 7 falls under the auspices of the Interim Measures Implementation Committee (IMIC). The IMIC is comprised of state, federal, tribal and private signatories to the KHSA whose purpose is to collaborate with PacifiCorp on ecological and other issues related to the implementation of several Interim Measures as set forth in Appendix D of the KHSA. The IMIC formed a technical subcommittee comprised of representatives from the Oregon Department of Fish and Wildlife (ODFW), Oregon Department of Water Resources (ODWR), the Klamath Tribes, PacifiCorp, and the Bureau of Land Management (BLM) to discuss the goals, objectives, regulatory requirements, and planning for Interim Measure 7. This subcommittee recommended the development of a long term gravel enhancement plan that would cover the expected time period (2010-2020) for implementation of Interim Measure 7.

Per the KHSA, PacifiCorp developed the J.C. Boyle Gravel Placement and Monitoring Plan (Plan) in the spring of 2011 (Mason, Bruce and Girard, et al. 2011). The Plan details monitoring objectives, methods for both gravel placement and monitoring, and annual reporting requirements. Approximately 500 cubic yards of gravel was placed in the river each year in the fall of 2011, 2012, 2013, 2014, and 2015. This document describes the fourth year of monitoring (gravel placed in October 2014) under Interim Measure 7. The October 2015 gravel placement monitoring results will be reported next year.

1.3 MONITORING OBJECTIVES

The monitoring objectives outlined in the Plan include assessments of both the implementation and effectiveness of gravel enhancements under Interim Measure 7. Field observations related to implementation were intended to answer three primary questions:

1. Were placement methods cost-effective and implemented within the proposed budget constraints?

2. Were placement procedures safe and effective for getting gravel placed in the intended locations and quantities?

3. Were there any unanticipated problems in either the implementation or the effectiveness of the placements?

Effectiveness monitoring was intended to evaluate whether the placed gravel distributed and sorted as intended given the flow regime experienced during the performance period (October through June). Effectiveness monitoring was designed to provide data to answer the following specific gravel distribution/sorting questions for each gravel placement site:

- Did the flows that occurred since the previous gravel placement result in movement (scour) of the placed gravel?

- Did the flows that occurred since the previous gravel placement result in a change in channel cross section (net scour or aggradation) across the gravel placement site or some distance downstream?

- Did the gravel placement result in a change in substrate composition across the gravel placement site or some distance downstream?

Methods used for both implementation and effectiveness monitoring are described below.

2 METHODS

2.1.1 Implementation Monitoring

Implementation of the gravel placement was addressed primarily through a questionnaire given to PacifiCorp's project manager and the gravel placement foreman. Responses addressed gravel quantities, the methods and safety of gravel placement activities, and any recommended actions to improve placement methods or related operations.

2.1.2 Effectiveness Monitoring

Effectiveness monitoring methods were designed to determine whether placed gravel distributed and sorted as intended given the flow regime experienced during the monitoring period. During previous monitoring periods, a combination of surveyed cross sections, scour monitors, and visual/photo observations were used to determine if placed gravel moved or not. Based on previous years' monitoring, it was determined that visual/photo observations were sufficient to determine if placed gravel had moved at the 2015 placement sites since gravel had

been placed at both these sites in previous years and previous monitoring determined that the majority of gravel had moved downstream.

3 RESULTS

Since 2011, approximately 500 cubic yards of gravel was placed in the Klamath River below the J.C. Boyle dam each year (Table 3.1-1, Figure 3.1-1). This monitoring report considers only the 250 cubic yards that were placed at each of the sites at RM 219.9 and 216.8 in October 2014.

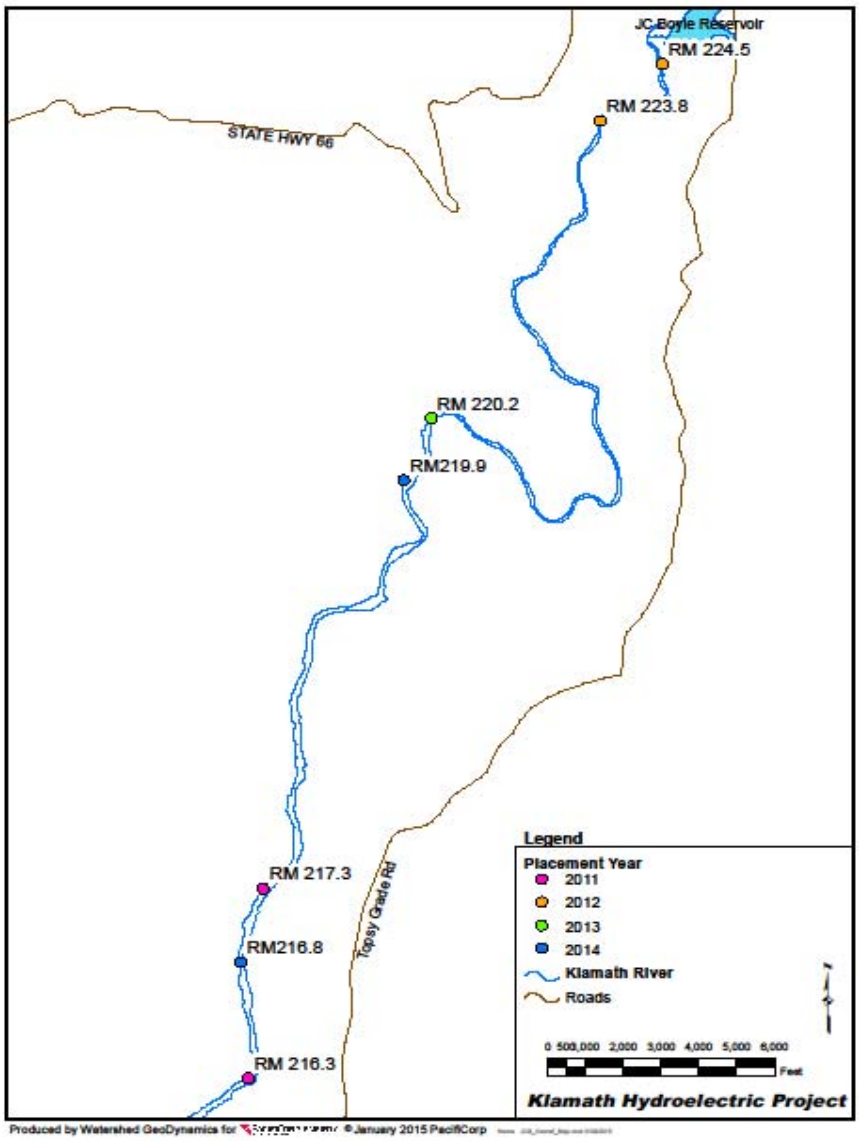
Table 3.1-1. Gravel Placement Locations, Dates, and Volumes.

Site (River Mile)	Placement Date/Volume (cubic yards)				
	November 2011	October 2012	October 2013	October 2014	October 2015
224.5	-	225	-	-	-
223.8	-	105	-	-	-
220.2	-	-	250	-	-
219.9	-	250	250	250	250
217.3	250	-	-	-	-
216.8	-	-	-	250	250
216.3	250	-	-	-	-

3.1 POST-PLACEMENT FLOWS

Both 2014 gravel placement sites are located in the peaking reach downstream of the J.C. Boyle powerhouse. Fifteen-minute flows at the USGS gage downstream of the J.C. Boyle powerhouse (USGS 1151070) were collected from the USGS website. These flows are provisional and have not been finalized by the USGS but are unlikely to change substantially since there were no high flows to alter the hydraulic control. Post gravel placement flows (October 2014-October 2015) ranged from 321 to 3,020 cfs (Figure 3.1-2).

Flows in the bypass reach were the normal minimum flows throughout the year with the exception of one day of spill for maintenance on September 16, 2015. Spill was 750 cfs at the upstream end of the bypass reach on that day (flow increases through the bypass reach due to accretion).



Note: Gravel was placed at RM219.9 in 2012, 2013, 2014, and 2015 and at RM 216.8 in 2014 and 2015

Figure 3.1-1. Gravel placement locations.

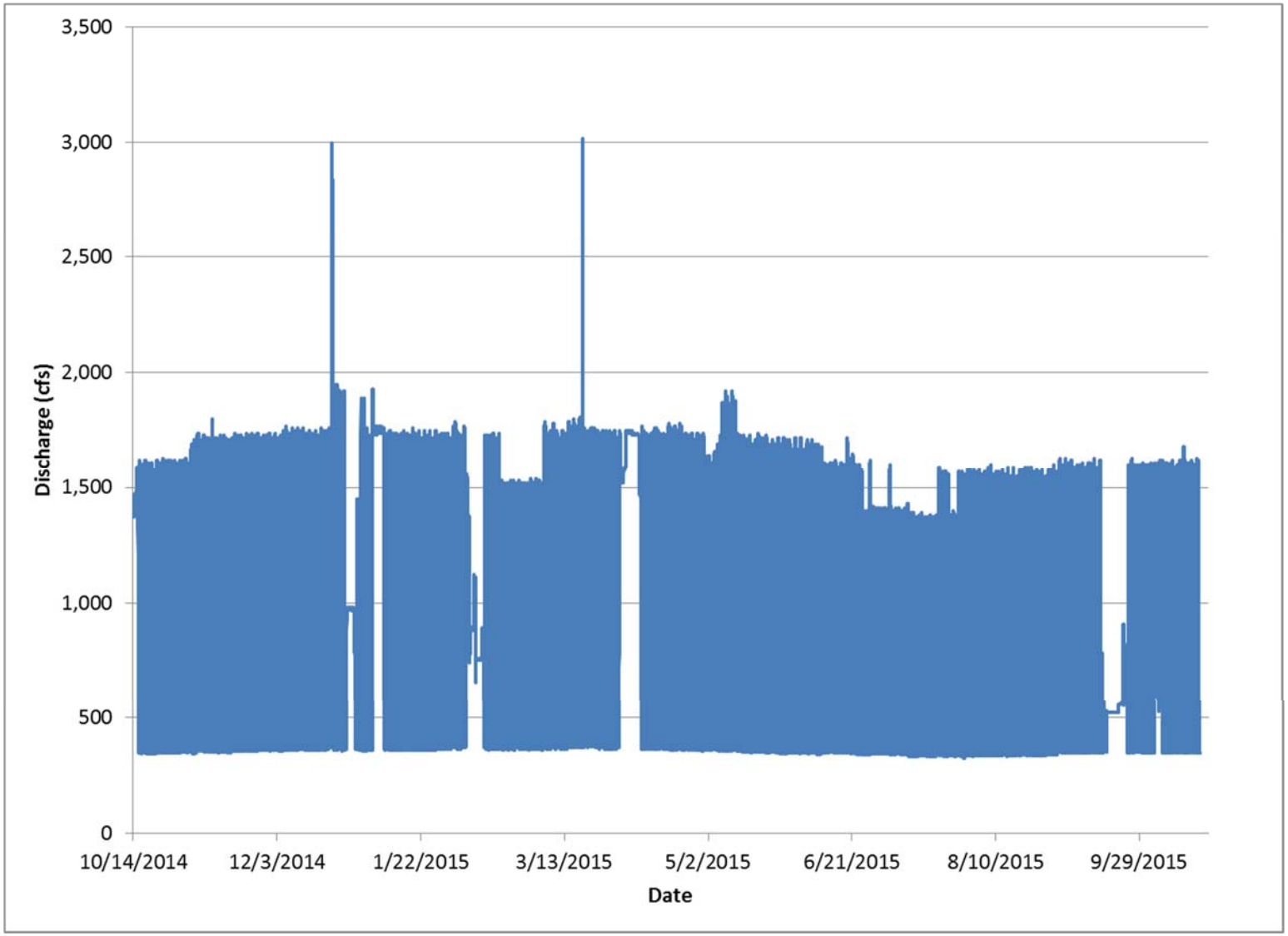


Figure 3.1-2. Post- gravel placement flows at USGS gage 1151070, October 2014-2015

3.2 IMPLEMENTATION MONITORING

Implementation monitoring questionnaires were filled out by the PacifiCorp project manager and the construction foreman to determine the amount of gravel placed, placement costs, and any efficiency/safety issues; responses are summarized in Table 3.2-1. Approximately 250 cubic yards of gravel was placed using gravel shooter trucks at the RM 219.9 site and another 250 cubic yards at the RM 216.8 site. No safety issues or problems were encountered during placement.

Table 3.2-1. Implementation monitoring questions.

Monitoring Question	2014 Results
How may cubic yards of gravel were placed at each site?	RM 219.9 – 250 cubic yards RM 216.8 – 250 cubic yards
Were the placement methods (truck/helicopter) able to place gravel where planned?	Both sites were placed using a high speed conveyor truck. No issues were encountered. Both sites are well suited for truck placement methods.
Were any safety issues encountered?	No safety issues were encountered.
Were any problems encountered during placement?	No problems were encountered.
Are there any recommendations to improve placement methods in the future?	None

3.3 EFFECTIVENESS MONITORING

Past bedload transport calculations at RM 219.9 suggested that flows of 1,800 cfs could initiate transport of 0.5 inch (12.7 mm) rocks, and flows above 2,200 to 3,900 cfs could move 1 to 3 inch (25.4 to 76.2 mm) rocks, respectively, at this site (PacifiCorp 2004, 2005). Gravel added in 2014 was within the 1 to 3 inch size range. Flows in the peaking reach where the RM 219.9 and RM 216.8 sites are located (just downstream of the powerhouse) ranged from 321-3,020 cfs during the monitoring period (October 2014-October 2015). The gravel placed at the RM 219.9 site in 2013 was transported downstream, so it was expected that the gravel added in 2014 would also be transported away from the sites.

3.3.1 Turnoff Downstream of Spring Island Boat Launch, RM 219.9

The RM 219.9 site is located along the road just downstream of the Spring Island Boat Launch (Figure 3.1-1, above). Gravel was shot from a truck on the road into the river.

Location: Peaking reach, RM 219.9, right bank looking downstream

Type of placement: Truck – gravel shooter

Habitat Description: Boulder run, outside of river bend. Average wetted width 85 feet; average local gradient 0.013.

Placement volume: 250 cubic yards.

Scour monitors were not placed at this site since previous monitors (2012) disappeared due to gravel movement. Visual observations at the RM 219.9 site showed the majority of placed

gravel had been transported away from the site during the monitoring period (Figure 3.3-1, and 3.3-2). This is consistent with measurements and observations in previous years that indicated the majority of gravel was transported away from this site.

Figure 3.3-1. Photo of placed gravel at RM 219.9, October 2014 (just after placement).

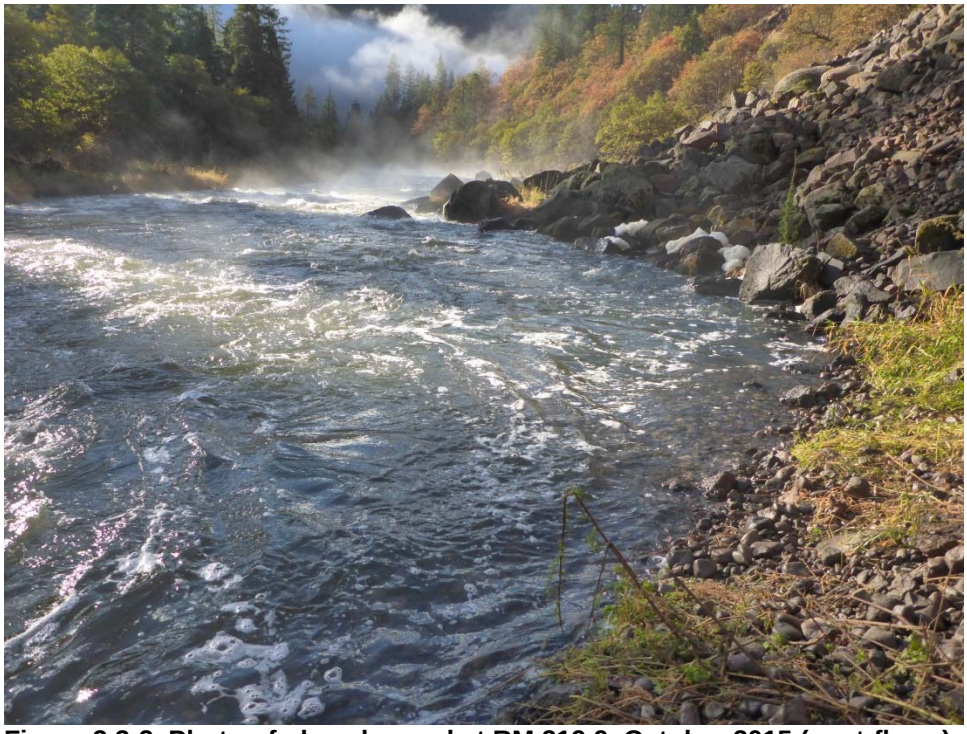


Figure 3.3-2. Photo of placed gravel at RM 219.9, October 2015 (post-flows).

3.3.2 Old Bridge Site RM 216.8

The RM 216.8 site is located at the old bridge site (Figures 3.1-1 above and 3.3-3, 3.3-4 below). Gravel was successfully placed at this site from a gravel shooter truck in 2014 and 2015.

Location: Peaking reach, RM 216.8 right bank looking downstream

Type of placement: Truck – gravel shooter

Habitat Description: Cobble/boulder/cobble riffle. Average wetted width 85 feet. Average local gradient 0.004.

Placement volume: 250 cubic yards.

Figure 3.3-3. Photo of placed gravel at RM 216.8, October 2014 (after placement).

Figure 3.3-4. Photo of placed gravel at RM 216.8, October 2015 (post-flows).

3.4 SUMMARY OF 2014 GRAVEL PLACEMENT

Truck-based gravel placement at the RM 219.9 and RM 216.8 (peaking reach) sites occurred in October 2014. No safety or other issues were encountered during the 2014 gravel placement. Approximately 250 cubic yards of gravel was placed at each site. Visual observations of the sites showed that flows in the peaking reach (321-3,020) from October 2014 to October 2015 removed the majority of gravel from the sites.

The two 2011 gravel placement sites at RM 217.3 and 216.3 in the peaking reach and the 2012 sites in the bypass reach at RM 224.5 and 223.8 were visually inspected; it did not appear that much if any gravel had been transported at these locations. The two sites in the bypass reach (RM 224.5 and 223.8) did encounter spill of 750 cfs during September 2015. There was evidence of flow over the gravel, with grass and annual plants pushed over (Figure 3.4-1). One scour monitor at RM 223.8 was found totally exposed and lying on the gravel bar, but it appears that it was pulled by recreationalists since the gravel on the bar did not appear to have been moved by flows (Figure 3.4-2).

Figure 3.4-1. RM 224.5 Site showing evidence of flow over placed gravel bar (now vegetated).

Figure 3.4-2. RM 223.8 Site showing evidence of flow over bar and pulled scour monitor.

3.5 FUTURE GRAVEL PLACEMENT SITES

Based on the placement and monitoring of gravel at the sites, it appears that gravel can be added to the RM 220.2, RM 219.9, and RM 216.3 sites in the future; normal operating flows

are capable of transporting added gravel from these site. No additional gravel should be placed at the RM 223.8, 224.5 (bypass reach) or RM 217.3 or 216.3 (peaking reach) sites until higher flows (e.g., large spill) occur that have the opportunity to move the placed gravel.

Two additional sites, one in the peaking reach and one in the bypass reach were investigated for potential placement in future years.

3.5.1 BLM Klamath Campground Site – Upstream location, RM 217.4

Location: Peaking reach, RM 217.4, N42° 3.48207' W122° 5.13421'

Type of placement: truck

Habitat Description: Boulder/cobble pool riffle/glide. Average wetted width 115 feet; average local gradient 0.003.

Potential placement volume: 400 cu yd

The RM 217.4 site is located at the upstream end of the BLM Klamath Campground (Figures 3.5-1 and 3.5-2). Gravel would be placed by truck from one or more locations along the shoreline. Access is via an existing spur off the main campground road.

Figure 3.5-1. RM 217.4 photo.

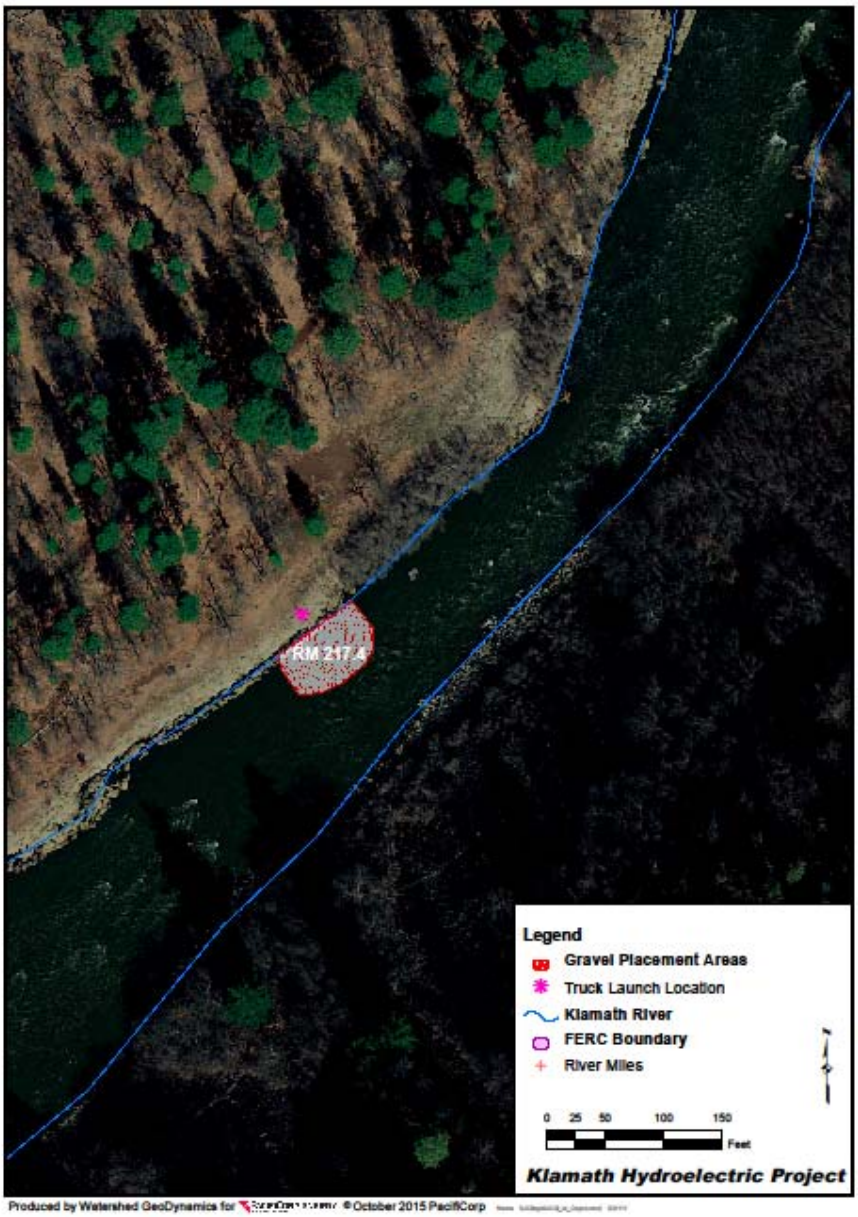


Figure 3.5-2. Site RM 217.4.

3.5.2 Upstream of Powerhouse Site, RM 220.3

Location: Bypass reach, RM 220.3, N42° 5.61473' W122° 4.09894'

Type of placement: truck

Habitat Description: Cobble/boulder riffle. Average wetted width 40 feet; average local gradient 0.013.

Potential placement volume: 250 cu yd

This truck access site is located just upstream from the powerhouse at RM 220.3 (Figures 3.5-3 and 3.5-4). The site would be access via the existing parking area upstream of the powerhouse/switchyard.

Figure 3.5-3. RM 220.3 photo.

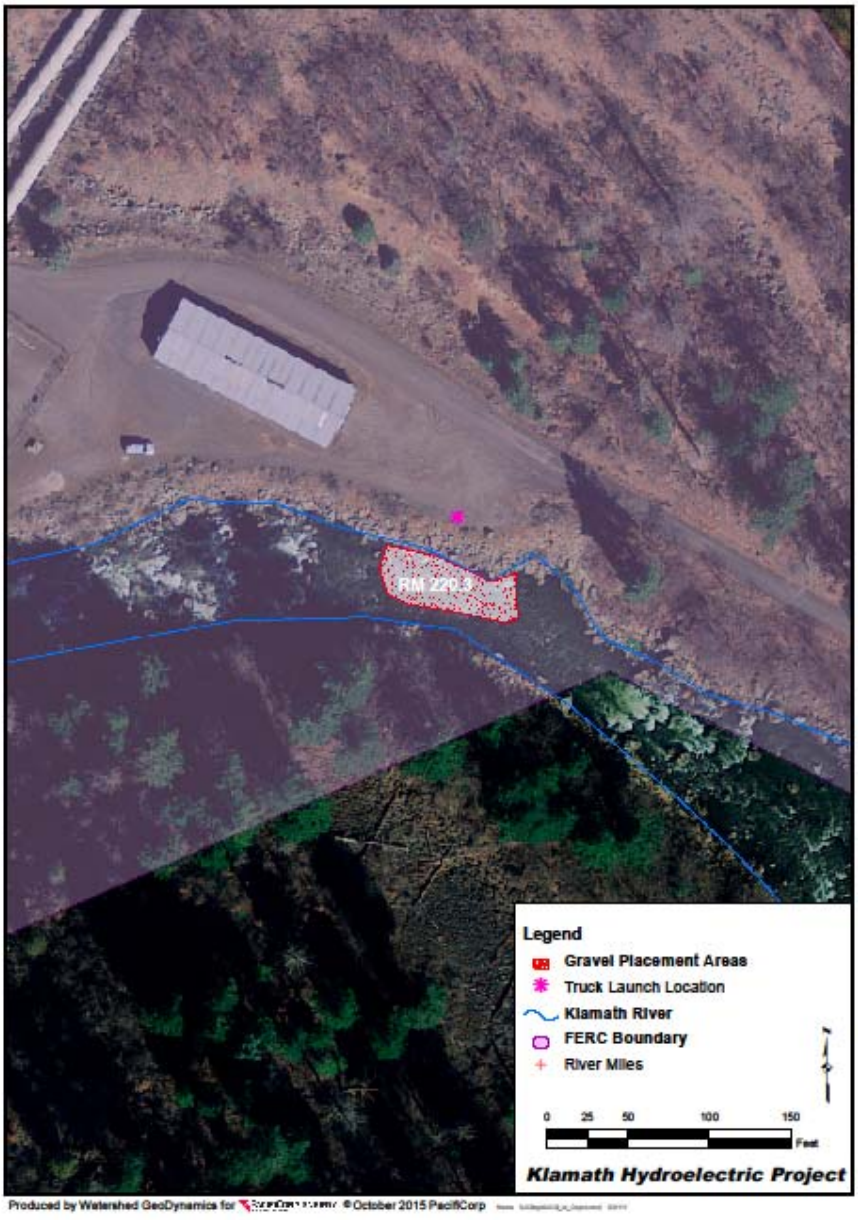


Figure 3.5-4. Site RM 220.3.

Figure 3.5-5 shows the location of all existing and potential gravel placement sites identified to date.

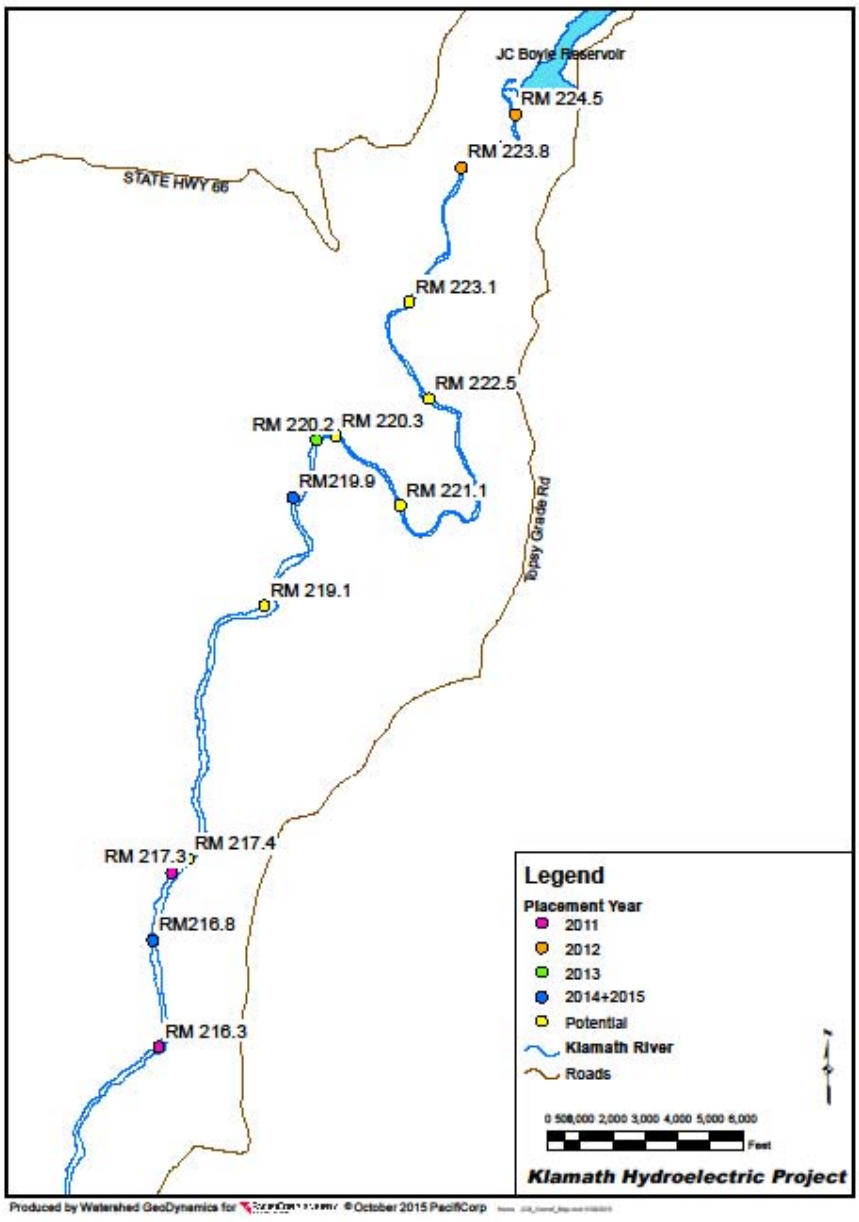


Figure 3.5-5. Existing and potential gravel placement sites.

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