Evaluation and Findings Report

401 Water Quality Certification for the Amendment to the City of Portland's Bull Run Hydroelectric Facility (FERC P-2821)

Submitted to: City of Portland

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State of Oregon
Department of
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Executive Summary

The City of Portland owns a hydroelectric facility at its' Bull Run Reservoir that supplies drinking water to the City of Portland. DEQ monitoring shows that this reservoir has caused warm water in the lower Bull Run River. Warm water is considered water pollution because it can impair habitat for threatened Western Steelhead and Chinook salmon.

The Oregon Department of Environmental Quality's plan to reduce water pollution in this river requires the City of Portland to modify the intake tower in the reservoir so that it can better manage the temperature of the water that is released downstream. This plan is called the Sandy River Basin Total Maximum Daily Load (also known as TMDL).
The city plans to modify the intake tower to have intake-ports at three different levels so that water of varying temperature can be withdrawn from the reservoir and released downstream.

The City of Portland holds a Federal Energy Regulatory Commission license to operate this hydroelectric project, and must amend the license in order to make the proposed changes to the north intake tower. The proposed license amendment requires DEQ to review the water quality impacts of the proposed project. This review is required under Section 401 of the Federal Clean Water Act, and is referred to as a § 401 Water Quality Certification.

This document describes DEQ's evaluation and findings for the required water quality certification review. In brief, DEQ supports the modification for the project because it will improve downstream water temperatures that are currently too warm. DEQ has found that there is a possibility that the project will cause changes to dissolved oxygen, pH or nutrients in the reservoir itself. The probability that these changes will occur is small, and could be addressed by altering the proportions of water withdrawn from different depths.

Therefore DEQ proposes to approve the water quality certification, provided that the City of Portland follows the conditions included in the 401 certification. These conditions require water quality monitoring in the reservoir for the first five years of operation. If the new tower is shown to contribute to decreased water quality, the city will work with DEQ to identify operational changes that may improve water quality in general, as well as manage downstream temperatures. Should water quality problems persist for more than five years, the § 401 conditions allow that the monitoring program could be extended until there is reasonable assurance that operations will not contribute to water quality problems.

Chapter 1: Project Description, Potential Impacts, and Scope of Review

1.1 Project Description and Background

The City of Portland (the city) operates two reservoirs on the Bull Run River, near Sandy Oregon. The Reservoirs, Bull Run #1 (Bull Run River Mile ~10) and Bull Run #2 (Bull Run River Mile ~6), are primarily operated to provide drinking water for the City of Portland. Reservoir #2 also houses a powerhouse for generating electricity.

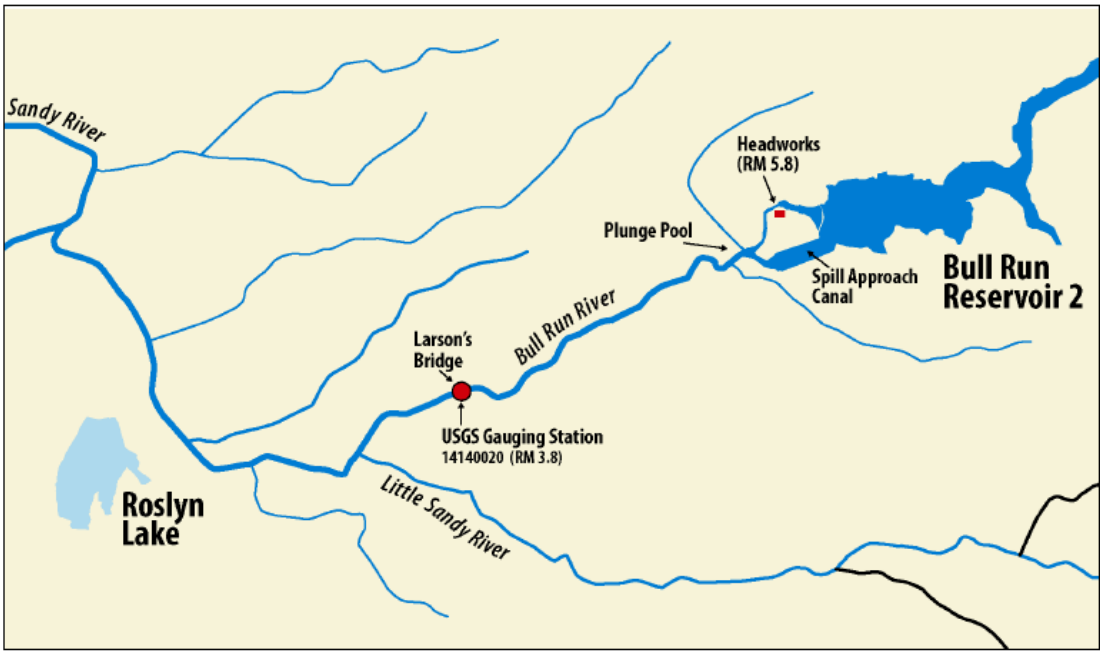

Figure 1: Lower Bull Run River, upstream to the city's Reservoir #2.

Water released from Bull Run Reservoir #2, the most downstream of the reservoirs, was found to increase the water temperature of the Bull Run River downstream of the dam and powerhouse. The Department of Environmental Quality (DEQ) identified violations of the water temperature standard in the lower Bull Run River, and developed a Total Maximum Daily Load (TMDL: A water quality pollution plan as required by the Federal Clean Water Act, DEQ 2005) for the Sandy River Basin to improve water temperature in the Bull Run River. The TMDL required the City of Portland to develop a plan and then implement measures that would deliver cooler water to the Bull Run River during the summer and early autumn months. The TMDL was adopted by the Oregon DEQ in March, 2005, and approved by the U.S. Environmental Protection Agency (EPA) in April, 2005. The TMDL requires the City of Portland to meet specific target temperatures at the Larson Bridge site on the Lower Bull Run River. The target temperatures are obtained by measuring stream temperatures on the Little Sandy River just upstream of the old PGE diversion dam, near the USGS gauge 14141500. The TMDL outlines both the amount of allowable difference in

temperature between the Bull Run and Little Sandy River stream temperatures, and identifies what conditions create allowable exceptions for deviations from the target temperatures.

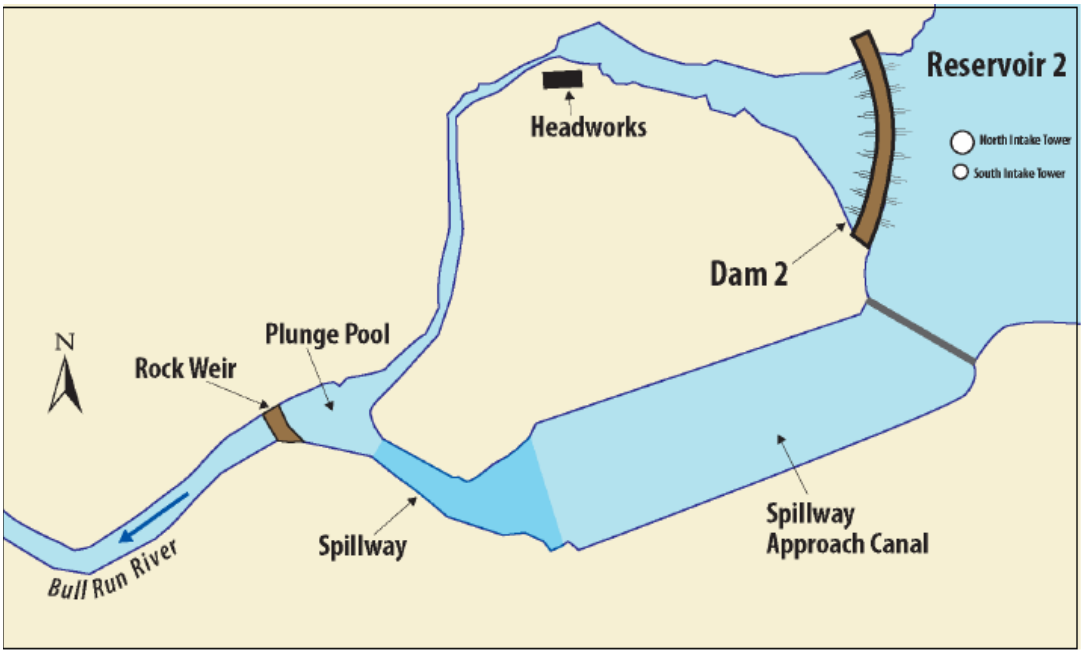

Figure 2: Reservoir dam and structures immediately downstream.

1.2 Bull Run Reservoir #2 Temperature Management Plan

In response to the Sandy Basin TMDL, the City of Portland adopted a Temperature Management Plan (TMP) for its Bull Run Reservoir #2 to meet the assigned thermal load allocation. The TMP was included as a chapter of the city's Habitat Conservation Plan (HCP). The HCP outlines how the city will manage the Bull Run Reservoirs to comply with the federal Endangered Species Act. The TMP was approved by DEQ on May 23, 2008. The TMP outlined interim term measures to improve water temperatures downstream of the project, and the city began implementing the measures in 2008.

To fully comply with Oregon's temperature standard , the city proposed to modify the water withdrawal structure for Bull Run Reservoir # 2 so that water can be withdrawn from multiple depths. Currently, water is withdrawn from the bottom of the reservoir, using up cold water stored in the reservoir, and eventually releasing warm water downstream. The proposed modification will allow water to be withdrawn from the bottom, from mid-depth, and from the surface. Altering the water withdrawal structure in this way provides a large range of options for the city to modify and manage the temperature of water released downstream. Thus surface water can be released downstream in early spring and summer, saving cold deep water for release later in the summer and early fall.

The proposed alteration will greatly improve temperature conditions in the Bull Run River downstream from Bull Run Reservoir #2, and as described in the HCP approved by the National Marine Fisheries Service (City of Portland, 2008) will improve water quality and habitat conditions for threatened and endangered salmonids that utilize the Bull Run River for both rearing and spawning. However, the proposed changes in Reservoir #2 may alter the flow patterns and thermal profiles within Reservoir # 2. The flow pattern and thermal profile alterations could result in changes in nutrient concentrations that may affect algal populations, or changes in dissolved oxygen (DO) within the reservoir, or in water withdrawn from the Reservoir, and released downstream.

1.3 Federal Energy Regulatory Commission Licensing

The City of Portland holds a license from the Federal Energy Regulatory Commission (FERC) to operate the hydroelectric facility at the Bull Run Reservoirs (License # P-2821). On October 12, 1978, Oregon

DEQ issued a § 401 Certification for the then new FERC license for this project. In March 1979, FERC issued a 50 year license to the city to operate this hydroelectric project. Although the FERC license does not expire until 2029, the proposed changes require the city to seek a non-capacity amendment to the existing FERC license. The application to alter or amend a federal license also triggers the need for a review of the existing § 401 water quality certification. In this case, the proposed changes to the water withdrawal structure have potential to impact water quality. So, the application for the FERC license amendment has triggered the need for a § 401 Water Quality review of the proposed activity by the Oregon DEQ. The existing § 401 Certification does not evaluate the impacts of withdrawing water from multiple depths in the reservoir. Therefore, DEQ is evaluating potential water quality impacts in this § 401 Certification review. This review is limited to evaluating potential impacts from the proposed changes to the project; no other impacts or water quality conditions will be included in this review, or addressed by this § 401 Water Quality Certification decision.

1.4 Bull Run Reservoir Water Quality Monitoring

The Bull Run Reservoirs were constructed to provide drinking water for the city of Portland. To ensure high quality drinking water, the city of Portland monitors the quality of water in both of the Bull Run Reservoirs every two weeks. This monitoring program has been in place since 1975, and includes measurements of temperature, bacteria, algae species, chlorophyll *a*, DO, silica and the nutrients nitrate, total nitrogen, orthophosphate and total phosphorus. In addition to characterizing the quality of drinking water, the long period of record provides a robust characterization of the Bull Run Reservoirs.

Chapter 2: Water Quality Standards Potentially Affected

2.1 401 Water Quality Certification Standards

Table 1 provides a list of water quality parameters that have some potential to be affected by the construction of a selective-depth water withdrawal structure in Bull Run Reservoir #2.

Table 1: Parameters that may be affected by Bull Run Reservoir #2 Structure Change

Water Quality Parameter	Oregon Administrative Rule	Potential Impact
Creation of Taste, Odors,	OAR-340-041-007(12)	Taste & Odor, or Toxic Conditions

Toxic Conditions		can occur from nuisance algal blooms
Dissolved Oxygen	OAR-340-041-0016	Changes in water circulation in Reservoir may alter dissolved oxygen concentration, especially at depth with change in residence time deep in Reservoir; algal bloom respiration and decay may also consume dissolved oxygen.
Nuisance Phytoplankton Growth	OAR-340-041-0019	Changes in Reservoir circulation may lead to changes in nutrient concentrations, which in turn may lead to algal blooms
pH	OAR-340-041-0021	Algal blooms may cause spikes in pH values
Temperature	OAR-340-041-0028	Changes in withdrawal depth may result in temperature changes downstream

A § 401 Water Quality Certification ensures that a proposed action will comply with Oregon's water quality standards. The objective is to determine whether the proposed action is likely to impact water quality. If the proposed action is likely to have a negative impact on water quality, to either identify conditions which can be applied to the proposed action that will minimize the impacts so that water quality standards are not violated, or to deny the proposed action. The review of a § 401 Water Quality Certification Application includes an evaluation of the impacts of the proposed action to each water quality standard. Generally, many of the water quality standards are not expected to be affected by the operations of a hydroelectric project.

In addition to the standards listed in **Table 1**, DEQ must make a finding that the proposed activity will not violate the anti-degradation policy. In short, if the proposed action will diminish the existing quality, but will be too small a change to cause a violation of the related water quality standard, DEQ must make a finding that the project meets the specified conditions of the Anti-degradation Policy (OAR-340-041-0004). Bull Run Reservoir #2 is located in the river reach of the Bull Run River that is designated as water quality limited for temperature. Therefore, the Water Quality Limited Waters Policy (OAR 340-041-0004(7)) and (OAR 340-041-0004(9)(a)(B-D)) of the Anti-degradation Policy applies to this reservoir. Conditions under which DEQ may allow degradation to occur are listed in **Table 2**. The § 401 Certification review for this project will include an anti-degradation analysis for all parameters that may negatively impact water quality.

Table 2: Anti-degradation Policy (OAR 340-041-0004)
(7) Water Quality Limited Waters: Water quality limited waters may not be further degraded except in accordance with section (9)(a)(B), (C) and (D) of this rule.
(9) Exceptions: The Commission may grant exceptions to this rule so long as the following procedures are met: (B) The action is necessary and benefits of lowered water quality outweigh the environmental costs of the reduced water quality. This evaluation will be conducted in accordance with DEQ's "Antidegradation Policy Implementation Internal Management Directive for NPDES Permits and section 401 water quality certifications," pages 27 and 33-39 (March 2001) incorporated herein by reference: and (C) The new or increased discharged load will not unacceptably threaten or impair any recognized beneficial uses or adversely affect threatened or endangered species. In making this determination, the Commission or Department may rely upon the presumption that if the numeric criteria established to protect specific uses are met the beneficial uses they are designed to protect are protected. In making the determination the Commission or Department may also evaluate

other State and federal agency data that would provide information on potential impacts to beneficial uses for which numeric data have not been set;

(D) The new or increased discharged load may not be granted if the receiving stream is classified as being water quality limited under OAR 340-041-0002(a) unless:

(i) The pollutant parameters associated with the proposed discharge are unrelated either directly or indirectly to the parameter(s) causing the receiving stream to violate water quality standards and being designated water quality limited; or

(ii) Total maximum daily loads (TMDLs), waste load allocations (WLAs) load allocations (LAs), and the reserve capacity have been established for the water quality limited receiving stream; and compliance plans under which enforcement action can be taken have been established; and there will be sufficient reserve capacity to assimilate the increased load under the established TMDL at the time of discharge; or

(iii) Effective July 1, 1996, in water bodies designated water-quality limited for dissolved oxygen, when establishing WLAs under a TMDL for water bodies meeting the conditions defined in this rule, the Department may at its discretion provide an allowance for WLAs calculated to result in no measurable reduction of dissolved oxygen (DO). For this purpose, "no measurable reduction" is defined as no more than 0.10 mg/L for a single source and no more than 0.20 mg/L for all anthropogenic activities that influence the water quality limited segment. The allowance applies for surface water DO criteria and for Intergravel Dissolved Oxygen (IGDO) if a determination is made that the conditions are natural. The allowance for WLAs applies only to surface water 30-day and seven-day means; or

(iv) Under extraordinary circumstances to solve an existing, immediate and critical environmental problem, the Commission or Department may, after the completion of a TMDL but before the water body has achieved compliance with standards, consider a waste load increase for an existing source on a receiving stream designated water quality limited under OAR 340-041-0002(62)(a). This action must be based on the following conditions:

(I) That TMDLs, WLAs and LAs have been set; and

(II) That a compliance plan under which enforcement actions can be taken has been established and is being implemented on schedule; and

(III) That an evaluation of the requested increased load shows that this increment of load will not have an unacceptable temporary or permanent adverse effect on beneficial uses or adversely affect threatened or endangered species; and

(IV) That any waste load increase granted under subparagraph (iv) of this paragraph is temporary and does not extend beyond the TMDL compliance deadline established for the water body. If this action will result in a permanent load increase, the action has to comply with sub-paragraphs (i) or (ii) of this paragraph.

In order to issue a § 401 Certification for the project, the § 401 Review must find that the proposed action will not contribute to violations of the above water quality standards. A § 401 Certification may include conditions that the project must meet to ensure that water quality standards are not affected. If a § 401 Certification is issued with conditions, the conditions become mandatory actions.

Chapter 3: Evaluation of Impacts for Potentially Affected Parameters

3.1 Temperature

The Bull Run Watershed is designated as core cold water habitat. The core cold water temperature criterion is 16° C as a seven-day average of the daily maximum temperatures (7DADM), or the natural thermal potential temperature, whichever is higher. The lower Bull Run River is also designated as anadromous salmonid spawning habitat. Bull Run Reservoir #2 creates a barrier to anadromous fish passage, so spawning is limited to the lower Bull Run River. Designated spawning periods are October 15 through June 15 for about a mile downstream of Reservoir #2, and August 15 through June 15 for the lower 5 miles of the Bull Run River. During these time periods, the applicable temperature criterion is 13° C (7DADM), or natural thermal potential temperature, whichever is higher. Natural thermal potential temperature is the temperature that would occur with no anthropogenic influence. In general, anthropogenic heat sources include reservoirs, reduced stream flow and depleted shade. During the summertime, and often during the beginning or end of the spawning season, water temperatures may naturally exceed the biological criteria set out in rule. Oregon DEQ uses sophisticated water quality models to identify the natural thermal potential temperatures. As described above in Section 1, water temperatures in the Bull Run River were shown to exceed the applicable temperature criteria. Thus the Sandy Basin TMDL was completed.

In its Temperature Management Plan (TMP), the City of Portland proposed to modify the water withdrawal structure so that downstream water temperatures can be better managed. Currently, cold deep water is released from the Reservoir during spring and early summer. By mid-summer, deep cold water reserves are exhausted, and water discharged downstream is warmer than water flowing into the Bull Run Reservoirs from upstream. Temperature of the released water also exceeds the natural thermal potential temperature for the lower Bull Run River as estimated by temperature models. This ongoing impact from Reservoir #2 has been dealt with extensively by an inter-agency committee known as the Sandy River Basin Partnership working with the City of Portland, and has been addressed by the Sandy Basin TMDL. The latter effort included extensive work developing water temperature models for the Reservoir and Lower Bull Run River. As a result of this multi-year effort of discussion and modeling, the City of Portland was able to both identify an approach to better manage downstream water temperatures in the Bull Run River, and to provide evidence that this approach will work well. This effort was documented in several reports and memos, and was memorialized as a chapter of the Habitat Conservation Plan (HCP), a requirement under the Endangered Species Act. The HCP chapter also served as the TMP, a document required from the City of Portland under the Sandy Basin TMDL (DEQ, 2005). The TMP was approved by DEQ in May of 2008, and provides reasonable assurance that the proposed project will meet the load allocation for the City of Portland's Bull Run Reservoir system. As described above in Section 1, the city's load allocation requires that the Lower Bull Run temperatures mimic the water temperatures in the nearby Little Sandy River.

3.1.1 DEQ Findings

The 401 Certification includes a condition that directs the City of Portland to construct and operate the multi-port withdrawal structure as proposed in this application for § 401 certification, and to carry out the monitoring and adaptive management that was set forth in the TMDL Implementation Plan (Habitat Conservation Plan, Chapter 7). No additional conditions are necessary for the § 401 Certification with regard to the project's effect on temperature. Indeed, the project proposed here has been approved by DEQ as the way that the City of Portland will meet its load allocation for temperature in the Bull Run River.

3.2 Dissolved Oxygen (DO)

DEQ water quality criteria for DO vary with designated fish uses. In locations where anadromous fish spawn, DO must be 11 mg/L during the spawning period. If temperature and barometric conditions preclude attaining 11mg/L, then DO must not be less than 95% saturation. This high DO concentration was adopted in part to protect the DO concentration of spawning redds. The DO standard allows surface water DO concentrations to drop as low as 9 mg/L when inter-gravel DO measures 8 mg/L or higher. During the non-spawning season, when the core cold water temperature criterion applies, DO must be at least 8 mg/L. However, at the discretion of DEQ, when sufficient information exists, DO may sometimes fall below 8 mg/L. DO may not fall below 8 mg/L, as a 30-day mean minimum and 6.5 mg/L, as a 7-day minimum mean; and may not fall below 6.0 mg/L as an absolute minimum. This exception does not apply to DO criteria for spawning periods.

3.2.1 In-Reservoir Dissolved Oxygen

Figure 3 displays the DO data collected by the city in Bull Run Reservoir #, in 2009. Dissolved oxygen concentrations in the Bull Run Reservoir # 2 are generally high. During the colder months of the year, DO throughout the water column is usually in the range of 11-14 mg/L (90%-105% saturation) of oxygen. In the warmer months when the reservoir is thermally stratified, DO ranges from 6.5- 10 mg/L. Dissolved oxygen is higher in the surface layer, with saturation values generally in the 90%-105% range. DO concentrations at lower depths range from 7-10 mg/L (75-95% saturation). The median DO value over bi-weekly sampling between 1975 and 2010 was 10.7 mg/L; only 5 % of samples were lower than 7.93 mg/L (**Table 3**).

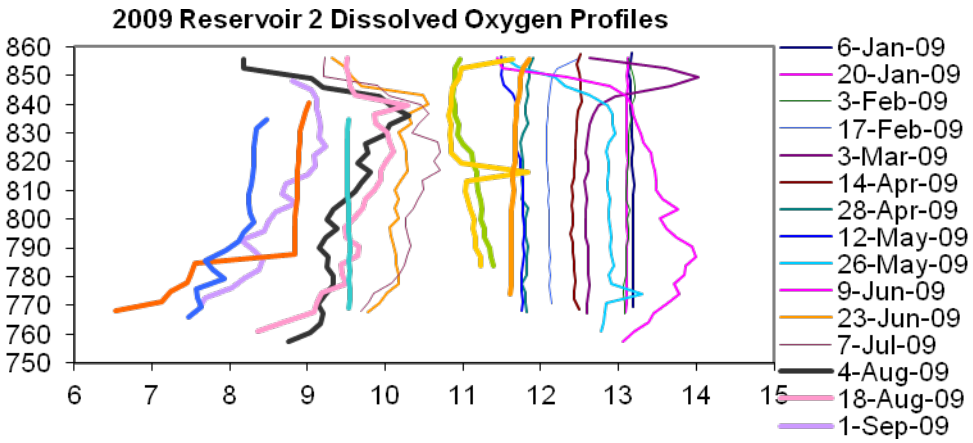

Figure 3: Profiles of DO collected bi-weekly in Bull Run Reservoir #2, during 2009. Y-axis = Reservoir depth above sea level measured in feet. X-axis = Dissolved oxygen (mg/L)

Table 3: Reservoir #2 Dissolved Oxygen, Nutrients, Algae and Chlorophyll								
Water Quality Parameter	**# of Samples**	**Date Range**	**95th Pctl**	**75th Pctl**	**Median**	**25th Pctl**	**5th Pctl**	**Detection Limit** (nutrients only)
DO Concentration (mg/L)	12,307	4/18/1975 – 9/13/2010	13	12	11	9	8	n/a
DO Saturation %	5,237	2/7/1989 – 9/13/2010	108	100	97	92	84	n/a
Total Algae (cells/mL)	1,849	9/15/1975 – 8/30/2010	1,284	472	166	64	27	n/a
Chlorophyll a (ug/L)	200	2/7/1989 – 8/16/2010	3.1	1.6	0.9	0.6	0.2	n/a
NO3-N (ug/L)	1,536	9/24/1975 – 9/13/2010	60	40	23	10	5	10
Total N (ug/L)	1,074	7/16/1985 – 9/13/2010	170	100	80	60	31	30
PO4-P (ug/L)	1,532	9/24/1975 – 9/13/2010	5.0	3.0	1.5	1.5	1.5	3.0
Total P (ug/L)	1,073	4/23/1985 – 9/13/2010	12.0	7.0	5.0	2.5	2.5	5.0

The proposed modifications to the water intake structure may alter stratification patterns in the Reservoir, and increase the residence time of cold water at the deepest layer in the Reservoir. This in turn may affect several water quality parameters in the Reservoir, particularly DO. As water spends more time in contact with the sediments at the bottom of a reservoir, the opportunity for biological and chemical processes that use oxygen increases. This action may result in lower DO concentrations. Lakes and reservoirs often stratify thermally; upper layers of water receive greater thermal input from solar radiation, and become warm. Warmer water is less dense than cold water, so less mixing occurs between the surface water with water at depth. When water at depth cannot mix with surface water, opportunities to replace DO at depth become limited. Under future operations, water at depth in the Reservoir may become lower in DO than it does under current operations.

Three impacts may arise from changes in DO at depth in Bull Run Reservoir # 2. First, water released from the deep water intake of the Reservoir and discharged downstream into the Bull Run River may be lower in DO during late summer or fall, which may affect fish downstream of the project in the Bull Run River. The second impact occurs at depth in the reservoir itself, and is caused by low DO, as well as changes in nutrient chemistry that occur under low oxygen conditions. When nutrient rich sediments in lakes are covered by water that is low in DO, sediments release phosphorous to the water column. This nutrient enriched water can lead to additional impacts, described in the discussion below regarding phosphorus, nuisance algae and pH. Finally, very low DO concentrations at depth in the Reservoir can impair aquatic life inhabiting those depths.

Low DO in the reservoir can impair biota at depth in the reservoir. Under current operations, cold water at depth is withdrawn from the Reservoir #2. Only 5% of DO measurements taken at the deepest point in the Reservoir were less than 7.9 mg/L. Profiles of DO in 2009 show that concentrations approaching 7 mg/L in September, increase fairly quickly by early October. Data from 2010 show no low DO levels in the Reservoir, particularly at depths less than 800 feet above sea level, the zone more likely to experience low DO.

Under current operations, the Reservoir is full of cold water in the early spring. The surface water gradually heats up with solar warming during summer. Solar radiation is not effective at heating water deep in a reservoir, so reservoirs often stratify; less dense warm surface water will no longer mix with the dense, cold deep water. As the deep cold water is withdrawn from Bull Run Reservoir #2 during the summer, the water at depth is replaced with either warmer surface water, or warmer water flowing from upstream, depending on the circulation dynamics in the Reservoir.

Future operations will increase the time period that cold water spends at depth in the Reservoir. Instead of releasing only cold water from depth, the warmer surface water will be released as well, allowing cold water to be stored at depth until later in the season. While this operation will increase the amount of cold water available for release in late summer and autumn, it will also increase the length of time that sediment may utilize oxygen from the water column. However, future operations may also be managed to capture colder water at depth earlier in the season. Storing colder water will have two advantages; the water stored will initially hold even more oxygen, and the colder temperature will inhibit biological activity, reducing the demand on oxygen at depth. Models were not calibrated to predict the residence time in Bull Run Reservoir #2, and sediment oxygen demand was not measured in the Reservoir. Even if we had access to this extensive data, models may not be able to predict DO concentrations at depth with a high level of accuracy. Even with model results, DEQ would still require future monitoring in the Reservoir to confirm that DO concentrations at depth remain supportive of the beneficial uses in the Reservoir.

3.2.2 Downstream Dissolved Oxygen

The criteria for DO in Oregon's water quality depend in part on the aquatic use present in the waterbody. The most stringent criteria apply during periods when anadromous fish spawn. This occurs between August 15 and June 15 in the Bull Run River downstream of Bull Run Reservoir # 2. Thus the most strict DO criteria of 11 mg/L applies in late summer and early fall; the time period when cold water, stored at depth since early spring, will likely be released downstream, to meet the temperature objectives of the Bull Run River. Though cold, because this water has been stored at depth in the reservoir for several months, the DO content is likely to be less than 11 mg/L or 95% saturation, as required during the spawning season. Use of

the multi-port withdrawal structure may alter stratification patterns in Bull Run Reservoir # 2 such that water at depth is retained in the Reservoir for a longer time period. This in turn could result in the release of water to the Bull Run River that is lower in DO than occurs without use of the multi-port device.

Data submitted in the § 401 Certification Application from the City of Portland indicates that water released from the Reservoir is well oxygenated by turbulence between the Diversion Pool and the rock weir before it is discharged to the Bull Run River (**Table 4:** DO Concentration, **Table 5:** DO Per Cent Saturation). Fish do not have access to the Diversion Pool, so water is fully oxygenated by the time it reaches a location in the river that fish can access.

Table 4: Dissolved Oxygen Concentration in the Lower Bull Run River (mg/L)

Dates	Diversion Pool (1 Meter Depth)	Diversion Pool (5 Meter Depth)	Headworks Bridge	Road 14 Bridge	Larson's Bridge
Aug. 16, 2010			9.81	9.67	9.40
Aug, 23, 2010	9.88	9.76	10.63	10.71	10.41
Aug. 30, 2010	9.88	9.86	10.56	10.81	10.57
Sept. 13, 2010	9.88	9.78	9.69	10.00	9.86
Sept. 20, 2010	10.11	10.00	9.93	10.04	10.21
Sept. 27, 2010	9.83	9.80	9.66	9.83	9.67
Oct. 4, 2010	8.77	8.61	10.07	10.21	10.35

Table 5: Dissolved Oxygen Per Cent Saturation in the Lower Bull Run River

Dates	Diversion Pool (1 Meter Depth)	Diversion Pool (5 Meter Depth)	Headworks Bridge	Road 14 Bridge	Larson's Bridge
Aug. 16, 2010			98.6	100.5	101.8
Aug, 23, 2010	95.6	94.3	104.7	104.3	107.3
Aug. 30, 2010	96.0	95.7	103.2	105.2	107.1
Sept. 13, 2010	97.8	96.7	96.8	97.8	99.7
Sept. 20, 2010	100.5	99.4	98.6	101.1	99.0
Sept. 27, 2010	96.8	96.5	95.9	97.3	98.3
Oct. 4, 2010	85.9	84.3	98.6	101.0	99.7

The City of Portland has demonstrated that the physical layout downstream of the Diversion Pool is capable of increasing DO, either by discharge through a Howell-Bunger Valve that sprays water through the air, or by turbulence generated as water flows past the Diversion Pool and down the channel to the Headworks Bridge.

3.2.3 DEQ Findings

Dissolved oxygen concentrations at depth in Bull Run Reservoir may be deleteriously affected by operation of the multiple-port intake structure, but whether concentrations will be lower, and the extent to which DO may be affected, is unknown.

Dissolved oxygen delivered downstream to the lower Bull Run River may change when the multiple port intake structure is put into operation. However, the city has demonstrated to DEQ that there is sufficient turbulence in the headworks canal to raise DO levels to saturated levels by the time water passes the rock weir and enters the Bull Run River channel.

In order to ensure that DO remains at levels that support the beneficial uses in Bull Run Reservoir and downstream in the Bull Run River, DEQ is including conditions in the § 401 Certification that requires that any changes to the project between the Reservoir and the rock weir remain successful at re-oxygenating

water that passes through this reach. In addition, the § 401 Certification includes a condition that requires the city to monitor profiles of DO in the Reservoir, and to determine if deleterious changes in DO concentrations are related to operation of the multiport structure. If so, the city will alter operation of the multi-port intake structure.

3.3 Nuisance Algae, Phosphorus & pH

3.3.1 In-Reservoir Conditions

Blooms of algae can occur rapidly when nutrients suddenly become available. Dense algal growth can cause pH levels to rise above 8.5, above which adverse effects to aquatic biota may occur (OAR 340-041-0021). Bluegreen algae, more correctly identified as bluegreen bacteria (also known as cyanobacteria) or members of the cyanophyte family, are capable of causing taste and odor problems, as well as excreting toxic chemicals. These bacteria often form when phosphorus becomes available, because they are able to extract nitrogen from the atmosphere, and are seldom limited by low nitrogen levels in the water column. Other algae are also known to contribute taste and odor problems to water as well as being capable of creating high pH levels. Changes in nutrient availability can trigger the growth of algal blooms. Therefore, changes in nutrient concentrations that result from changes in operations in Bull Run Reservoir #2 are an item of potential concern under the proposed changes of water withdrawal.

Phosphorus and nitrogen are the two major nutrients for algal growth. As important nutrients, often either phosphorus or nitrogen is a limiting factor controlling algal growth in water systems. In Bull Run Reservoir #2, with phosphorus levels commonly below detection limits, it is reasonable to assume that phosphorus may be a nutrient that limits algal growth in Bull Run Reservoir during some times of the year. However, either nitrogen or phosphorus can limit algal growth; therefore changes in concentration of either limiting nutrient could result in algal bloom formation, which in –turn could become a nuisance bloom. The proposed changes in reservoir operation are more likely to increase phosphorus than nitrogen concentrations.

The major concern regarding phosphorus under the proposed changes to Bull Run Reservoir #2 is related to potential changes in DO at depth in the reservoir. Phosphorus has a strong affinity for sediment particles, but is easily released under conditions of low or no oxygen. Thus, lake sediments can be a source of phosphorus in lakes. When deep layers of lake water remain oxygenated, phosphorus release is very low to non-existent. The fact that Bull Run Reservoir remains well oxygenated at depth (see Figures: depth profiles, box & whisker plots) clearly contributes to the low concentrations of phosphorus in the Reservoir.

Under current operations, water is withdrawn from depth in Bull Run Reservoir #2. This tends to pull cold water from upstream through the reservoir, providing a longer retention of warm surface water, and a shorter retention time of cold deep water. With deep water withdrawal, Bull Run Reservoir begins to stratify in April, and reaches maximum stratification in August, when surface temperatures are in the mid-20° C range, and bottom water is around 15° C to 18° C. The existing intake structures draw all the water from the bottom, therefore always releasing the coldest water in the reservoir. When this water is replaced with oxygenated river water from upstream during the season, the deep water released under the current operating scenario may be replenished with well-oxygenated water, keeping the water at depth sufficiently high in oxygen to limit phosphorus release from lake sediments.

The new intake structure will allow water to be withdrawn selectively from the surface, mid-depth or bottom. The operation plan for the new structure is to shift the majority of withdrawal to near surface level in spring and early summer, then transition to mid-depth withdrawal later in summer and fall. The bottom-level intake will be used as necessary to provide cold water downstream in the Bull Run River. This change could cause water at depth to decrease in DO concentration, eventually creating a condition where phosphorus may be released from lake sediments.

Phosphorus and nitrogen levels are both found in low concentrations in Bull Run Reservoir #2. This is likely why chlorophyll levels, an indication of algal density, is also low (**Table 3; Figures 4, 5, 6 and 7**).

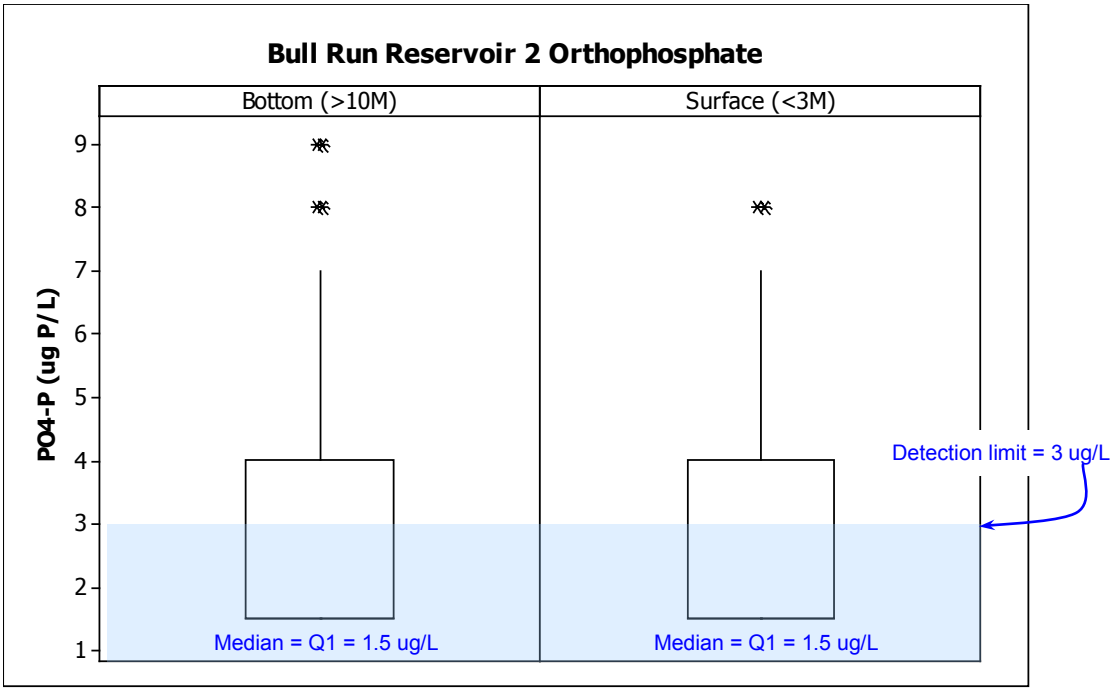

Figure 4: Ortho-phosphorus concentrations box plots. Samples collected at depth and near the surface of Bull Run Reservoir #2, between April 1975, and September 2010.

Median levels of ortho-phosphate in Reservoir # 2 are less than the 3 µg/L detection limit; and median levels of total phosphorus roughly equal the 5 µg/L detection limit. Distributions comparing either total or ortho- phosphorus in surface water to concentrations at depth in the Reservoir show no differences, indicating that phosphorus occurs at low levels throughout the water column. Nitrogen levels are generally higher than detection limits, and thus are significantly easier to measure, but are still relatively low.

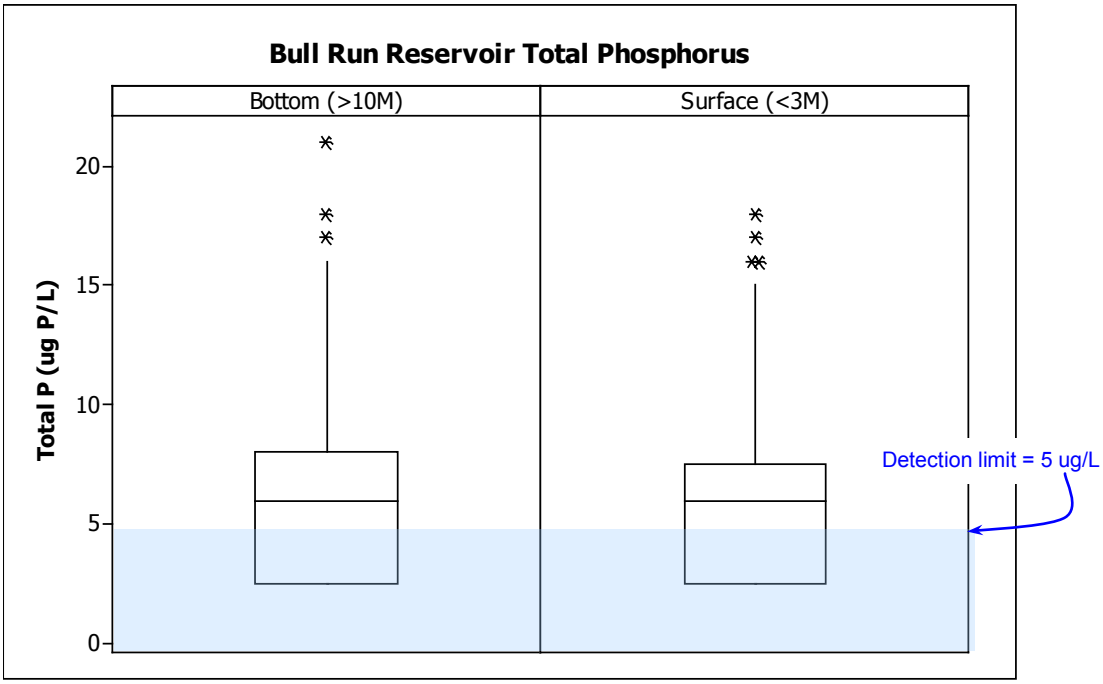

Figure 5: Total phosphorus concentrations box plots. Samples collected at depth and near the surface of Bull Run Reservoir #2, between April 1975, and September 2010.

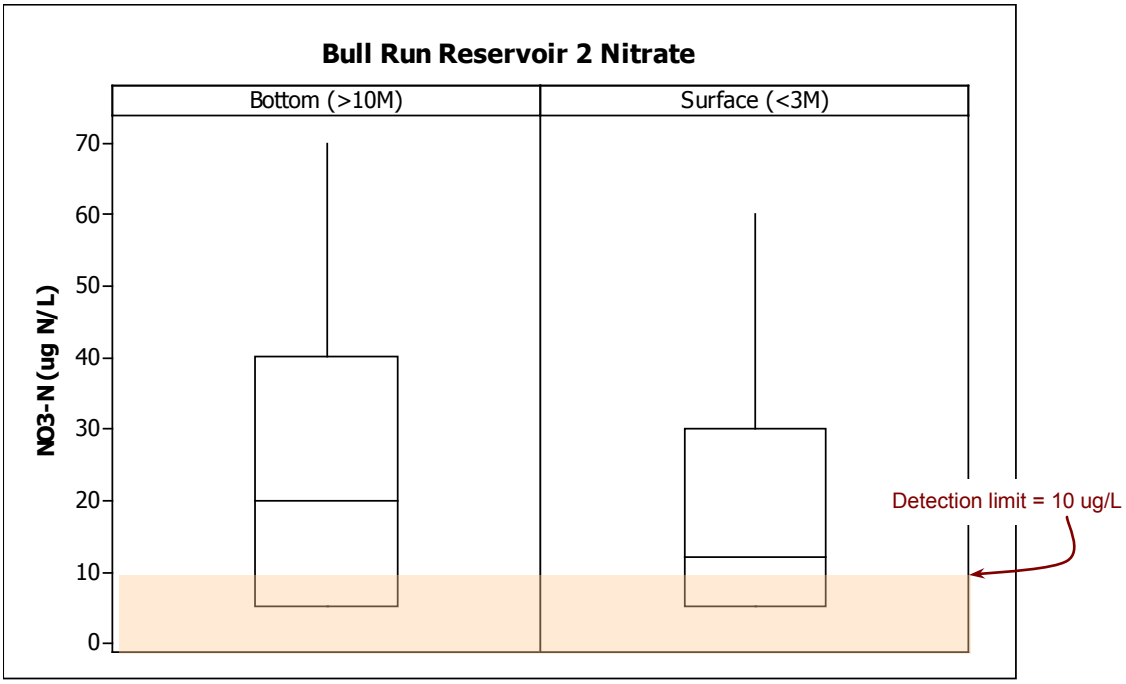

Figure 6: Nitrate concentrations box plots. Samples collected at depth and near the surface of Bull Run Reservoir #2, between April, 1975, and September 2010.

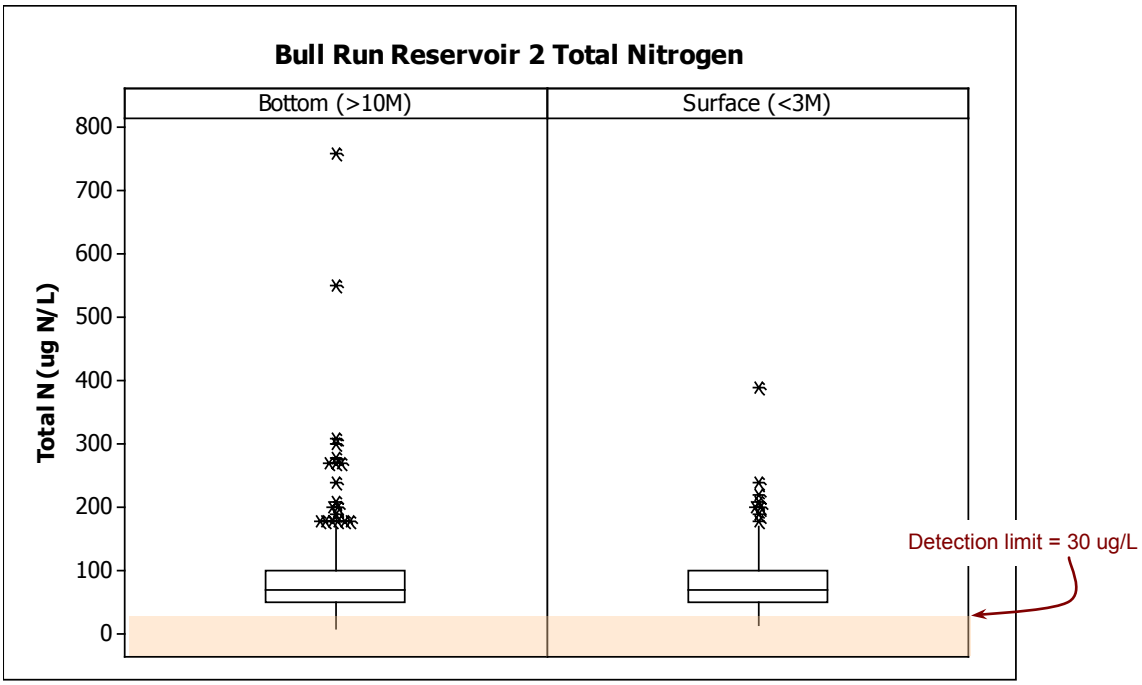

Figure 7: Total nitrate concentrations box plots. Samples collected at depth and near the surface of Bull Run Reservoir #2, between April, 1975, and September 2010.

It is difficult to predict how the proposed change in withdrawal will alter the stratification observed in Bull Run Reservoir #2. Currently water is withdrawn at depth, allowing a longer retention time, and therefore

greater opportunity for heating in the surface layer. Under the new operation, the surface layer should be cooler, and indeed water at depth may stay colder longer, as cold winter water is stored at depth into the summer and fall. Whether the timing or strength of stratification changes, it is likely that water at the bottom of the reservoir will exhibit a longer retention time than under current operations.

Currently, DO levels deep in the Reservoir remain high. The fifth percentile of oxygen values, including data collected at all depths in the reservoir since 1975, is 7.93 mg/L. This value is quite high for a stratified lake or reservoir, and shows that the system as currently operated is well oxygenated. If stratification begins to establish in April – May, as would be expected with surface withdrawal in increasing spring and summer temperatures, water stored at depth would have an initial oxygen level well over 11 mg/L (**Figure 3**). Even though residence time may increase at depth, this water would begin the storage period very well oxygenated and cold; two factors that would slow down the sediment oxygen demand, and would thus tend to keep the oxygen level at depth from becoming sufficiently low to encourage the release of phosphorus from sediments.

No models have been used to predict future concentrations of DO or phosphorus in Bull Run Reservoir #2 under the proposed operations. Given the low levels of phosphorus and nitrogen currently in the reservoir and the high level of oxygenation and cold temperatures at depth in early spring, there is little evidence that adverse conditions will occur in the Reservoir with the proposed changes in reservoir management. If this is true, then changes in water withdrawal structure would have little impact on Bull Run water quality. If this prediction is incorrect, then the multi-port water withdrawal structure will provide opportunities to alter the water mix withdrawn from the Reservoir in order to alter the impact on water quality.

The Bull Run Reservoir's main purpose is to supply drinking water for the Portland metropolitan area. This water is renowned for its high quality without the need for a filtration system. Thus the city maintains a diligent water quality monitoring program that includes taking bi-weekly profiles of temperature and DO, and monthly samples of nutrients, to ensure that the drinking water source remains of high quality. This monitoring program will allow the city to monitor the impacts of altering water withdrawal levels should water quality degrade in the Reservoirs.

3.3.2 DEQ Findings

Given the low likelihood of adverse nutrient, algae and pH levels in Bull Run Reservoir #2, combined with an intensive water quality monitoring program, and strict water quality requirements for drinking water sources, and the management flexibility inherent in the design of the new water withdrawal structure DEQ is reasonably assured that any adverse water quality conditions created by the new withdrawal structure will be detected at a minor level of impact, and can be reversed with an adaptive approach to managing water withdrawal depths.

DEQ has included conditions in the § 401 Certification that requires bi-weekly profiles and monthly nutrient samples be taken until the operation plan of the multi-port withdrawal structure is well established.

3.4 Anti-degradation Review

The Anti-degradation Policy requires a review of any DEQ actions, such as issuing § 401 Certifications or discharge permits, to determine whether the action may result in lowering water quality. Water quality rules preclude lowering water quality to a point that causes violations of water quality criteria. However, DEQ must make specific findings before even small degradation of water quality is allowed to occur. These include 1) no violations of water quality criteria will occur, 2) the action is necessary, and the benefits of lowered water quality outweigh the environmental costs of reduced water quality, and 3) new or increased loads will not unacceptably threaten or impair recognized beneficial uses, or adversely affect threatened or endangered species.

Issuance of a § 401 Certification indicates that DEQ has found reasonable assurance that a proposed activity will not contribute to violations of Oregon's water quality standards. In this draft evaluation report, DEQ demonstrates why it anticipates that the proposed changes to the Bull Run Reservoir intake structure

will not impair water quality sufficiently to cause violations of Oregon's water quality standards. In addition, the § 401 Certification conditions require continued water quality monitoring so that any changes in water quality that are attributable to new intake structure are detected and addressed.

The City of Portland is installing the new multi-port intake structure to address a water temperature violation, and to thus improve water quality conditions for threatened salmonids, and other beneficial uses in the Bull Run River. The installation and use of this structure will improve water temperature conditions downstream of Reservoir #2, and will meet the requirements of an approved Total Maximum Daily Load Implementation Plan that was submitted to and approved by DEQ in response to a Total Maximum Daily Load for Temperature in the Sandy River Basin. As noted in the analysis above, it is possible that installation of the multiple port intake structure could result in slightly lower DO concentrations in some areas of the reservoir, and some potential changes in nutrient concentrations that could in turn affect pH levels or algal populations in the reservoir. If such changes in water quality do occur, and they do not contribute to water quality violations, there is a clear water quality benefit to the project overall by reversing Project-related violations of the water temperature standard. Any impairments to water quality that may be caused by the proposed changes to the project will be detected by the monitoring program and, as required in the § 401 conditions, project operations may be modified to reverse any unpredicted water quality impairments.

The Habitat Conservation Plan, completed to meet requirements under the federal Endangered Species Act, concluded that threatened and endangered aquatic species will clearly benefit from the proposed project. The origin for the proposed multi-port withdrawal structure was to address water temperature impairment downstream of the Bull Run Reservoir #2. Alternatively, if this project is not constructed, the significant impairment to threatened and endangered aquatic species that currently exists will continue.

Chapter 4: Other State Law

Once DEQ has made a finding that the proposed project will comply with water quality standards, the § 401 review must then determine whether other requirements related to water quality under state law have been met. Following is an evaluation of other requirements.

Clackamas County has determined that no land use review or permits are required for this project, thus meeting the Land-Use Compatibility requirements set out in Oregon Administrative Rule 340-048-0020(2)(i)(A).

The changes proposed in this project must be shown to meet criteria set out by the Oregon Department of Fish and Wildlife (ODFW) for screening the new facility, and providing fish passage at the project. In August of 2008, ODFW determined that screens to prevent entrainment of fish were not necessary to meet requirements under Oregon Revised Statute (ORS) 498.306.

ODFW has also approved a fish passage waiver for this project in 2010, meeting the requirements for fish passage under ORS 509.585.

Chapter 5: Public Comment

5.1 Issuance of Public Notice, Opportunity to Comment

Public Notice of the City of Portland's Hydrolectric Project § 401 Application and proposed § 401 certification documents were distributed November 30, 2011. DEQ distributed this notice to the Agency's mailing list, including known interested persons and agencies, to adjacent landowners and to the FERC mailing list for the City of Portland Project. Public comments were accepted through January 4, 2012. No Public Hearing was requested, so none was held.

5.2 Comments Received

Comments were received from two different commenters, and are included in Appendix A of this document. Commenter number 1 voiced support for this project and its' environmental benefits, and recommended that DEQ issue the § 401 Certification. DEQ did decide to issue the certification; no changes were made to the § 401 Certification or the Evaluation Report to address this comment.

The City of Portland provided the second set of comments, and requested that the water quality monitoring to evaluate the impact of the new tower begin once construction on the new tower is completed and it is in operation. One reason for initiating monitoring as soon as the FERC amendment is issued would be to gather information about current conditions in the reservoir, prior to changing operations with the new tower. As the City of Portland points out, they have collected data in the reservoir for over 30 years. This long data record provides a better source of information about both the long term average conditions and the annual variability of conditions in the reservoir than could be determined with short term monitoring that may occur between the time the FERC amendment is issued and construction begins. DEQ concurs with this request, and changed the language in Conditions 2.b.(1), 3.a(1), 4.a(1) and 5.b(1) to clarify when monitoring should begin.

The City of Portland also requested that payment implementation fees be more clearly tied to the years that they would be used. These fees can only be used for adaptive management activities related to the § 401 Certification for this project, so DEQ concurs that the dates when the fee should be paid should be clearly tied to the dates when they would be used. DEQ made changes to the language in Condition 7.j(2) that clarify when the initial implementation fee payment will be due.

Chapter 6: References

DEQ, 2005. The Sandy River Basin Total Maximum Daily Load.
http://www.deq.state.or.us/WQ/TMDLs/docs/sandybasin/tmdlwqmp.pdf

City of Portland. 2008. Bull Run Water Supply Habitat Conservation Plan.
http://www.portlandonline.com/water/index.cfm?c=46157

Appendix A

Comment letters received during the public comment period.

Commenter 1:

3652 SW Spring Garden Street
Portland, OR 97219
503-452-1877
dshoemaker@macforcego.com or dorothyshoemaker@centurylink.net

December 19, 2011

To: Avis Newell
Oregon Department of Environmental Quality
2020 SW 4th Ave., Suite 400
Portland, OR 97201
Newell.avis@deq.state.or.us

Dear Avis Newell:

I'm writing to comment on the Bull Run Hydroelectric Project application for certification of multi-port withdrawal structures at Reservoir #2.

The City of Portland has two reservoirs at Bull Run, 20 miles from Oregon, and the reservoirs provide drinking water for City of Portland residents and businesses. Turbines are used to generate electricity at the reservoirs as well.

The City of Portland is asking for Clean Water Act Section 401 certification by the Oregon DEQ to add intake locations at three different levels for hydroelectric generating. In the proposal, technicians at Reservoir #2 would find the warmest of the three levels, and water for the turbines would be taken from that level. This will leave cooler water to go downstream for drinking water and fish.

This project seems very good from an environmentalist point of view. It will result in cooler water downstream from the turbines. It uses technology to favor withdrawal of warmer water in the reservoir, leaving cooler water for the fish who use the river. I think it should be approved by DEQ.

Thank you for reading my comments,
Dorothy Shoemaker

Commenter 2:

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Randy Leonard, Commissioner
David G. Shaff, Administrator

1120 SW 5th Avenue, Room 600
Portland, Oregon 97204-1926
Information: 503-823-7404
www.portlandonline.com/water

An Equal Opportunity Employer

January 30, 2012

Avis Newell
Oregon Department of Environmental Quality
2020 SW 4th Ave., Suite 400
Portland, OR 97201

Re: Clean Water Act Section 401 Certification, City of Portland's Bull Run Reservoir Hydroelectric Project (FERC No. 2821), Comments from the Portland Water Bureau

Dear Avis:

The Portland Water Bureau (PWB) has comments on the 401 Certification Conditions for your consideration. PWB requests that language be added to the conditions to clarify the required start of the monitoring and payment of the project specific fees for Bull Run Reservoir No. 2.

PWB suggests that the reservoir monitoring should start the year after the completion of the modification to the water intake towers at Dam 2. Since the purpose of the data collection will be to determine whether operation of the multi-port withdrawal structure contributes to changes in water quality parameters, it seems appropriate to start the monitoring after the improvements. PWB suggests the following language to be added to the Certification under the sections for dissolved oxygen, hydrogen ion concentration, nuisance algae, and temperature:

> "For the purpose of this 401 Certification, this requirement for monitoring will start the year following successful modification of the water intake towers."

PWB also suggests that the fees for DEQ should start the first calendar year after the completion of the modification to the water intake towers at Dam 2. That timing would coincide with the monitoring efforts.

PWB already has sufficient water quality information for Reservoir 2 to document any potential changes in the reservoir after the intake tower has been modified. Water quality data has been collected for over 30 years and that data will serve as a solid "baseline" of

water quality information. The baseline information can be compared to new data collected after the intake tower has been modified.

Thank you for your consideration.

Sincerely,

Steve Kucas
Senior Environmental Program Manager