EXHIBIT A (WQMMP)

July 2004

PELTON ROUND BUTTE PROJECT WATER QUALITY MANAGEMENT AND MONITORING PLAN

PREPARED BY:

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and
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1.0 INTRODUCTION AND BACKGROUND

The management and monitoring plans outlined in this document describe procedures that will be employed by Portland General Electric Company and the Confederated Tribes of the Warm Springs Reservation of Oregon (the Joint Applicants) to satisfy the requirements of the 401 Water Quality Certification for the Pelton Round Butte Hydroelectric Project (PRB Project or Project) (FERC # 2030). The Pelton Round Butte Project (PRB Project) consists of a three-dam complex on the Deschutes River west of Madras, Oregon. A complete description of the Project is available in the Final Joint Application Amendment to the Federal Energy Regulatory Commission (FERC) dated June 2001 (PGE and CTWS 2001).

The earliest water quality work on Lake Billy Chinook was conducted during 1964-65 (Mullarkey 1967). Later, as part of relicensing, E&S Environmental Chemistry was contracted to conduct a limnological study from 1994 through 1996 (Raymond et al. 1997). It was more extensive and included sampling sites below Lake Billy Chinook. At the completion of this study, it was decided to continue monitoring water temperatures at most of the same sites to support other aquatic studies being conducted during the relicensing process (Lewis 1997). Beginning in 1998, other water quality parameters were also collected at the same sites. Water temperatures in the lower Deschutes River were investigated at about the same time by assessing the effects of the Project based on historical data and modeling (Huntington et al. 1999). Additional studies in the lower Deschutes River were conducted during 1998-99 to better understand the processes affecting water quality in the lower river (Eilers et al. 2000). In 2000, a subset of the water temperature recorders used for the lower river studies was replaced so that long-term monitoring could continue.

To evaluate the effects of surface withdrawal from Lake Billy Chinook, hydrodynamic and water quality modeling was initiated (Yang et al. 2000). Modeling results indicate the potential for modifying water currents in Lake Billy Chinook, moving the annual temperature patterns of the water released from the Project's Reregulating Dam back towards pre-Project patterns and improving water quality in the Project's reservoirs and in the lower Deschutes River (PGE and CTWS 2001).

As a major mitigation measure for the new license period, the Joint Applicants propose to reintroduce anadromous fish upstream of the Project. To enhance surface currents in Lake Billy Chinook, the reservoir upstream of Round Butte Dam, the Joint Applicants propose to construct a selective water withdrawal facility (SWW) at the existing Round Butte Dam intake tower. This new facility will allow water withdrawal from both the surface (warmer epilimnion) and the bottom (cooler hypolimnion) of the reservoir. This new facility will meet two significant purposes:

- Help the Project meet temperature and water quality goals and standards in the lower Deschutes River and Project reservoirs, and,

- Allow the withdrawal of surface waters during salmonid smolt migration periods to facilitate the capture of downstream emigrating smolts from Lake Billy Chinook in support of the anadromous fish reintroduction goal

The following plans provide information regarding ODEQ and CTWS WCB standards and goals, their application to the Project, facilities for compliance and the management approach, monitoring, adaptive management strategies, and reporting of monitoring results and management operations. Schedule aspects of this plan are set relative to the completion of the selective water withdrawal facilities and the implementation of selective withdrawal operations at the Project. Construction related schedule information can be found in the Pelton Round Butte Fish Passage Plan and § 401 certification.

Various management activities that will be conducted pursuant to this plan, or pursuant to the terms and conditions of the new FERC license, may require the Joint Applicants to conduct instream work. The Joint Applicants will obtain any permits, such as a Corps 404 permit and associated 401 certification, or a CTWS Hydrologic Project Application permit, which may be required prior to conducting such activities.

1.1 Adaptive Management Considerations

Because operation of the selective withdrawal facility has the potential to affect numerous water quality parameters, as well as fish passage success, changes in the operation of the selective withdrawal facility must consider all possible impacts, not merely a single water quality parameter. In addition, actual impacts to water quality and currents will not be known with certainty until the selective withdrawal facility is constructed, operated, and monitored, highlighting the need for an adaptive management approach to ensure compliance with water quality standards.

For the purpose of satisfying water quality standards for temperature, DO, pH, and nuisance phytoplankton, as well as ensuring downstream fish passage, and implementing the adaptive management requirements of the § 401 certification and the Section 401 Implementation Agreement, the Joint Applicants shall operate the selective withdrawal facility pursuant to general adaptive management considerations. These considerations are based on the staged implementation of selective withdrawal, with the selective withdrawal facilities being constructed in advance of the fish screening facilities.

Prior to the date on which fish screening devices on the selective withdrawal facility have been installed and tested, and determined by the Interagency Fisheries Technical Subcommittee (FTS) to be operational, DEQ or WCB may request the Joint Applicants to modify the blend of water being discharged from the selective withdrawal facility (in addition to any modifications made by the Joint Applicants, without DEQ or WCB request being necessary, pursuant to Section 3.7, 4.6, or 5.6) , subject to the following limitations:

(a) The blend discharged is within the range set forth in Table 2.1;

(b) The FTS has been provided a reasonable opportunity to review the proposed blend; and

(c) Such modification would not require the Joint Applicants to make any significant capital expenditures to structurally modify the SWW facility.

After the date on which fish screening devices on the selective withdrawal facility have been determined by the FTS to be operational, DEQ or WCB may request the Joint Applicants to modify the blend of water being discharged from the selective withdrawal facility (in addition to any modifications made by the Joint Applicants, without DEQ or WCB request being necessary, pursuant to Section 3.7, 4.6, or 5.6), subject to the following limitations:

(a) The blend discharged is within the range set forth in Table 2.1,

(b) Blend changes based on water quality concerns may be requested no more than two times per year (in addition to any modifications made by the Joint Applicants pursuant to Section 3.7),

(c) The FTS has been provided a reasonable opportunity to review the effects of the request on all water quality and fish passage parameters over the entire year, and

(d) Such modification would not require the Joint Applicants to make any significant capital expenditures to structurally modify the SWW.

After the fish screening devices on the selective withdrawal facility have been operational for five years, DEQ or WCB may request that the Joint Applicants modify the blend of water being discharged from the selective withdrawal facility such that the blend discharged is *outside* the range set forth in Table 2.1, provided the proposed modification is described in a written proposal submitted to the Joint Applicants and the FTS at least two months prior to the date on which the proposal is intended to be implemented. If the Joint Applicants or the FTS do not concur with a modification requested by DEQ or WCB, or if the modification requested by DEQ or WCB would require the Joint Applicants to make significant capital expenditures to structurally modify the selective withdrawal facility, and the Joint Applicants in either event elect not to implement the modification requested by DEQ or WCB, then DEQ, WCB and the Joint Applicants may exercise their reserved rights, remedies, and defenses regarding implementation of the modification.

2.0 WATER TEMPERATURE MANAGEMENT PLAN

2.1 ODEQ and CTWS temperature standards

The applicable ODEQ and Tribal water quality standards can be found in OAR 340-41 and Tribal Ordinance 80, respectively.

2.2 Application to the Pelton Round Butte Hydroelectric Project

As required by the Federal Clean Water Act, the temperature standard that must be satisfied for the lower Deschutes River below the Project's Reregulating Dam is the most stringent applicable standard, the State's bull trout standard. The DEQ and the WCB interpret the temperature standard to restrict the PRB Project from warming the water discharged into the lower Deschutes River below the Reregulating Dam more than 0.25 ºF over what would occur at that location in the river if the PRB Project were not in place, when surface waters exceed 50°F (10°C) or when federally listed Threatened and Endangered species use the river.

2.3 Facilities for compliance

A selective withdrawal facility will be constructed at the existing turbine intake at Round Butte Dam. The facility, which will have intake gates at near the reservoir's surface and at depth, will be operated to blend water from the two intakes when necessary to meet the applicable ODEQ and CTWS temperature standards in the lower Deschutes River and reduce overall temperatures in Project reservoirs.

2.4 Approach to temperature management

To meet the ODEQ and WCB temperature standards, the amount of colder, hypolimnic water will be increased to ensure that the Project does not measurably increase the temperature over what would occur naturally at the Madras USGS Gauge (RM 100) if the Project were not present. Based on the results of a series of hydrodynamic and temperature models (Huntington et al. 1999; Yang et al. 2000), and an iterative model-run sequence, the percentages of surface and bottom withdrawals listed in Table 2.1 (referred to during development as Blends 13 and 16) will result in compliance with the temperature standard throughout the year at the Reregulating Dam based on flow and temperature data from the 1995 water-year (Khangaonkar 2001). Modeling results (Khangaonkar 2001) indicate that management of water withdrawal within the ranges shown in Table 2.1 result in lower temperatures than those that would occur if the Project were not present (Figures 2.1 and 2.2).

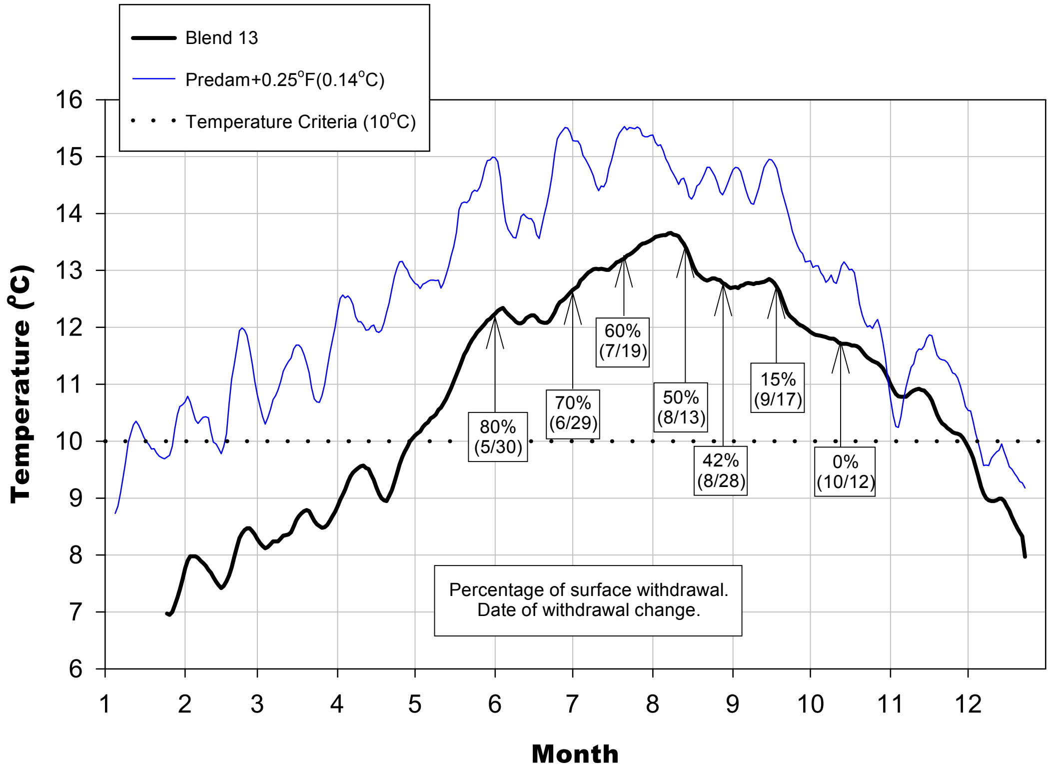
Table 2.1. Range of surface and bottom withdrawals (%) from Lake Billy Chinook that will achieve compliance with the bull trout temperature standard in the lower Deschutes River at the Reregulating Dam. The actual blend of surface and bottom withdrawal at a given time will fall within the range of percent values in the appropriate row (i.e., somewhere within the limits of Blends 13 and 16).

	Surface Withdrawal (%)		Deep Withdrawal (%)	
Month	Blend 13	Blend 16	Blend 13	Blend 16
Jan	100	100	0	0
Feb	100	100	0	0
Mar	100	100	0	0
Apr	100	100	0	0
May	100	100	0	0
Jun	80	100	20	0
01 Jul - 18 Jul	70	85	30	15
19 Jul - 31 Jul	60	85	40	15
01 Aug - 13 Aug	60	70	40	30
14 Aug - 28 Aug	50	70	50	30
29 Aug - 17 Sep	42	60	58	40
18 Sep – 30 Sep	15	60	85	40
01 Oct - 12 Oct	15	50	85	50
13 Oct - 31 Oct	0	25	100	75
November	0	50	100	50
December	0	100	100	0

When the mean 7-day maximum calculated temperature for the combined inflows to Lake Billy Chinook reaches 8 ºC the discharge temperature at the Reregulating Dam will be closely monitored. If needed, the percentage of water discharged from the lower or hypolimnic outlet in Lake Billy Chinook will be increased to maintain outflow temperatures no greater than 0.25 ºF of temperatures that would occur if the Project were not present. In the fall, as inflow temperatures naturally decrease, the percentage of deep water will be decreased. Allowing more surface withdrawal during fall will aid surface attraction during the downstream emigration of fall-migrating juvenile spring chinook salmon (Lindsay et al. 1989).

The Joint Applicants will work with ODEQ and WCB to determine how to select a withdrawal blend within the limits specified in Table 2.1. As discussed in Section 2.7, adjustments to the withdrawal blend will be made automatically by the Joint Applicants to ensure that discharges meet the applicable temperature standard. In addition, DEQ and WCB will have the right, within limits specified in the Section 401 Implementation Agreement, to request further modification of the blend.

Based on modeling, the expectation is that the withdrawal of warmer surface waters—primarily from the Deschutes and Crooked Rivers—during winter and spring will allow the accumulation of colder and denser Metolius River water, and lead to a colder mean reservoir temperature as summer approaches, which would improve the temperature regime in Lake Billy Chinook for reservoir dwelling salmonids.

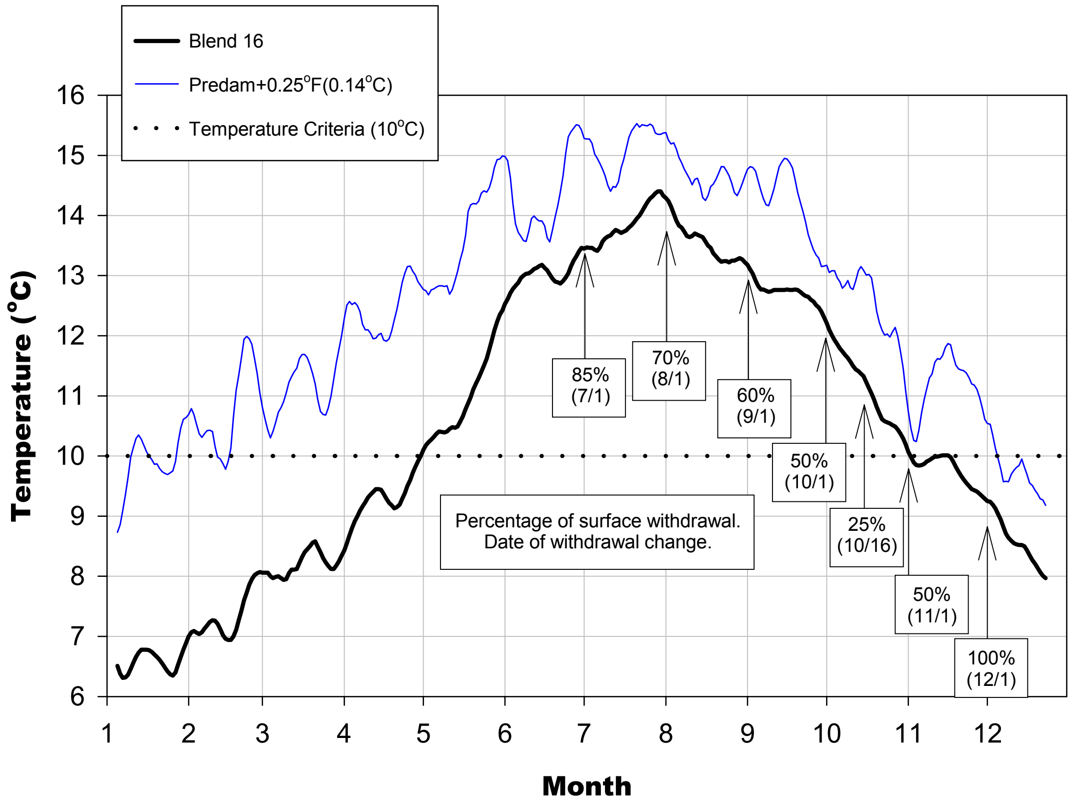


Figures 2.1. Water temperatures under Blend 13.

Temperatures within the Project impoundments currently comply with applicable temperature standards in that the bull trout standard of 50°F (10°C) is met at the depths where bull trout occur or would be expected to occur. The model run sequences that have been performed to date indicate that selective withdrawal pursuant to Blend 13 or Blend 16, as shown in Table 2.1, will improve temperature conditions within the Project impoundments, increasing the volume of water in compliance with the bull trout standard. As described below, long-term monitoring will provide data to determine that the Joint Applicants continue to comply with this standard.

2.5 Calculating outflow temperatures

Based on measurement of inflow temperatures, a regression equation (Huntington et al. 1999) will be used to calculate the seven-day moving average of the daily maximum temperature at the location of the Reregulating Dam if the Project were not in place. The method used to derive the estimate of daily maximum temperature at the Reregulating Dam will account for the influence of groundwater inflow in the Project area on water temperature at the discharge point.



Figures 2.2. Water temperatures under the Blend 16.

2.6 Temperature monitoring

Temperature monitoring will be conducted at numerous sites as identified in Table 6.1. This monitoring will be performed to achieve multiple objectives over the life of the license. As data are collected and analyzed, specific temperature monitoring sites may be added or eliminated in accordance with the 401 certifications. Temperature monitors will be installed at the USGS flow gages on the three major tributaries to Lake Billy Chinook as part of the gaging station upgrades. These monitors will allow recording and transmission of real-time (hourly) temperature of each of the major tributaries and will be used for calculating seven-day moving averages of daily maximum temperature entering the Project. These data will also be used to calculate/model expected temperature and temperature gain at the Reregulating Dam if the Project were not in place (natural warming).

Real-time temperature measurements will also be collected at the Madras USGS Gauge (RM 100) in the lower Deschutes River, and will be used to determine compliance with the calculated temperature target at the Reregulating Dam. To eventually improve temperature management operations, a continuous temperature monitor will also be installed in the Round Butte Dam tailrace (see Section *2.7, Temperature management operations*). Temperature monitors will also be placed at multiple depths within Lake Billy Chinook and Lake Simtustus to evaluate how reservoir temperatures are impacted by future operations and management of the selective water withdrawal facility.

2.7 Temperature management operations

It is anticipated that the surface intake will be used exclusively from January through May or June, depending upon the actual blending regime (Table 2.1). Starting in June or July, or when inflow temperatures reach 8 ºC, mean maximum temperature of the inflow will be closely monitored and compared to a chart of modeled temperature targets at the Reregulating Dam (Huntington et al. 1999; Yang et al. 2000). If the temperature approaches the maximum limit, the percentage of deep water discharged will be adjusted upward. The Joint Applicants would make adjustments automatically and provide a follow-up report to ODEQ and the CTWS WCB as outlined in Section 2.9. All adjustments would fall within the ranges established in Table 2.1. However, unless it appears that the standard will be exceeded, adjustment of the intake gates for other purposes will be limited to twice per month, near the first and the 15th of each month. Any additional adjustments will be implemented subject to the limitations described in Section 1.1, which addresses overarching adaptive management concerns.

Current understanding of the relationship between inflow temperatures, Round Butte Dam discharge temperatures, and the Reregulating Dam discharge temperatures is based on recent modeling efforts (Huntington et al. 1999; Yang et al. 2000). Over time, it is expected that Project operators will further refine the correlation between air temperature, wind, and other environmental variables and discharge temperature at the Reregulating Dam as compared to Round Butte Dam, and as compared to conditions that would exist if the Project were not present. This correlation would be used to provide more rapid feedback and quick adjustment capabilities during periods when temperatures are warming rapidly. There is approximately a three-day delay from when water is discharged through the Round Butte Dam before it is discharged into the lower Deschutes River at the Reregulating Dam. Being able to more accurately determine the relation between the change in temperatures in the tailrace at Round Butte Dam and the change in temperature of water entering the lower Deschutes River will allow for quicker and more accurate adjustments.

2.8 Reporting

Reports will be produced in two forms. Updates on water temperatures and changes in operation of the selective withdrawal facility will be provided by email monthly—or more often if temperature changes prompt a change in the mix of surface and bottom discharges during a month. These email reports will include attached data files that will include the water temperature data gathered during the time period. In addition, an annual report will be produced that will include graphs of temperature data, timing and mix of surface and bottom water discharges, and a discussion of temperature control activities. This annual report will be submitted to ODEQ, the CTWS WCB, and the FTS each February and presented at the annual Fisheries Technical Workshop.

3.0 DISSOLVED OXYGEN MANAGEMENT PLAN

3.1 ODEQ and CTWS dissolved oxygen standards

The applicable ODEQ and Tribal water quality standards can be found in OAR 340-41 and Tribal Ordinance 80, respectively.

3.2 Application to the Pelton Round Butte Hydroelectric Project

The ODEQ and CTWS salmonid spawning DO criterion will apply to the Deschutes River downstream of the PRB Project during the periods of salmonid spawning and incubation, which in the lower Deschutes River is the entire year.

Based on water quality modeling (Khangaonkar 2001), the percentages of surface and bottom withdrawals listed in Table 2.1 would result in ambient DO concentrations in the Project discharge in excess of 11.0 mg/L during most of the year. During the 3.5 months (approximately 1 August through 15 November) when modeling indicates that DO concentrations would fall below 11.0 mg/L, they would still exceed 9.0 mg/L.

The Joint Applicants acknowledge that the 11.0 mg/L criterion is applicable in light of currently available information. The determination of whether the IGDO criterion will be met under selective withdrawal conditions cannot be made before selective withdrawal has been implemented and DO concentrations downstream reflect the actual blends being discharged. Accordingly, until post selective withdrawal IGDO monitoring demonstrates whether the 9.0 mg/L alternate criterion is applicable, the 11.0 mg/L criterion will apply.

For Project reservoirs, an 8.0 mg/L salmonid-rearing DO criterion applies at depths of occurrence or expected occurrence of salmonids.

3.3 Facilities for compliance

A selective withdrawal facility will be constructed at the existing turbine intake at Round Butte Dam. The facility, which will have intake gates at near the reservoir's surface and at depth, will be operated to blend water from the two intakes to meet the applicable ODEQ and CTWS DO standards in the lower Deschutes River and in Project reservoirs. The existing Reregulation Dam spillway facilities may also be used to comply with the applicable lower river DO and IGDO criteria, if needed (described below).

3.4 Approach to DO management

To meet the ODEQ and WCB DO standards, the Joint Applicants propose to operate the selective withdrawal facility within the range of surface and bottom withdrawals shown in Table

2.1. Based on an iterative model-run sequence using data from 1995 (based on flow, temperature, and water quality data from the 1995 water-year [Khangaonkar 2001]), the percentages of surface and bottom withdrawals listed in Table 2.1 would result in DO concentrations in the Project discharge that would exceed 11.0 mg/L during most of the year. During the period when DO concentrations would fall below 11.0 mg/L, DO concentrations are expected to be greater than 9.0 mg/L. These results indicate that the Project will meet the ambient DO criterion of 11.0 mg/L most of the time and during the rest of the year will comply with the 9.0 mg/L DO criterion.

Controlled spills at the Reregulating Dam have been shown to increase DO concentration in the discharge (Raymond et al. 1999). Therefore, if under the temperature management selective withdrawal regime it appears that the DO concentration in the Reregulating Dam discharge is going to drop below 11.0 mg/l or 95% saturation, the Joint Applicants will institute controlled spills at the Reregulating Dam to maintain ambient DO concentrations above 11.0 mg/L or 95% saturation.

Based on modeling results, it is also anticipated that DO concentrations will exceed 9.0 mg/L at all times, regardless of whether controlled spills are instituted at the Reregulating Dam. If post-selective withdrawal monitoring of IGDO demonstrates that IGDO levels exceed 8.0 mg/L at all times, the alternate water column criterion of 9.0 mg/L will apply. The need for controlled spills at the Reregulating Dam to meet the 11.0 mg/L criterion would thus be eliminated.

3.5 Dissolved oxygen monitoring

Dissolved oxygen monitoring will be conducted for the life of the license at sites identified in Table 6.1. As data are collected and analyzed, specific DO monitoring sites may be added or eliminated in accordance with the 401 certifications. Real-time monitoring of DO will occur at the Reregulating Dam (RM 100) and in the Round Butte Dam tailrace. Monitoring at these locations will allow recording and transmission of hourly DO concentration measurements, which will be used to determine when controlled spills at the Reregulating Dam might be necessary to comply with ODEQ and CTWS standards.

Intergravel dissolved oxygen will be monitored downstream of the Reregulating Dam after the implementation of the selective withdrawal facility to verify the relationship between IGDO and ambient DO concentrations under selective withdrawal conditions. In accordance with current ODEQ and WCB protocols, sampling will be conducted during the first three years following implementation of the selective withdrawal facility. Thereafter, if the relationship between IGDO and ambient DO levels indicates that the 9.0 mg/L water column criterion is applicable, both IGDO and ambient DO levels will be monitored to demonstrate compliance with the dissolved oxygen standard.

3.6 DO management operations

It is anticipated that the surface intake will be used exclusively from January through May or June, depending upon the actual blending regime (Table 2.1). During the remaining months of the year, a blend of surface and bottom withdrawal will be released as part of the proposed temperature management program for the Project. If DO concentrations measured in the Round Butte Dam tailrace fall below 12 mg/L, the Joint Applicants will closely monitor discharge at the Reregulating Dam. If the seven-day mean minimum dissolved oxygen concentration in the discharge from the Reregulating Dam drops below 11.5 mg/L, the Joint Applicants will notify ODEQ and the WCB. The Joint applicants will institute controlled spills at the Reregulating Dam as the Joint Applicants determine necessary to maintain DO concentrations above 11.0 mg/L or 95% saturation.

However, if post-selective withdrawal IGDO monitoring demonstrates that the 9.0 mg/L standard is applicable, the management plan will be modified as follows:

> If DO concentrations measured in the Round Butte Dam tailrace fall below 10 mg/L, the Joint Applicants will closely monitor discharge at the Reregulating Dam. If the seven-day mean minimum dissolved oxygen concentration in the discharge from the Reregulating Dam drops below 9.5 mg/L, the Joint Applicants will notify ODEQ and the WCB. The Joint Applicants will institute controlled spills at the Reregulating Dam as the Joint Applicants determine necessary to maintain DO concentrations above 9.0 mg/L.

Over time, it is expected that Project operators will further refine the relationship between DO concentrations in the Round Butte Dam tailrace and the Reregulating Dam discharge, which will lead to more effective prediction of when DO concentrations in the Reregulating Dam tailrace might approach ODEQ and CTWS standards. An improved correlation would allow for quicker and more accurate adjustments.

3.7 Reporting

Reports will be produced in two forms. Updates on DO concentrations at the two monitoring locations will be provided by email monthly, or more often if DO changes prompt the implementation of controlled spills. These email reports will include attached data files that will include the DO data gathered during the time period. In the event that a controlled spill program is instituted, regular reports (the reporting interval to be agreed upon at the time by ODEQ, the CTWS WCB, and the Joint Applicants) will be submitted via email. In addition, annual reports will be produced that will include graphs of DO data and a summary of the results of spills, if they occur. Annual reports will be submitted to ODEQ, the WCB, and the FTS February and presented at the annual Fisheries Technical Workshop.

4.0 pH (HYDROGEN ION CONCENTRATION) MANAGEMENT PLAN

4.1 ODEQ and CTWS pH standards

The applicable ODEQ and Tribal water quality standards can be found in OAR 340-41 and Tribal Ordinance 80, respectively.

4.2 Application to the Pelton Round Butte Hydroelectric Project

The pH criterion of 6.5 to 8.5 Standard Units applies in the lower river. This same criterion also applies in the Project reservoirs with an exception allowed for exceedances of 8.5 in instances where all practical measures are being employed to minimize exceedance

4.3 Facilities for compliance

A selective withdrawal facility will be constructed at the existing turbine intake at Round Butte Dam. The facility, which will have intake gates at near the reservoir's surface and at depth, will be operated to blend water from the two intakes to meet the applicable ODEQ and CTWS pH standards in the lower Deschutes River and in Project reservoirs.

4.4 Approach to pH management

To meet the ODEQ and WCB pH standard, the Joint Applicants propose to operate the selective withdrawal facility in within the range of surface and bottom withdrawals shown in Table 2.1. Based on an iterative model-run sequence, the percentages of surface and bottom withdrawals listed in Table 2.1 would result in Project discharge values of pH that are lower than inflow pH values (see section 4.2). Because of this, the selective withdrawal regime proposed for the management of temperature and DO will suffice for management of pH as well.

4.5 pH monitoring

pH monitoring will be conducted for the life of the license at sites identified in Table 6.1. As data is developed and analyzed, specific pH monitoring sites may be added or eliminated in accordance with the 401 certifications. Continuous monitoring of pH will occur at the Reregulating Dam (RM 100). The tributaries to Lake Billy Chinook will be monitored monthly (see Table 6.1). When pH at the Reregulating Dam exceeds 8.3 S.U., monitoring in the three tributaries will be conducted weekly until pH at the Reregulating Dam drops below 8.3 S.U, when monthly sampling will be resumed. Data collected at the Reregulating Dam will be compared to data collected in the tributary inflows.

4.6 pH management operations

It is anticipated that the surface intake will be used exclusively from January through May or June, depending upon the actual blending regime (Table 2.1). During the remaining months of the year, a blend of surface and bottom withdrawal will be released as part of the temperature management program for the Project.

It is anticipated that Project discharge pH will be lower than that of the weighted average of the three inflows. Data collected upstream and downstream of the Project area and in Project reservoirs from 1994 through 2001 indicate that inflow pH exceeds that of the Project discharge (Figure 4.1). However, if pH at the Reregulating Dam is found to exceed that of the weighted average of the inflows, the Joint Applicants will immediately contact ODEQ and the CTWS WCB to develop an approach to reduce pH that is consistent with maintaining compliant temperature and DO values and surface withdrawal volumes necessary to facilitate smolt movement in Lake Billy Chinook.

Under the guidance of the two regulatory agencies, the Joint Applicants will modify the selective withdrawal regime within the range of surface and bottom withdrawals shown in Table 2.1. Because pH of the Project discharge could exceed inflow pH as a result of withdrawal of surface water from Lake Billy Chinook (due to photosynthetic activity in the reservoir's epilimnion), the likely modification would be the reduction in the amount of surface withdrawal relative to bottom withdrawal. The change in the proportion would be determined on a case-specific basis, if such modification can be undertaken consistent with temperature, DO, and fish passage considerations.

Over time, it is expected that Project operators will further refine the relationship between pH in the Round Butte Dam tailrace and the Reregulating Dam discharge, which will lead to more effective prediction of whether pH concentrations in the Reregulating Dam tailrace might approach ODEQ and CTWS standards. An improved correlation would allow for quicker and more accurate adjustments. If adjustment of the proportions of surface and bottom withdrawal becomes necessary, experience with the adjustments' effect on pH will also help refine the understanding of measures needed to maintain pH in compliance with ODEQ and CTWS standards at the discharge, while still meeting applicable temperature, DO, and fish passage obligations.

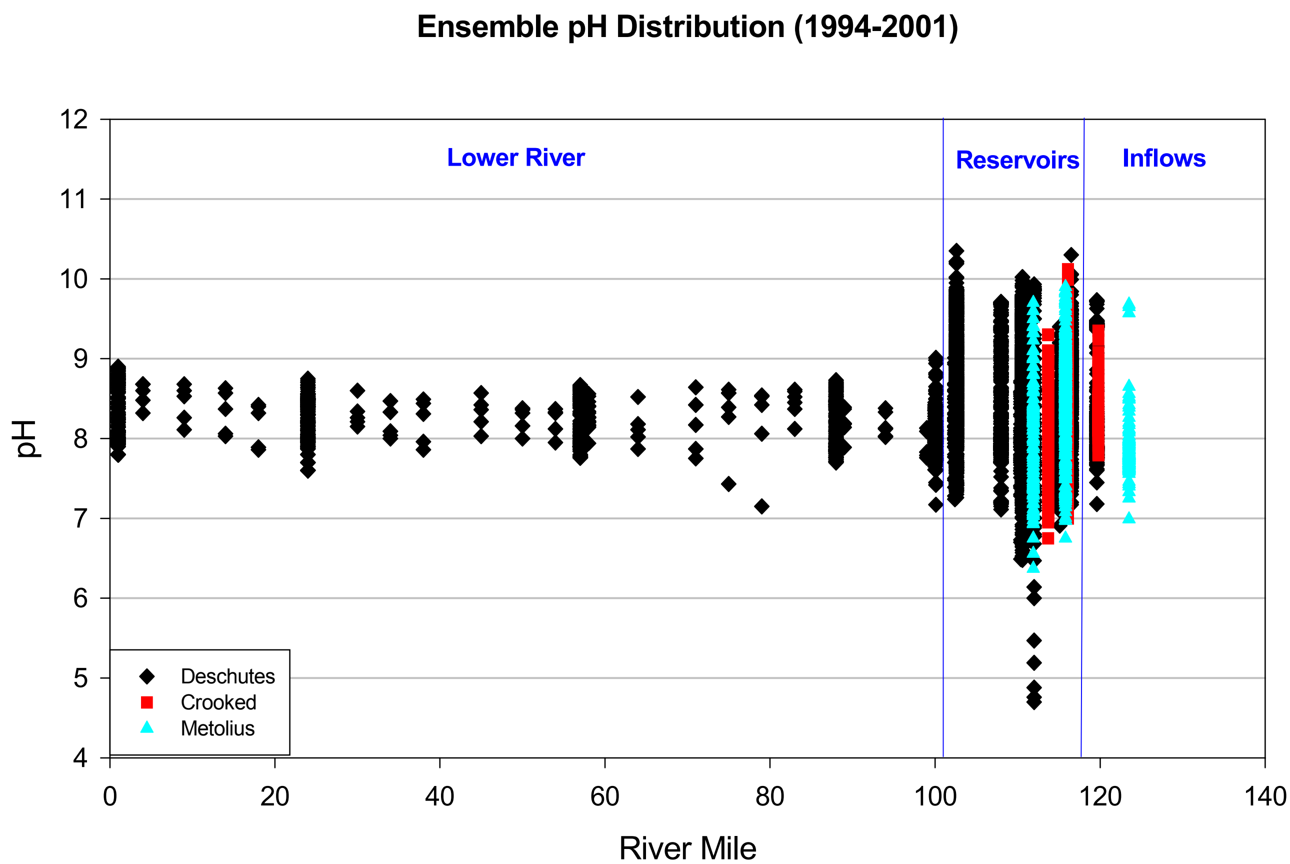


Figure 4.1. pH data collected in the Project area between 1994 and 2001 (Foster Wheeler 2002).

4.7 Reporting

Reports will be produced in two forms. Updates on pH will be provided by email monthly, or more often if pH changes prompt the implementation of a modified withdrawal regime. These email reports will include attached data files that will include the pH data gathered during the time period. In the event that a modified withdrawal regime is instituted, regular reports (the reporting interval to be agreed upon at the time by ODEQ, the CTWS WCB, and the Joint Applicants) will be submitted via email. In addition, annual reports will be produced that will include graphs of pH data and a summary of the results of withdrawal modifications, if they occur. Annual reports will be submitted to ODEQ, the WCB, and the FTS each February and presented at the annual Fisheries Technical Workshop.

5.0 NUISANCE PHYTOPLANKTON GROWTH MANAGEMENT PLAN

5.1 ODEQ and CTWS nuisance phytoplankton standards

The applicable ODEQ and Tribal water quality standards can be found in OAR 340-41 and Tribal Ordinance 80, respectively.

5.2 Application to the Pelton Round Butte Hydroelectric Project

Based on existing survey information and recreational use of the Project reservoirs, beneficial uses under existing conditions have not been identified as impaired by nuisance phytoplankton. Compliance with the ODEQ and CTWS standards will consist of monitoring Project reservoirs to detect whether increases in chlorophyll *a* (an indicator of phytoplankton biomass) occur as the result of implementing the selective water withdrawal regime shown in Table 2.1, and potentially, as indicated below, conducting user surveys and implementing adaptive management.

5.3 Approach to nuisance phytoplankton management

The Joint Applicants will monitor chlorophyll *a* levels in the forebays of Lake Billy Chinook and Lake Simtustus (see Section 6.3.3; other sites will be sampled as part of long-term monitoring, but the forebay sites will be used for comparisons of pre- and post-selective withdrawal chlorophyll *a* levels). Samples from the epilimnion and 50 m depth will be integrated.

Results of sampling conducted after the implementation of selective withdrawal will be compared to data collected at the same location under current operations. Comparisons of pre- and post-selective withdrawal chlorophyll *a* concentrations will be based on average values from at least three consecutive months. Post selective withdrawal data will be collected between April and October, i.e., the season of significant on-reservoir use. If average chlorophyll *a* concentrations after implementation of selective withdrawal exceed average pre-selective withdrawal concentrations by more than 10% for two consecutive years, the Joint Applicants will consult with ODEQ and the CTWS WCB regarding the need to conduct a recreational user survey to assess whether or not beneficial uses have been impaired. If results of any required recreational survey indicate that impairment has occurred, the Joint Applicants—under the guidance of ODEQ and the CTWS WCB—will assess the feasibility of implementing a control strategy for attaining compliance that is technically and economically practicable.

5.4 Reporting

Updates on nuisance phytoplankton growth will be provided by email quarterly. These email reports will include summaries of chlorophyll *a* measurements from Lake Billy Chinook and Lake Simtustus. If an exceedance is measured, the Joint Applicants will notify ODEQ and the

CTWS WCB and work with these agencies to develop an appropriate recreational user survey. Results from these surveys will be provided via email to ODEQ and the CTWS WCB within one week after completion of the survey. Annual reports will be submitted to ODEQ, the WCB, and the FTS each February and presented at the annual Fisheries Technical Workshop.

6.0 WATER QUALITY MONITORING PLAN

6.1 Monitoring objectives

There are four primary objectives of this water quality monitoring plan:

1. To determine whether the Project is in compliance with the ODEQ and WCB water quality standards as well as the 401 certification.

2. To collect water quality data to aid in the identification of adaptive management measures needed to ensure compliance with the ODEQ and WCB water quality standards, and the 401 certification.

3. To continue to collect water quality data at sites that have been used in other baseline studies to determine if trends exist related to the Project or other sources.

4. To collect water quality data that can be used for other aquatic studies related to reintroduction of anadromous fish.

5. To collect data on *E. coli* that will be provided to the appropriate recreation facility managers.

6.2 Methods

6.2.1 Temperature monitoring

Onset® temperature loggers (or equivalent), set at 1 h and 1.5 h recording intervals, will be installed at 16 locations (Table 6.1). The locations include 14 of the original 19 sites that were sampled during a limnological study (Raymond et al. 1997). Site 7 in the forebay of Round Butte Dam will be a continuous profile station with 12 recorders suspended in the water column from the surface to 100 m in depth. Site 4 in the forebay of Pelton Dam will also be a continuous profile with 4 recorders from the surface to 40 m. In addition, four grab temperature profiles will be collected monthly in Lake Billy Chinook (sites 7, 10, 13, and 16) and in the forebay of Pelton Dam (site 4). Profile stations will determine the level of temperature stratification (Hutchinson 1957).

Seven of the eight sites in the lower Deschutes River are the same as those used by Huntington et al. (1999) for validating their model. The eight loggers in the lower river will record temperature every 1 h and will be downloaded quarterly (the logger at site 2 will be downloaded monthly for the fish facility report). The remaining loggers that record at 1.5-h intervals will be downloaded quarterly. Data summaries would include seven-day moving means of the daily maximum temperature.

Real-time temperature monitoring equipment will be installed at the three USGS gauging stations upstream and the one USGS gauging station downstream of the Project. When this occurs, data would be more readily available for evaluating temperatures.

6.2.2 Multi-parameter monitoring (including DO and pH)

A Hydrolab® (or equivalent) water quality multi-parameter probe will be used monthly at 16 sites to collect both grab and profile samples. Three of the sixteen sites will be in the lower Deschutes River. The parameters recorded will include: temperature, dissolved oxygen, conductivity, total dissolved solids, turbidity, and pH. The remaining five sites in the lower river will be sampled quarterly coinciding with logger downloading. There will be one continuous Hydrolab® operating in the tailrace of the Reregulating Dam. It will record at 1-h intervals and be downloaded monthly. In addition to the previously mentioned water quality parameters, it will also record total dissolved gas and chlorophyll *a*. There will be one continuous Hydrolab® in the tailrace of Round Butte Dam. It will record hourly measurements of: temperature, dissolved oxygen, conductivity, and pH.

If Reregulating Dam tailrace readings of pH or dissolved oxygen exceed applicable water quality standards, water quality probes will be placed in the tributary inflows to collect short-term continuous data.

Intergravel dissolved oxygen will be monitored downstream of the Reregulating Dam the first three years following implementation of the selective withdrawal facility to verify the relationship between IGDO and ambient DO concentrations. This monitoring will be performed in accordance with current ODEQ and CTWS-WCB protocol. Prior to conducting this monitoring, the Joint Applicants will submit for approval a study plan that clearly identifies the protocol for collecting the information for evaluating the IGDO/DO relationship.

6.2.3 Nutrient and chlorophyll *a* monitoring

Water samples will be collected from 12 sites monthly for nutrient analysis and 7 sites for chlorophyll *a*. The months of November, January, and February will not be sampled. Nutrients will include: nitrate-nitrogen, ammonia-nitrogen, total Kjeldahl nitrogen, total phosphorus, and orthophosphate. Sample sites in Lake Billy Chinook will include all three tributaries and points midway down each arm of the lake at the surface. In the forebay of Round Butte Dam, two samples will be collected, one from the epilimnion at the surface and one from the hypolimnion at 50 m with a Van Dorn sampler. In Lake Simtustus, the tributary Willow Creek will be sampled along with two samples from the forebay of Pelton Dam, at the surface and 40 m. There will be two sites in the lower river. One will be at the Reregulating Dam tailrace and the other below White River. This sampling will be done for two years starting one year after implementation of selective withdrawal at the Project. A complete list of all monitoring sites, parameters, and sampling frequencies is located in Table 6.1.

Samples collected from the epilimnion and hypolimnion (50 m) in the forebay Lake Billy Chinook will be integrated. Results of sampling conducted after the implementation of selective withdrawal will be compared to data collected at the same locations under current operations. Comparisons of pre- and post-selective withdrawal chlorophyll *a* concentrations will be based on average values from at least three consecutive months.

Also as an indicator of phytoplankton productivity, Secchi visibility will be measured monthly at four sites in Lake Billy Chinook and at one site in Lake Simtustus using the methods described in Lind (1974).

6.2.4 *E. coli* monitoring

E. coli bacteria samples will be collected on a monthly basis for two years following implementation of the selective withdrawal facility at the same locations as the chlorophyll *a* samples indicated above. If such monitoring reveals a bacteria problem, and follow-up investigation of the source of such a problem rules out any link to failing Project-owned wastewater facilities, then the Joint Applicants' responsibility to play a part in remedying the problem will be fully served by performing the monitoring set out in this monitoring plan.

6.2.5 Zooplankton monitoring

Beginning one year after implementation of selective withdrawal, zooplankton will be sampled quarterly at five sites. This sampling will be conducted for four years. The samples will be collected using a high-efficiency zooplankton net (64 µm mesh size) with a 20 cm mouth opening. At each site two vertical samples will be collected; one sample from 30-10 m and one from 10 m to the surface. Zooplankton sampling sites in Lake Billy Chinook will be the same as those used for 5 years during the Lake Billy Chinook Kokanee Study (Thiesfeld et al. 1999) and a previous limnological study (Raymond et al. 1997). Zooplankton will be classified into three major taxonomic groups: cladocera, copepoda, and rotifera (Wetzel 1983). Laboratory methods for zooplankton can be found in Standard Methods (1998) and Lewis (1979).

6.2.6 Lower Deschutes River macroinvertebrate and periphyton monitoring

A macroinvertebrate and periphyton study was conducted from the fall of 1999 to the fall of 2001 (Kvam et al. 2001, Kvam 2002). This study was intended to establish the baseline data to which comparisons could be made after the implementation of the selective withdrawal at Round Butte Dam. The study will be repeated (i.e., two spring and two fall sampling events) starting three years after implementation of selective withdrawal once a new equilibrium has been reached using the same methods and locations. A new equilibrium could be the result of many potential factors such as: limnological changes of Lake Billy Chinook and Lake Simtustus, lagging lake bottom sediment interactions (Wetzel 1983), multiple year life cycles of some aquatic invertebrates (Anderson and Wallace 1988), and ecological interactions within the benthic community.

6.2.7 Total dissolved gas monitoring

Total dissolved gas (TDG) will be measured below the Reregulating Dam during the two years following implementation of selective withdrawal. Sampling will take place during significant spill events at the Reregulating Dam. Two years of frequent spill with TDG values less than 110% of saturation, would indicate that TDG is not a concern downstream of the Project. If monitoring of total dissolved gas at the Reregulating Dam tailrace at times of spill indicates noncompliance with the total dissolved gas standard, then the Joint Applicants will immediately develop a plan and schedule for assessing the problem and developing a remedy. The plan and schedule will be submitted to ODEQ and the CTWS WCB for approval within sixty days of identifying the excessive total dissolved gas concentrations via monitoring.

6.2.8 Lower River geomorphic monitoring

Monitoring will be conducted in the lower Deschutes River to address potential continuing Project effects on sediment transport and spawning gravel. The Joint Applicants will implement the monitoring efforts detailed in Exhibit E-III of the Final Joint Application Amendment (see pg. E-III-90).

6.2.9 Large wood monitoring

All large wood (greater than 20 cm by 3 m); (Moore et al. 1993; Maser and Sedell 1994) entering Lake Billy Chinook will be removed and placed into the lower Deschutes River below the Reregulating Dam. Following a flow event that results in the transport of significant amounts of large wood into Lake Billy Chinook, the Joint Applicants will consult with ODFW and CTWS Natural Resources to obtain specific guidance pertaining to the placement and monitoring of that large wood in the lower Deschutes River below the Project's Reregulating Dam. The Joint Applicants will obtain all necessary regulatory licenses, permits, or approvals from tribal, federal, state and local authorities prior to large wood placement.

6.2.10 Project operations monitoring

The Joint Applicants will monitor Project operations related to Project inflow and outflow, minimum flow releases, run-of-river operations, and stage changes of the Project reservoirs and the river below the Project. These are described below.

6.2.10.1 Flow monitoring at the USGS Madras Gage

To enhance the accuracy of lower-river flow data readings and maintain agreement between the Project and USGS data, the Joint Applicants will install modern flow monitoring equipment at the Madras gage. This equipment will be used for both the Project's control of downstream flows and for USGS flow monitoring. For compliance purposes, the daily outflow of the Project will be defined as the average flow measured at the USGS Madras gage each calendar day.

6.2.10.2 Hourly monitoring of Project inflows

Operation of the Project will require monitoring changing inflow conditions and to set flow releases to maintain a run-of-river operation. The Joint Applicants will improve flow monitoring systems upstream of the project and prepare hourly estimates of inflows to the project. The hourly inflow estimates will be the sum of USGS-gauged flows at upstream locations in the three arms of Lake Billy Chinook and an estimate of ungaged flows to the project. The Joint Applicants may also improve reservoir level monitoring systems in Lake Billy Chinook or may add additional stream flow gages on tributaries to the project impoundments to improve the accuracy of the ungaged inflow estimating technique.

6.2.10.3 Monitoring minimum flow releases below the Reregulating Development

The Joint Applicants propose to increase minimum flows below the project to protect downstream river values (see the 401 application contained in the Final Joint Application Amendment).

For compliance purposes, flows released at the Madras USGS gage shall not be less than the target daily flow. To accommodate flow disturbances and control changes, instantaneous flow rates may vary from the target daily flows. The instantaneous flow at the Madras gage shall not be more than 260 cfs less than the target daily flow for any two consecutive 30-minute readings at the USGS Madras gage. The daily outflow from the Reregulating Development may be less than the target daily flow under conditions of low project inflows or low reservoir levels in Lake Billy Chinook. The required minimum flows may be reduced by 150 cfs, if the licensee determines that the reduced outflows are necessary to ensure the refilling of Lake Billy Chinook to its minimum summer operating level of 1,944 ft by June 15. This provision will protect resource values in Lake Billy Chinook.

6.2.10.4 Monitoring run-of-river operation for lower river flows

To protect downstream river resources the Joint Applicants propose to hold river flows below the Reregulating Development to within +/- 10 percent of the measured project inflow under most conditions. Conditions or events where this criterion would not be followed include: (1) days with measured inflow in excess of 6,000 cfs, (2) any event that triggers the Project Emergency Action Plan, (3) power emergencies, as defined in the Western Systems Coordinating Council Minimum Operating Reliability Criteria (WSCC 1999),[1] (4) equipment failures or emergencies at one of the Project dams or power plants, and (5) reservoir drawdowns needed for safe passage of anticipated floods to minimize damage to life and property.

1 Page X-60: "Power Emergency: An abnormal system condition which requires immediate manual or automatic action to prevent loss of firm load, equipment damage, or tripping of system elements that could adversely affect the reliability of the electric system."

A flow of 6,000 cfs has historically been exceeded about 12 percent of the time over the period of record. Inflows of this magnitude occur during storm events or the spring runoff season. The Joint Applicants will not follow the run-of-river provision when inflows are above this level because the Project must be operated to ensure the structural safety of the Project facilities and to protect downstream life and property during flood events. Compliance with this requirement will be based on information from the modernized USGS Madras gage and hourly inflow estimates to Lake Billy Chinook.

6.2.10.5 Monitoring river stage changes below the Reregulating Development

As an enhancement for recreational safety and downstream river resources, the Joint Applicants propose to limit river level (stage) changes at the Reregulating Development as detailed below:

Period	**Hourly Stage Change Control Limit**	**Daily Stage Change Control Limit**
May 15 to October 15	0.05 ft	0.2 ft
October 16 to May 14	0.1 ft	0.4 ft

During extraordinary situations the Project Operator may deviate from these stage change limits. Such extraordinary situations include: (1) flood events, (2) any event that triggers the Project Emergency Action Plan, (3) rapid changes in Project inflows, i.e., when the rate of inflow change exceeds the proposed stage change limits, and (4) equipment failures or emergencies at the Reregulating Development.

To monitor compliance with this requirement, the Project Operator will record the time and control signal value for all stage change instructions at the Reregulating Development and will report any control signal changes that are greater than the value specified above. In addition, the project operator will provide written documentation of all measured stage changes at the USGS Madras gage that deviate more than 0.15 ft from the control set-point value.

6.2.10.6 Monitoring seasonal drawdown and fluctuation limits for Project reservoirs

The Joint Applicants will limit normal maximum seasonal drawdown of Lake Billy Chinook to 20 feet. Lake Billy Chinook shall be filled and at normal operation level of 1944 feet by June 15. The minimum level will be maintained at 1944 ft from June 15 to September 15 for Lake Billy Chinook. During the refill period, usually January through March, the Project may reduce outflows to the Lower River by a maximum of 150 cfs to ensure refill.

Seasonal drawdown limits for Lake Simtustus and the Reregulating Reservoir will be as follows: Lake Simtustus, 1,576 ft elevation from June 1 through August 31 and 1,573 ft from September 1 to May 31; Reregulating Reservoir 1,414 year round. Certain extraordinary situations are specified when the Project Operator may exceed the normal seasonal drawdown limits for the three reservoirs. These include (1) drawdown needed for safe passage of anticipated floods to minimize damage to life and property, (2) drawdown required to complete repairs on Project facilities, including spillway gates, intake structures, or other dam structures, and (3) power emergencies, as defined in the WSCC Minimum Operating Reliability Criteria. Refill of Lake Billy Chinook in the spring will not be delayed unless daily inflows are below the target daily flows for the downstream river and a specified extraordinary situation occurs. Under these conditions, the project operator will refill Lake Billy Chinook according to the low Lake Billy Chinook Reservoir condition, i.e., if the reservoir level in Lake Billy Chinook is projected to be below the summer operating level (minimum elevation of 1,944 ft) between June 15 and September 15, the Project Operator may reduce the flow release to ensure the reservoir reaches the minimum pools elevation of 1,944 feet. The flow release at the Madras gage under these conditions shall be defined as the daily inflow less 150 cfs.

Compliance with these drawdown limits will use real-time lake level monitoring devices located at Lake Billy Chinook and Lake Simtustus.

6.3 Quality assurance and quality control

The Joint Applicants will develop and submit for approval to the Environmental Protection Agency (EPA) on behalf of the CTWS WCB and ODEQ a comprehensive Quality Assurance and Quality Control (QA/QC) plan, based on EPA and ODEQ guidelines. The QA/QC plan shall be submitted to these regulatory agencies by no later than April 1, 2003. All measures outlined in the QA/QC plan will be Project-specific, with explanations of how data collection conducted at all sites will comply with the guidelines. The following sections provide a brief outline of expected QA/QC measures, by parameter. The Joint Applicants will implement this Water Quality Monitoring Plan in accordance with the approved QA/QC plan.

6.3.1 Equipment calibration and maintenance

Routine calibration and maintenance of field and lab equipment will be done in accordance with manufacturer's guidelines. The Hydrolab® used for monthly grab samples will be calibrated just prior to sampling using manufacturer's recommended standards. The continuous Hydrolab® located in the Reregulating Dam tailrace will be downloaded and calibrated monthly. All temperature loggers will be checked against a National Institute of Standards and Technology thermometer before and after field deployment. If a temperature logger is more than ±0.5°C, it will be sent to the manufacturer for re-calibration.

6.3.2 Nutrient and chlorophyll *a* laboratory analyses

Laboratory analyses will be conducted by an Environmental Protection Agency (EPA) and/or ODEQ certified laboratory. All test detection limits and methods are in Table 6.2.

6.3.3 Audits and Replicates

Temperature audits of 25 loggers will occur monthly and the remaining five located in the lower Deschutes River will be audited every 3 months coinciding with data downloading. The continuous Hydrolab® in the Reregulating Dam tailrace will also be audited monthly for temperature, dissolved oxygen, conductivity, total dissolved solids, turbidity, and pH. The continuous Hydrolab® in Round Butte Dam tailrace will be audited monthly for temperature, dissolved oxygen, conductivity, and pH. This will be staggered two weeks from the calibration (i.e., every two weeks the probe will be calibrated or audited). This probe will be audited monthly for chlorophyll *a*. One replicate will be collected and processed for zooplankton for every sampling event. One nutrient and chlorophyll *a* replicate will be collected and processed for every sampling event. One replicate Hydrolab® grab sample will be collected for every sampling event.

6.3.4 Data quality

Data quality objectives will be in accordance with that of Level A as outlined in the Water Quality Monitoring Guidebook (OPSW 1999).

6.3.5 Field notebooks

Field notebooks will be maintained for a record of all sampling events. They will include as necessary: date, time, location, personnel, Secchi depth, percent cloud cover, sample identification numbers, water depth of sample, audits, calibrations, data downloads, and equipment maintenance and repair.

6.3.6 Reporting

An annual report will be produced that summarizes relevant water quality data. It will be submitted to the ODEQ, the WCB and the PRB FTS during February and distributed at the annual Fisheries Technical Workshop in March for the preceding year.

Table 6.1. Water quality monitoring locations and sampling summary.

Site Number	Site Description	Site Location[a]	Method of Sampling[b]	Type of Sampling[c]	Frequency
1	Disney Riffle	D 160 km	Temperature	Continuous	1 h
			Hydrolab	Grab	Monthly
2	Reregulating Dam tailrace	D 161 km	Temperature	Continuous	Real time
			Hydrolab	Continuous	1 h
			Hydrolab	Grab	Monthly
			Nutrients[d]	Grab	Monthly
			Chlorophyll *a*[e]	Grab	Monthly
3	Pelton Dam tailrace	D 165 km	Temperature	Continuous	1.5 h
			Hydrolab	Grab	Monthly
4	Pelton Dam forebay	D 166 km	Temperature	Continuous profile	1.5 h
			Hydrolab	Grab profile	Monthly
			Secchi	Grab	Monthly
			Zooplankton	Grab profile	Quarterly
			Nutrients[d]	Grab profile	Monthly
			Chlorophyll *a*[e]	Grab profile	Monthly
5	Willow Creek inflow	W 1 km	Temperature	Continuous	1.5 h
			Hydrolab	Grab	Monthly
			Nutrients[d]	Grab	Monthly
6	Round Butte Dam tailrace	D 178 km	Temperature	Continuous	Real time
			Hydrolab	Continuous	1 h
			Hydrolab	Grab	Monthly
			Nutrients[d]	Grab	Monthly
			Chlorophyll *a*[e]	Grab	Monthly
7	Round Butte Dam forebay	D 179 km	Temperature	Continuous profile	1.5 h
			Hydrolab	Grab profile	Monthly
			Secchi	Grab	Monthly
			Zooplankton	Grab profile	Quarterly
			Nutrients[d]	Grab profile	Monthly
			Chlorophyll *a*[e]	Grab profile	Monthly
10	Crooked River arm at bridge	C 5 km	Hydrolab	Grab profile	Monthly
			Secchi	Grab	Monthly
			Zooplankton	Grab profile	Quarterly
			Nutrients[d]	Grab	Quarterly
			Chlorophyll *a*[e]	Grab	Monthly
11	Crooked River inflow	C 10 km	Temperature	Continuous	Real time
			Hydrolab	Grab	Monthly
			Nutrients[d]	Grab	Quarterly
13	Deschutes River arm at bridge	D 189 km	Hydrolab	Grab profile	Monthly
			Secchi	Grab	Monthly
			Zooplankton	Grab profile	Quarterly
			Nutrients[d]	Grab	Monthly
			Chlorophyll *a*[e]	Grab	Monthly
14	Deschutes River inflow	D 192 km	Temperature	Continuous	Real time
			Hydrolab	Grab	Monthly
			Nutrients[d]	Grab	Monthly
16	Metolius River arm at Chinook Island	M 8 km	Hydrolab	Grab profile	Monthly
			Secchi	Grab	Monthly
			Zooplankton	Grab profile	Quarterly
			Nutrients[d]	Grab	Monthly
			Chlorophyll *a*[e]	Grab	Monthly
17	Metolius River inflow	M 19 km	Temperature	Continuous	Real time

Site Number	Site Description	Site Location[a]	Method of Sampling[b]	Type of Sampling[c]	Frequency
			Hydrolab	Grab	Monthly
			Nutrients[d]	Grab	Monthly
26	Crooked River at Lone Pine Bridge	C 48 km	Hydrolab	Grab	Monthly
27	Deschutes River at Lower Bridge	D 216 km	Hydrolab	Grab	Monthly
28	Dry Creek	D 149 km	Temperature	Continuous	1 h
			Hydrolab	Grab	Biannual
29	Kaskela	D 127 km	Temperature	Continuous	1 h
			Hydrolab	Grab	Biannual
30	Nena	D 93 km	Temperature	Continuous	1 h
			Hydrolab	Grab	Biannual
31	Sandy Beach	D 72 km	Temperature	Continuous	1 h
			Hydrolab	Grab	Monthly
			Nutrients[d]	Grab	Monthly
32	Mack Canyon	D 39 km	Temperature	Continuous	1 h
			Hydrolab	Grab	Biannual
33	Rockpile Campground	D 2 km	Temperature	Continuous	1 h
			Hydrolab	Grab	Biannual

[a] Site location is identified by the river system and kilometers from its confluence. C = Crooked River, D = Deschutes River, M = Metolius, and W = Willow Creek.

[b] Temperature data will be collected with programmable recorders. Hydrolab multi-probes will be used to collect other water quality measurements that include: temperature, dissolved oxygen, conductivity, turbidity, and pH. The continuous Hydrolab sampling at the Reregulating Dam tailrace site will also record total dissolved gas and chlorophyll *a*. Zooplankton and phytoplankton will be sampled from 30 m to 10 m and from 10 m to the surface. In Lake Billy Chinook, a nutrient sample will be collected from 50 m and the surface. In Lake Simtustus, a nutrient sample will be collected from 40 m and the surface.

[c] Continuous sampling data will be collected at the frequency indicated. Grab samples will be samples collected just one time at the frequency indicated. Profile sampling data will be collected at different depths and will be: 0, 2, 4, 6, 8, 10, 20, 30, 40, 50, 75, and 100 m. If the water depth is less than 100 m, the last profile sample will be as close the bottom as possible. The continuous temperature profile in Lake Simtustus will be conducted at 0, 4, 10, and 40 m in depth.

[d] Nutrients will include: nitrate-nitrogen, ammonia-nitrogen, total Kjeldahl nitrogen, total phosphorus, and orthophosphate. Monthly sampling will not include November, January, and February.

[e] Chlorophyll *a*, as an indicator of algae biomass, monthly will not include November, January, and February.

Table 6.2. Tests and sampling with associated detection, accuracy, and resolution.

Test/Sample	Lab/Equipment	Detection Limit	Accuracy/ Resolution	Method
Nitrate nitrogen (NO_3-N)	NCA	10 ppb		EPA 353.2
Ammonia nitrogen (NH_4-N)	NCA	10 ppb		EPA 350.2
Total Kjeldahl nitrogen (TKN)	NCA	200 ppb		EPA 351.4
Orthophosphate (OP)	NCA	5 ppb		EPA 365.2/3
Total phosphorus (TP)	NCA	5 ppb		EPA 365.2/4
Chlorophyll *a*	AA	0.1 µg/L		Standard Methods (1998) 10200H.c
Temperature	Onset		± 0.4°C	
Temperature	Hydrolab		± 0.1°C	
Specific conductance	Hydrolab		± 1% of reading	
Total dissolved solids	Hydrolab			From linear relation with conductance
Dissolved oxygen	Hydrolab		± 0.2 mg/L	
Total dissolved gas	Hydrolab		0.1% of reading	
Turbidity	Hydrolab		± 5 NTU	
PH	Hydrolab		± 0.2 units	
Chlorophyll *a*	Hydrolab	0.02 µg/L	0.01 µg/L	

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