AVISTA CORPORATION

2019
LONG LAKE
TOTAL DISSOLVED GAS
MONITORING REPORT

WASHINGTON 401 CERTIFICATION, SECTION 5.4(D)

Spokane River Hydroelectric Project
FERC Project No. 2545

Prepared By:

April 14, 2020

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICIES

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®
PDT	Pacific Daylight Time
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 includes the following components: general monitoring; operational changes – spill protocols; structural modifications; and effectiveness monitoring (Figure 1-1).

Avista implemented 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 2019. 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 2019.

This report discusses the results of the TDG monitoring at Long Lake Dam during 2019. A summary of the 2019 data quality is provided in Appendix A and a record of consultation with Ecology and the Spokane Tribe is provided in Appendix B. Additionally, this report proposes future TDG monitoring at Long Lake Dam.

[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 measured and recorded TDG (pressure), optical DO, temperature, and depth sensors 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 instruments were maintained and calibrated by the factory's service department prior to the 2019

[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

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. Avista voluntarily initiated monitoring at LLFB in 2017 and 2018 to substantiate the results seen at LLGEN, but did not monitor at LLFB in 2019.

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 one to three week intervals, beginning in April. Spot measurements were taken across the river from LLTR, at LLTRSP1 (Table 2-1). 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. Before deployment, four MS5s successfully passed the mass verification test, indicating they were operating correctly and providing reliable values. The two MS5s that failed the mass verification test were sent back to Hach for repair. Multiple data collection issues were also encountered at both of the stations monitored in 2019.

- MS5 #48765 was calibrated and deployed at LLTR on March 28 to begin the monitoring season. At the next site visit on April 15, 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 April 15 at 7:00 am, indicated by an over 100 mm Hg drop in the time period between 6:45 am and 7:00 am. TDG data before 6:45 am were included in the final LLTR dataset and data after 6:45 am were flagged and removed. MS5 #48765 was sent into Hach for repairs and it was determined that the TDG sensor needed replacement. Hach replaced the sensor and returned the probe to Avista at the end of May. Probe #48765 was not used for data collection at Long Lake Dam for the remainder of the TDG monitoring season.

- MS5 #60376 was calibrated and deployed at LLGEN on March 28 to begin the monitoring season. At the next site visit on April 15, the MS5 failed TDG calibration, but passed DO, depth, and temperature calibration. During QC of the data during this timeframe, there was no clear indication of when the TDG sensor failed, therefore all TDG data at LLGEN from March 28 and April 15 were flagged and removed from the final dataset. MS5 #60376 was sent into Hach for repairs. Hach determined that the internal barometric sensor was out of calibration and a two-point factory calibration was completed. Probe #60376 was returned to Avista in early June and was not used at Long Lake Dam for the remainder of the TDG monitoring season.

- On May 3, MS5 #64542 and MS5 #65294 were calibrated and deployed at LLGEN and LLTR respectively. At the next site visit on May 17, both MS5s failed DO calibration,

but passed the calibration for TDG and temperature. With no indication of when DO readings became unreliable, DO data at LLGEN and LLTR from May 3 to May 17 were flagged and removed from the final dataset. TDG and temperature data from this time period were included in the final dataset.

- On May 17, MS5 #64542 was recalibrated and deployed at LLGEN. At the next site visit on June 3, the MS5 failed the patency test on the TDG membrane, but passed calibration for DO and temperature. With no indicator of when the membrane failed, TDG data at LLGEN from May 17 to June 3 were flagged and removed from the final dataset. DO and temperature data from this time period were included in the final dataset.

- With multiple MS5s at Hach for repair, Avista did not have enough MS5s to collect data at LLTR or LLGEN from April 15 to May 3. Rental MS5s were obtained, mass verified, and deployed at the standard locations at LLTR and LLGEN on May 3. These rental MS5s were the same make and model of the MS5 used in previous TDG monitoring, except they were not capable of measuring depth. Without depth readings, it could not be verified that these MS5s remained below TDG compensation depth. However, TDG data from these probes was deemed reliable and included in the final dataset since they were deployed at the same depths as the previous MS5s and the water temperature data during this time period indicated that the MS5 were always submerged.

- Only three spot measurements were taken at LLTRSP1 in 2019. The need for Avista's MS5s to undergo manufacturer repair/service limited the availability of a roving MS5s for spot measurements.

3.0 2019 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 2019, use of the Long Lake Dam spillway began for a short duration (30 min) on March 28. The spillway was utilized on a more consistent basis starting on March 31 continuing through June 9. Avista monitored TDG from March 28 through June 9. Discharge at the Long Lake Dam did not exceed the 7Q10 discharge in 2019 (see section 3.1).

The TDG monitoring season included 6,985 15-minute periods (Table 2-2). The MS5s at LLTR were deployed from March 28 to April 15 and then again from May 3 to June 9 and recorded reliable data for 51 – 75% of the sampling season. The MS5s at LLGEN were deployed from March 28 to April 15 and then again from May 3 to June 9 and recorded reliable data for 26 – 75% of the sampling season.

Comparable TDG data pairs from LLTR and LLGEN were collected for 1,796 15-minute data pairs, or 18.7 days, in the 2019 monitoring season. Due to substantial equipment failures, TDG data is not available during peak flows and the seasonal maximum TDG value might not have been captured in 2019.

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 April 15, May 17, and June 3 (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 2019 monitoring period ranged from approximately 6,139 cubic feet per second (cfs) to 24,947 cfs. Spills at Long Lake Dam reached a maximum of approximately 18,217 cfs on April 14, and spill occurred at the dam until June 9. 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 2019.

3.2 Water Temperature

Water temperature during the monitoring period at LLTR reached a low of 6.4 °C in mid-April and a high of 16.2°C in early June (Figure 2-2). Similarly, water temperature measured at LLGEN reached a low of 6.2°C in mid-April and a high of 16.7°C in early 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 710 to 734 mmHg based on the Solonist® barologger deployed at LLTR (Figure 2-2).

3.4 Total Dissolved Gas

TDG % for LLGEN, which is essentially unaffected by spill at Long Lake Dam and represents background TDG, ranged from 106.2 to 114.1 % (Table 2.2 and Figure 2.4). It should be noted, data for LLGEN was available only from May 3 through May 17 and June 3 through June 9. During this timeframe, TDG % at LLGEN exceeded 110 percent of saturation at all times with the exception of May 17 and after June 7.

TDG % at LLTR, which is affected by spill at the dam, ranged from 99.2 to 116.0 % (Table 2-2; Figure 2-4). TDG % for LLTR exceeded 110 percent of saturation from April 9 through April 15, then from May 3 through May 22, and then periodically fell below 110 percent from May 23 to June 9.

Spot values for LLTRSP1 differed from the continuous monitoring data for LLTR by up to 1.8%.

3.5 Dissolved Oxygen

Measured DO concentrations ranged from 9.7 to 13.0 mg/L for LLTR, and 9.6 to 12.6 mg/L for LLGEN (Figure 2-5). The greatest DO concentrations seen in the 2019 data occurred during the peak flow in mid-April, although values remained above the 8.0 mg/L DO criterion throughout the entire monitoring period at both monitoring stations.

4.0 2019 DISCUSSION

The limited data set collected in 2019 prevents a thorough evaluation of the impacts Long Lake Dam had on TDG downstream. The unprecedented number of issues with the MS5s, coupled with the long repair times at Hach, resulted in substantial missing data. A thorough evaluation of the MS5s will be conducted prior to TDG data collection in 2020.

During the limited time TDG data was collected at both stations, TDG % for LLTR was less than background values measured at LLGEN for 83.7% of the time. During the times that TDG at LLTR exceeded LLGEN, it was never more than 1.4% greater (Figure 2-4). Stated differently, the limited data collected in 2019 showed Long Lake Dam's maximum short-term contribution to downstream TDG to be no more than 1.3%.

5.0 CURRENT STATUS

Avista completed the Long Lake Dam Spillway Modification Project in 2016 to reduce the production of excess TDG. Effectiveness monitoring was conducted in 2017, 2018, and 2019 to evaluate spillway gate operational protocols and to assess the effectiveness of the structural modifications.

Spillway Gate Operational Protocol

Initial post-spillway modification gate testing was conducted in 2017 and 2018 to evaluate whether adjusting the number of gates used and how high the gates were opened would influence TDG % trends downstream (Avista 2018). Results showed that spreading out the spill discharge between multiple gates at lower gate heights decreased TDG % downstream when compared to upstream values. Based upon the 2017 and 2018 data, the altered spillway gate operational protocol was adopted for continued implementation following the 2018 spill season and includes opening more gates at a lesser height, ultimately spreading out spill over a greater area.

Structural Modification Effectiveness

Avista has made substantial progress towards reducing TDG following the construction of the spillway modification, as demonstrated by the results of the effectiveness monitoring conducted in 2017 through 2019.

These data show that TDG % at LLTR, which includes water that is spilled over the dam's spillway, were frequently lower than the values from LLGEN and LLFB, at higher river flows. This relationship, seen in both 2017 and 2018, had not been seen in the pre-spillway modification annual monitoring, reinforcing the conclusion that the spillway modification project significantly reduces TDG levels downstream of Long Lake Dam.

The maximum TDG % downstream of the dam before the Spillway Modification Project were frequently above 130% and reached a maximum of 143% in 2012 when discharge reached just over 37,000 cfs. After the Spillway Modification Project, the greatest maximum TDG level downstream reached only 126% in 2017, at a discharge of over 46,000 cfs (a flow greater than the 7Q10).

In 2018, the maximum TDG percent at LLTR was 120%, which was the lowest maximum TDG % seen at LLTR, below 7Q10 flows, since monitoring began in 2003 (Table 2-5). By comparison, discharge flows in 2003, 2004, and 2013 had lower peak discharge flows than seen in 2018, suggesting that TDG percent would be lower. However, for those years, the maximum TDG percent was 129%, 125%, and 126%, respectively. This is compared to a maximum of 120% in 2018. When considering the low maximum TDG % seen in 2017[3] monitoring, especially given 2017 had the 4th highest peak discharge measured on record, the 2017 and 2018 TDG results further substantiate the positive influence the spillway modification project had on TDG levels downstream of the dam.

Furthermore, comparing 2017, 2018, and 2019 data pairs from LLTR and LLGEN, when river flows are less than the Ecology-specified 7Q10 of 32,000 cfs and the TDG % at either LLTR or LLGEN are at or above 110%, TDG % values at LLTR were less than or equal to TDG % values at LLGEN 69% of the time. Stated differently, under these conditions, Long Lake Dam was either not creating or actually reducing TDG for nearly 69% of the monitoring seasons following the Spillway Modification Project and with the new spillway gate operational protocol in place. When LLTR exceeded LLGEN, it was by less than or equal to 1% saturation for over a third of the time, and by less than or equal to 4% saturation nearly 95% of the time. Since mid-April of 2017, the maximum TDG % created by Long Lake Dam was 6.9%, with the average being 2.3%.

Avista has collected TDG data over a range of maximum discharge values, from 28,463 cfs to 46,331 cfs. Avista believes collecting additional TDG data will provide a more thorough understanding of the impact Long Lake HED has on TDG values downstream with the structural modifications and new spillway gate operational protocol in place. Initial conclusions from the available, post-spillway project dataset are outlined below. These conclusions highlight the need to collect further data in an effort to both confirm these observations and further understand the many factors affecting TDG at Long Lake HED (flow, background TDG, environmental conditions, etc.).

- Overall, TDG % at LLTR, LLGEN, and LLFB increase as river flows increase.
- TDG % at LLTR exceed the 110% criterion earlier in the season than at LLGEN and LLFB.
- TDG % at all stations appear to increase/decrease in response to incoming environmental conditions (water temperature, dissolved oxygen).
- Maximum TDG % at LLTR no longer reach the maximum values seen at LLGEN and LLFB prior to the construction of the Spillway Modification Project.

Avista proposes to conduct annual TDG monitoring at Long Lake Dam for an additional three years (2020 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 the requirements of the License and explore the need for additional abatement of TDG levels.

[3] Due to above-average precipitation, spring of 2017 saw the 4th highest peak discharge measured in the Spokane River since measurements began in 1894.

6.0 NEXT STEPS

Given the additional data needs previously discussed, Avista plans to implement the following work:

- 2020: Monitor TDG and other relevant water quality conditions at LLGEN and LLTR during the spill season.
- 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)	3/28/19 13:15	6/9/19 6:45	6,983	3/28/19 12:45	6/9/19 6:45	6,985
Water Temperature (°C)	6.2	16.7	5,242	6.4	16.2	5,256
Dissolved Oxygen (mg/L)	9.6	12.6	5,242	9.7	13.0	4,878
BAR (mm Hg)	Used LLTR BAR			710	734	5,263
TDG (mm Hg)	775	823	1,880	728	833	5,214
TDG (% saturation)[1]	106.2	114.1	1,807	99.2	116.0	5,214

Notes:

1. TDG (% saturation) calculated using site-specific barometric pressure (BAR) data collected at LLTR a

Table 2-3. LLTRSP1 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]
LLTRSP1	4/15/19 13:00	6.4	12.9	820	718	114.2
LLTRSP1	5/17/19 12:15	14.1	10.4	799	715	111.7
LLTRSP1	6/3/19 13:30	15.0	10.6	799	720	111.0

Notes:

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

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	2,460			1,564		
Total # of records	5,211			1,807		
Periods when TDG exceeded 110% saturation (PDT)[1,2]	4/9/2019 15:30	to	4/15/2019 6:45	5/3/2019 13:00	to	5/14/2019 4:45
	5/3/2019 15:30	to	5/4/2019 4:15	5/14/2019 7:45	to	5/16/2019 22:15
	5/4/2019 7:15	to	5/13/2019 2:15	5/17/2019 0:00	to	5/17/2019 0:15
	5/13/2019 10:00	to	5/13/2019 21:45	5/17/2019 1:30	to	5/17/2019 1:45
	5/14/2019 8:30	to	5/17/2019 12:15	6/3/2019 16:45	to	6/4/2019 2:45
	5/17/2019 17:30	to	5/22/2019 1:45	6/4/2019 4:30	to	6/4/2019 4:45
	5/22/2019 17:45	to	5/22/2019 18:00	6/4/2019 7:45	to	6/5/2019 3:00
	5/23/2019 11:45	to	5/23/2019 12:30	6/5/2019 3:30	to	6/6/2019 10:00
	5/23/2019 13:00			6/6/2019 10:45	to	6/6/2019 20:45
	5/23/2019 14:30	to	5/23/2019 14:45			
	5/23/2019 15:45	to	5/23/2019 16:15			
	5/23/2019 17:30					
	5/25/2019 14:00	to	5/25/2019 21:00			
	5/25/2019 21:30	to	5/26/2019 1:45			
	5/26/2019 4:00	to	5/26/2019 21:15			
	5/27/2019 12:00	to	5/27/2019 21:30			
	5/29/2019 14:15	to	5/29/2019 18:15			
	6/2/2019 13:15	to	6/2/2019 19:15			
	6/4/2019 14:45	to	6/4/2019 16:00			
	6/5/2019 13:30	to	6/5/2019 19:00			
	6/5/2019 19:30	to	6/5/2019 22:00			

Notes:

1. Flows did not exceeded the 7Q10 in 2019.
2. Refer to Figure 2-4 and Appendix A for data gaps.

Table 2-5. Maximum discharge flow and TDG% at LLTR, LLGEN, and LLFB.

Year	Max. Discharge (cfs)	Max. TDG%		
		LLTR	LLGEN	LLFB
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

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

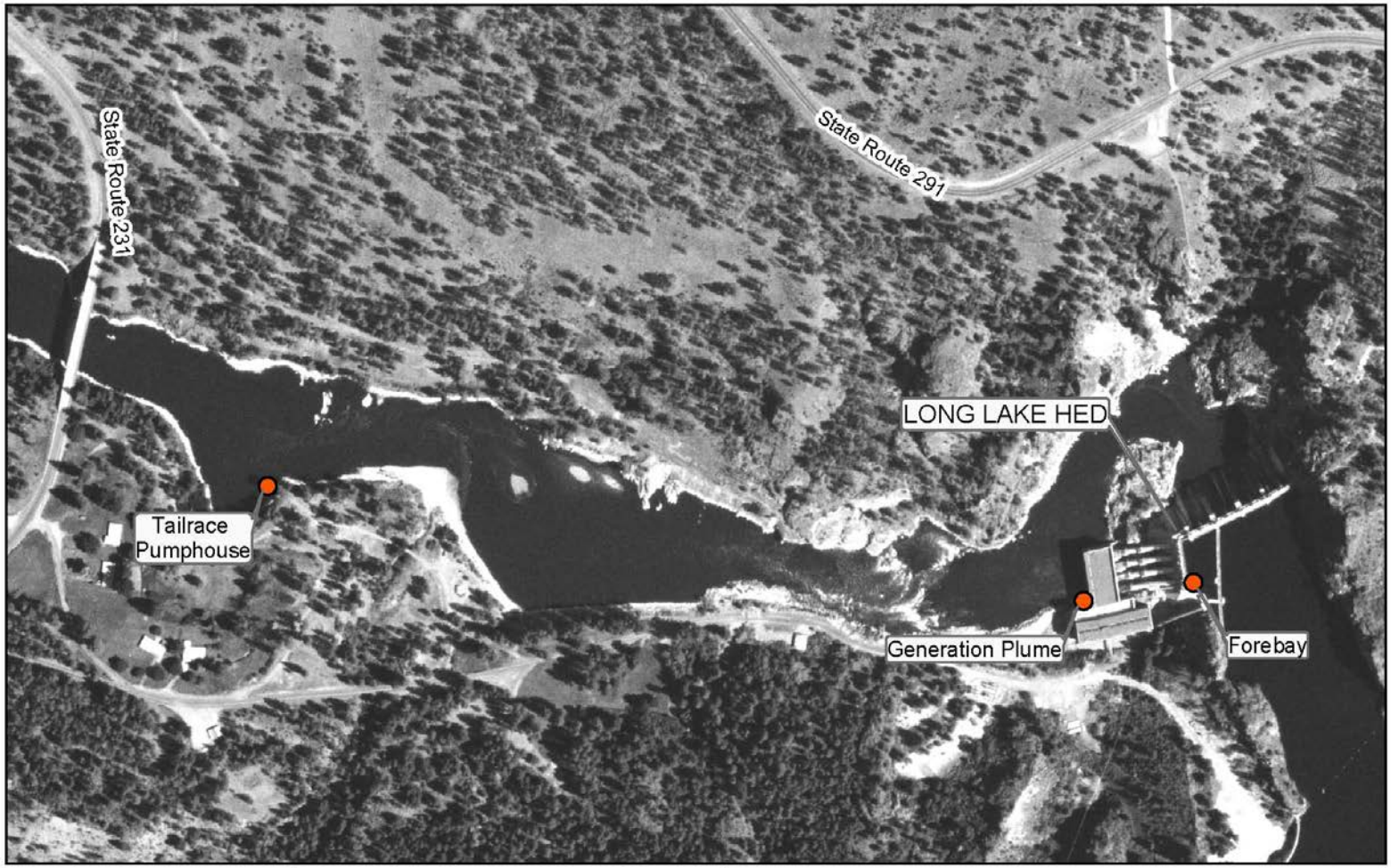
Action	Task	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
General Monitoring	Select/design permanent monitoring stations and develop monitoring plan	M	M										
	Monitor TDG and other relevant water quality conditions at the Unit 4 generation plume (LLGEN) and the tailrace (LLTR) [1]		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: 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.

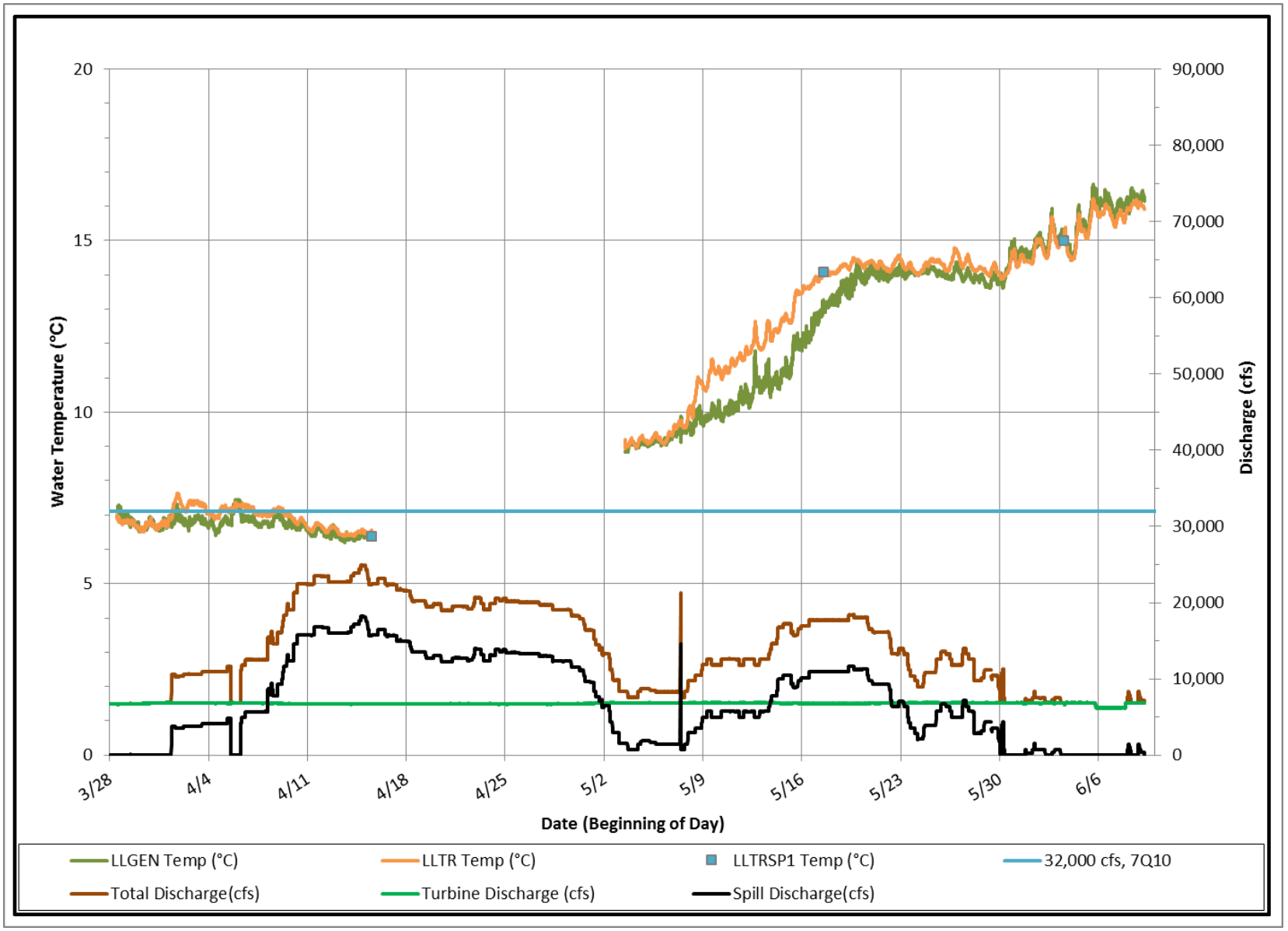


Figure 2-2: Long Lake HED 2019 water temperature (°C) and operations.

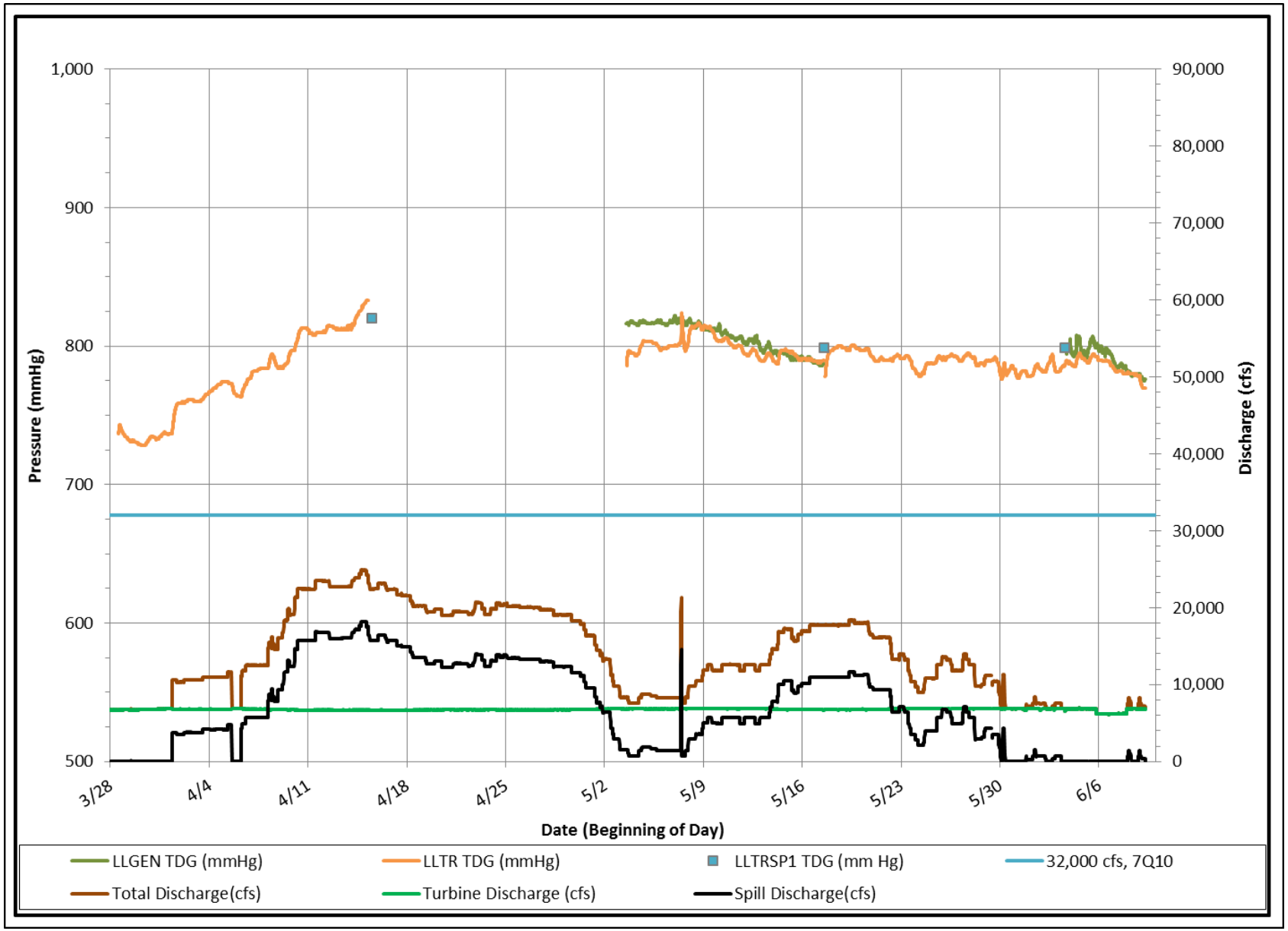


Figure 2-3: Long Lake HED 2019 barometric pressure (mmHg) and operations.

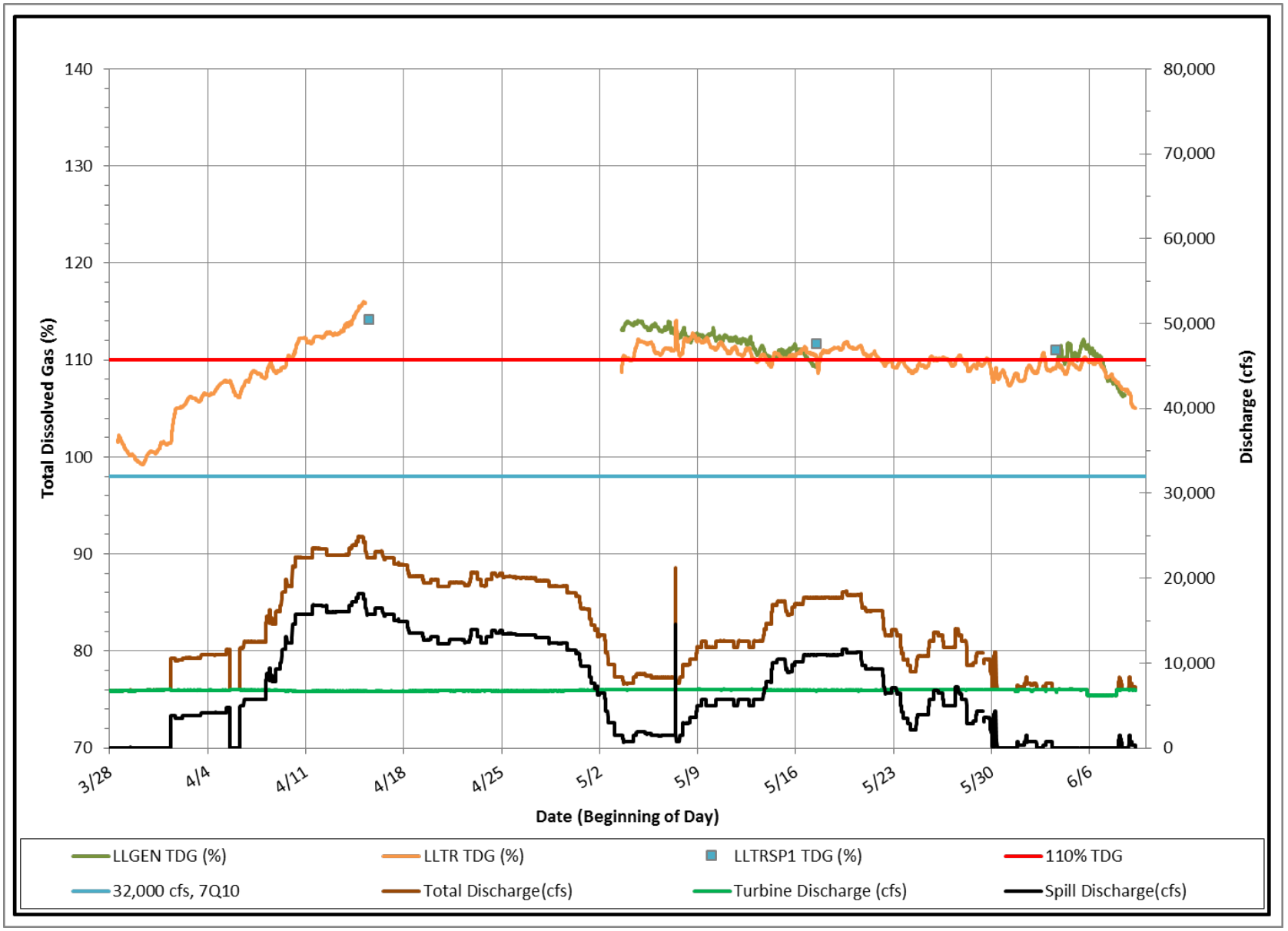


Figure 2-4: Long Lake HED 2019 total dissolved gas (%) and operations.

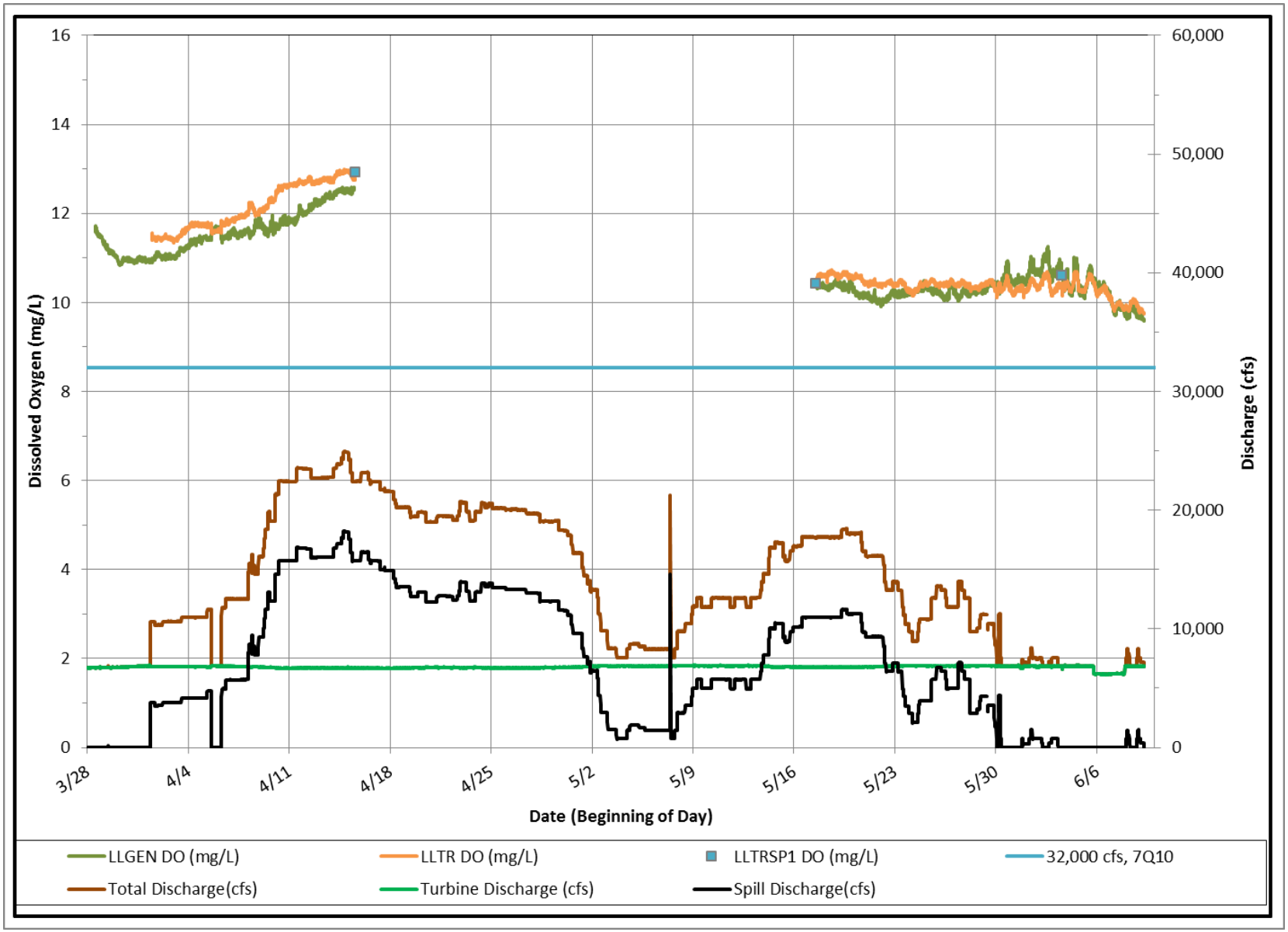


Figure 2-5: Long Lake HED 2019 dissolved oxygen (mg/l) and operations.

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 [4]

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-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

[4] 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
40905	1.00	0.14	0.14	5.59	2	1	1	5	-1.00	-0.86	-0.86	0.59
48762	1.00	0.14	0.14	N/A	2	1	1	5	-1.00	-0.86	-0.86	N/A
48765	1.00	0.14	0.14	N/A	2	1	1	5	-1.00	-0.86	-0.86	N/A
60376	1.00	0.14	0.14	N/A	2	1	1	5	-1.00	-0.86	-0.86	N/A
64542	2.00	0.28	0.28	N/A	2	1	1	5	0.00	-0.72	-0.72	N/A
65294	0.00	0.00	0.00	5.59	2	1	1	5	-2.00	-1.00	-1.00	0.59
Overall RMSE	1.46	0.20	0.20	5.59	2	1	1	5	-0.54	-0.80	-0.80	0.59

[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
40905	0.10	0.00	0.05	0.17	0.5	0.5	-0.40	-0.50	-0.45	-0.33
48762	0.10	0.08	0.11	0.08	0.5	0.5	-0.40	-0.43	-0.39	-0.42
48765	0.60	0.08	0.04	0.07	0.5	0.5	0.10	-0.43	-0.46	-0.43
60376	0.50	N/A	0.05	N/A	0.5	0.5	0.00	N/A	-0.45	N/A
64542	0.10	N/A	0.19	N/A	0.5	0.5	-0.40	N/A	-0.31	N/A
65294	0.16	0.00	0.14	0.17	0.5	0.5	-0.34	-0.50	-0.36	-0.33
Overall RMSE	0.30	0.04	0.11	0.12	0.5	0.5	-0.20	-0.46	-0.39	-0.38

[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) = $\sqrt{\frac{\sum_{i=1}^{n}(x_{1,i}-x_{2,i})^2}{n}}$.

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 and pre-calibration TDG % were met for all meters, whereas the MQO for TDG-Spot was exceeded for meters 40905 and 65294 (Table A-3). All MS5s met the 0.5 mg/L DO MQO for pre-calibration and spot measurements. All MS5s except 48765 met the 0.5°C MQO for temperature (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-4). The TDG data collection period consisted of 6,985 15-minute periods at LLTR and 6,983 at LLGEN. Data completeness was 75 percent for water temperature, barometric pressure, TDG and TDG % at LLTR and 70 percent for dissolved oxygen. Completeness at LLGEN was 75 percent for water temperature and dissolved oxygen and 27 percent for TDG and 26 percent for TDG %.

Table A-5 summarizes the number of specific DQCodes applied to LLTR, LLGEN, and LLFB data.

Table A-4. Project completeness.

	LLGEN		LLTR	
Parameter	**Count**	**Completeness (%)**	**Count**	**Completeness (%)**
Monitoring Period	6,983	--	6,985	--
Water Temperature (°C)	5,242	75%	5,256	75%
Dissolved Oxygen (mg/L)	5,242	75%	4,878	70%
BAR (mm Hg)	Used LLTR BAR		5,263	75%
TDG (mm Hg)	1,880	27%	5,214	75%
TDG (% saturation)	1,807	26%	5,214	75%

Table A-5. 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	5	5	1	5	1	2	2	1	2	0	0	0
998	Out of water after recovery	2	2	1	2	2	5	5	0	5	0	0	0
997	Equilibrating after deployment	0	12	0	0	0	0	15	0	0	0	0	0
994	Parameter not monitored during the monitoring period	0	0	2,983	0	0	0	0	2,988	0	0	0	0
993	Out of water for calibration/servicing	9	9	9	9	9	3	3	3	3	3	0	0
886	Logger not deployed at site	1,725	1,725	1,725	1,725	1,725	1,719	1,719	1,719	1,719	1,719	0	0
666	Unknown	0	0	0	0	0	0	0	0	0	0	2	2
499	Faulty silastic (TDG) membrane	0	1,628	0	0	0	0	0	0	0	0	0	0
497	Faulty TDG sensor	0	0	0	0	0	0	27	0	0	0	0	0
304	Suspect DO value not accurate	1	1,723	1	1	0	0	0	0	378	0	0	0
-211	Depth < TDG compensation depth, but data appear reliable	0	0	0	0	0	0	351	0	0	0	0	0
-990	Depth <0.25 meter, but data appear reliable	0	0	0	0	0	0	200	0	0	0	0	0
-1002	Corresponds with spot measurement	0	0	0	0	0	3	2	1	3	3	0	0
0	No data qualifiers	5,294	1,932	2,316	5,294	5,299	5,232	4,643	2,252	4,875	5,239	6,962	6,962
	Monitoring Period[1]	6,983	6,983	6,983	6,983	6,983	6,985	6,985	6,985	6,985	6,985	6,985	6,985

Notes:

1. Monitoring periods consisted of 3/28/2019 12:45 PDT to 6/9/2018 6:45 PDT for LLTR and 3/28/2019 13:15 PDT to 6/9/2019 6:45 PDT for LLGEN.

APPENDIX B
CONSULTATION RECORD

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

February 28, 2020

Chad Atkins, Water Quality Program
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 Mr. Atkins:

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. In accordance with Section 5.4 and Section 5.6 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:

- *2019 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 spillway gate operational protocols. The enclosed 2019 Long Lake TDG Monitoring Report (LL TDG Report) provides the results of TDG monitoring completed during 2019.

  Additionally, Avista proposes to conduct annual TDG monitoring at Long Lake Dam for another three years (2020 through 2022), following the same Long Lake HED TDG Monitoring Plan and reporting structure used in previous annual monitoring. As the additional monitoring data is collected, Avista will work with Ecology to evaluate Long Lake HED's compliance to the requirements of the License.

- *2019 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 to resume the first season following the completion of these projects.

  Avista has completed one year of TDG monitoring following the completion of these projects. The enclosed 2019 Nine Mile HED Total Dissolved Gas Monitoring Report (NM TDG Report) provides the results of TDG monitoring completed during 2019. Monitoring results demonstrate that Nine Mile Dam added no TDG compared to upstream levels at flows up to 25,489 cfs (as measured at Nine Mile Dam on April 14).

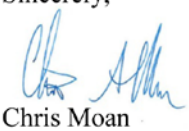
  Avista will monitor TDG in 2020 assuming snowpack and runoff forecasts result in flows reaching the 7Q10 flow.

Section 5.6.B: Dissolved Oxygen
The enclosed 2019 Long Lake HED Tailrace Dissolved Oxygen (DO) Monitoring Report (LL DO Report) provides the results of the 2019 Dissolved Oxygen (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 2020, and to continue monitoring DO and TDG at the Long Lake Dam Tailrace Station.

With this, Avista is submitting the LL TDG Report, the NM 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, 2020**, which will allow us time to file the Report with FERC by April 15, 2020.

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 (3)

cc: Chad Brown, Ecology
Brian Crossley, Spokane Tribe
Meghan Lunney, Avista

From: Bauer, Jordan (ECY) <jbau461@ECY.WA.GOV>

Sent: Friday, April 3, 2020 4:20 PM

To: Moan, Chris

Cc: Lunney, Meghan; Atkins, Chad (ECY)

Subject: [External] RE: Request for Ecology Review and Approval – Avista 2019 Long Lake Total Dissolved Gas Monitoring Report – Section 5.4(D) Spokane River Hydroelectric Project No. 2545

Dear Chris Moan,

The Department of Ecology (Ecology) has reviewed Avista's submittal of the *2019 Long Lake Total Dissolved Gas Monitoring Report*. This report was received by Ecology on February 28, 2020. The report is required in accordance with Section 5.4 (D) of Ecology's 401 Certification (Certification) and consistent with Spokane River Hydroelectric Project No. 2545 (License).

The purpose of this e-mail is to inform you that Ecology ***approves*** this report as meeting all the requirements of reporting defined in Section 5.4 of the Certification. We agree monitoring of TDG at the Long Lake facility should continue for another three years (2020-2022). Due to the data inconsistency experienced in 2019, it would be beneficial to meet and discuss what steps should be considered to ensure data collection improves in 2020 and future monitoring efforts.

Ecology looks forward to future discussions as we continue to work together to evaluate TDG at the Long Lake Dam for compliance to the requirements of the License. Please feel free to contact me with any questions.

Sincerely,

Jordan Bauer
Hydropower Compliance Coordinator
Washington Department of Ecology
Water Quality Program
(509) 590-5486

ECOLOGY COMMENTS AND AVISTA RESPONSES

Ecology Comment
Ecology acknowledged that the 2019 Long Lake HED Total Dissolved Gas Monitoring Report is required in accordance with Section 5.4 (D) of Ecology's 401 Certification (Certification) and consistent with Spokane River Hydroelectric Project No. 2545 (License).

Avista Response
Comment noted.

Ecology Comment
Ecology approves the 2019 Long Lake HED Total Dissolved Gas Monitoring Report as meeting all the requirements of reporting defined in Section 5.4 of the Certification.

Avista Response
Avista appreciates Ecology's approval of the 2019 Long Lake HED Total Dissolved Gas Monitoring Report.

Ecology Comment
We agree monitoring of TDG at the Long Lake facility should continue for another three years (2020-2022). Due to the data inconsistency experienced in 2019, it would be beneficial to meet and discuss what steps should be considered to ensure data collection improves in 2020 and future monitoring efforts.

Avista Response
Avista will continue to monitoring TDG at Long Lake HED annually for another three years (through 2022). Avista looks forward to meeting with Ecology to discuss data collection issues encountered in 2019 and the steps Avista has taken in 2020 to remedy those issues, as well as future monitoring efforts.

Ecology Comment
Ecology looks forward to future discussions as we continue to work together to evaluate TDG at the Long Lake Dam for compliance to the requirements of the License.

Avista Response
Avista looks forward to continued collaboration and discussions with Ecology in evaluating TDG at Long Lake HED.

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

February 28, 2020

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 Mr. Crossley:

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 providing the following updates.

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

- *2019 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 spillway gate operational protocols. The enclosed 2019 Long Lake TDG Monitoring Report (LL TDG Report) provides the results of TDG monitoring completed during 2019.

  Additionally, Avista proposes to conduct annual TDG monitoring at Long Lake Dam for another three years (2020 through 2022), following the same Long Lake HED TDG Monitoring Plan and reporting structure used in previous annual monitoring. As the additional monitoring data is collected, Avista will work with Ecology to evaluate Long Lake HED's compliance to the requirements of the License.

- *2019 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 to resume the first season following the completion of these projects.

  During 2019, Avista completed one year of TDG monitoring following the completion of these projects. Avista plans to monitor TDG in 2020 assuming snowpack and runoff forecasts result in flows reaching the 7Q10 flow.

Section 5.6.B: Dissolved Oxygen
The enclosed 2019 Long Lake HED Tailrace Dissolved Oxygen (DO) Monitoring Report (LL DO Report) provides the results of the 2019 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 2020, and to 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, 2020**, which will allow us time to file the Report with FERC by April 15, 2020.

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: Chad Atkins, Ecology
Meghan Lunney, Avista

Spokane Tribal Natural Resources
P.O. Box 480 • Wellpinit, WA 99040 • (509) 626 - 4400 • fax 258 - 9600

3/31/2020

Chris Moan, Avista Corp.
1411 East Mission Avenue
PO Box 3727 MSC-25
Spokane WA 99220

Dear Chris:

Casey Flanagan, my staff Project Manager, and I have reviewed the 2019 total dissolved gas, dissolved oxygen and temperature monitoring reports. These reports focus on Long Lake Dam and its effects on dissolved oxygen, total dissolved gas and temperature.

The dissolved oxygen (DO) mitigation continues to improve below the dam by an increased quantity of fish sampled. Non-generation dissolved oxygen levels are not adequately characterized and in the last paragraph of the results section it talks about only meeting the DO criteria during generation, whereas the 1st paragraph in the Discussion includes non-aeration times in the determination of success in meeting the 110% criterion. Naturally there would not have been high levels at the site during these time periods. DO was less than the 8 mg/L 49.7% of the non-generation hours and was measured as low as 6.5 mg/L in August.

With respect to Total Dissolved Gas (TDG) the spill deflectors reduce the TDG however the range of TDG measurements was not provided. Reporting TDG similar to DO would be helpful in showing the exceedences of the standards by the percentage of the study period.

Temperature in the Spokane River continues to exceed standards through the summer and fall, which can be detrimental to native salmonid species living within Little Falls Pool and within the Spokane Arm of Lake Roosevelt. During the monitoring period Avista tracked trout in Lake Spokane but no water quality data is provided. An interflow layer exists in Lake Spokane where temperatures are conducive to salmonid rearing however is there enough oxygen within that layer to support their normal activities.

Sincerely,

Brian Crossley
Water & Fish Program Manager
crossley@spokanetribe.com

cc: Patrick McGuire, Dept. of Ecology
BJ Kieffer, Director Dept. of Natural Resources
Danny Kieffer, Tribal Council

SPOKANE TRIBE OF INDIANS COMMENTS AND AVISTA RESPONSES

Spokane Tribe of Indians (STOI) Comment
With respect to Total Dissolved Gas (TDG) the spill defectors reduce TDG however the range of TDG measurements was not provided. Reporting TDG similar to DO would be helpful in showing the exceedance of the standards by the percentage of the study period.

Avista Response
The range of TDG measurements collected and any exceedance of the standard during this timeframe was provided, reported in Section 3.4 of the report. As stated in the report, due to substantial equipment failures, TDG data during 2019 was not available during peak flows and the seasonal maximum TDG value might not have been captured in 2019.

Section 3.4 of the TDG report states the range of TDG values collected at LLGEN and LLTR in 2019. Section 3.4 reads, in part:

> TDG % for LLGEN, which is essentially unaffected by spill at Long Lake Dam and represents background TDG, ranged from 106.2 to 114.1 % (Table 2.2 and Figure 2.4). It should be noted, data for LLGEN was available only from May 3 through May 17 and June 3 through June 9. During this timeframe, TDG % at LLGEN exceeded 110 percent of saturation at all times with the exception of May 17 and after June 7.
>
> TDG % at LLTR, which is affected by spill at the dam, ranged from 99.2 to 116.0 % (Table 2-2; Figure 2-4). TDG % for LLTR exceeded 110 percent of saturation from April 9 through April 15, then from May 3 through May 22, and then periodically fell below 110 percent from May 23 to June 9.

On April 7, 2020, Avista and the Spokane Tribe discussed (via phone) the comments submitted by the Spokane Tribe on March 31, 2020. Avista reviewed the results of the post-spillway modification gate testing conducted in 2017 and 2018 which indicates spreading out the spill discharge between multiple gates at lower gate heights decreases TDG % downstream when compared to upstream values. Avista further reviewed that based upon the 2017 and 2018 data, the altered spillway gate operational protocol was adopted for continued implementation following the 2018 spill season and includes opening more gates at a lesser height, ultimately spreading out spill over a greater area. Avista and the Spokane Tribe agreed to discuss the results of the post-spillway modification gate testing in person, once the coronavirus pandemic has subsided.