AVISTA CORPORATION

2021

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, 2022

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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 2021. A summary of the 2021 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, 60376, and 68481) 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 2021 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 January. 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, seven 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 remaining three MS5s were mass verified at later tests, before they were used for data collection. Data collection issues encountered in 2021 are summarized below with further detail provided in Appendix A.

- MS5 #60376 was calibrated and deployed at LLGEN on January 13 to begin the monitoring season. When the MS5 was retrieved on January 27 for recalibration, data showed that on January 15 the MS5 indicated it had lost power, even though the data showed that it had 11.1 volts of internal and external power at the time of the power loss, and stopped logging data. On January 29, MS5 #60376 was replaced by MS5 #48764 at LLGEN leaving a data gap at LLGEN from January 15 to January 27.

- MS5 #48764 was deployed at LLGEN on January 29, following the power loss issue with MS5 #60376. On February 10, the MS5 was pulled for recalibration and results showed that on February 4, the MS5 indicated it had lost power, even though the data showed that it had 11.1 volts of internal and external power at the time of the power loss, and stopped logging data, resulting in a data gap at LLGEN from February 4 through February 10. Since the power loss issue had occurred on two different MS5s at LLGEN, all future MS5 deployments at the station were connected to external power, but were not connected to the communication electronics that are used to communicate live readings to Long Lake Dam. This power loss issue did not occur again in 2021.

- MS5 #68481 was calibrated and redeployed at LLTR on January 27. At the next site visit on February 10, the MS5 passed TDG, DO, depth, and temperature calibration, but the TDG membrane failed its patency test. The TDG membrane was replaced and the MS5 was redeployed at LLTR. Because there was no clear indication of when the membrane

failed following the January 27 recalibration, all TDG data from January 27 through February 10 was removed from the final data set.

- On February 24, MS5 #60376 was deployed for a spot reading at LLTRSP1. Again MS5 #60376 indicated it had lost power and failed to collect data. After consulting with Hach about the power loss, MS5 #60376 was used successfully to collect a spot reading on March 2. The delay in collecting a sport reading resulted in approximately 20 days between spot readings and calibration of the MS5 at LLTR, instead of the typical 14 days. The MS5 at LLTR met all the calibration qualifications during recalibration on March 2 therefore these data were included in the final data set. MS5 #60376 was removed from use following the spot reading on March 2.

- MS5 #68481 was calibrated and deployed at LLTR on March 10. At the next site visit on March 24, the MS5 passed DO, depth, TDG, and temperature calibration. Upon review of the DO data during QC, DO data collected between March 10 at 11:45 and March 14 at 12:30 showed extreme variability between 15-minute readings. This variability was not corroborated by the other parameters collected at this time (TDG, temperature, depth, dam operations) indicating that this variability seen in the DO readings were most likely not representative of the natural environment and were eliminated from the final data set.

- MS5 #68481 was calibrated and deployed at LLTR on June 1. At the next site visit on June 16, the MS5 passed DO, depth, TDG, and temperature calibration. Upon review of the DO data during QC, DO data collected between June 1 at 13:00 and June 2 at 15:15 and again from June 7 at 9:00 to June 15 at 9:00 showed extreme variability between 15-minute readings. This variability was not corroborated by the other parameters collected at this time (TDG, temperature, depth, dam operations) indicating that this variability seen in the DO readings were most likely not representative of the natural environment and were eliminated from the final data set.

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 2021, use of the Long Lake Dam spillway began for a short duration from January 17 through January 25. Spilling did not occur again until April 10 and continued consistently through May 23. After May 23, spilling occurred intermittently until June 10. Avista monitored TDG from January 13 through June 16. Discharge at the Long Lake Dam did not exceed the 7Q10 discharge in 2021 (see section 3.1).

The TDG monitoring season included 14,784 15-minute periods at LLTR and 14,779 at LLGEN (Table 2-2). The MS5s were deployed from January 13 to June 16 and recorded reliable data for 90 – 100% of the sampling season at LLTR and 87 - 88% 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 January 27, February 10, March 2 and 10, April 8 and 21, May 4 and 19, and June 1 and 16

(Table 2-3). Spot measurements were collected at LLTR on March 24 (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 2021 monitoring period ranged from approximately 210 cubic feet per second (cfs) to 17,460 cfs and spills at Long Lake Dam reached a maximum of approximately 10,630 cfs on May 10. Maximum spill and discharge occurred on May 10 when Avista conducted a FERC required spill gate test, where one gate was raised to its maximum opening for a short period of time (less than 5 minutes). Under normal dam operations, discharge ranged from 210 – 14,133 cfs and maximum spill was 7,202 on May 4. Overall, spill occurred at the dam until June 10. 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 2021.

3.2 Water Temperature

Water temperature during the monitoring period at LLTR reached a low of 3.6 °C in mid-February and a high of 17.0°C in mid-June (Table 2-2; Figure 2-2). Similarly, water temperature measured at LLGEN reached a low of 3.1°C in mid-February and a high of 17.0°C in mid-June. Water temperatures remained low 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 712 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 0.8 mmHg on average (Figure 2-3). Spot values for LLTRSP1 coincided with the continuous monitoring data for LLTR, ranging in difference from 0-9 mmHg and an average of 3 mmHg.

TDG percent values for LLGEN, which is essentially unaffected by spill at Long Lake Dam, exceeded 110 percent of saturation at times between April 21 and April 26, then for short periods of time on May 6, and then at times between May 14 and May 19. The TDG percent values at LLGEN ranged from 96.1 to 114.4 percent. TDG percent at LLTR, which is affected by spill at the dam, exceeded 110 percent of saturation at times from April 21 to April 25, then for short periods of time on May 4, then consistently from May 5 through May 6, then at times between May 9 and 10, for a short period of time on May 15, then at times between May 16 to May 19. TDG percent values at LLTR ranged from 96.2 to 112.5 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 2021

monitoring season, maximum total discharge (spill plus turbine discharge) was 17,460 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 8.8 to 12.3 mg/L for LLTR, and 9.2 to 12.3 mg/L for LLGEN (Table 2-2; Figure 2-5). Peak DO concentrations during the 2021 monitoring period occurred from late January through mid-February and then again in mid-April. DO values remained above the 8.0 mg/L DO criterion throughout the entire monitoring period at both monitoring stations.

4.0 DISCUSSION

Overall, 2021 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, 2019, 2020, 2021), 2021 TDG levels at LLTR were frequently less than the TDG levels at LLGEN for portions of the monitoring season. In 2021, TDG % at LLTR was less than or equal to background values measured at LLGEN for 61.5% of the monitoring season. During the times that TDG at LLTR exceeded LLGEN, it was never more than 2.1% greater (Figure 2-4). At times when TDG % at LLTR was greater than 110%, TDG % at LLTR was less than or equal to LLGEN 53.1% of the 736 15-minute data pairs and was never more than 1.6% greater than LLGEN. TDG levels at LLTR did not reach the maximum values seen at LLGEN.

Comparison of the TDG % at LLTR and spill discharges for 2021 indicates TDG % was greater than the 110 percent criterion 23% of the time when spills were between 5,000 and 11,000 cfs, 11% of the time when spill was less than 5,000 cfs, and 0% of the time when no spill occurred (Table 2-5). Spill did not exceed 11,000 cfs in 2021. 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 3% of the data pairs with spill of less than 5,000 cfs and 23% when spill was between 5,000 and 11,000 cfs.

In 2021, the maximum TDG % at LLTR was 112.5% and the maximum TDG % at LLGEN was 114.4%. These values are the lowest maximum TDG percent values measured at each station since monitoring began in 2003 (Table 2-6). Additionally, the 2021 data corresponds with the data from 2018 and 2020 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 during 2022. The same Long Lake HED TDG Monitoring Plan and reporting structure will be utilized as in previous annual monitoring. Following the same monitoring plan will allow for the data to be directly comparable to the previously collected data.

Following the 2022 spill season and data collection efforts, Avista will consult with Ecology to determine whether the effectiveness monitoring should be extended. The goal of the three-year monitoring extension (2020 – 2022) was to obtain additional data at flows near the 7Q10 (32,000 cfs), where there is limited data following completion of the spillway modification. Total discharge during 2020 and 2021 only reached 21,835 cfs and 14,133[3] cfs (with maximum spill recorded at 18,217 cfs and 7,202 cfs), respectively. Pending flows during 2022, Avista may have a limited data set to complete the effectiveness evaluation of the TDG project. 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:

- 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 parameters at LLGEN and LLTR during the spill season.

  Following the 2022 spill season, Avista and Ecology will meet to discuss additional effectiveness monitoring needs.

- 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.

[3] A discharge of 17,460 cfs was reached in 2021 during a FERC required gate test conducted on May 10. It was not considered representative of the natural conditions in 2021, lasting 5 minutes.

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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)	1/13/21 13:15	6/16/21 11:45	14,779	1/13/21 12:45	6/16/21 12:30	14,784
Water Temperature (°C)	3.1	17.0	12,956	3.6	17.0	14,760
Dissolved Oxygen (mg/L)	9.2	12.3	12,956	8.8	12.3	13,499
BAR (mm Hg)	Used LLTR BAR			712	737	14,770
TDG (mm Hg)	701	819	12,918	704	805	13,343
TDG (% saturation)[1]	96.1	114.4	12,917	96.2	112.5	13,343

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]
LLTRSP1	1/27/21 10:45	4.3	11.7	736	714	103.1
LLTRSP1	2/10/21 11:30	4.5	12.2	728	726	100.3
LLTRSP1	3/2/21 12:00	4.1	11.8	723	721	100.3
LLTRSP1	3/10/21 10:15	5.7	11.4	724	721	100.5
LLTR	3/24/21 11:30	6.9	11.6	744	718	103.6
LLTRSP1	4/8/21 11:45	7.0	11.9	765	723	105.8
LLTRSP1	4/21/21 11:15	8.7	12.1	794	724	109.7
LLTRSP1	5/4/21 11:30	10.8	11.3	801	725	110.5
LLTRSP1	5/19/21 11:15	13.3	11.1	796	722	110.2
LLTRSP1	6/1/21 11:15	14.7	10.0	767	724	105.9
LLTRSP1	6/16/21 11:30	16.2	9.5	760	730	104.1

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	828			960		
Total # of records	13,343			12,917		
Periods when TDG exceeded 110% saturation (PDT)[1,2]	4/21/2021 15:15	to	4/22/2021 2:15	4/21/2021 16:15	to	4/23/2021 4:45
	4/22/2021 9:15	to	4/22/2021 22:45	4/23/2021 8:15	to	4/23/2021 9:30
	4/23/2021 12:15	to	4/25/2021 23:15	4/23/2021 12:15	to	4/26/2021 19:00
	5/4/2021 8:30	to	5/4/2021 12:30	4/26/2021 19:45		
	5/4/2021 14:45	to	5/4/2021 19:00	5/6/2021 9:15	to	5/6/2021 9:45
	5/4/2021 21:00			5/6/2021 10:15	to	5/6/2021 22:30
	5/5/2021 10:15	to	5/7/2021 0:00	5/14/2021 14:15	to	5/15/2021 0:00
	5/9/2021 9:45	to	5/9/2021 22:00	5/15/2021 5:00	to	5/15/2021 6:00
	5/10/2021 14:00	to	5/10/2021 17:00	5/15/2021 10:30	to	5/15/2021 10:45
	5/10/2021 18:00	to	5/10/2021 18:15	5/15/2021 11:30	to	5/19/2021 11:30
	5/15/2021 16:00	to	5/15/2021 20:45	5/19/2021 15:00	to	5/19/2021 15:45
	5/16/2021 10:00	to	5/18/2021 7:00			
	5/18/2021 8:00	to	5/18/2021 10:00			
	5/19/2021 4:15	to	5/19/2021 4:45			
	5/19/2021 6:15	to	5/19/2021 12:15			

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	0	0	0%	0	0	0%
5-11 kcfs spill	961	219	23%	956	216	23%
<5 kcfs spill	4,793	523	11%	4,042	129	3%
No spill	7,583	0	0%	7,129	0	0%
All spill and non-spill	13,337	742	6%	12,127	345	3%

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 [2]	Max. Discharge (cfs)	Max. TDG%		
		LLTR	LLGEN [1]	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	-
2021 [3]	14,133	113	114	-

Notes:

(1) LLGEN was not monitored in 2003, 2004, and 2011; LLFB was not monitored in 2010, 2020 or 2021.

(2) Data from 2019 is not included in the table because monitoring difficulties resulted in TDG data not being collected during 2019's maximum discharge.

(3) A discharge of 17,460 cfs was reached in 2021, however it was not considered representative of the natural conditions, or the maximum discharge, since it was due to a FERC required short-term gate test.

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

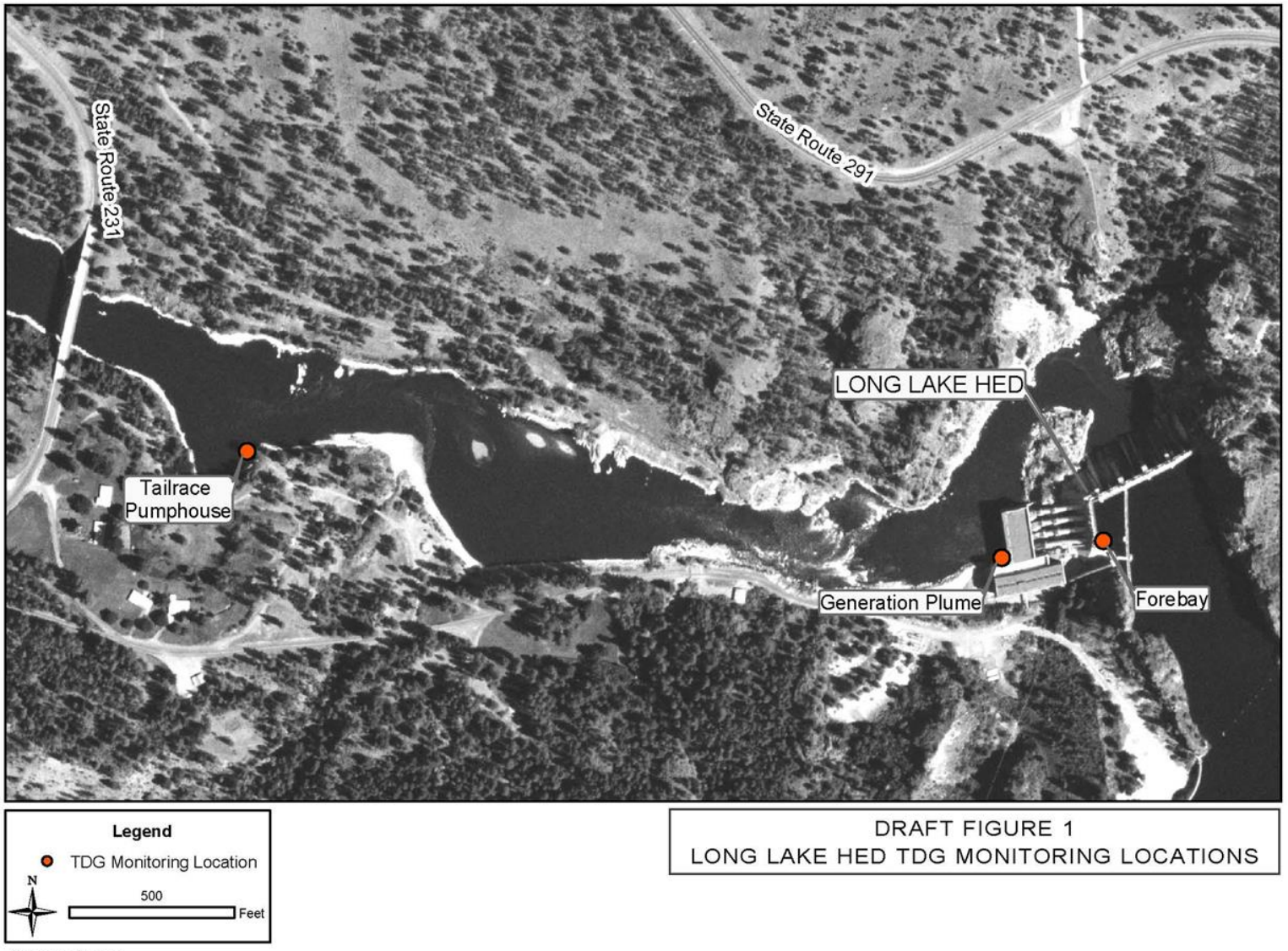
Notes

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.

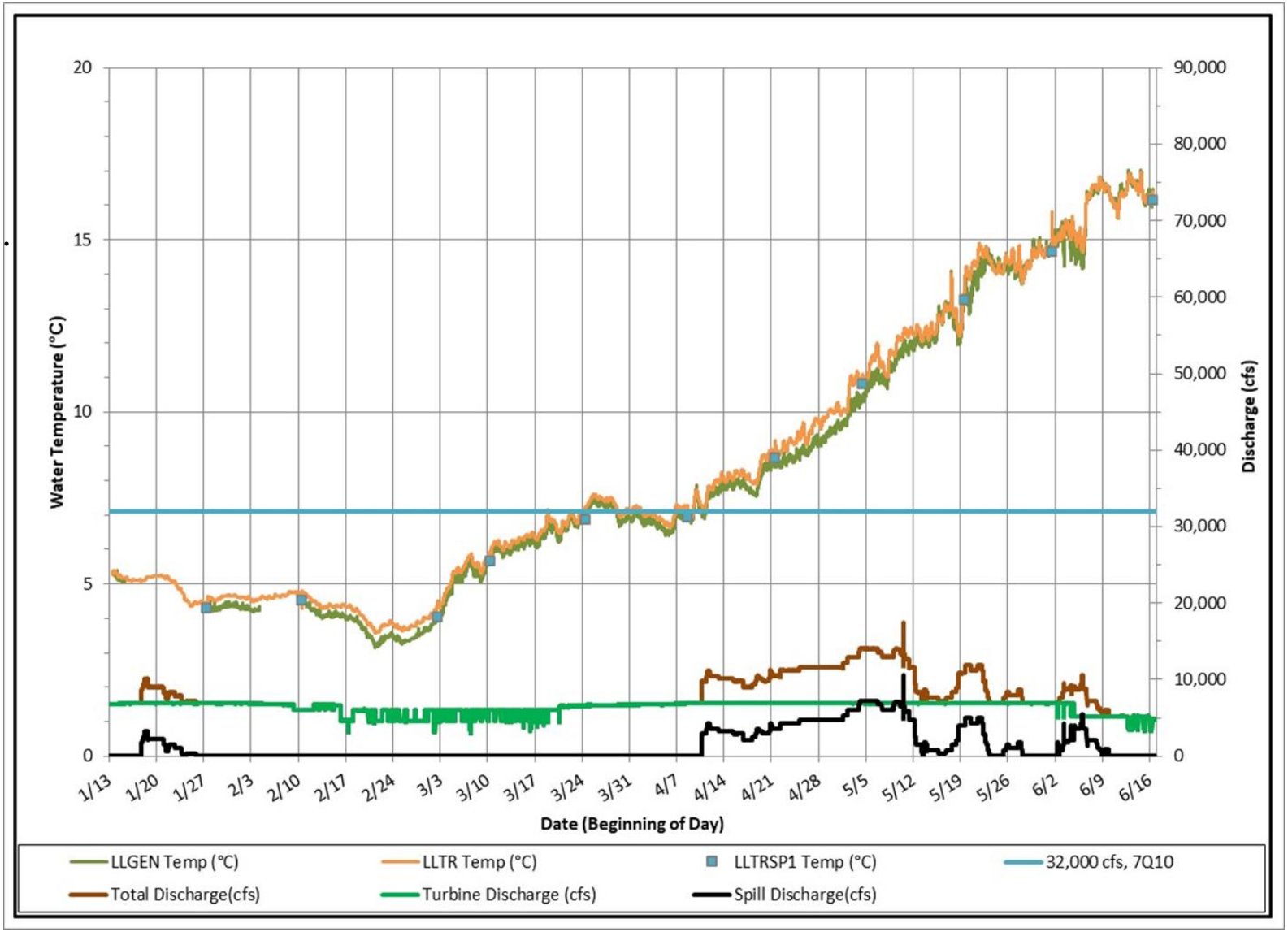


Figure 2-2: Long Lake HED 2021 water temperature (°C) and operations

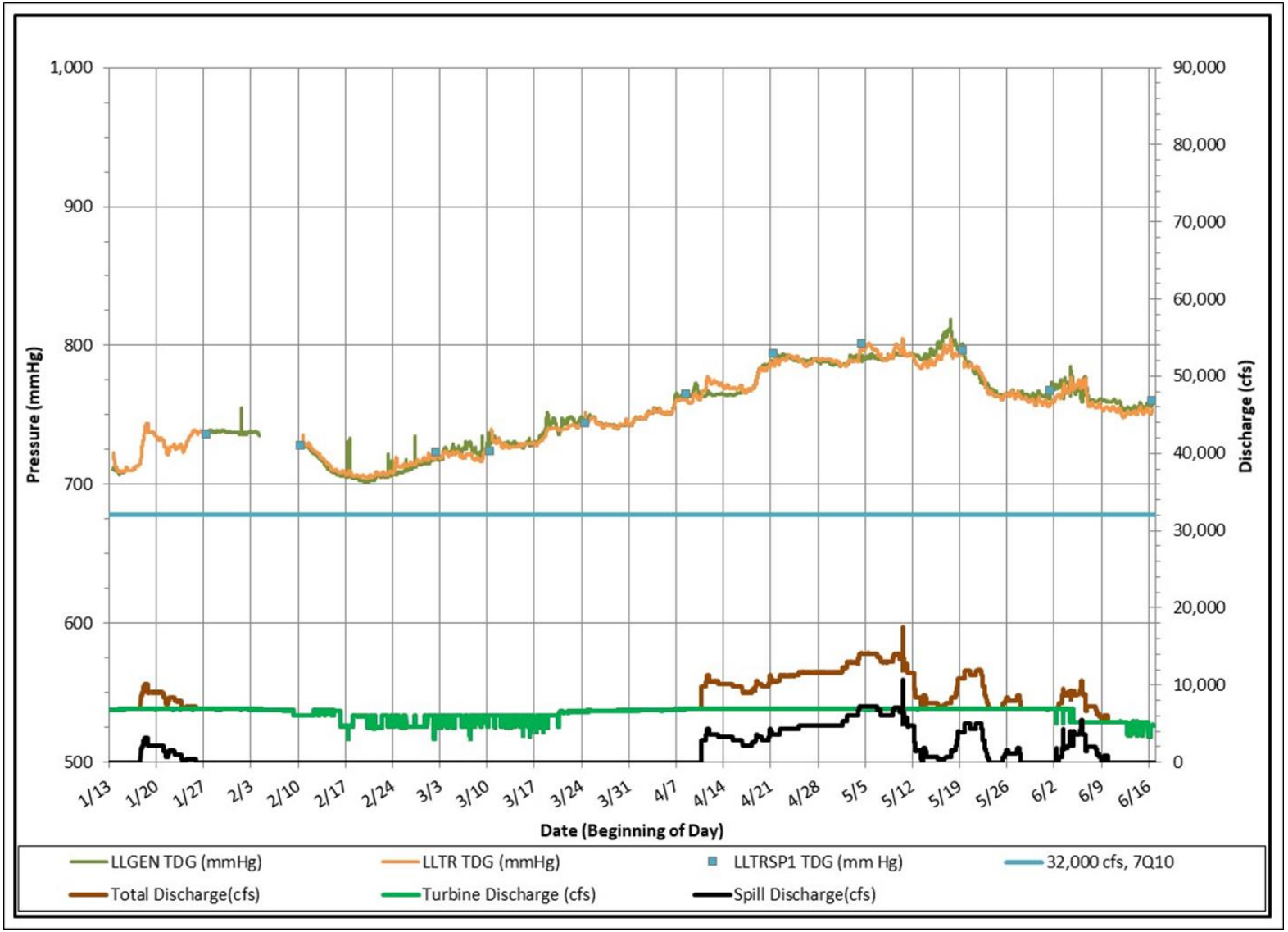


Figure 2.3. Long Lake HED 2021 barometric pressure (mmHg) and operations.

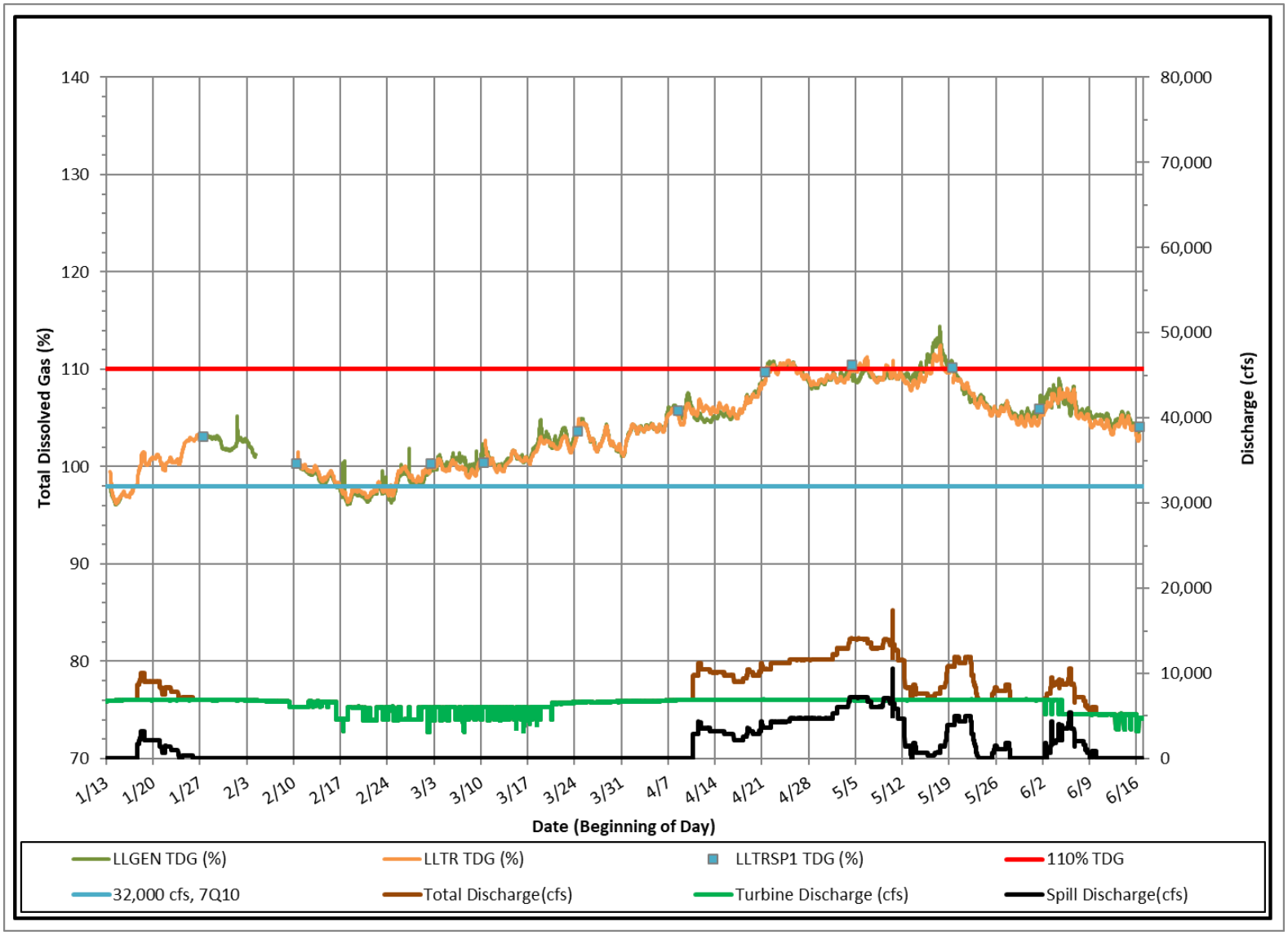


Figure 2-4: Long Lake HED 2021 total dissolved gas (%) and operations.

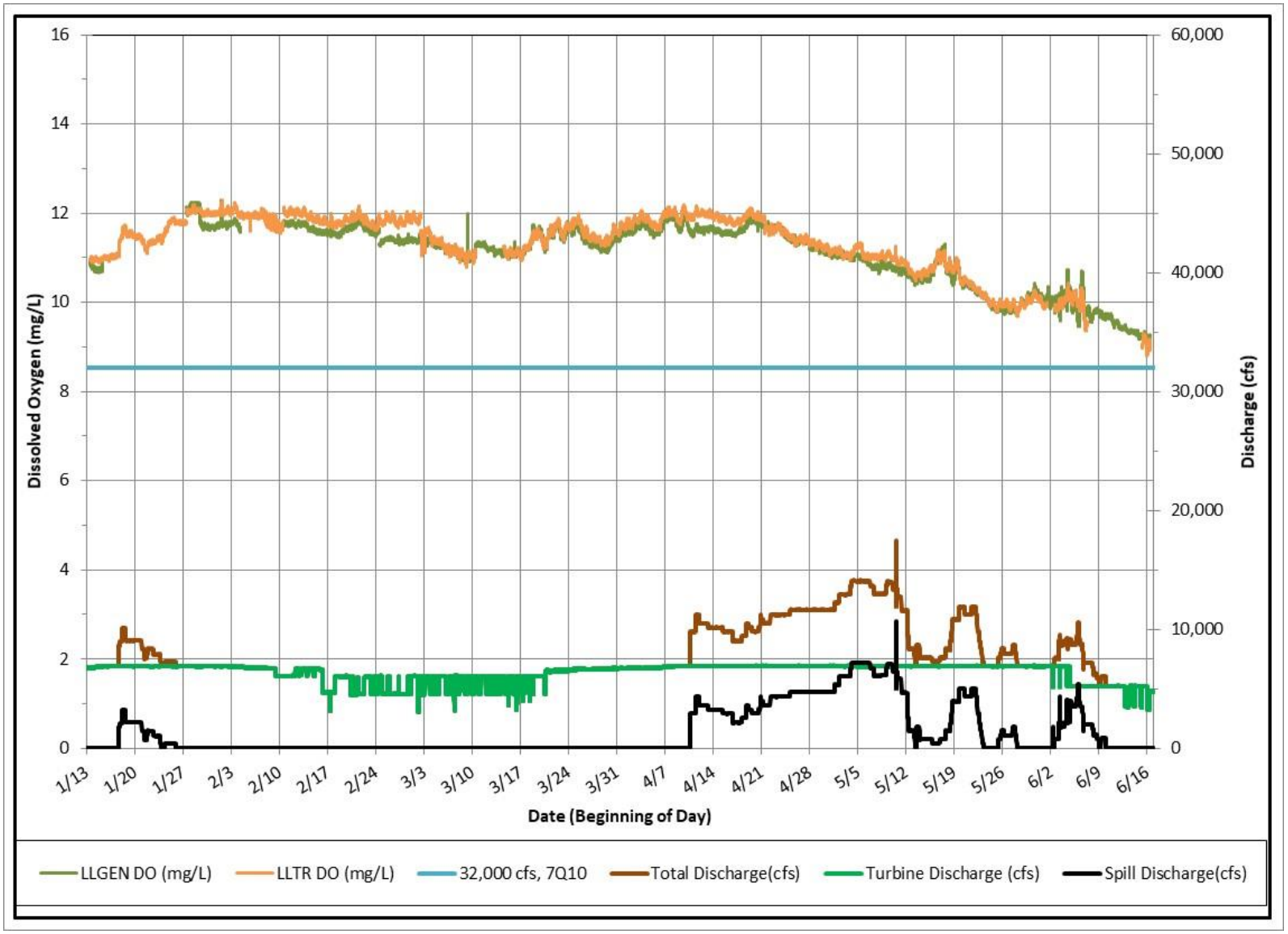


Figure 2-5: Long Lake HED 2021 dissolved oxygen (mg/l) and operations.

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-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

[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
48762	1.69	0.23	0.23	2.69	2	1	1	5	-0.31	-0.77	-0.77	-2.31
48764	1.83	0.25	0.25	0.50	2	1	1	5	-0.17	-0.75	-0.75	-4.50
68481	2.39	0.33	0.33	2.28	2	1	1	5	0.39	-0.67	-0.67	-2.72
48763	1.00	0.14	0.14	1.00	2	1	1	5	-1.00	-0.86	-0.86	-4.00
60376	0.82	0.11	0.11	0.50	2	1	1	5	-1.18	-0.89	-0.89	-4.50
Overall RMSE	1.93	0.27	0.27	1.39	2	1	1	5	-0.07	-0.73	-0.73	-3.61

[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	0.05	0.11	0.09	0.11	0.5	0.5	-0.45	-0.39	-0.41	-0.39
48764	0.07	0.06	0.11	0.04	0.5	0.5	-0.43	-0.44	-0.39	-0.47
68481	0.10	0.12	0.07	0.22	0.5	0.5	-0.40	-0.38	-0.43	-0.28
48763	0.06	0.15	0.08	0.33	0.5	0.5	-0.44	-0.36	-0.42	-0.17
60376	0.07	0.15	0.18	0.13	0.5	0.5	-0.43	-0.35	-0.32	-0.37
Overall RMSE	0.08	0.12	0.10	0.17	0.5	0.5	-0.42	-0.38	-0.40	-0.33

[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 2021.

Deployment Timeframe	LLTR	LLGEN	LLTRSP1
1/13 - 1/29	68481	60376	48764
1/29 - 2/10	68481	48764	60376
2/10 - 2/24	68481	48764	60376
2/24 - 3/02	68481	48764	60376
3/02 - 3/10	68481	48764	48763
3/10 - 3/24	68481	48764	48762
3/24 - 4/08	68481	48764	48762
4/08 - 4/21	68481	48764	48762
4/21 - 5/4	68481	48764	48762
5/4 - 5/19	68481	48764	48762
5/19 - 6/1	68481	48764	48762
6/1 - 6/16	68481	48764	48762

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, and all but MS5 #68481 met the MQO for barometric pressure (Table A-3). All MS5s met the 0.5 mg/L DO

MQO for pre-calibration and 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 14,784 15-minute periods at LLTR and 14,779 at LLGEN. Data completeness was 100 percent for water temperature, 91 percent for dissolved oxygen, 100 percent of barometric pressure, and 90 percent for TDG and TDG % at LLTR. Completeness at LLGEN was 88 percent for water temperature and dissolved oxygen, and 87 percent for TDG and TDG %.

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

Table A-5. Project completeness.

	LLGEN		LLTR	
Parameter	**Count**	**Completeness (%)**	**Count**	**Completeness (%)**
Monitoring Period	14,779	--	14,784	--
Water Temperature (°C)	12,956	88%	14,760	100%
Dissolved Oxygen (mg/L)	12,956	88%	13,499	91%
BAR (mm Hg)	Used LLTR BAR		14,770	100%
TDG (mm Hg)	12,918	87%	13,342	90%
TDG (% saturation)	12,917	87%	13,342	90%

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)
1001	Mass verification at location other than long-term monitoring station	14	14	14	14	14	0	0	0	0	0	0	0
999	Instrument logging data before deployment at monitoring station	16	16	16	16	16	2	2	2	2	2	0	0
998	Out of water after recovery	9	9	9	9	9	3	3	3	3	3	0	0
997	Equilibrating after deployment	0	38	0	0	0	10	78	0	8	0	0	0
993	Out of water for calibration/servicing	18	18	18	18	18	9	9	9	9	9	0	0
888	Power loss	1,767	1,767	1,767	1,767	1,767	0	0	0	0	0	0	0
666	Unknown	0	0	0	0	0	0	0	0	0	0	1	7
499	Faulty silastic (TDG) membrane	0	0	0	0	0	0	1,350	0	0	0	0	0
304	Suspect DO value not accurate	0	0	0	0	0	0	0	0	1,263	0	0	0
-1002	Corresponds with spot measurement	0	0	0	0	0	11	10	11	11	11	0	0
0	No data qualifiers	13,004	12,966	13,004	13,004	13,004	9,027	7,629	9,034	8,641	9,034	9,048	9,046
	Monitoring Period[1]	14,779	14,779	14,779	14,779	14,779	14,784	14,784	14,784	14,784	14,784	14,784	14,784

Notes:

1. Monitoring periods consisted of 1/13/2021 12:45 PDT to 6/16/2021 12:30 PDT for LLTR and 1/13/2021 13:15 PDT to 6/16/2021 11:45 PDT for LLGEN.

APPENDIX B
CONSULTATION RECORD

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

February 28, 2022

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:

- *2021 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 2021 Long Lake TDG Monitoring Report provides the results of the TDG monitoring completed during 2021.

  Avista plans to monitor TDG during 2022, however pending flows Avista may have a limited data set to complete the effectiveness evaluation of the TDG project. Following the 2022 spill season, Avista will work with Ecology to evaluate Long Lake HED's compliance with requirements of the License and explore the need for additional effectiveness monitoring in order to obtain TDG data at flows near the 7Q10 median flow of 32,000 cfs, where there is limited data following completion of the spillway modification.

- *2021 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 2021, discharge flows at the Spokane gage reached a maximum of 13,600 cfs and did not get near the 7Q10 flows, therefore TDG monitoring was not applicable. Avista plans to monitor TDG in 2022 assuming snowpack and runoff forecasts results in flows reaching the 7Q10 flow to fulfill the second year of the required monitoring.

Section 5.6.B: Dissolved Oxygen
The enclosed 2021 Long Lake HED Tailrace Dissolved Oxygen (DO) Monitoring Report provides the results of the 2021 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 2022 and continue monitoring DO and TDG at the Long Lake Dam Tailrace Station.

The 2021 Long Lake TDG Monitoring Report and the 2021 Long Lake HED DO Tailrace Monitoring Report are enclosed for Ecology's review and approval. We would like to receive any comments or recommendations that you may have by **March 31, 2022**, which will allow us time to file the reports with FERC by April 15, 2022.

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, Spokane Tribe
Meghan Lunney, Avista

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

March 22, 2022

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

RE: Request for Ecology Review and Approval – Avista 2021 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 "2021 Long Lake HED Tailrace Dissolved Oxygen Monitoring Report" and "2021 Long Lake Total Dissolved Gas Monitoring Report." These reports were received by Ecology on February 28, 2022, 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.

Spring runoff in 2021 did not come near the 7Q10 flows which still leaves holes in the total dissolved gas (TDG) dataset needed to assess the effectiveness of TDG abatement modifications at Long Lake Dam. Avista has one more spill year (2022) to conduct effectiveness monitoring with the goal of capturing higher flows before the three additional years of monitoring approved by Ecology is complete. Ecology agrees on meeting after the 2022 spill season to discuss next steps and whether additional monitoring is needed to evaluate the TDG abatement modification. Please consult with Ecology once runoff and forecasts stabilize to schedule the meeting.

In terms of the Long Lake Dam tailrace monitoring, dissolved oxygen (DO) and temperature continue to exceed standards during low flow periods of the year. A new compliance schedule for the Lake Spokane Temperature and Dissolved Oxygen Attainment Plans (WQAP) are being developed which will incorporate improvement measures and ensure a biological protective balance upstream and downstream of Long Lake Dam. Improvements made upstream will seek to reduce temperatures and the need for aeration for depleted DO to the downstream tailrace waters. Approvable WQAPs are scheduled for submittal to Ecology later this year.

Chris Moan
March 22, 2022
Page 2

Ecology has no additional comments and APPROVES the 2021 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
Spring runoff in 2021 did not come near the 7Q10 flows which still leaves holes in the total dissolved gas (TDG) dataset needed to assess the effectiveness of TDG abatement modifications at Long Lake Dam. Avista has one more spill year (2022) to conduct effectiveness monitoring with the goal of capturing higher flows before the three additional years of monitoring approved by Ecology is complete. Ecology agrees on meeting after the 2022 spill season to discuss next steps and whether additional monitoring is needed to evaluate the TDG abatement modification. Please consult with Ecology once runoff and forecasts stabilize to schedule the meeting.

Avista Response
Avista will schedule a meeting with Ecology following the 2022 spill season to discuss next steps and future TDG monitoring needs.

Ecology Comment
Ecology has no additional comments and **APPROVES** the 2021 Long Lake HED Dissolved Oxygen and Total Dissolved Gas Monitoring Reports.

Avista Response
Avista appreciates Ecology's review and approval of the 2021 Long Lake Total Dissolved Gas Monitoring Report.

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

February 28, 2022

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:

- *2021 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 2021 Long Lake TDG Monitoring Report provides the results of the TDG monitoring completed during 2021.

  Avista plans to monitor TDG in 2022, however pending flows Avista may have a limited data set to complete the effectiveness evaluation of the TDG project. Following the 2022 spill season, Avista will work with Ecology to evaluate Long Lake HED's compliance with requirements of the License and explore the need for additional effectiveness monitoring in order to obtain TDG data at flows near the 7Q10 median flow of 32,000 cfs, where there is limited data following completion of the spillway modification.

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  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 2021, discharge flows at the Spokane gage reached a maximum of 13,600 cfs and did not get near the 7Q10 flows, therefore TDG monitoring was not applicable. Avista plans to monitor TDG in 2022 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 2021 Long Lake HED Tailrace Dissolved Oxygen (DO) Monitoring Report provides the results of the 2021 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 2022 and continue monitoring DO and TDG at the Long Lake Dam Tailrace Station.

The 2021 Long Lake TDG Monitoring Report and the 2021 Long Lake HED DO Tailrace Monitoring Report are enclosed for the Spokane Tribe's review and comment. We would like to receive any comments or recommendations that you may have by **March 31, 2022**, which will allow us time to file the reports with FERC by April 15, 2022.

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
P.O. Box 480 ● Wellpinit, WA 99040 ● (509) 626 - 4400 ● fax 258 - 9600

3/24/2022

Chris Moan
1411 East Mission Avenue
PO Box 3727 MSC-25
Spokane WA 99220

Dear Chris:

I have reviewed the 2021 total dissolved gas and dissolved oxygen reports with the assistance of Brian Crossley, Water & Fish Program Manager. These reports focus on Long Lake Dam and its effects on dissolved oxygen and total dissolved gas. In 2016, the spill deflectors were installed on Long Lake Dam and improvements in overall total dissolved gas concentrations during spring flows have been seen since their installation. With these spill deflectors, TDG concentrations were recorded marginally exceeding TDG standards at the tailrace below the 7Q10 flows. With dam operations being modified over time to better regulate TDG concentrations below Long Lake Dam, we hope that these concentrations consistently remain marginal so that native species are not critically impacted. We promote future monitoring and adaptive management to effectively maintain low TDG during spring runoff.

The dissolved oxygen mitigation continues to improve below the dam evident by lower dissolved gas spikes and higher levels of dissolved oxygen during power generation. However, as noted in previous comments of annual reports, dissolved oxygen declines and dips below 8mg/L when the Long Lake Dam is not generating. These declines in dissolved oxygen can negatively impact native species that reside in this reservoir and reduce their already limited available habitat during that time. We encourage Avista to continue their efforts in improving water quality in Long Lake (Lake Spokane) and at Long Lake Dam so native species can benefit from those efforts downstream in Reservation waters.

Sincerely,

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

cc: Jordan Bauer, Dept. of Ecology
Chad McCrea, Director Dept. of Natural Resources
Brian Crossley, Water and Fish Program Manager

SPOKANE TRIBE COMMENTS AND AVISTA RESPONSES

Spokane Tribe Comment
In 2016, the spill deflectors were installed on Long Lake Dam and improvements in overall total dissolved gas concentrations during spring flows have been seen since their installation. With these spill deflectors, TDG concentrations were recorded marginally exceeding TDG standards at the tailrace below the 7Q10 flows. With dam operations being modified over time to better regulate TDG concentrations below Long Lake Dam, we hope that these concentrations consistently remain marginal so that native species are not critically impacted.

Avista Response
The 2016 installation of the spill deflectors along with the results of the 2017 and 2018 spillway gate testing, which identified how best to operate the spill gates to reduce TDG impacts downstream, have resulted in reduced TDG concentrations recorded downstream of Long Lake Dam. Avista will continue to operate Long Lake Dam as we have from 2019 through 2021, which includes the new spill gate protocol of spilling flows in excess of generation over the spillway deflectors and spreading the flow across multiple spill gates.

Spokane Tribe Comment
We promote future monitoring and adaptive management to effectively maintain low TDG during spring runoff.

Avista Response
Avista will monitor TDG at Long Lake Dam in 2022. Following the 2022 TDG monitoring season, Avista will engage the Spokane Tribe as it consults with Ecology to evaluate Long Lake HED's compliance with the TDG requirements of the License and explore the need for additional management to effectively abate TDG levels.