Klamath Hydroelectric Project
FERC Project No. 2082

# Klamath Hydroelectric Settlement Agreement
# Interim Measure 7
# J.C. Boyle Gravel Monitoring Report
# 2013-2014


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January 2015

# KLAMATH HYDROELECTERIC PROJECT SETTLEMENT AGREEMENT
# INTERIM MEASURE 7
# J.C. BOYLE 2013-2014 GRAVEL MONITORING REPORT

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# 1 INTRODUCTION

## 1.1 PROJECT DESCRIPTION

PacifiCorp Energy (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, and 2014. This document describes the third year of monitoring (gravel placed in October 2013) under Interim Measure 7. The October 2014 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 scour monitors (Shuett-Hames et al. 1999) and visual/photo observations were sufficient to determine if placed gravel had moved at the 2013 placement sites.

## 3 RESULTS

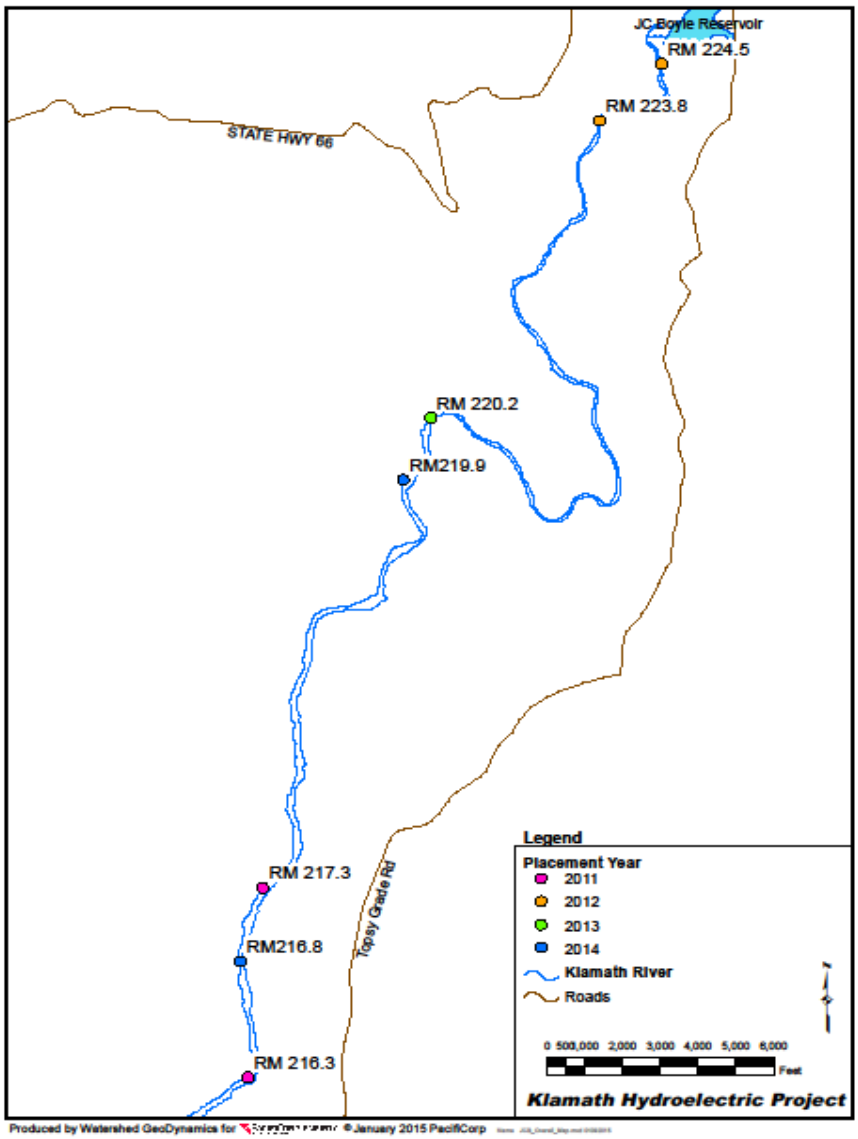
Since 2011, approximately 2,000 cubic yards of gravel have been placed in the Klamath River below the J.C. Boyle dam (Table 3.1-1, Figure 3.1-1). However, this monitoring report considers only the 250 cubic yards that were placed at each of the sites at RM 219.9 and 220.2 in October 2013.

**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 |
| 224.5 | - | 225 | - | - |
| 223.8 | - | 105 | - | - |
| 220.2 | - | - | 250 | - |
| 219.9 | - | 250 | 250 | 250 |
| 217.3 | 250 | - | - | - |
| 216.8 | - | - | - | 250 |
| 216.3 | 250 | - | - | - |

### 3.1 POST-PLACEMENT FLOWS

Both 2013 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 2013-October 2014) ranged from 337 to 2,650 cfs (Figure 3.1-2).




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

**Figure 3.1-1. Gravel placement locations.**

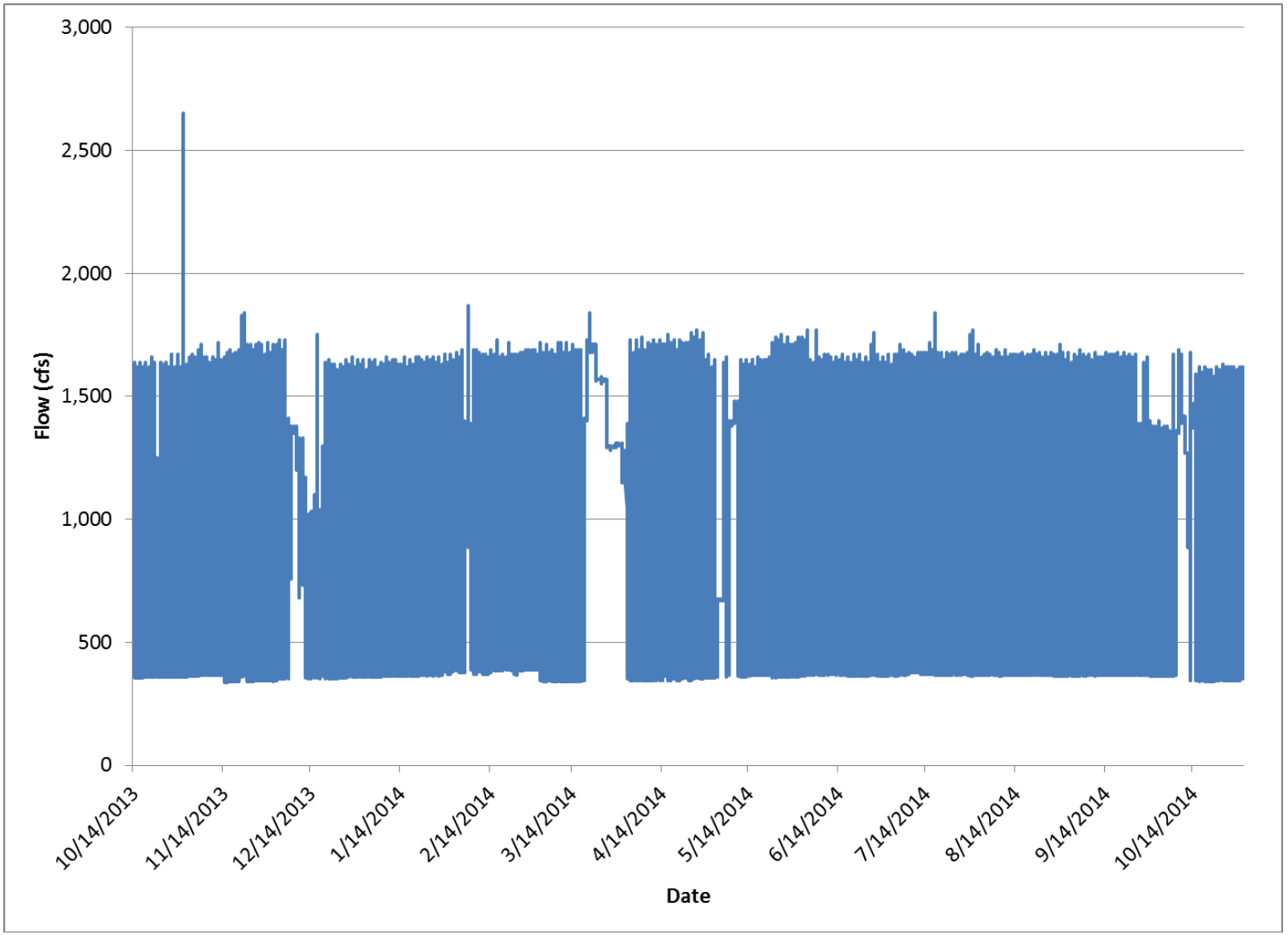



**Figure 3.1-2. Post- gravel placement flows at USGS gage 1151070, October 2013-2014**

## 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 220.2 site. No safety issues or problems were encountered during placement.

**Table 3.2-1. Implementation monitoring questions.**

| Monitoring Question | 2013 Results |
|---|---|
| How may cubic yards of gravel were placed at each site? | RM 220.2 – 250 cubic yards<br>RM 219.9 – 250 cubic yards |
| What was the average cost/yard of gravel placement? | Approximately $245/cu yard |
| 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? | Additional communication prior to placement or proposing to meet the scheduling needs of the client and their consultants. We were able to adjust the schedule to fit their needs. If the campground (old bridge site) is used next year additional time will be required due to slow access. |

## 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 2013 was within this size range. Flows in the peaking reach where the RM 220.2 and RM 219.9 sites are located (just downstream of the powerhouse) ranged from 337 to 2,650 cfs during the monitoring period (October 2013-October 2014). The gravel placed at the RM 219.9 site in 2012 was transported downstream, so it was expected that the gravel added in 2013 would also be transported away from the sites.

### 3.3.1 Downstream of Powerhouse Site RM 220.2

The RM 220.2 site is located in the peaking reach just downstream of the powerhouse (Figures 3.1-1 above and 3.3-1 below). Gravel was successfully placed at this site from a gravel shooter truck.

Location: Peaking reach, RM 220.2, right bank looking downstream

Type of placement: Truck – gravel shooter

Habitat Description: Boulder/cobble riffle. Average wetted width 90 feet.

Placement volume: 250 cubic yards

**Figure 3.3-1. Photo of gravel placement site at RM 220.2, October 2013 (just prior to placement).**

Four scour monitors were installed at the RM 220.2 site in October 2013. All of the scour monitors were gone during the October 2014 site visit, and visual observations at the RM 220.2 site showed the majority of placed gravel had been transported away from the site during the monitoring period (Figure 3.3-2, and 3.3-3). Some of the gravel, presumably from this site, was observed in the lee of boulders for a distance of approximately 500 feet downstream of the placement site in October 2014 (Figure 3.3-4).

**Figure 3.3-2. Photo of placed gravel at RM 220.2, October 2013 (just after placement).**

**Figure 3.3-3. Photo of placed gravel at RM 220.2, October 2014 (post-flows).**


**Figure 3.3-4. Gravel in lee of mid-channel boulders approximately 500 feet downstream from RM 220.2 placement site, October 2014 (post-flows).**

### 3.3.2 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 (Figures 3.3-5 and 3.3-6). This is consistent with measurements and observations in previous years that indicated the majority of gravel was transported away from this site.

**Figure 3.3-5. Photo of placed gravel at RM 219.9, October 2013 (just after placement).**

**Figure 3.3-6. Photo of placed gravel at RM 219.9, October 2014 (post-flows).**

## 3.4 SUMMARY OF 2013 GRAVEL PLACEMENT

The truck-based gravel placement at the RM 220.2 and RM 219.9 (peaking reach) sites occurred in October 2013. No safety or other issues were encountered during the 2013 gravel placement. Approximately 250 cubic yards of gravel was placed at each site. Monitoring of the placed gravel showed that flows in the peaking reach (367 - 2,650 cfs) from October 2013 to October 2014 transported the majority of gravel placed at the RM 220.2 and RM 219.9 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 any gravel had been transported at these locations.

Based on the placement and monitoring of gravel at the sites, it appears that gravel can be added to the RM 220.2 and RM 219.9 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., spill) occur that have the opportunity to move the placed gravel.

In addition to the RM 219.9 site, gravel placement for 2014 took place at the old bridge site in the peaking reach at RM 216.8. These sites will be checked for gravel movement in fall 2015.

# 4 REFERENCES

Mason, Bruce, & Girard, Inc., Watershed GeoDynamics, and Northwest Hydraulic Consultants. 2011. Klamath hydroelectric project settlement agreement interim measure 7, J.C. Boyle gravel placement and monitoring plan. Report prepared for PacifiCorp. September 2011.

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