Boundary Hydroelectric Project (FERC No. 2144)

Dissolved Oxygen Attainment Plan
Annotated Outline

Seattle City Light

April 2009

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1 INTRODUCTION

This document provides an outline of Seattle City Light's (SCL) proposed Dissolved Oxygen (DO) Attainment Plan for the Boundary Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC) No. 2144. The following sections include a summary of DO data collected in the Project area during 2007 and 2008 and a description of SCL's proposed approach to post-license DO monitoring and attainment, i.e., monitoring design, monitoring methods, DO response to proposed macrophyte control measures, evaluation of monitorng results, potential secondary actions, and an implementation schedule.

1.1. Dissolved Oxygen Standard

The Washington Department of Ecology's (Ecology) water quality criteria for the Pend Oreille River dictate that the lowest one-day minimum concentration of DO shall be 8.0 mg/L (Ecology 2006). This 8.0 mg/L criterion has been established by Ecology to support salmonid spawning, rearing, and migration. The criterion states that DO concentrations are not to fall below 8.0 mg/L at a probability frequency of more than once every ten years on average.

2 DISSOLVED OXYGEN IN THE PROJECT AREA

DO was measured at eight sampling sites in 2007 and 2008 as part of the Project's relicensing studies (Table 2.0-1). For a map showing the locations of these sampling sites within the Project area, see Figure 5.3-6 in SCL's Preliminary Licensing Proposal (PLP) (SCL 2009a).

Table 2.0-1. Dissolved oxygen sampling sites used in 2007 -2008 relicensing studies.

Sample site	Location description
Box Canyon Tailrace (V7)	In Boundary Reservoir just downstream of Box Canyon Dam
Wolf Creek (V1)	Adjacent to Wolf Creek inlet (above Metaline Falls)
Metaline Old (V2)	Old channel of Pend Oreille River across from Metaline (above Metaline Falls)
Pend Oreille Mine (V3)	Downstream of Pend Oreille Mine (below Metaline Falls)
Slate Creek (V4)	Downstream of Slate Creek across from campsite on left bank (below Metaline Falls)
Everett Creek Island (V5)	Upstream of Everett Creek Island (below Metaline Falls)
Boundary Forebay (V6)	Boundary Forebay
Boundary Tailrace (V8)	Downstream of Boundary Dam

Average, maximum, and minimum DO concentrations measured at all sampling sites during 2007 and 2008 are presented, by sampling month, in Table 2.0-2. The DO values measured in the field were not recorded simultaneously at each site, and therefore are not directly comparable, but still allow for general longitudinal trends to be inferred for the entire sampling period. All DO concentrations measured in May and June and September through March were greater than 8.0 mg/L, but a few exceedances of the Ecology criterion occurred in July and August (Table 2.0-2). The complete DO dataset is included in Appendix 2 of the Water Quality Constituent and Productivity Monitoring Final Report (SCL 2009b) and was provided in Excel® format to Ecology (C. Pratt [SCL] email to M. Mangold [Ecology], February 13, 2009).

In July 2007, DO concentrations were in compliance with Ecology's DO criterion at all sampling stations, except for the Everett Creek Island (V5) and Boundary Forebay (V6) stations, where DO values at depths below 28.0 m (7.0 mg/L minimum) and below 35.0 m (7.7 mg/L minimum), respectively, fell below 8.0 mg/L. In August 2007, DO concentrations were below 8.0 mg/L at the Metaline Old (V2), Boundary Forebay (V6), and Boundary Tailrace (V8) stations, where minimum DO concentrations were 7.9, 7.6, and 7.7 mg/L, respectively. DO values that were below the 8.0 mg/L standard were also often below saturation, which was about 7.9 mg/L in July and 8.5 mg/L in August. This means that DO was less than the maximum concentration the reservoir water could hold based on ambient temperature and atmospheric pressure. DO profiles also suggest that the water column may not be as thoroughly mixed as the generally uniform temperature profiles for the Project indicate, at least during the sampling events in July and August 2007. In the absence of the Project, water depths would be significantly less in the reach where DO exceedances were observed and vertical mixing of the water column would be greater, potentially resulting in DO at saturation levels throughout the water column.

Table 2.0-2. Dissolved oxygen (mg/L) data summary for water quality monitoring sites in Boundary Reservoir and tailrace (May 2007–March 2008).

Site	May			June			July			August			September/October			November			March		
	Avg.	Max	Min	Avg.	Max	Min	Avg.	Max	Min	Avg.	Max	Min	Avg.	Max	Min	Avg.	Max	Min	Avg.	Max	Min
V7	11.0	11.0	11.0	10.0	10.0	10.0	8.6	8.6	8.5	8.4	8.4	8.4	9.6	9.7	9.6	12.4	13.6	12.0	12.8	12.9	12.4
V1	11.4	11.4	11.4	10.0	10.1	9.9	8.7	8.8	8.7	8.1	8.1	8.1	9.6	9.7	9.6	12.1	13.1	11.9	12.7	12.9	12.3
V2	11.3	11.3	11.2	10.0	10.1	9.9	9.2	9.7	8.9	**7.9**	8.0	**7.9**	9.6	9.7	9.5	11.8	11.9	11.8	12.7	12.8	12.7
V3	11.4	11.4	11.4	9.5	9.6	9.4	8.2	8.4	8.1	8.9	9.1	8.8	9.6	9.9	9.4	12.1	12.2	12.0	12.6	12.7	12.5
V4	11.3	11.3	11.3	9.2	9.3	9.1	8.5	8.7	8.4	8.8	9.0	8.6	9.6	9.9	9.4	12.1	12.3	12.0	12.7	12.7	12.6
V5	11.2	11.2	11.2	9.2	9.3	9.1	8.1	8.5	**7.7**	8.5	8.9	8.1	9.6	10.0	9.3	12.0	12.5	11.9	12.7	12.8	12.6
V6	11.2	11.2	11.2	9.0	9.3	8.8	**7.8**	8.4	**7.0**	8.0	8.4	**7.6**	9.4	9.9	9.1	11.8	12.3	11.7	12.5	12.6	12.4
V8	11.2	11.2	11.2	9.5	9.5	9.5	8.2	8.2	8.2	**7.7**	**7.7**	**7.7**	9.7	9.7	9.7	12.0	12.1	12.0	12.6	12.7	12.4

Note:
Bold and underlined text indicates when DO measurements were lower than the one-day minimum numeric criterion of 8.0 mg/L.

3 DISSOLVED OXGYGEN ATTAINMENT PLAN

3.1. Dissolved Oxygen Monitoring

Based on the DO data described in Section 2 of this document, Ecology has determined that a DO Attainment Plan is required to address the infrequent DO exceedances observed in the Project area (M. Mangold, Ecology, personal communication, February 19, 2009). Ecology has recommended that a five-year DO monitoring plan, including annual reporting and consultation with Ecology, be implemented following issuance of the new FERC license (M. Mangold, Ecology, personal communication, February 19, 2009). SCL proposes to monitor DO in the reservoir during the first five years following issuance of the new FERC license to better define the magnitude and spatial and temporal extent of DO exceedances in the Project area and assess potential changes in DO concentrations resulting from measures implemented to reduce the abundance of invasive macrophytes in the Project area (see Section 3.4 of this plan).

3.2. Monitoring Design

SCL will coordinate with Ecology and other relicensing participants during the Integrated Resource Analysis (IRA) process to finalize the specifics of the DO monitoring program identified below, including sampling depths, duration of monitoring periods, and measurement equipment to be used. Because DO concentration is dependent on water temperature, temperature will be measured every time DO measurements are made.

SCL anticipates that monitoring will be conducted continuously (see Section 3.3. of this plan) at the following sites: Box Canyon Tailrace (V7), Metaline Old (V2), Everett Creek Island (V5), Boundary Forebay (V6), and Boundary Tailrace (V8) stations (Table 2.0-1). Sampling depth intervals along vertical profiles at these sites may be the same as those used during 2007 and 2008, i.e., a minimum of 10 measurement locations at evenly-spaced five-meter (16-foot) intervals over the entire water column.

Because exceedances were only observed in July and August of 2007, SCL proposes to conduct post-license DO monitoring during the warmer months of the year, when exceedances are more likely. SCL proposes to "bracket" the period when exceedances occurred and conduct monitoring from June 15 through September 15 during each of the five post-license monitoring years.

3.3. Monitoring Methods

Continuous DO monitoring will be conducted for the duration of the period described in the preceding section (June 15 - September 15) at each sampling site (V7, V2, V5, V6, and V8). A Hydrolab®, or other comparable measurement device, will be attached to a profile cable at the depth intervals identified above (five meters). Calibration and sampling will be performed per manufacturer's specifications and distributor configuration. DO and temperature will be measured every 15 minutes throughout the data collection period. Data will be downloaded and measurement equipment will be checked for maintenance at a minimum of every 30 days.

A Quality Assurance Project Plan (QAPP) will be developed in consultation with Ecology following the filing of SCL's final application for Section 401 water quality certification. The QAPP is anticipated to be comparable to that developed, and approved by Ecology, for the 2007 - 2008 water quality sampling (SCL 2009b).

3.4. Dissolved Oxygen Response to Macrophyte Control Measures

SCL has agreed to undertake measures aimed at reducing the abundance of introduced submerged aquatic macrophytes (chiefly Eurasian watermilfoil, *Myriophyllum spicatum*, and curly pondweed, *Potamogeton crispus*) in Boundary Reservoir. As part of the IRA process, SCL will use habitat modeling results to investigate potential operational measures designed to reduce the distribution and abundance of introduced macrophytes. If operational measures are determined to be infeasible or undesirable due to adverse effects on other resources, SCL will implement non-operational measures to control introduced macrophytes. Bottom barriers that prevent light from reaching macrophytes may be deployed in target areas, such as boat launches or other locations of concern (e.g., stranding/trapping pools where effects on fish may be increased by macrophyte presence). Macrophyte harvest methods may also be applied. If non-operational measures are selected as the appropriate approach to macrophyte control, SCL will work with Ecology and other relicensing participants during the IRA process to identify the specifics of the control program, including target locations for macrophyte control, the area over which control measures are to be applied, the frequency and duration of treatment, and metrics used to assess success of the program (See SCL's Aquatic Invasive Species Control and Prevention Plan Annotated Outline [SCL 2009c]).

Although data from relicensing studies (conducted in 2007 - 2008) designed to assess the effects of macrophyte beds on DO showed that DO fluctuations within macrophyte beds did not influence reservoir-wide DO concentrations (SCL 2009b), respiration linked to the decomposition of plant matter in the reservoir may contribute to DO declines. As a result, SCL will measure DO, biological oxygen demand (BOD), and chemical oxygen demand (COD) at monitoring sites V7, V2, V5, V6, and V8, before, during, and, after macrophyte control measures have been implemented to ascertain what, if any, effect macrophyte control has on DO concentrations.

3.5. Evaluating Monitoring Results and Potential Secondary Actions

If DO concentrations are not positively influenced by macrophyte control measures, SCL will, in coordination with Ecology, extend the monitoring period for DO response to macrophyte control measures or investigate other potential measures to address DO exceedances. No additional measures have yet been identified, but potential alternative measures will be discussed during the IRA process and, as needed, during implementation of the DO attainment program.

3.6. Implementation Schedule

As noted above, DO monitoring will be conducted during the first five years following issuance of the new Project license. Macrophyte control measures may be implemented as early as the second summer following license issuance. After five years of DO monitoring, SCL will consult with Ecology regarding interpretation of results and potential next steps. SCL will summarize

each year's data in a brief technical memorandum, which will be submitted to Ecology in December of each year. A more detailed schedule will be provided in the DO Attainment Plan submitted with the final 401 application.

4 REFERENCES

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