AVISTA CORPORATION

LONG LAKE
TOTAL DISSOLVED GAS
MONITORING REPORT

WASHINGTON 401 CERTIFICATION, SECTION 5.4(D)

Spokane River Hydroelectric Project
FERC Project No. 2545

Prepared By:

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LIST OF ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
7Q10	7-day average flow with a 10-year return period
ft amsl	feet above mean sea level
Avista	Avista Corporation
BAR	barometric pressure
cfs	cubic feet per second
DO	dissolved oxygen
DQO	data quality objective(s)
Ecology	Washington State Department of Ecology
FERC	Federal Energy Regulatory Commission
Golder	Golder Associates Inc.
HED	hydroelectric development
LLFB	monitoring station at Long Lake forebay
LLGEN	monitoring station at Long Lake HED Unit 4 generation plume
LLTR	monitoring station at Long Lake tailrace
LLTRSP1	monitoring station across the river from LLTR
m	meter(s)
mg/L	milligrams per liter
mmHg	millimeters mercury (pressure)
MQO	measurement quality objective
MS5	Hydrolab® MS5 Multiprobe®
RMSE	root mean squared error
Spokane Tribe	Spokane Tribe of Indians
TDG	total dissolved gas
TDG%	total dissolved gas, as percent of saturation
WQAP	Water Quality Attainment Plan

1.0 INTRODUCTION

1.1 Background

On June 18, 2009, the Federal Energy Regulatory Commission (FERC) issued Avista Corporation (Avista) a new License for the Spokane River Project, which includes Long Lake Dam (FERC 2009). Article 401(a) of the License required Avista to develop a Total Dissolved Gas (TDG) monitoring plan and a TDG Water Quality Attainment Plan (WQAP) for Long Lake Dam.

Avista consulted with the Washington State Department of Ecology (Ecology) and the Spokane Tribe of Indians (Spokane Tribe) as it developed the Washington TDG Monitoring Plan, which addresses TDG associated with spills from the Long Lake and Nine Mile Hydroelectric Development (HEDs) (Golder 2010a). Ecology approved this plan on March 17, 2010, and Avista filed the Ecology-approved plan with FERC on March 26, 2010. Avista filed the WQAP with FERC on July 16, 2010, and FERC approved it, and the Washington TDG Monitoring Plan, on December 14, 2010 (FERC 2010). Upon FERC's approval, Avista began implementing the WQAP in accordance with the Revised Long Lake HED TDG Compliance Schedule, which included the following components: general monitoring; operational changes – spill protocols; structural modifications; and effectiveness monitoring.

Avista began implementing the WQAP (Golder 2010b) in 2010 and continued seasonal TDG monitoring through 2013 at Long Lake Dam. Annual reports document the TDG monitoring for 2010, 2011, 2012, and 2013 (Golder 2011, 2012, 2013, and 2014). In accordance with the approved Revised Long Lake HED TDG Compliance Schedule (Figure 1-1)[1], 2013 was the last season of monitoring TDG before construction began on structural changes to address TDG abatement. Monitoring was to be re-initiated once the changes were complete.

Avista implemented the structural modification components of the Revised Long Lake HED TDG Compliance Schedule from 2010 through 2018. These components included Phase II and III Feasibility Analyses, computational and physical modeling, and the selection of the spillway deflectors as the alternative for gas abatement at Long Lake Dam. The Long Lake Dam Spillway Modification Project was complete by December 2016 and included the installation of two deflectors at the base of the spillway, removal of a portion of a rock outcrop, and filling the 60-80 foot deep plunge pool at the base of the dam. Effectiveness monitoring was conducted from 2017 through 2020. On April 3, 2020, Ecology approved Avista's plans to conduct an additional three years of effectiveness monitoring and reporting, as outlined in the 2019 Long Lake Total Dissolved Gas Monitoring Report (Avista 2020). Avista filed the Ecology-approved 2019 report with FERC on April 14, 2020.

This report discusses the results of the TDG monitoring at Long Lake Dam during 2020. A summary of the 2020 data quality is provided in Appendix A and a record of consultation with Ecology and the Spokane Tribe is provided in Appendix B.

[1] Ecology and FERC approved the Revised Long Lake HED TDG Compliance Schedule on November 21, 2014 and February 19, 2015, respectively.

1.2 Objectives

The objectives of the Long Lake HED TDG Monitoring Plan, a component of the Washington TDG Monitoring Plan, are to:

- Collect data to test the efficacy of selected operational measures in reducing gas production by Long Lake Dam spillway(s);
- Collect data for modeling the effectiveness of selected structural measures in reducing gas production by Long Lake Dam spillway(s);
- Test the effectiveness of selected operational and structural TDG abatement measures for Long Lake HED; and
- Confirm that Long Lake Dam does not cause exceedances of the TDG standard after implementation of selected operational and/or structural measures.

2.0 METHODS

Water quality parameters that were recorded include TDG (millimeters mercury [mmHg]), dissolved oxygen (DO) concentration (milligrams per Liter [mg/L]), and water temperature (°C). Water depth (meters [m]) was also recorded and used in conjunction with water temperature to evaluate the timing for any water quality monitoring instruments being out of water and above the minimum TDG compensation depth. In addition, barometric pressure (BAR; mmHg) was recorded.

2.1 Equipment and Calibration

Hydrolab® MS5 Multiprobe® (MS5) instruments (ID Numbers 48762, 48763, 48764, 48765, 60375, 60376, 68481and 68482) measured and recorded TDG (pressure), optical DO, temperature, and depth. When applicable, MS5s that were deployed for extended periods were connected to an external alternating current power source throughout the entire monitoring period to address problems from low power or power loss.

Solinst® barologgers measured and recorded local barometric pressure (BAR). A primary barologger was deployed at the Long Lake Tailrace monitoring location (LLTR) for the entire monitoring season. As an additional quality assurance measure, site-specific barometric pressures were compared to corresponding values published for the Spokane International Airport. The Spokane International Airport station's sea-level daily ranges for barometric pressure were downloaded from the Weather Underground[2] and adjusted by subtracting 37.05 mmHg to account for the altitude of the Long Lake Dam tailrace (1,365 feet above mean sea level [ft amsl]).

Monitoring equipment was calibrated according to the manufacturer's instructions and following the data quality objectives for the project prior to deployment and on periodic site visits. All

[2] On each site visit day, Spokane, Washington KGEG barometric pressure data were downloaded from the History & Almanac section of https://www.wunderground.com/history/airport/KGEG/2017/4/7/DailyHistory.html?req_city=Spokane+International&req_state=WA&req_statename=&reqdb.zip=99224&reqdb.magic=3&reqdb.wmo=99999

instruments were maintained and calibrated by the factory's service department prior to the 2020 monitoring season. Pre-deployment field verification included synchronizing the clocks, comparing the MS5s' TDG pressure value with the silastic membrane removed to the ambient barometric pressure, confirming the MS5s' patency of the TDG silastic membrane, and testing the barologgers to confirm that the recorded values were comparable to the Spokane International Airport.

During service periods, each MS5 was retrieved and the pull time recorded. Each service session included verification of logging status and downloading the data to a portable field computer. The Solinst® barologgers also were downloaded during these service periods. Patency of the original TDG membrane was confirmed by observing a rapid increase in TDG pressure while pressurizing the sensor with carbonated soda water. Depth, temperature, and DO sensors were calibrated according to the manufacturer's instructions.

2.2 Station Facilities

To facilitate TDG and DO monitoring at Long Lake Dam, permanent water quality monitoring facilities were constructed at three locations: 1) 0.6 mile downstream of the Long Lake Dam, referred to as LLTR, 2) in the Long Lake HED Unit 4 generation plume, referred to as LLGEN, and 3) in the Long Lake HED forebay, referred to as LLFB (Table 2-1; Figure 2-1). The long-term monitoring strategy described in the TDG monitoring plan (Golder 2010a) calls for TDG monitoring at two of the permanent monitoring stations, LLTR and LLGEN.

Each permanent station consists of a 4-inch-diameter pipe stilling-well (standpipe), which is sealed at the pipes' submerged end to prevent the MS5 from falling out of the pipe. Each standpipe has ½-inch-diameter perforations along its sides and a hole at the bottom to provide water exchange between the interior and exterior of the pipe and limit accumulation of sediment and debris in the bottom of the pipe. Each standpipe's top end is protected by an enclosed box containing AC power and data communication equipment.

2.3 Spot Measurements

Spot measurements of TDG, water temperature, and DO were made during each site visit, on two week intervals, beginning in February. Most spot measurements were taken across the river from LLTR, at LLTRSP1 (Table 2-1). The spot measurements on February 17, June 26, and June 30 were conducted at LLTR. Spot measurements were not conducted at LLGEN due to the extremely turbulent waters at this location, which made it unsafe to deploy a temporary MS5.

2.4 Data Collection and Processing

Parameters monitored at 15-minute log intervals with the MS5s described above included:

- Barometric pressure (mmHg)
- Air Temperature (°C)
- Depth (m)
- TDG (mmHg)
- Dissolved Oxygen (mg/L)

- Water Temperature (°C)

In addition, TDG percent of saturation (TDG%) was computed, as:

- TDG% = TDG in mmHg / Barometric pressure in mmHg x 100

Data downloaded to the laptop computer were transferred to an office server and were checked for errors using Microsoft Excel®. Erroneous data were identified, assigned data quality codes, and removed from the final data set (see Appendix A).

Long Lake Dam's operations are monitored and recorded by Avista's internal plant control software, which was used to extract data including: discharge passing over the dam's spillway; discharge passing through the dam's generation units; and total discharge on a fifteen minute basis during the extent of the TDG monitoring period.

2.5 Monitoring Difficulties

Prior to the TDG monitoring season, all six of Avista's MS5s were serviced and calibrated at Hach Hydromet (Hach) Technical Support & Service. Additionally, two new MS5s were acquired to ensure Avista had sufficient backup MS5s to alleviate the issues encountered during the 2019 TDG monitoring season. Before deployment, five MS5s successfully passed the mass verification test, indicating they were operating correctly and providing reliable values. The remaining three MS5s were mass verified at later tests, before they were used for data collection. Data collection issues encountered in 2020 are summarized below with further detail provided in Appendix A.

- MS5 #60376 was calibrated and deployed at LLTR on February 6 to begin the monitoring season. On February 7, the TDG readings showed an abnormal drop in TDG pressure and had unrealistic TDG readings. On February 17, the MS5 failed TDG recalibration but passed DO, depth, and temperature calibration. The MS5 was removed from use and TDG data from February 7 through February 17 were eliminated from the final dataset. MS5 #48764 was deployed at LLTR on February 17 and MS5 #60376 was sent to Hach for repair.

- MS5 #48764 was calibrated and deployed at LLTR on April 15. At the next site visit on April 28, the MS5 passed DO, depth, TDG, and temperature calibration. Upon review of the DO data during QC, DO data collected between April 15 and April 28 was consistently 0.61 mg/L less than the DO values immediately before calibration on April 15 and 0.68 mg/L less than the DO values after the April 28 calibration, but followed a similar trend as seen in the DO values at LLGEN, indicating these data were representative of the DO at LLTR, but off by a consistent factor. A correction factor of 0.64 mg/L was applied to all DO values between the calibrations on April 15 and April 28.

- MS5 #48764 was calibrated and redeployed at LLTR on May 13. At the next site visit on May 26, the MS5 failed TDG calibration, but passed DO, depth, and temperature

calibration. During QC of the data during this timeframe, there was a clear sign that the TDG sensor failed on May 24 at 1:45 am, indicated by a 200 mm Hg increase in the time period between 1:30 am and 1:45 am. TDG data before 1:45 am were included in the final LLTR dataset and data after 1:45 am were flagged and removed from the final dataset. MS5 #68481 was deployed at LLTR on May 26 and MS5 #48764 was sent to Hach for repair.

- MS5 #60375 was calibrated and deployed at LLGEN on March 5. At the next site visit on March 18, the MS5 passed DO, depth, TDG, and temperature calibration. Upon review of the DO data during QC, DO data collected between March 5 and March 18 was consistently 0.72 mg/L greater than the DO immediately before calibration on March 5 and 0.76 mg/L greater than the DO values after calibration on March 18, but the DO data between March 5 and March 18 followed a similar trend as seen in the DO values at LLTR during this time period, indicating these data were representative of the DO at LLGEN, but off by a consistent factor. Therefore, a correction factor of 0.74 mg/L was applied to all DO values between the calibrations on March 5 and March 18.

- Starting on June 6, the low water level at both LLTR and LLGEN intermittently left the MS5's depth in the water slightly less than the suggested TDG compensation depth, as defined in the TDG WQAP. Some of these TDG values were included in the final data set based on how the less than-compensation-depth TDG values compared and fit the TDG value trends of the neighboring greater than-compensation-depth TDG values. Data were eliminated from the final dataset when water level dropped low enough that the MS5 was <0.25m at LLTR and <0.5m at LLGEN. The MS5 at LLTR was removed from the stations stilling well and placed on the riverbed directly adjacent to the stilling well on June 22. The MS5 at LLGEN could not be placed on the riverbed due to the extremely turbulent water at this location making it unsafe. This resulted in various lengths of data gaps from June 6 to June 22 at LLTR and from June 6 to June 30 at LLGEN.

3.0 RESULTS

The License requires Avista to monitor TDG below Long Lake Dam during flows close to the 7Q10 (32,000 cubic feet per second) (Section 5.4(B), FERC 2009). In 2020, use of the Long Lake Dam spillway began for a short duration on January 27 and then spilled continually from February 3 through 19. Spilling did not occur again until April 21 and continued consistently through June 11. After June 11, spilling occurred intermittently until June 30. Avista monitored TDG from February 6 through June 30. Discharge at the Long Lake Dam did not exceed the 7Q10 discharge in 2020 (see section 3.1).

The TDG monitoring season included 13,970 15-minute periods at LLTR and 13,968 at LLGEN (Table 2-2). The MS5s were deployed from February 6 to June 30 and recorded reliable data for 86 – 100% of the sampling season at LLTR and 98 – 100% of the sampling season at LLGEN.

The barologger deployed at LLTR provided local barometric pressure for 100% of the monitoring period (Appendix A, Table A-4). Spot measurements were collected at LLTRSP1 on March 5 and 18, April 1, 15, and 28, May 13 and 26, and June 8 and 22 (Table 2-3). Spot measurements were collected at LLTR on February 17, June 26, and June 30 (Table 2-3). All results of continuous and spot measurements are displayed in Figures 2-2 through 2-5.

3.1 Discharge

Total Long Lake Dam generation plus spill discharge for the 2020 monitoring period ranged from approximately 210 cubic feet per second (cfs) to 21,835 cfs. Spills at Long Lake Dam reached a maximum of approximately 15,091 cfs on May 22, and spill occurred at the dam until June 30. Long Lake Dam generation was near full capacity during the entire monitoring period. Total river discharge did not exceed the Ecology-designated 7Q10 (32,000 cfs) in 2020.

3.2 Water Temperature

Water temperature during the monitoring period at LLTR reached a low of 3.9 °C in mid-February and a high of 18.5°C in late June (Table 2-2; Figure 2-2). Similarly, water temperature measured at LLGEN reached a low of 3.8°C in mid-February and a high of 18.5°C in late June. Water temperatures remained steady at the beginning of the spring freshet and then increased steadily throughout the monitoring season as atmospheric temperatures began to increase and precipitation became less frequent.

3.3 Barometric Pressure

Site-specific barometric pressures ranged from 708 to 737 mmHg based on the Solonist® barologger deployed at LLTR (Table 2-2).

3.4 Total Dissolved Gas

TDG pressure (mmHg) for LLTR and LLGEN followed similar patterns throughout the monitoring season, differing by 2.09 mmHg on average (Figure 2-3). Spot values for LLTRSP1 coincided with the continuous monitoring data for LLTR, ranging in difference from 0-10 mmHg and an average of 2 mmHg.

TDG percent values for LLGEN, which is essentially unaffected by spill at Long Lake Dam, exceeded 110 percent of saturation at times between May 2 and May 6, then consistently from May 7 through June 13, and then intermittently from June 21 until June 30. The TDG percent values at LLGEN ranged from 100.3 to 116.9 percent. TDG percent at LLTR, which is affected by spill at the dam, exceeded 110 percent of saturation first from April 29 until June 9, then periodically from June 26 to June 30. TDG percent values at LLTR ranged from 100.1 to 114.6 percent (Table 2-2; Figure 2-4).

The 110 percent of saturation TDG criterion is not applicable when stream discharge exceeds the 7-day average flow with a 10-year return period (7Q10), which Ecology specified as 32,000 cfs for the Spokane River at Long Lake Dam and Nine Mile Dam (Ecology 2009). During the 2020 monitoring season, maximum total discharge (spill plus turbine discharge) was 21,835 cfs, hence

the 7Q10 was not exceeded. Table 2-4 provides the specific periods where TDG saturation was greater than the 110 percent of saturation criterion when total discharge was less than the 7Q10.

3.5 Dissolved Oxygen

Measured DO concentrations ranged from 9.5 to 12.8 mg/L for LLTR, and 9.3 to 13.1 mg/L for LLGEN (Table 2-2; Figure 2-5). Peak DO concentrations during the 2020 monitoring period occurred in late March, when Lake Spokane was drawn down nearly 12 feet. DO values remained above the 8.0 mg/L DO criterion throughout the entire monitoring period at both monitoring stations.

4.0 DISCUSSION

Overall, 2020 TDG levels at LLTR, and LLGEN increased as river flows increased. Contrary to historic measurements at Long Lake Dam (Golder 2003, 2004, 2011, 2012, 2013), but similar to previous post-spillway modification monitoring (Avista 2018, Avista 2019, Avista 2020), TDG levels in 2020 at LLTR were frequently less than the TDG levels at LLGEN for portions of the monitoring season. In 2020, TDG % at LLTR was less than or equal to background values measured at LLGEN for 75.1% of the monitoring season. During the times that TDG at LLTR exceeded LLGEN, it was never more than 3.6% greater (Figure 2-4). At times when TDG % at LLTR was greater than 110%, TDG % at LLTR was less than or equal to LLGEN 59.6% of the 3,815 15-minute data pairs, and was never more than 2.5% greater than LLGEN. TDG percent values at LLTR exceeded the 110% criterion earlier in the season than LLGEN, but TDG levels at LLTR did not reach the maximum values seen at LLGEN.

Comparison of the TDG % at LLTR and spill discharges for 2020 indicates TDG % was greater than the 110 percent criterion 100% of the time when spill was greater than 11,000 cfs, 76% of the time when spills were between 5,000 and 11,000 cfs, 18 percent of the time when spill was less than 5,000 cfs, and 3% of the time when no spill occurred (Table 2-5). When comparing LLTR TDG % to LLGEN TDG % for the data pairs, TDG % values at LLTR were greater than at LLGEN and exceeded the 110 percent criterion for 0% of the data pairs with spill of less than 5,000 cfs, 17% when spill was between 5,000 and 11,000 cfs, and 60% when spill was greater than 11,000 cfs. These data are similar to the 2017 and 2018 monitoring results which are in stark contrast to historic measurement from 2011-2013 where LLTR TDG % was rarely lower than LLGEN or LLFB at spills greater than 11,000 cfs. These data further reinforce the conclusion that the spillway modification project positively influences TDG percent levels downstream of Long Lake Dam.

In 2020, the maximum TDG % at LLTR was 114.6% and the maximum TDG % at LLGEN was 116.9%. These values are the lowest maximum TDG percent values measured at each station since monitoring began in 2003 (Table 2-6). Additionally, the 2020 data corresponds with the data from 2018 monitoring, where the maximum TDG % at LLTR was less than the maximum seen at LLGEN.

5.0 NEXT STEPS

Avista plans to continue conducting annual TDG monitoring at Long Lake Dam for an additional two years (2021 through 2022), following the same Long Lake HED TDG Monitoring Plan and reporting structure used in previous annual monitoring. Following the same monitoring plan will allow for the data to be directly comparable to the previously collected data. As this additional monitoring data is collected, Avista will work with Ecology to evaluate Long Lake HED's compliance with requirements of the License and explore the need for additional abatement of TDG levels.

Avista plans to implement the following work:

- 2021: Submit 2020 Annual Monitoring Report to Ecology and the Spokane Tribe by March 1 for review and comment, and file with FERC by April 15. Monitor TDG and other relevant water quality conditions at LLGEN and LLTR during the spill season.

- 2022: Submit 2021 Annual Monitoring Report to Ecology and the Spokane Tribe by March 1 for review and comment, and file with FERC by April 15. Monitor TDG and other relevant water quality conditions at LLGEN and LLTR during the spill season.

- 2023: Submit 2022 Annual Monitoring Report to Ecology and the Spokane Tribe by March 1 for review and comment, and file with FERC by April 15.

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TABLES

Table 2-1. Long Lake HED TDG monitoring stations.

Station Code	Description	Latitude / Longitude (NAD83)	Monitoring Type
LLGEN	Long Lake HED Unit 4 generation plume	47°37'48" / 117°31'47"	Long-term
LLTR	On left downstream bank, at a water pump house approximately 0.6 mile downstream from Long Lake dam	47°37'48"/ 117°31'47"	Long-term
LLTRSP1	On right downstream bank, across river from LLTR station	47° 50'19" / 117° 51'02"	Spot during spillway use

Table 2-2. Summary of continuous monitoring results.

Parameter	LLGEN			LLTR		
	Minimum	Maximum	Count	Minimum	Maximum	Count
Date/Time (m/dd/yyyy PDT)	2/6/20 12:00	6/30/20 23:45	13,968	2/6/20 11:30	6/30/20 23:45	13,970
Water Temperature (°C)	3.8	18.5	13,732	3.9	18.5	13,291
Dissolved Oxygen (mg/L)	9.3	13.1	13,731	9.5	12.8	13,291
BAR (mm Hg)	Used LLTR BAR			708	737	13,918
TDG (mm Hg)	728	830	13,683	726	824	12,083
TDG (% saturation)[1]	100.3	116.9	13,675	100.1	114.6	12,076

Notes:

1. TDG (% saturation) calculated using site-specific barometric pressure (BAR) data collected at LLTR and corrected for altitude.

Table 2-3. Spot measurement results.

Station Code	Date Time (PDT)	Water Temperature (°C)	Dissolved Oxygen (mg/L)	TDG (mm Hg)	LLTR BAR (mm Hg)	TDG (% of saturation)[1]
LLTR	2/17/20 14:00	4.3	12.5	760	728	104.4
LLTRSP1	3/5/20 12:30	5.0	12.5	750	724	103.6
LLTRSP1	3/18/20 11:30	6.0	11.7	736	718	102.5
LLTRSP1	4/1/20 11:30	6.9	11.7	747	722	103.4
LLTRSP1	4/15/20 11:45	8.0	12.1	770	727	105.9
LLTRSP1	4/28/20 13:30	9.9	11.6	804	728	110.4
LLTRSP1	5/13/20 11:30	11.6	11.3	812	718	113.2
LLTRSP1	5/26/20 11:15	12.1	11.3	823	723	113.8
LLTRSP1	6/8/20 12:15	14.6	9.9	799	722	110.6
LLTRSP1	6/22/20 12:15	15.2	9.9	769	727	105.8
LLTR	6/26/20 12:30	16.3	10.4	789	720	109.6
LLTR	6/30/20 23:45	17.2	9.7	779	717	108.7

Table 2-4. Summary of exceedance of TDG criterion when total discharge was less than or equal to Ecology-specified 7Q10 of 32,000 cfs.

	LLTR			LLGEN		
# of records that exceeded 110% saturation	4,156			3,703		
Total # of records	12,076			13,675		
Periods when TDG exceeded 110% saturation (PDT)[1,2]	4/29/2020 11:15	to	5/1/2020 6:30	5/2/2020 15:00	to	5/3/2020 0:30
	5/1/2020 7:00	to	6/8/2020 13:30	5/3/2020 0:45		
	6/8/2020 15:15	to	6/9/2020 0:30	5/3/2020 2:15		
	6/9/2020 2:00	to	6/9/2020 2:45	5/5/2020 12:45	to	5/6/2020 21:00
	6/9/2020 3:15	to	6/9/2020 3:45	5/7/2020 18:30	to	5/8/2020 6:30
	6/9/2020 7:30	to	6/9/2020 8:15	5/8/2020 7:00	to	5/13/2020 15:00
	6/9/2020 9:15	to	6/9/2020 9:45	5/13/2020 15:30	to	6/13/2020 5:15
	6/9/2020 10:45	to	6/9/2020 11:00	6/21/2020 10:30		
	6/9/2020 11:30	to	6/9/2020 13:00	6/24/2020 9:45		
	6/9/2020 14:00	to	6/9/2020 17:30	6/24/2020 11:30	to	6/24/2020 13:30
	6/26/2020 9:30	to	6/26/2020 23:30	6/24/2020 14:00	to	6/24/2020 14:15
	6/27/2020 4:45			6/24/2020 14:45	to	6/24/2020 17:15
	6/27/2020 6:00	to	6/28/2020 1:45	6/24/2020 18:00		
	6/28/2020 2:15	to	6/28/2020 18:00	6/24/2020 18:45	to	6/24/2020 19:00
	6/29/2020 22:15	to	6/29/2020 23:30	6/24/2020 20:00	to	6/24/2020 21:15
				6/24/2020 21:45		
				6/24/2020 23:00	to	6/25/2020 6:30
				6/25/2020 7:30	to	6/25/2020 8:30
				6/25/2020 9:15	to	6/25/2020 19:45
				6/25/2020 20:15	to	6/25/2020 20:30
				6/25/2020 21:15	to	6/25/2020 21:30
				6/25/2020 22:00	to	6/25/2020 23:00
				6/26/2020 1:15		
				6/26/2020 4:00		
				6/26/2020 4:45		
				6/26/2020 5:15	to	6/26/2020 5:45
				6/26/2020 6:15	to	6/26/2020 8:45
				6/26/2020 14:45	to	6/26/2020 23:45
				6/27/2020 2:15	to	6/28/2020 19:15
				6/28/2020 22:30	to	6/28/2020 23:15
				6/29/2020 5:15		
				6/29/2020 11:15	to	6/29/2020 11:30
				6/29/2020 15:00	to	6/29/2020 15:45

Notes:
1. Flows did not exceeded the 7Q10 in 2020.
2. Refer to Figure 2-4 and Appendix A for data gaps.

Table 2-5: Summary of LLTR TDG% by Spill Category and Comparison with LLGEN TDG%

Spill Category	All LLTR TDG% Values			LLTR TDG% Paired with LLGEN TDG%[1]		
	Total Count	Count >110%	% >110%	Total Count	Count >110% and >LLGEN	% >110% and >LLGEN
>11 kcfs spill	2,070	2,070	100%	2,061	1,237	60%
5-11 kcfs spill	1,754	1,329	76%	1,744	291	17%
<5 kcfs spill	1,575	284	18%	1,562	6	0%
No spill	6,670	181	3%	6,532	8	0%
All spill and non-spill	12,069	3,864	32%	11,899	1,542	13%

Notes:

1. TDG (% saturation) calculated using site-specific barometric pressure (BAR) data collected at LLTR and corrected for altitude.

Table 2-6. Maximum discharge flow and TDG% at LLTR, LLGEN, and LLFB.

Year	Max. Discharge (cfs)	Max. TDG%		
		LLTR	LLGEN	LLFB[1]
2003	22,310	129	-	123
2004	22,420	125	-	123
2010	17,910	121	113	-
2011	34,400	138	-	123
2012	37,100	143	123	118
2013	20,480	130	116	112
2017	46,331	126	125	119
2018	28,463	120	126	126
2020	21,835	115	117	-

Notes:

1. LLFB was not monitored in 2010 and 2020.

FIGURES

Revised January 8, 2015

Revised Long Lake HED TDG Compliance Schedule

Schedule for Operational Adjustments and Structural Modifications to Address TDG Production at Long Lake Dam

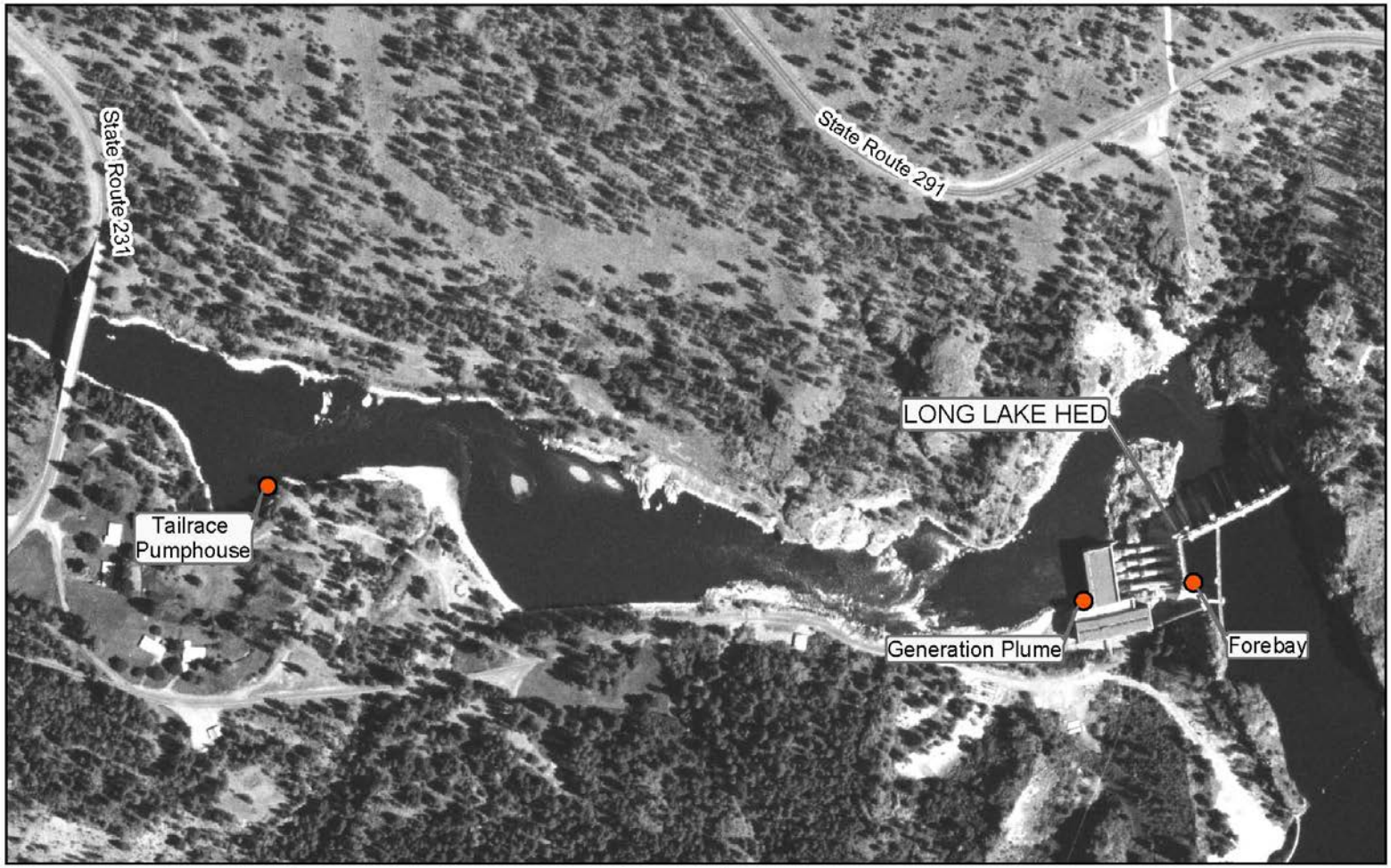
Action	Task	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
General Monitoring	Select/design permanent monitoring stations and develop monitoring plan	M	M										
	Monitor TDG and other relevant water quality conditions at the Unit 4 generation plume (LLGEN) and the tailrace (LLTR) [1]		M	M	M	M					M	M	
	Annual Monitoring Report[2]			M	M	M	M					M	M
Operational Changes - Spill Protocols	Continue historical preferential use of spill gates	O	O										
	Develop reasonable and feasible interim spill gate protocol based on the 2003/2004 spill testing		O										
	Implement selected reasonable and feasible interim spill gate protocol based on 2003/2004 spill testing			O	O	O	O	O					
	Suspend interim spill operations in 2016 and 2017 during construction								O	O			
	Implement revised spill gate protocol, which takes advantage of constructed structural modifications										O	O	O
Structural Modifications	Phase II Feasibility Study- Evaluation of Alternatives		S										
	Phase III Feasibility Study - Select Alternatives, Physical Model			S	S								
	Submit and request agency review of Phase III Recommendation					S							
	Upon FERC approval, prepare RFP for design engineering services and secure contract					S							
	Phase IV - Formulate design, plans, and specs						S						
	Phase V – Award construction bid and permit project						S	S					
	Phase VI - Construction								S	S			
	Phase VII – Testing, performance evaluation, and define spillgate protocol										S	S	
Effectiveness Monitoring	Confirm effectiveness of structural modifications and spillgate operations at reducing TDG										M	M	M

Notes

S	Structural
O	Operations
M	Monitoring

(1) Monitoring will be suspended following FERC approval of the Phase III recommendation and will resume once construction has been completed.
(2) Annual Monitoring Reports are only required following a monitoring season.

Figure 1-1: Revised Long Lake HED TDG compliance schedule.
Note: Approved by Ecology on November 21, 2014 and approved by FERC in an Order Granting Extension of Time Under Total Dissolved Gas Attainment Plan issued February 19, 2015 (FERC 2015).



Source: Avista

Figure 2-1: Long Lake HED long-term water quality monitoring locations.

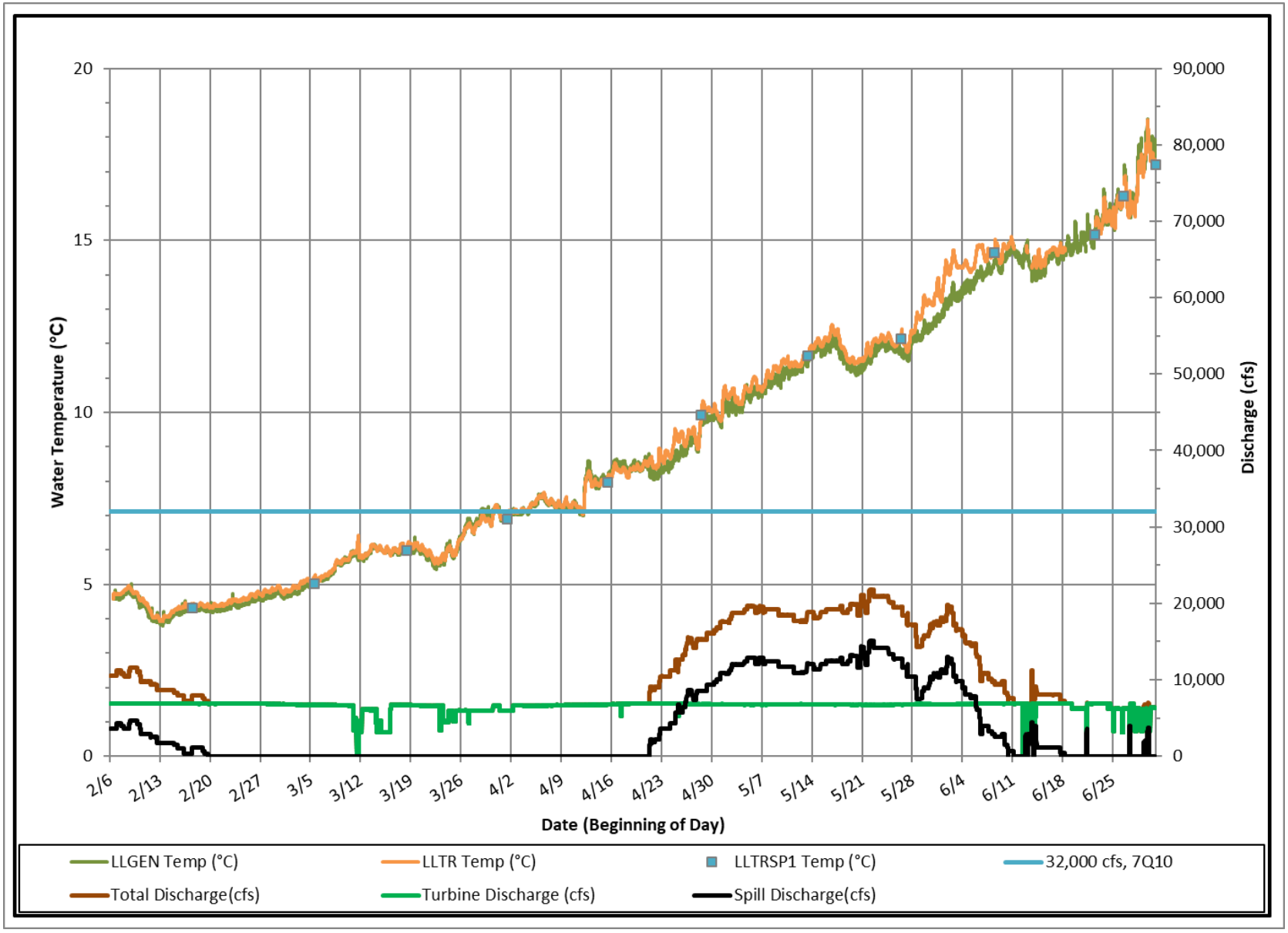


Figure 2-2: Long Lake HED 2020 water temperature (°C) and operations.

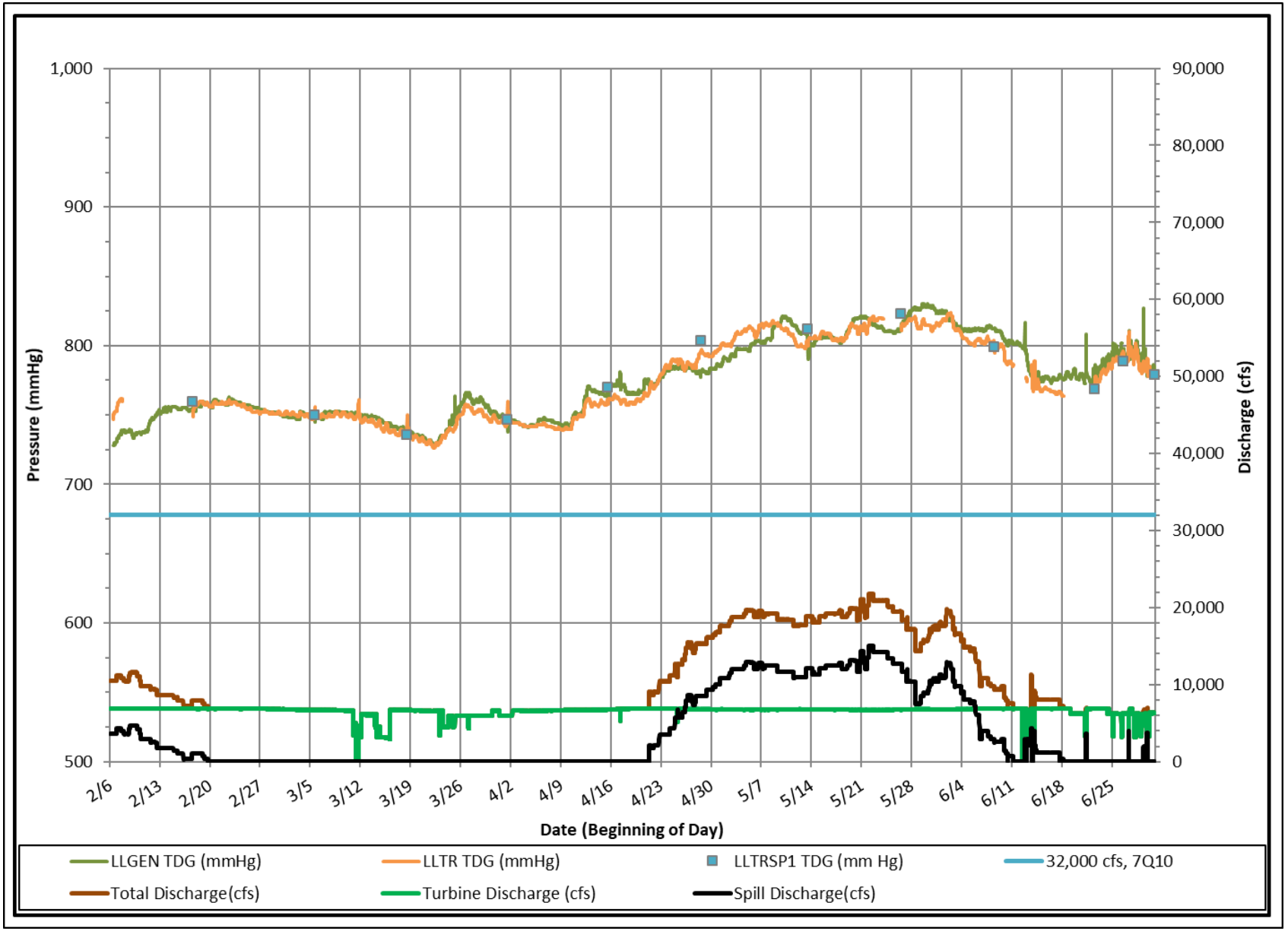


Figure 2-3: Long Lake HED 2020 barometric pressure (mmHg) and operations.

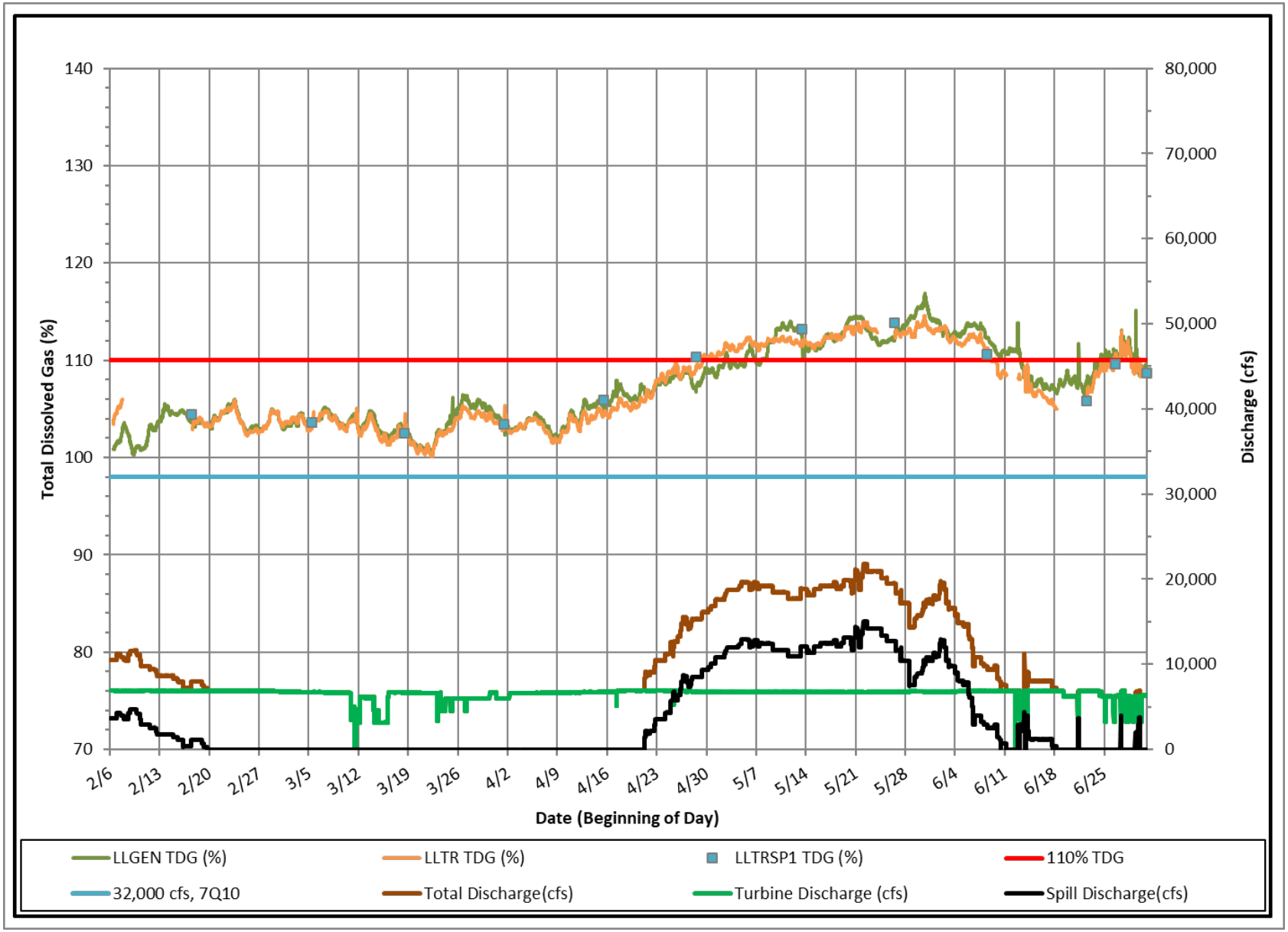


Figure 2-4: Long Lake HED 2020 total dissolved gas (%) and operations.

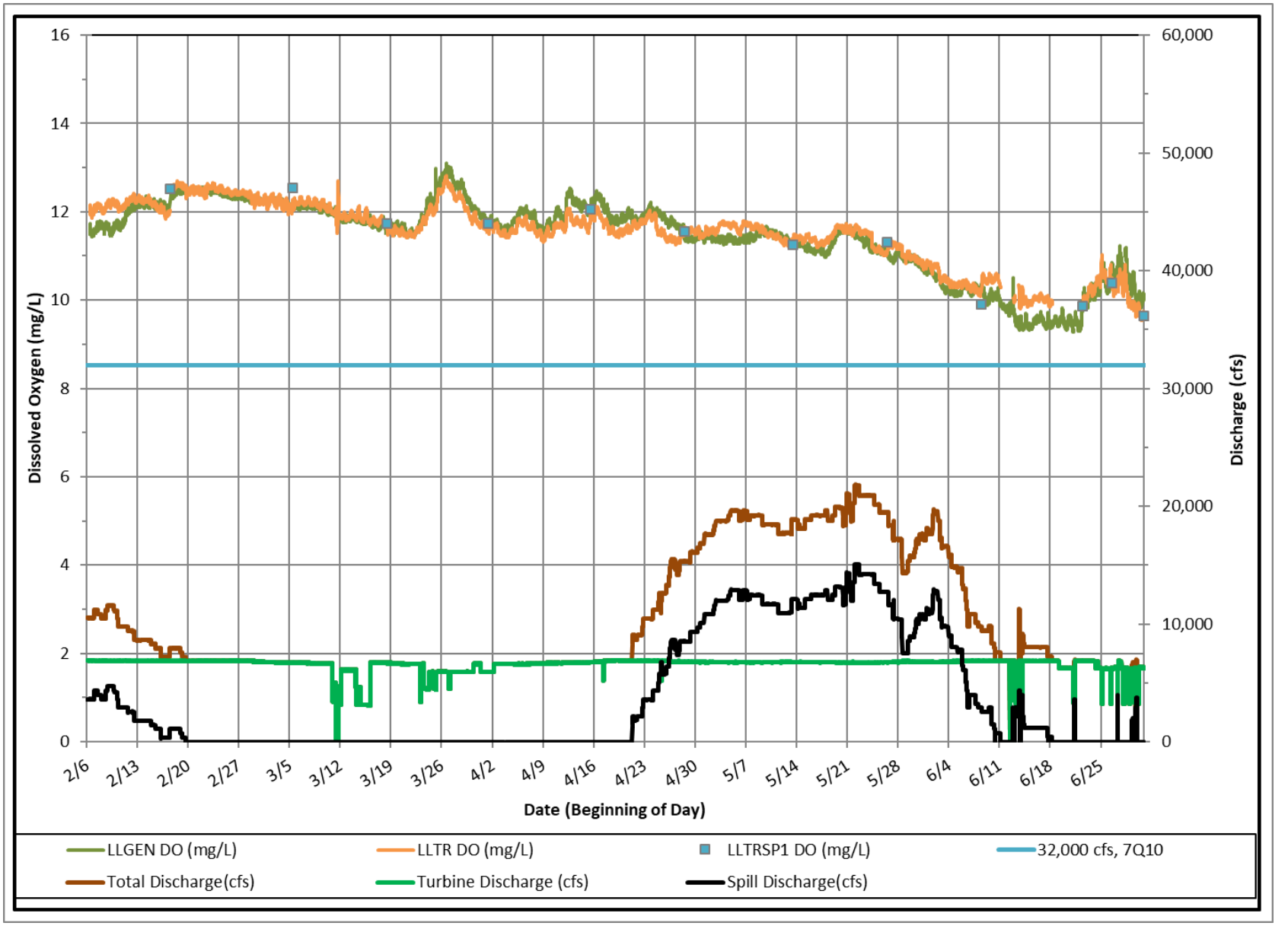


Figure 2-5: Long Lake HED 2020 dissolved oxygen (mg/l) and operations.

APPENDIX A
DATA QUALITY ANALYSIS

DATA QUALITY SUMMARY

Data quality objectives (DQOs) and Measurement Quality Objectives (MQOs) are the quantitative and qualitative terms used to specify how good the data need to be to meet the project's specific monitoring objectives. DQOs for measurement data, also referred to as data quality indicators, include measurement range, accuracy, precision, representativeness, completeness, and comparability. The range, accuracy, and resolution for each measured parameter are provided in Table A-1.

Table A-1. Range, accuracy and resolution of parameters recorded.

Instrument and Parameter	Range	Accuracy	Resolution
MS5 Total Dissolved Gas	400 to 1300 mmHg	±0.1% of span	1.0 mmHg
MS5 Dissolved Oxygen	0 to 30 mg/L	± 0.01 mg/L for 0 to 8 mg/L ± 0.02 mg/L for >8mg/L	0.01 mg/L
MS5 Temperature	-5 to 50°C	±0.10°C	0.01°C
MS5 Depth (0-25 meters)	0 to 25 meters	±0.05 meter	0.01 meter
Barologger Relative Barometric Pressure	1.5 meter of water	± 0.1 cm of water	0.002% of full scale
Barologger Temperature	-10 to 40°C	± 0.05°C	0.003°C

Notes: Sources: Hach MS5 User Manual and Solinist Levelogger User Guide [3]

MQOs are the performance or acceptance thresholds or goals for the project's data, based primarily on the data quality indicators precision, bias, and sensitivity. Table A-2 presents MQOs selected during preparation of the Washington TDG Monitoring Plan along with the same MQO for DO as used for the Long Lake HED tailrace DO monitoring plan. The meter-specific root mean squared error (RMSE) of the calibration corrections applied after each calibration, and an overall RMSE for all meters compared to MQOs are shown in Table A-3. Table A-4 shows which MS5 was deployed at each monitoring location during the sampling period.

Table A-2. Measurement quality objectives (MQOs).

Parameter	MQOs
Barometric Pressure	2 mmHg
Temperature	0.5ºC
Total Pressure	1% (5 to 8 mmHg)
TDG%	1%
Dissolved Oxygen	0.5 mg/L

[3] Hach Corporation. 2006. Hydrolab DS5X, DS5, and MS5 Water Quality Multiprobes User Manual. February 2006, Edition 3. Catalog Number 003078HY and Solinist. 2010. Levelogger Series (Levelogger Gold, Barologger Gold, Levelogger Junior, LTC Levelogger Junior and Rainlogger) User Guide - Software Version 3.4.0. August 17, 2010.

Table A-3: Difference between RMSE and MQOs by MS5

Table Part 1: Barometric pressure (BAR), total pressure, total dissolved gas (TDG).

LLHED TDG Monitoring	RMSE [1]				MQO				RMSE - MQO (positive shaded values denote exceedance of MQO)			
Meter and Site IDs	BAR[2]	Total Pressure[3]	TDG-cal[4]	TDG-spot	BAR	Total Pressure	TDG	TDG	BAR	Total Pressure	TDG-cal	TDG-spot
	mm Hg	%	%	mm Hg	mm Hg	%	%	mmHg	mm Hg	%	%	mm Hg
48762	1.26	0.17	0.17	3.20	2	1	1	5	-0.74	-0.83	-0.83	-1.80
48764	1.58	0.22	0.22	3.20	2	1	1	5	-0.42	-0.78	-0.78	-1.80
68482	1.00	0.14	0.14	N/A	2	1	1	5	-1.00	-0.86	-0.86	N/A
60375	2.00	0.28	0.28	2.16	2	1	1	5	0.00	-0.72	-0.72	-2.84
68481	2.00	0.35	0.35	2.16	2	1	1	5	0.00	-0.65	-0.65	-2.84
48763	0.71	0.10	0.10	0.50	2	1	1	5	-1.29	-0.90	-0.90	-4.50
48765	0.00	0.00	0.00	0.50	2	1	1	5	-2.00	-1.00	-1.00	-4.50
60376	N/A	N/A	N/A	N/A	2	1	1	5	N/A	N/A	N/A	N/A
Overall RMSE	1.62	0.22	0.22	1.95	2	1	1	5	-0.38	-0.78	-0.78	-3.05

[1] RMSE calculated for each meter during calibration checks while in use and between spot measurements from multiple meters.

[2] RMSE calculated from BAR measured during calibration compared to the TDG in air uncorrected reading.

[3] RMSE calculated as the difference in TDG in air uncorrected measured during calibration minus the BAR, then divided by the TDG and multiplied by 100%.

[4] RMSE calculated as TDG in air uncorrected measured during calibrations divided by the BAR and multiplied by 100%

N/A - No value reported or not applicable

Table A-3 (Continued): Difference between RMSE and MQOs by MS5

Table Part 2: Temperature and dissolved oxygen (DO).

LLHED DO Monitoring	RMSE				MQO		RMSE - MQO (positive shaded values denote exceedance of MQO)			
Meter and Site IDs	Temperature[1]		Dissolved Oxygen[2]		Temp	DO	Temperature[1]		Dissolved Oxygen[2]	
	Calibration	Spot	Calibration	Spot			Calibration	Spot	Calibration	Spot
	ºC	ºC	mg/L	mg/L	ºC	mg/L	ºC	ºC	mg/L	mg/L
48762	0.06	0.05	0.07	0.34	0.5	0.5	-0.44	-0.45	-0.43	-0.16
48764	0.05	0.05	0.13	0.55	0.5	0.5	-0.45	-0.45	-0.37	0.05
68482	0.17	N/A	0.01	N/A	0.5	0.5	-0.33	N/A	-0.49	N/A
60375	0.09	0.05	0.14	0.14	0.5	0.5	-0.41	-0.45	-0.36	-0.36
68481	0.09	0.05	0.06	0.14	0.5	0.5	-0.41	-0.45	-0.44	-0.36
48763	0.09	0.02	0.05	0.01	0.5	0.5	-0.41	-0.48	-0.45	-0.49
48765	0.17	0.01	0.02	0.02	0.5	0.5	-0.33	-0.49	-0.48	-0.48
60376	0.06	0.04	0.05	0.23	0.5	0.5	-0.44	-0.46	-0.45	-0.27
Overall RMSE	0.08	0.04	0.10	0.20	0.5	0.5	-0.42	-0.46	-0.40	-0.30

[1] For Calibration, RMSE calculated from the difference between the meter and calibration thermometer at all calibration checks while the meter was in use. Spot differences are average differences between measured values from group average.

[2] Calibration RMSE as difference of the calculated pre-calibration and post-calibration measurement. Spot RMSE calculated as average difference between measured values from group average.

N/A - No value reported or not applicable

Root mean squared error (RMSE) = $\sqrt{\frac{\sum_{i=1}^{n}(x_{1,i}-x_{2,i})^2}{n}}$.

Table A-4. ID number, and deployment station and timeframe of MS5s used in 2020.

Deployment Timeframe	LLTR	LLGEN	LLTRSP1
2/6 - 2/17	60376	48762	
2/17 - 3/5	48764	60375	48762
3/5 - 3/18	48764	60375	48762
3/18 - 4/1	48764	60375	48762
4/1 - 4/15	48764	60375	48762
4/15 - 4/28	48764	60375	48762
4/28 - 5/13	48764	60375	48762
5/13 - 5/26	48764	60375	48762
5/26 - 6/8	68481	48762	60375
6/8 - 6/22	68481	48762	60375
6/22 - 6/26	68481	48762	60375
6/26 - 6/30	48765	68482	48763

Measurement Range

The measurement range, range of reliable readings of an instrument or measuring device, specified by the manufacturer is displayed in Table A-1 for each measured parameter. Maintenance of field sampling equipment was conducted in a manner consistent with the corresponding manufacturer's recommendations to provide reliable readings within each instrument's reported measurement range.

Bias

TDG meters, like other field monitoring instruments, are subject to bias due to systematic errors introduced by calibration, equipment hardware or software functioning, or field methods. Bias was minimized by following standard protocols for calibration and maintenance, and by following field protocols for stabilization of meter readings.

Precision

Precision refers to the degree of variability in replicate measurements and is typically defined by the instrument's manufacturer. Manufacturer values for the MS5 and barologger (Table A-1) were within MQOs.

Accuracy

Accuracy is a measure of confidence that describes how close the average of a series of replicate measurements is to the "true" value (low bias). Throughout this seasonal TDG monitoring study, the MS5s underwent calibration and verification procedures.

Instrument accuracy was evaluated through the calibration and maintenance activities. MQOs for total pressure, pre-calibration TDG %, and TDG-Spot were met for all meters (Table A-3). All MS5s met the 0.5 mg/L DO MQO for pre-calibration and all but MS5 #48764 met the MQO for

spot measurements. All MS5s met the 0.5°C MQO for temperature and spot measurements (Table A-3)

Discharge data were obtained from Avista's internal plant control software and is found to be accurate and reliable.

Representativeness

Representativeness qualitatively reflects the extent to which sample data represent a characteristic of actual environmental conditions. For this project, representativeness was addressed through proper design of the sampling program to ensure that the monitoring locations were properly located and sufficient data were collected to characterize TDG at that location.

Comparability

Comparability is the degree to which data can be compared directly to previously collected data. Comparability was achieved by consistently monitoring the same long-term monitoring stations as in the past, and conducting spot measurements at the same location across the river from LLTR as in past years.

Completeness

Completeness is the comparison between the quantity of data planned to be collected and how much usable data was actually collected, expressed as a percentage (Table A-5). The TDG data collection period consisted of 13,970 15-minute periods at LLTR and 13,968 at LLGEN. Data completeness was 95 percent for water temperature and dissolved oxygen, 100 percent of barometric pressure, and 86 percent for TDG and TDG % at LLTR. Completeness at LLGEN was 98 percent for water temperature, dissolved oxygen, TDG and TDG %.

Table A-6 summarizes the number of specific DQCodes applied to LLTR and LLGEN data.

Table A-5. Project completeness.

Table A-4: Project Completeness				
	LLGEN		LLTR	
Parameter	Count	Completeness (%)	Count	Completeness (%)
Monitoring Period	13,968	--	13,970	--
Water Temperature (°C)	13,732	98%	13,291	95%
Dissolved Oxygen (mg/L)	13,731	98%	13,291	95%
BAR (mm Hg)	Used LLTR BAR		13,918	100%
TDG (mm Hg)	13,683	98%	12,083	86%
TDG (% saturation)	13,675	98%	12,076	86%

Table A-6. Number of specific DQ Codes during the monitoring period.

DQ Code	DQ Code Description	LLGEN					LLTR						
		Temp (°C)	TDG (mmHg)	Depth (meters)	DO (mg/L)	Batt (volts)	Temp (°C)	TDG (mmHg)	Depth (meters)	DO (mg/L)	Batt (volts)	Level (m H2O)	ATemp (°C)
999	Instrument logging data before deployment at monitoring station	21	21	21	21	21	4	4	4	4	4	0	0
998	Out of water after recovery	20	20	20	20	20	3	2	3	3	3	0	0
997	Equilibrating after deployment	0	48	0	0	0	0	48	0	0	0	0	0
993	Out of water for calibration/servicing	68	68	68	68	68	45	45	45	45	45	0	0
991	Instrument not deployed at typical long-term depth	0	0	0	0	0	0	0	0	0	0	8	5
990	Depth <0.25 meter at LLTR or <0.5 m at LLGEN	93	93	93	93	0	412	412	412	412	0	0	0
599	Suspect out of water based on depth	4	4	4	4	0	214	214	214	214	0	0	0
497	Faulty TDG sensor	0	0	0	0	0	0	1,161	0	0	0	0	0
304	Suspect DO value not accurate	0	0	0	1	0	0	0	0	0	0	0	0
211	Depth < TDG compensation depth	30	30	30	30	0	0	0	0	0	0	0	0
-101	Less than "minimum operating voltage" (<7 volts), but other data appear reliable	0	0	0	0	35	0	0	0	0	0	0	0
-211	Depth < TDG compensation depth, but data appear reliable	0	684	0	0	0	0	825	0	0	0	0	0
-301	Consistent DO measurement bias corrected with offset	0	0	0	1,203	0	0	0	0	1,233	0	0	0
-990	Depth <0.25 meter, but data appear reliable	0	0	0	0	0	15	15	15	15	0	0	0
-1002	Corresponds with spot measurement	0	0	0	0	0	9	7	9	9	10	0	0
0	No data qualifiers	13,776	13,044	13,776	12,572	13,868	9,022	11,278	13,309	12,076	13,950	14,004	9,044
	Monitoring Period[1]	13,968	13,968	13,968	13,968	13,968	13,970	13,970	13,970	13,970	13,970	13,970	13,970

APPENDIX B
CONSULTATION RECORD

1411 East Mission Avenue
PO Box 3727
Spokane, WA 99220-3727

February 26, 2021

Jordan Bauer, Hydropower Compliance Coordinator
Washington Department of Ecology
Eastern Regional Office
4601 N Monroe Street
Spokane, WA 99205-1295

Subject: Federal Energy Regulatory Commission's Spokane River Hydroelectric Project License, Appendix B, Sections 5.4 and 5.6.B, TDG and DO Reporting Requirements

Dear Jordan:

Ordering Paragraph E of the Federal Energy Regulatory Commission (FERC) Spokane River Hydroelectric Project License incorporated the Washington Department of Ecology (Ecology) Certification Conditions under Section 401 of the Federal Clean Water Act Water Quality Certification (Certification) as Appendix B of the License. Per Sections 5.4 and 5.6.B of the Certification, Avista is submitting the following project status and reports for your review and approval.

Section 5.4: Total Dissolved Gas
There are two components related to Total Dissolved Gas (TDG), which include the following:

- *2020 Long Lake Total Dissolved Gas Monitoring Report*
  Avista completed the Long Lake Dam Spillway Modification Project in December 2016. Following completion of the project, Avista monitored TDG to assess the effectiveness of the modifications and to evaluate spillgate operational protocols. In 2020, Ecology approved Avista's plans to conduct an additional three years on effectiveness monitoring (2020 – 2022) and reporting (2021 – 2023). The enclosed 2020 Long Lake TDG Monitoring Report provides the results the TDG monitoring completed during 2020.

  Avista plans to monitor TDG in 2021 and will work with Ecology to evaluate Long Lake HED's compliance to the requirements of the License.

- *2020 Nine Mile HED Total Dissolved Gas Monitoring Report*
  In February 2012, Ecology approved Avista's request to delay the required TDG monitoring at Nine Mile Dam until Avista completed the turbine units 1 and 2 replacement project and the sediment bypass system upgrade and associated intake deck and trashrack cleaning system. Ecology required TDG monitoring for two years, resuming the first season following the completion of these projects, when flows occur during the 7Q10 median flow of 25,400 cfs or higher at the Spokane gage (USGS 12422500). In 2019, Avista completed one year of TDG monitoring following the completion of these projects.

In 2020, discharge flows at the Spokane gage reached a maximum of 19,400 cfs and did not get near the 7Q10 flows, therefore TDG monitoring was not applicable. Avista plans to monitor TDG in 2021 assuming snowpack and runoff forecasts results in flows reaching the 7Q10 flow to fulfill the second year of required monitoring.

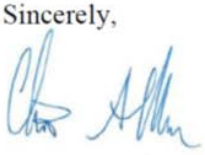
Section 5.6.B: Dissolved Oxygen

The enclosed 2020 Long Lake HED Tailrace Dissolved Oxygen (DO) Monitoring Report (LL DO Report) provides the results of the 2020 DO monitoring immediately downstream of Long Lake Dam for the low-flow period of the year and summarizes the use of draft tube aeration to increase DO levels in the river below the dam's tailrace. Avista plans to continue with the aeration program in 2021 and continue monitoring DO and TDG at the Long Lake Dam Tailrace Station.

Attached, please find the LL TDG Report and the LL DO Report for Ecology's review and approval. We would like to receive any comments or recommendations that you may have by March 31, 2021, which will allow us time to file the Report with FERC by April 15, 2021.

Please feel free to contact me at (509) 495-4084 or Meghan Lunney at (509) 495-4643 if you have any questions or wish to discuss the report.

Sincerely,



Chris Moan
Fisheries Habitat Biologist

Enclosures (2)

cc: Brian Crossley, Ecology
Meghan Lunney, Avista

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
4601 N. Monroe Street • Spokane, Washington 99205-1295 • (509) 329-3400

March 24, 2021

Chris Moan
Avista Corp.
1411 East Mission Avenue
PO Box 3727
Spokane, WA 99220

RE: Request for Ecology Review and Approval – Avista 2020 Long Lake Tailrace HED Dissolved Oxygen and Total Dissolved Gas Monitoring Reports – Spokane River FERC Project No. 2545

Dear Chris Moan:

The Department of Ecology (Ecology) has reviewed Avista's submittal of the "2020 Long Lake HED Tailrace Dissolved Oxygen Monitoring Report" and "2020 Long Lake Total Dissolved Gas Monitoring Report." These reports were received by Ecology on February 26, 2021, via email. The reports were completed in accordance with Sections 5.4(D) and 5.6(B) of Ecology's 401 Certification (Certification) and consistent with Spokane River Hydroelectric Project No. 2545 (License) Appendix B.

The critical period of standard exceedance for both dissolved oxygen (DO) and total dissolved gas (TDG) appears to occur late August until the end of the September. It would be helpful to provide language discussing the tradeoff between aeration vs TDG increases during that time. It is not clear in the discussion to what extent aeration is impacting the elevated TDG levels during use. However, perhaps additional monitoring is needed to provide more information on this during times of standard exceedance.

Otherwise, Ecology has no additional comments and **APPROVES** the 2020 Long Lake HED Dissolved Oxygen and Total Dissolved Gas Monitoring Reports.

Please contact me with any questions at (509) 688-9403 or jordan.bauer@ecy.wa.gov.

Sincerely,

Jordan Bauer
Hydropower Compliance Coordinator
Water Quality Program

JB:red
cc: Meghan Lunney, Avista
Monica Ott, Avista
Brian Crossley, Spokane Tribe
Chad Atkins, Ecology

ECOLOGY COMMENTS AND AVISTA RESPONSES

Ecology Comment
Otherwise, Ecology has no additional comments and **APPROVES** the 2020 Long Lake HED Dissolved Oxygen and Total Dissolved Gas Monitoring Reports.

Avista Response
Avista appreciates Ecology's review and approval of the 2020 Long Lake HED Tailrace Dissolved Oxygen Monitoring Report.

1411 East Mission Avenue
PO Box 3727
Spokane, WA 99220-3727

February 26, 2021

Brian Crossley
Water & Fish Program Manager
Spokane Tribe Natural Resources
P.O. Box 480
Wellpinit, WA 99040

Subject: Federal Energy Regulatory Commission's Spokane River Hydroelectric Project License, Appendix B, Sections 5.4 and 5.6.B, TDG and DO Reporting Requirements

Dear Brian:

Ordering Paragraph E of the Federal Energy Regulatory Commission (FERC) Spokane River Hydroelectric Project License incorporated the Washington Department of Ecology (Ecology) Certification Conditions under Section 401 of the Federal Clean Water Act Water Quality Certification (Certification) as Appendix B of the License. Per Sections 5.4 and 5.6.B of the Certification, and the October 2008 Settlement Agreement between Avista and the Spokane Tribe, Avista is submitting the following project status and reports for your review and comment.

Section 5.4: Total Dissolved Gas
There are two components related to Total Dissolved Gas (TDG), which include the following:

- *2020 Long Lake Total Dissolved Gas Monitoring Report*
  Avista completed the Long Lake Dam Spillway Modification Project in December 2016. Following completion of the project, Avista monitored TDG to assess the effectiveness of the modifications and to evaluate spillgate operational protocols. In 2020, Ecology approved Avista's plans to conduct an additional three years on effectiveness monitoring (2020 – 2022) and reporting (2021 – 2023). The enclosed 2020 Long Lake TDG Monitoring Report provides the results the TDG monitoring completed during 2020.

  Avista plans to monitor TDG in 2021 and will work with Ecology to evaluate Long Lake HED's compliance to the requirements of the License.

- *2020 Nine Mile HED Total Dissolved Gas Monitoring Report*
  In February 2012, Ecology approved Avista's request to delay the required TDG monitoring at Nine Mile Dam until Avista completed the turbine units 1 and 2 replacement project and the sediment bypass system upgrade and associated intake deck and trashrack cleaning system. Ecology required TDG monitoring for two years, resuming the first season following the completion of these projects, when flows occur during the 7Q10 median flow of 25,400 cfs or higher at the Spokane gage (USGS 12422500). In 2019, Avista completed one year of TDG monitoring following the completion of these projects.

In 2020, discharge flows at the Spokane gage reached a maximum of 19,400 cfs and did not get near the 7Q10 flows, therefore TDG monitoring was not applicable. Avista plans to monitor TDG in 2021 assuming snowpack and runoff forecasts results in flows reaching the 7Q10 flow to fulfill the second year of required monitoring.

Section 5.6.B: Dissolved Oxygen
The enclosed 2020 Long Lake HED Tailrace Dissolved Oxygen (DO) Monitoring Report (LL DO Report) provides the results of the 2020 DO monitoring immediately downstream of Long Lake Dam for the low-flow period of the year and summarizes the use of draft tube aeration to increase DO levels in the river below the dam's tailrace. Avista plans to continue with the aeration program in 2021 and continue monitoring DO and TDG at the Long Lake Dam Tailrace Station.

Attached, please find the LL TDG Report and the LL DO Report for the Spokane Tribe's review and comment. We would like to receive any comments or recommendations that you may have by **March 31, 2021**, which will allow us time to file the Report with FERC by April 15, 2021.

Please feel free to contact me at (509) 495-4084 or Meghan Lunney at (509) 495-4643 if you have any questions or wish to discuss the report.

Sincerely,

Chris Moan
Fisheries Habitat Biologist

Enclosures (2)

cc: Jordan Bauer, Ecology
Meghan Lunney, Avista

Spokane Tribal Natural Resources
PO BOX 480 • Wellpinit, WA 99040 • (509) 258-9042 • fax 258-9600

MEMORANDUM

TO: **Chris Moan; Avista Corp.**

FROM: **Casey Flanagan, Water & Fish Program**

SUBJECT: **Spokane Tribe Review of Avista 2020 DO, Temperature and TDG Reports**

DATE: **March 31, 2021**

Dear Chris Moan,

The Spokane Tribe of Indians has reviewed Avista's 2020 Long Lake HED Tailrace Dissolved Oxygen Monitoring Report, the 2020 Long Lake Total Dissolved Gas Monitoring Report and the 2020 Long Lake HED Temperature Monitoring Report.

In regards to the Dissolved Oxygen Monitoring Report, the Tribe is optimistic by Avista meeting 8.0mg/L standard 88.8% of the time during generation. We also observed that dissolved oxygen standards were met 57.2% of the time during non-generation. We encourage Avista to look at aeration during non-generation in order to meet the dissolved oxygen standard throughout 24-hour periods in the summer months. We noticed that dissolved oxygen standards were met after Mid-September, but the dam continued to aerate until October 20th; a brief explanation of why that happened would be beneficial to the report.

When reviewing the Total Dissolved Gas Monitoring Report, the Tribe is encouraged to see improvements in TDG due to spillway deflectors installed on Long Lake Dam in 2016. The report shows that TDG concentrations are still above the 110% standard even when the Spokane River flows are below the 7Q10, with 2020 maximum TDG being 114.6% at LLTR. The Tribe recommends Avista to study reducing TDG through gate operations specifically when flows are greater than or equal to 11,000cfs.

The Tribe recognizes in the Lake Spokane Temperature Report that Lake Spokane continues to have issues with temperature in the epilimnion while also having issues with

dissolved oxygen in the hypolimnion in the summer and fall months. This can limit available summer habitat to cold water species in Lake Spokane, as well as downstream of Long Lake Dam on Spokane Indian Reservation waters. The Tribe is interested in reading the report regarding habitat utilization of cold-water species in Lake Spokane. We suggest that the habitat utilization report be included in the appendices or be referenced heavily within the discussion of the temperature report to allow readers to understand Avista's biological optimization justification of Lake Spokane.

If you have any questions regarding the Spokane Tribe's comments, please contact Brian Crossley or Casey Flanagan with the Spokane Tribe's Water and Fish Program.

Sincerely,

C. Flanagan

Casey Flanagan
Water and Fish Project Manager
caseyf@spokanetribe.com

cc: Brent Nichols, Fisheries and Water Division Manager
Brian Crossley, Water & Fish Program Manager
Jordan Bauer, Dept. of Ecology
BJ Kieffer, Director Dept. of Natural Resources
Danny Kieffer, Spokane Tribal Council

SPOKANE TRIBE COMMENTS AND AVISTA RESPONSES

Spokane Tribe Comment
When reviewing the Total Dissolved Gas Monitoring Report, the Tribe is encouraged to see improvements in TDG due to spillway deflectors installed on Long Lake Dam in 2016.

Avista Response
Avista is pleased that the Tribe is encouraged by its efforts to reduce TDG downstream of Long Lake Dam.

Spokane Tribe Comment
The report shows that TDG concentrations are still above 110% standard even when the Spokane River flows are below 7Q10, with 2020 maximum TDG being 114.6% at LLTR. The Tribe recommends Avista to study reducing TDG through gate operations specifically when flows are greater than or equal to 11,000 cfs.

Avista Response
Incoming TDG levels are highly influenced by seasonal and environmental conditions beyond Avista's control. Based upon the 2017, 2018, and 2020 monitoring seasons, the Spokane River above Long Lake Dam experiences higher natural TDG values when flows are above 11,000 cfs. It is important to note that Avista's monitoring data demonstrates the spillway deflectors on Long Lake Dam are most effective at stripping TDG at higher river flows. For example, the incoming TDG was 116.9% when TDG at LLTR reached 114.6%, indicating that Long Lake Dam operations reduced TDG downstream by 2.3%, reducing the impact these naturally high TDG values have on aquatic species downstream.

Avista tested 40 different spillgate scenarios, which included single and multiple gate configurations in accordance with the Revised Long Lake HED TDG Compliance Schedule during 2017 and 2018. Test results during these two years were consistent and demonstrated spreading flows across multiple gates reduces the spillway's influence on TDG downstream. The 40 spillgate configurations exhausted the feasible scenarios that the spillgates would encounter while discharging during the 7Q10 (32,000 cfs). Based on the consistent results of the two years of spillgate testing, and because the potential spillgate scenarios have been exhausted, Avista does not plan to conduct further spillway gate testing.