AVISTA CORPORATION

2018

LONG LAKE HED

TEMPERATURE MONITORING REPORT

WASHINGTON 401 CERTIFICATION, SECTION 5.5

Spokane River Hydroelectric Project
FERC Project No. 2545

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List of Acronyms and Abbreviations

7-DADM	7-day average daily maximum temperature
°C	degrees Celsius
°C/m	degrees Celsius per meter
Avista	Avista Corporation
Certification	Section 401 water quality certification
DNR	Washington State Department of Natural Resources
DO	dissolved oxygen
Ecology	Washington State Department of Ecology
DO WQAP	Dissolved Oxygen Water Quality Attainment Plan
FERC	Federal Energy Regulatory Commission
Golder	Golder Associates Inc.
HED	hydroelectric development
LLFB	Long Lake forebay monitoring station
LLTR	Long Lake HED tailwater monitoring station
LLGEN	Long Lake generation plume monitoring station
m	meter(s)
MS5	Hydrolab® MS5 Multiprobe®
Project	Spokane River Project
QAPP	Quality Assurance Project Plan
RM	River mile
SCC	Spokane Community College
SCCD	Stevens County Conservation District
Spokane Tribe	Spokane Tribe of Indians
TDG	total dissolved gas
Temperature WQAP	Long Lake Dam Reservoir and Tailrace Temperature Water Quality Attainment Plan
WAC	Washington Administrative Code
WRIA	Water Resource Inventory Area
WQM QAPP	Water Quality Monitoring and Quality Assurance Project Plan

1.0 INTRODUCTION

On June 18, 2009, the Federal Energy Regulatory Commission (FERC) issued a new license for the Spokane River Project (Project), FERC Project No. 2545 (FERC 2009a), which incorporated the Washington Department of Ecology (Ecology) Section 401 Water Quality Certification (Certification; Ecology 2009). In accordance with Section 5.10 and 5.5 of the Certification, Avista Corporation (Avista) developed the Water Quality Monitoring and Quality Assurance Project Plan (WQM QAPP; Avista 2009) and the Long Lake Dam Reservoir and Tailrace Temperature Water Quality Attainment Plan (Temperature WQAP; Avista 2011) in consultation with Ecology and the Spokane Tribe of Indians (Spokane Tribe). Avista filed the Ecology-approved WQM QAPP with FERC on August 13, 2009 and FERC approved it with modification on September 17, 2009 (FERC 2009b). Avista filed the Ecology-approved Temperature WQAP with FERC on January 26, 2011. On May 10, 2011, FERC (2011) issued an order approving and amending the 2009 WQM QAPP, pursuant to Article 401(A)(12) of the license.

As part of the Temperature WQAP, Avista is required to provide an annual summary report of the available temperature water quality monitoring results to Ecology by March 1 on an annual basis. Previous reports summarized Long Lake Hydroelectric Development (HED) temperature data collected in 2010 and 2011 (Golder 2012), in 2012 (Golder 2013), in 2013 (Golder 2014), in 2014 (Golder 2015), in 2015 (Golder and Mattax Solutions 2016), in 2016 (Golder and Mattax Solutions 2017), and in 2017 (Avista 2018a). This report summarizes temperature monitoring conducted for Long Lake HED during the 2018 calendar year.

2.0 MONITORING ACTIVITIES

2.1 2018 Monitoring Results

The overall objectives of the Temperature WQAP Monitoring Report are to:

- Document monitoring periods
- Summarize temperature monitoring results
- Document compliance with the applicable water quality standards
- Describe any proposed changes to the Temperature WQAP and WQM QAPP

In addition to the above objectives, we have included information pertaining to the Spokane Tribe's water quality standards in regards to waters downstream of the Project.

2.2 Monitoring Locations and Periods

Water temperature data that are included in annual summary reports are from a number of water quality monitoring programs as described in the Temperature WQAP (Avista 2011). This report presents temperatures obtained as a component of monitoring programs focused on Spokane River water quality (Ecology 2019a, 2019b), Lake Spokane water quality (Avista 2019a), Long Lake HED total dissolved gas (Avista 2019b), and Long Lake HED dissolved oxygen (Avista

2019c). Additional temperature data related to studies outside the scope of the Temperature WQAP are available upon request.

2.2.1 Lake Spokane

Temperature monitoring was conducted at two river stations upstream of Lake Spokane (inflow stations), ten stations within Lake Spokane, and one location in the Long Lake Dam Tailrace (Table 2-1 and Figure 2-1). These monitoring efforts are described in more detail below.

2.2.1.1 Inflow Stations

Ecology has monitored temperature, along with other water quality parameters, in the Spokane River and Little Spokane River a short distance upstream of its confluence with Lake Spokane. This was done under Ecology's River and Stream Water Quality Ambient Monitoring Program, which monitors by water year.[1] Ecology's sampling effort at these two stations was conducted in accordance with the Stream Ambient Monitoring QAPP (Ecology 2003). Preliminary data for the Spokane River at Nine Mile Bridge station (54A090) and Little Spokane River near Mouth station (55B070) located on the Little Spokane River at River Mile (RM) 1.1 were accessed on February 8, 2019.

2.2.1.2 Within Lake Spokane

In 2018, Avista monitored temperature and other water quality parameters through implementation of the Lake Spokane nutrient monitoring program, which it collaboratively implemented with Ecology in 2010 and 2011, and has solely implemented since 2012. The 2018 monitoring included one sampling event in May and October, and two sampling events per month in June through September. All sampling was completed in accordance with the Ecology-approved QAPP for Lake Spokane Nutrient Monitoring.[2] Sampling was conducted at the six long term Lake Spokane monitoring stations that have been monitored since 2010, as well as four supplemental locations added in 2018, described in Table 2-1 and include:

- LL5, at approximately RM 54.20;
- LL4, at approximately RM 51.47;
- LL3a, at approximately RM 48.46;
- LL3, at approximately RM 46.42;
- LL2b, at approximately RM 45.69;
- LL2a, at approximately RM 44.45;
- LL2, at approximately RM 42.06;
- LL1a, at approximately RM 40.99;

[1] The "water year" is defined as the 12-month period from October 1 to September 30 of the following year.
[2] Avista's *Quality Assurance Project Plan for Lake Spokane Baseline Nutrient Monitoring* (QAPP), was approved by Ecology on March 13, 2014 and submitted to FERC March 21, 2014. This QAPP is a revised version of an earlier QAPP written by Ecology for the 2010 and 2011 monitoring efforts and amended in 2012. The 2014 QAPP was supplemented by addendum in 2018 with the addition of four supplemental monitoring stations, and was approved by Ecology on March 27, 2018 and submitted to FERC on March 30, 2018.

- LL1, at approximately RM 37.62; and
- LL0, at approximately RM 32.66.

2.2.2 Long Lake Dam Tailrace

In 2018, Avista monitored temperature at one location at the Long Lake HED: at a station 0.6 mile downstream of Long Lake Dam referred to as LLTR. All monitoring, including quality control protocols, was conducted in accordance with Avista's Total Dissolved Gas (TDG) Monitoring Plan (Golder Associates Inc 2010) and Detailed Dissolved Oxygen (DO) Phase II Feasibility and Implementation Plan (Avista 2010). Under this program, water temperature, total dissolved gas, and DO concentrations were monitored with Hydrolab® MS5 Multiprobe® (MS5) instruments.

In the past, Ecology has conducted monitoring at Station 54A070, which is located below Long Lake Dam. Ecology ceased monitoring at this station in 2010, and hence no new temperature data were available when Ecology's database was accessed on February 11, 2019 (Ecology 2019c).

2.3 Temperature Numeric Criteria

The Washington state numeric temperature criterion that applies to Lake Spokane and the Long Lake HED tailrace (WAC 173-201A-602, WRIA 54 Notes 1, 2, and 3) limits 1-day maximum temperature to no more than 20.0 degrees Celsius (°C) due to human activities. In addition, water temperature shall not be increased by greater than 0.3°C when natural conditions exceed 20.0°C.

The numeric temperature criteria for the Spokane Tribe, whose reservation is located downstream of the Project, are applicable from the upstream Spokane Indian Reservation boundary (approximately RM 32.7) to the mouth of the Spokane River (RM 0). For reference, the upstream boundary of the Spokane Indian Reservation is located approximately 1.2 miles downstream of Long Lake Dam and approximately 0.6 miles downstream of the Avista and Ecology monitoring stations located below the dam (LLTR). The Spokane River temperature criteria are the Class A 7-day average daily maximum temperature (7-DADM) criteria. The 7-DADM is calculated as the arithmetic average of seven consecutive measures of daily maximum temperatures, with the 7-DADM for any individual day calculated by averaging that day's daily maximum temperature with the daily maximum temperatures of the three days before and the three days after that date. The maximum allowable limit (7-DADM) for the Spokane River varies throughout the year as described below (Spokane Tribe 2003):

- 18.5°C between June 1 and August 31;
- 13.5°C between September 1 and September 30;
- 11°C between October 1 and March 31; and
- 13.5°C between April 1 and May 31.

3.0 RESULTS

Results of the 2018 temperature monitoring are discussed by monitoring location, along with a comparison to the 20.0°C Washington State water quality criterion. In addition, the discussion in Section 5.0 presents a comparison of the temperature results for the monitoring location below Long Lake Dam with the corresponding Spokane Tribe water quality criteria.

3.1.1 Lake Spokane

Water temperature was monitored at thirteen locations: Ecology's Spokane River at Nine Mile Bridge station (54A090), Ecology's Little Spokane River station (55B070), Avista's LL5, LL4, LL3a, LL3, LL2b, LL2a, LL2, LL1a, LL1 and LL0 stations, and Avista's LLTR station in the Long Lake Dam Tailrace.

3.1.1.1 Inflow Stations

Ecology's Spokane River at Nine Mile Bridge station (54A090) was monitored monthly from January through November. Reported water temperatures for this timeframe ranged from 4.8°C in March to 18.3°C in July (Table 3-1). All monitored water temperatures were less than the 20.0°C Washington State criterion.

Ecology's Little Spokane River station, 55B070, was monitored monthly from January through November. Water temperatures during this timeframe ranged from 6.0°C in February to 15.9°C in July (Table 3-2). All monitored water temperatures were less than the 20.0°C Washington State criterion.

3.1.1.2 Within Lake Spokane

Vertical profiles of water temperatures were monitored at the ten Lake Spokane sampling stations in 2018. The 2018 monitoring frequency was once in May; twice in the months of June, July, August, and September; and once in October. Results for each of the ten lake stations are described below in order from upstream to downstream.

LL5

Water temperature measurements were conducted near the surface at 0.5 meter (m) and at 1-m intervals from 1 to 5 m below the water surface. Temperature varied more than 1.0°C throughout the water column for three of the ten vertical profiles measured in 2018 and thermal stratification, as defined by greater than 1.0 °C/m, occurred on all sampling events from July 24 through August 29 (Table 3-3). The results indicate the thermocline was at a depth of 0.75 m on July 24 and August 29, and was at 1.5 m on August 8 (Table 3-3).[3] Three LL5 temperature measurements were greater than the 20.0°C Washington State criterion and reached up to 24.3°C on August 8. The high temperatures occurred only in the near surface water at 0.5 m on July 24, and down to 1 m on August 8 (Table 3-3).

[3] Thermocline depths are presented as the mid-point between depths of temperature measurements with the greatest change in temperature per meter that exceeds 1.0 °C/m.

LL4

At LL4, water temperature measurements were taken at 0.5 m and then at 1-m intervals from 1 m below the water surface to within 1 m of the bottom. The maximum temperature change rate was greater than 1.0 °C/m for the vertical temperature profiles taken during June 20 through September 26 (Table 3-4). The results indicate the thermocline was at 0.75 m in late June, 4.5 m in July and late August through September, and 5.5 m in early August. Nineteen of the temperature measurements were greater than the 20.0°C Washington State criterion and reached a maximum of 25.3°C on August 8. Other exceedance of the 20.0°C temperature criterion occurred from the surface down to 3 m in early July and late August, down to 4 m on July 24, and down to 5 m on August 8 (Table 3-4).

LL3a

At LL3a, water temperature measurements were taken at 0.5 m, at 1-m intervals from 1 m to 10 m, at 3-m intervals from 12 m to 18 m, and ended within 1 m of the bottom. Vertical temperature profiles from June 7 through August 8 and again on September 13 had maximum temperature change rates greater than 1.0 °C/m. The August 29 and September 26 sampling had temperature changes at 1.0 °C/m and all remaining periods had temperature change rates less than 1.0 °C/m (Table 3-5). Here, the thermocline depth ranged from 1.5 m in early Jun to 9.5 m in early September. Twenty-seven of the temperature measurements were greater than the 20.0°C Washington State criterion and reached up to 24.5°C at 0.5 m of depth on July 24 (Table 3-5). Depths for the other greater than 20.0°C measurements were from the surface down to 0.5 m on June 20, down to 6 m on July 11, down to 5 m on July 24, down to 7 m on August 8, and down to 4 m on August 29 (Table 3-5).

LL3

For water column sampling at LL3, water temperature measurements were taken at 0.5 m, at 1-m intervals from 1 m to 10 m, at 3-m intervals from 12 m to 18 m, and ended within 1 m of the bottom. Vertical temperature profiles in June, July 24 and August 8, and September 13 had maximum temperature change rates greater than 1.0 °C/m. The July 11 sampling showed a change at 1.0 °C/m and all remaining periods had temperature change rates less than 1.0 °C/m (Table 3-6). The thermocline depth ranged from 1.5 m in June to 5.5 m in September. Twenty-eight of the temperature measurements were greater than the 20.0°C Washington State criterion, and reached a maximum of 24.7°C at 0.5 m of depth on August 8 (Table 3-6). Depths for the other greater than 20.0°C measurements were from the surface down to 0.5 m on June 20, down to 6 m on July 11 and both samplings in August, and down to 5 m on July 24 (Table 3-6).

LL2b

At LL2b, water temperature measurements were taken at 0.5 m, 1-m intervals from 1 m to 10 m, 3-m intervals from 12 m to 18 m, and then within 1 m of the bottom. Vertical temperature profiles had maximum temperature change rates greater than 1.0 °C/m during July 11 through August 8 sampling events (Table 3-7). The maximum temperature change rate was less than 1.0 °C/m for all remaining profiles. The thermocline was at a depth of 4.5 m on July 24 and August

8, and 6.5 m on July 11. Twenty-eight temperature measurements were greater than the 20.0°C Washington State criterion and reached up to 24.6°C at 0.5 m on August 8. Depths for the other greater than 20.0°C measurements were from the surface down to 6 m July 11 through August 29 (Table 3-7).

LL2a

LL2a water temperature measurements were taken at 0.5 m, 1-m intervals from 1 m to 10 m, 3-m intervals from 12 m to 21 m, and within 1 m of the bottom. Vertical temperature profiles had maximum temperature change rates greater than 1.0 °C/m during July 10 through August 7 sampling events (Table 3-8). The maximum temperature change rate was 1.0 °C/m on September 12 and was less than 1.0 °C/m for all remaining profiles. The thermocline was at a depth of 7.5 m on July 10, 3.5 m on July 23, and 5.5 m on August 7. Twenty-eight temperature measurements were greater than the 20.0°C Washington State criterion and peaked at 24.9°C at 0.5 m on August 7. Depths for the other greater than 20.0°C measurements were from the surface down to 6 m on July 10 and August 28, 5 m on July 23, and down to 7 m on August 7 (Table 3-8).

LL2

Water temperature measurements at LL2 were taken at 0.5 m, 1-m intervals from 1 m to 10 m, 3-m intervals from 12 m to 24 m, and within 1 m of the bottom. Vertical temperature profiles had maximum temperature change rates greater than 1.0 °C/m during July 23 through September 12 sampling events (Table 3-9). The maximum temperature change rate was 1.0 °C/m on July 10 and September 25, and was less than 1.0 °C/m for all other profiles. The thermocline was at a depth of 6.5 m on July 23 and August 28, 5.5 m on August 7, and 7.5 m on September 12. Twenty-seven temperature measurements were greater than the 20.0°C Washington State criterion and reached a maximum of 24.4°C at 0.5 m on July 23. Depths for the other greater than 20.0°C measurements were from the surface down to 5 m on July 10, and down to 6 m on July 23 through August 28 (Table 3-9).

LL1a

Water temperature measurements at LL1a were taken at 0.5 m, 1-m intervals from 1 m to 10 m, then 3-m intervals from 12 m to 27 m, and then within 1 m of the bottom. Temperature change rates of greater than 1.0 °C/m occurred in the vertical profiles for July 23 through August 28, and was less than 1.0 °C/m for all remaining profiles (Table 3-10). The thermocline depth was 4.5 m on July 23 through August 7, and 7.5 m on August 28. Twenty-eight temperature measurements were greater than the 20.0°C Washington State criterion and reached a maximum of 24.3°C at 0.5 m on July 23. Depths for the other greater than 20.0°C measurements where down to 5 m on July 10, down to 6 m on July 23 through August 7, and down to 7 m on August 28 (Table 3-10).

LL1

At LL1, water temperature measurements were taken at 0.5 m, 1-m intervals from 1 m to 10 m, and then 3-m intervals from 12 m to 33 m. Temperature change rates of greater than 1.0 °C/m occurred in the vertical profiles for July 23 through August 28 (Table 3-11). The thermocline depth was 5.5 m on June 23, 6.5 m on August 7, and 8.5 m on August 28. Twenty-nine temperature measurements were greater than the 20.0°C Washington State criterion and reached a maximum of 23.9°C at 0.5 m on July 23 and down to 1 m August 7. Depths for the other greater than 20.0°C measurements where from the surface down to 5 m on July 10, down to 6 m on July 23, and down to 7 m in both August sampling events (Table 3-11).

LL0

LL0 water temperature measurements were taken at 0.5 m, 1-m intervals from 1 m to 10 m, and at 3-m intervals from 12 m to 45 m, and then at 1 m of the bottom. Temperature change rates of greater than 1.0 °C/m occurred in the vertical profiles for July 23 and August 7, with a temperature change rate of exactly 1.0 °C/m occurring on May 16 and July 10, all other profiles had a less than 1.0 °C/m change (Table 3-12). Twenty-nine temperature measurements were greater than the 20.0°C Washington State criterion and peaked at 23.0 °C at 0.5 m on July 23 and from the surface down to 4 m in depth on August 7. The other greater than 20.0°C temperatures occurred down to 6 m on July 10 through August 7, and down to 7 m on August 28 (Table 3-12).

Lake Station Temperature Profile Comparisons

Comparison of the 2018 temperature profiles for the ten sampling stations during late June, July, August, and September are displayed in Figures 3-1 through 3-4, respectively. The maximum monthly temperatures reached 20.2°C in late June, 24.8°C in late July, 25.3°C in early August, and 20.0°C in early September. In late June, LL3 and LL3a had surface temperatures at or near 20°C and were showing signs of stratification, whereas LL4 and LL2b through LL0 all had surface temperatures between 18°C and 19°C, with only LL4 being stratified. LL5 had a surface temp of 16.1°C and was not stratified at this time. By late July, thermal stratification was well established and the epilimnetic temperatures exceeded 20.0°C at all 10 locations (Figure 3-2). In late August, all stations besides LL5 exceeded 20.0°C in the epilimnion and sites LL5, LL4, LL2, LL1a, and LL1 were stratified (Figure 3-3). By late September, cooling had occurred in the epilimnion to where temperatures did not exceed 18°C, and only LL4 was fully stratified (Figure 3-4).

3.1.2 Long Lake Dam Tailrace

Long Lake Dam Tailrace data was collected at one location: LLTR. Water temperature data was collected in 15-minute intervals from January 1 through October 31 as part of Avista's Washington Total Dissolved Gas Monitoring Plan and the Detailed DO Phase II Feasibility and Implementation Plan (Figure 3-5).

LLTR

Daily maximum water temperatures ranged from 2.8°C on February 27 to 20.3°C on August 20 (Table 3-13). Temperatures of greater than the 20.0°C Washington State criterion occurred on two days, August 20 and 21, ranging from 20.2°C to 20.3°C.

4.0 SCHEDULE

Avista has prepared, obtained approval for, and implemented the Temperature WQAP and WQM QAPP, as well as other plans to address Lake Spokane temperatures, nutrients, and DO. Avista will continue to coordinate implementation of measures to improve water quality with the ultimate goal of meeting the water quality standard which consists of a numeric and narrative component. The list below summarizes plans that are currently being implemented along with Avista's planned actions towards this goal.

- **WQM QAPP -** Prepared the WQM QAPP (Avista 2009) in consultation with Ecology and the Spokane Tribe. Approval of this plan was obtained from Ecology on August 13, 2009 and from FERC with modifications on September 17, 2009 (FERC 2009b).
- **Temperature WQAP -** Prepared the Temperature WQAP (Avista 2011) in consultation with Ecology and the Spokane Tribe. Approval of this plan was obtained from Ecology on January 25, 2011 and from FERC (2011) on May 10, 2011 in an order approving and amending the 2009 WQM QAPP, pursuant to Article 401(A)(12). Avista will continue to provide annual reports summarizing water temperature data for the Long Lake HED in accordance to the approved Temperature WQAP, WQ QAPP and WQM QAPP.
- **Lake Spokane DO WQAP** – Avista prepared the Lake Spokane DO WQAP (Avista and Golder 2012), which discussed nine feasible potential measures to improve DO conditions. Upon receiving FERC approval (December 19, 2012), Avista began implementing the DO WQAP and has submitted Annual Reports for the work completed in 2013 through 2015 and 2017 to 2018 (Avista 2014, 2015, 2016a, 2018b, and 2019a) as well as a Five Year Summary Report for the work completed from 2013 through 2016 (Avista 2017). In accordance with the DO WQAP, following completion of the 2017 nutrient monitoring season, Avista and Ecology evaluated the results and success of monitoring baseline nutrient conditions in Lake Spokane. Nutrient monitoring (ex. nitrogen and phosphorus) was not conducted in 2018, but in-situ DO, temperature, conductivity and pH were measured and zooplankton were collected at the six baseline monitoring stations (LL5 through LL0), and at the four supplemental monitoring stations (LL3a, LL2a, LL2b, and LL1a). During 2019, Avista will shift focus from baseline monitoring to conducting more detailed analysis on the 2010 through 2018 water quality data in an effort to explore the relationship between rainbow trout habitat utilization in Lake Spokane and the multitude of water quality attribute information that is available from the lake (Avista 2019a).

  The Lake Spokane DO WQAP Annual Reports provide a summary of the baseline monitoring, implementation activities, effectiveness of the implementation activities, and proposed actions of the upcoming year. The implementation activities' goals, with the exception of the cold water fish habitat evaluation and native tree plantings on Avista's shoreline property, for these potential reasonable and feasible measures are primarily related to improving DO in the lake.

  - **Cold Water Fish Habitat Evaluation** – Avista continued to evaluate cold water fish habitat in Lake Spokane. Based on a 16°C thermal standard and an 8.0 mg/L DO standard, water quality data within Lake Spokane suggests that rainbow trout are likely inhabiting cooler water in the metalimnion and upper portions of the hypolimnion. In addition, the habitat volumes for temperature and DO together, as well as separately, suggest that temperature is restricting habitat more than DO.

    Interestingly, and as discussed in the Lake Spokane DO WQAP 2018 Annual Summary Report (Avista 2019a), results from Avista's multi-year fish population and habitat assessment for rainbow trout indicate rainbow trout in Lake Spokane are inhabiting the epilimnion during the summer months, frequently surpassing the 16°C temperature and 8.0 mg/l DO standards. This is based on results of tagged rainbow trout, tracked throughout the reservoir from early July through November in 2017 and April through October of 2018.

- **Native Tree Plantings on Avista Shoreline Property** – Avista, in coordination with Stevens County Conservation District, planted 300 Drummond willow trees along 0.5 miles of shoreline at Avista's North Shore Campsites. Once mature, the trees will improve habitat and help reduce water temperatures along the lake's shoreline. Additionally, Avista conducted several site visits to previous tree planting locations to monitor site conditions and conduct maintenance activities such as browsing fence repair and noxious weed control.
- **Hangman Creek Basin Shoreline Stabilization and Agricultural Practices -** Avista continues to track plans and progress addressing erosion control in the Hangman Creek Basin by participating in meetings, including the Spokane Conservation District's Hangman Creek Bi-State Watershed Project and Ecology's Spokane River and Lake Spokane DO TMDL Advisory Committee meetings.
- **Upper Hangman Creek Wetland Restoration-** Avista and the Coeur d'Alene Tribe have acquired approximately 1,022 acres on upper Hangman Creek, within the southern portion of the Coeur d'Alene Tribe Reservation in Benewah County, Idaho approximately 10 miles east of the Washington-Idaho Stateline. Site-specific wetland management plans are updated annually for approximately 500-acres of these properties and include establishing long-term, self-sustaining native emergent, scrub-shrub and/or forested wetlands, riparian habitat and associated uplands, through preservation, restoration and enhancement activities. These properties were all previously in agricultural use and include straightened creek beds prior to the acquisition. Given Hangman Creek is a significant contributor of sediment and associated phosphorus loading to the Spokane River, Avista anticipates a TP load reduction from the wetland mitigation work. Since 2013, approximately 14,649 native tree and shrub species have been planted on this wetland complex. Avista continues to maintain and replace trees as needed.
- **Wetland Restoration/Enhancement -** Avista acquired the 109-acre Sacheen Springs property, located on the west branch of the Little Spokane River. This property contains a highly valuable wetland complex with approximately 59 acres of emergent, scrub-shrub and forested wetlands and approximately 50 acres of adjacent upland forested buffer. Several seeps, springs, perennial and annual creeks are also found on the property. Avista completed a detailed site-specific wetland management plan and began implementing it upon Ecology and FERC's approval in 2014. Herbicide application to control terrestrial invasive weeds was completed in 2014, 2015, and 2016 which should help improve the overall biodiversity and function of the wetland property. The property was purchased "in fee" and in 2017, Avista pursued a conservation easement in order to protect it in perpetuity. Activities conducted during 2018 included several site visits to monitor site conditions, identify future maintenance activities and control invasive weeds in accordance with the site-specific wetland management plan. Invasive weed control measures included herbicide treatment of 8.5 acres, primarily to control infestation of Reed canary grass, an invasive species present along the access road.

- **Little Spokane Wetland & Shoreline Restoration -** As part of the Nine Mile Hydroelectric Development's Rehabilitation Program, Avista partnered with the Washington State Parks and Recreation Commission Parks (State Parks) to complete a wetland and shoreline restoration project on four acres within the Little Spokane Natural Area Preserve. The Natural Area Preserve is a popular location for recreation, however two invasive weed species, yellow flag iris and purple loosestrife, have severely constricted large sections of the river and adjacent shoreline. The mitigation project included herbicide treatments on four acres of yellow flag iris and purple loosestrife invasive weed species during 2014 and 2015. Additionally, in 2014 four trees were removed from the Nine Mile barge landing site and relocated to the Little Spokane River Mitigation Site for large woody debris habitat. After two consecutive years of herbicide applications the stands of invasive weeds greatly reduced by an estimated 90%-100%. Also, during 2015, Avista partnered with the Washington Department of Natural Resources to implement re-vegetation of the site which included planting 400 trees and shrubs (black cottonwoods, quaking aspens, chock cherry and red osier dogwood). Individual plants were enclosed with four foot welded wire fencing for protection from browsing and the base was wrapped with a protective sleeve for protection from small mammals, and herbicide spot treatments are completed as well. During 2018, Avista conducted several site visits to monitor site conditions and conduct maintenance activities such as, noxious weed control by mechanical and chemical means, and fence repair and removal. Avista anticipates transferring the long-term maintenance of this project back to State Parks (owner of the property) in early 2019, having fulfilled the project components.
- **Floating Treatment Wetland -** Avista partnered with the Stevens County Conservation District (SCCD) and Spokane Community College (SCC) to install a floating wetland in the downstream portion of Lake Spokane, adjacent to Avista owned shoreline. The purpose of the floating wetland is for potential TP removal and wave attenuation, as well as to gain information on plant species growth and fish habitat. The floating wetland was installed during April and May of 2018 and consisted of two 40-foot long log structures (each consisting of three logs bolted together), located approximately 100 feet from the shore. During June of 2018, SCC students assembled approximately 20 floating wetland platforms, anchored the platforms to the log structure, and planted the platforms with approximately 240 plants (including, but not limited to sedge, rush, willow, and bulrush species). Throughout the summer season, the SCC students monitored the site for plant survivability, presence of invasive plants, wildlife activity, fish habitat, and shoreline wave impacts. The floating wetland platform was removed in October and approximately 180 of the plants were planted along the adjacent shoreline. Three plant samples (two sedge and one rush) were submitted for total phosphorus and total nitrogen analyses in order to get a rough estimate of the total phosphorus and nitrogen removed by the plants. Additionally, basic field water quality parameters were collected, including the deployment of temperature logger arrays. The data collected from this work is currently being reviewed and consolidated. Avista, SCCD, and SCC plan to further continue and enhance the floating wetland study during 2019.
- **Land Protection -** Avista previously identified approximately 215 acres of land that was used for grazing under lease from Washington State Department of Natural Resources (DNR). This land is located within the south half of Section 16 in Township 27 North, Rand 40 E.W. M. in Stevens County. Avista and State Parks pursued a lease for the 215 acres of land from DNR with the intent of changing the land use. DNR

leased the property to State Parks in 2017 for public recreation, and therefore no longer allows grazing on this property.

In addition, Avista owns over 1,000 acres of land, of which approximately 350 acres are located within 200 feet of the Lake Spokane shoreline in Spokane, Stevens, and Lincoln counties at the downstream end of the reservoir. This includes approximately 14-miles of Avista-owned shoreline that is managed in accordance with Avista's, FERC approved, Spokane River Project Land Use Management Plan (Avista 2016b). For the most part this land is contiguous along the north and south shorelines and is managed primarily for conservation purposes. Specific details related to Avista's land use management activities are included in the Land Use Management Plan, a copy of which is available upon request. During 2018 Avista continued to protect this area and will pursue identifying the potential TP load that could be avoided by maintaining a 200-foot buffer along the Avista-owned lake shoreline. Avista will pursue the quantification of this activity along the wetland/restoration enhancements as the 200-foot buffer should create similar sediment-filtering effects.

- **Bulkhead Removal -** During 2018, Avista worked with several Lake Spokane shoreline landowners in Spokane County to replace existing concrete, stacked rock, riprap, or other similar hardened bulkheads with natural shoreline materials or those that utilize bioengineered products that use native vegetation, when and where possible. The 2018/2019 winter drawdown allowed construction to begin on one of these bulkhead replacement projects, the Wright Project, located just downstream of Sportsman's Paradise. When implemented, the Wright Project will help reduce non-point source phosphorus loading into Lake Spokane and will be used as a prototype to educate other Lake Spokane shoreline homeowners about how they too can improve water quality in Lake Spokane by these types of projects. Construction of this project is anticipated to be complete in January 2019, with plantings to be installed in the spring of 2019.
- **Carp Population Reduction Program –** In 2018, Avista implemented the second year of its common carp (*Cyprinus carpio*) removal program on Lake Spokane. The removal effort was done in cooperation with WDFW and the Spokane Tribe of Indians, and completed under a Scientific Collection Permit issued by WDFW.

  The removal effort occurred during two, four day sampling events; May 21 – 24 and June 11 – 14, and focused on sampling carp during their spring spawning behavior. A total of 557 carp were collected totaling approximately 5,183 lbs of biomass being completely removed from the watershed. All carp collected were removed from the water and taken the Greater Wenatchee Regional Landfill for disposal. Using the average total phosphorus to weight ratio, provided in the ALS Environmental 2018 lab analysis, removal was calculated to be 27.5 lbs of total phosphorus in 2018. Combining the 2017 and 2018 carp removal sampling, a total of 114.1 lbs of total phosphorous has been removed from Lake Spokane by Avista's carp reduction program. That number does not quantify the amount of phosphorous that will no longer be re-activated in the water column by excretion or bioturbation (during the feeding and spawning behavior of these carp).

  Based on lessons learned from the 2017 and 2018 sampling, Avista plans to remove carp again in 2019, placing gill nets in the sampling locations that had the greatest catch-per-unit-effort in 2018 sampling. Avista is also exploring the effectiveness of carp removal through an archery program. Avista is coordinating these efforts with WDFW and will obtained a scientific collection permit to implement these activities.

- **Long Lake HED Turbine Aeration and Tailrace DO Monitoring** – Avista will continue to refine implementation of turbine aeration that was initiated in 2010, based on real-time water quality measurements that are monitored 0.6 miles downstream of Long Lake Dam from July 1 through October 30. Avista also will continue to coordinate results with the DO TMDL efforts, and evaluate the need for additional DO enhancement measures in accordance with the FERC-approved schedule (FERC 2010).
- **Long Lake Dam Spillway Modification Project for TDG Abatement and Monitoring** Avista completed construction of the Long Lake Dam spillway modifications for the TDG project in December 2016. The performance of the structural modifications and spillgate protocols were evaluated during 2017 and 2018. Water quality monitoring is also being conducted (2017 through 2018) in order to confirm the effectiveness of the spillway modifications and spillgate operations. Results of the 2017 and 2018 water quality monitoring indicate TDG values downstream are frequently below incoming values at higher flows, suggesting the spillway modification project has positively influenced TDG percent saturation downstream (Avista 2018c and 2019b).

5.0 DISCUSSION

5.1 Lake Spokane

Temperature profile monitoring conducted in Lake Spokane during 2018 indicated that the 20.0°C Washington State criterion was exceeded within Lake Spokane at certain depths and locations during late June through August. The maximum monthly temperatures reached 20.2°C in late June, 24.8°C in late July, 25.3°C in early August, and 20.0°C in early September. Exceedances of 20.0°C occurred at two stations in late June, nine stations in early July and late August, and all ten lake stations in late July and early August. Exceedances of 20.0°C within the lake occurred to depths of .5 m in June, 6 m in July, and 7 m in August. Measurements at both the Spokane River at Nine Mile Bridge station and Little Spokane River station did not exceed the 20.0°C criterion.

The exceedances reported in Lake Spokane during 2018 are indicative of the natural stratification process typical of eastern Washington and northern Idaho lakes during the summer season. Avista, however, is continuing to pursue reasonable and feasible mitigation measures in accordance with its Ecology-approved Temperature WQAP and Lake Spokane DO WQAP that may have positive localized effects on temperature within the lake.

5.2 Long Lake Dam Tailrace

The 20.0°C Washington State criterion was exceeded at LLTR on two days in 2018 and reached a maximum temperature of 20.3°C (Table 3-13).

Monitoring results indicate the Spokane Tribe's 7-DADM criteria established for tribal waters were exceeded at LLTR from May 15 through May 31, July 13 through August 28, and September 1 through the end of sampling on October 28 (Table 5-1, Figure 5-1). It is important to note the LLTR monitoring station, from which 2018 temperature data were collected, is located approximately 0.6 miles upstream from the reservation boundary where the Tribe's criteria is applicable.

As part of a non-License Agreement, Avista provides the Spokane Tribe with funds to complete water quality improvements to help address temperature exceedances, along with other water quality improvement needs downstream of the Project. To date, the Spokane Tribe has planted trees and completed stream stabilization efforts in the Chamokane Creek watershed to reduce surface water temperatures. Avista and the Spokane Tribe will continue working together in the future to improve water quality within the reservation. These projects relate to DO, TDG, and temperature within the reservation.

6.0 PROPOSED CHANGES TO THE TEMPERATURE WQAP AND WQM QAPP

6.1 Spring Season Monitoring

Given completion of the Long Lake Dam Spillway Modification construction in 2016, Avista plans to monitor TDG at LLTR and LLGEN during the high-flow season (typically March/April through June) in 2019.

6.2 Summer Season, Tailrace Monitoring

As approved by Ecology in 2015, Avista will continue to monitor summer critical season water quality at the LLTR station, but not at LLFB because the complex hydraulic dynamics near the forebay intake cause substantial temperature variability near the dam over short time periods. These conditions result in LLFB measurements that are much less consistent and reliable than those at LL0 to use as the upstream reference condition.

6.3 Summer Season, Lake Spokane Monitoring

Avista has proposed shifting its focus during 2019 from baseline water quality monitoring, to conducting more detailed analysis on the 2010-2018 water quality data, in an effort to explore the relationship between rainbow trout habitat utilization in Lake Spokane and the multitude of water quality attribute information that is available from the lake. This detailed analysis may be helpful in understanding the complex connections between fish habitat utilization, water quality, and zooplankton/phytoplankton data available for Lake Spokane. Results of analysis could be used to more accurately assess the core summer salmonid habitat available in Lake Spokane or identify data gaps in the existing water quality data. We anticipate the results of past and future sampling will be incorporated in the CEQUAL-W2 model as a means to extrapolate the point data to help characterize habitat in the entire reservoir.

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TABLES

Table 2-1: Long Lake HED Temperature Monitoring Stations and Periods.

Monitoring Station	Location	NAD83 Decimal Degrees		2018 Monitoring Year	
		Latitude	Longitude	Start	End
54A090	Spokane River at Nine mile Bridge approximately 0.2 miles downstream of Nine Mile Dam, at river mile (RM) 58	47.7767	117.5448	1/9/2018	11/6/2018
55B070	On the Little Spokane River approximately 1.5 miles upstream from its confluence with Lake Spokane, at RM 1.1	47.7829	117.5305	1/9/2018	11/6/2018
LL5	Long Lake sampling site 5, at RM 54.20	47.7985	117.5692	5/17/2018	10/17/2018
LL4	Long Lake sampling site 4, at RM 51.47	47.8137	117.6106	5/17/2018	10/17/2018
LL3a	Long Lake sampling site 3a, at RM 48.46	47.8445	117.6618	5/17/2018	10/17/2018
LL3	Long Lake sampling site 3, at RM 46.42	47.8641	117.6668	5/17/2018	10/17/2018
LL2b	Long Lake sampling site 2b, at RM 45.69	47.8835	117.6665	5/17/2018	10/17/2018
LL2a	Long Lake sampling site 2a, at RM 44.45	47.8876	117.6890	5/16/2018	10/16/2018
LL2	Long Lake sampling site 2, at RM 42.06	47.8636	117.7014	5/16/2018	10/16/2018
LL1a	Long Lake sampling site 1a, at RM 40.99	47.8437	117.7221	5/16/2018	10/16/2018
LL1	Long Lake sampling site 1, at RM 37.62	47.8305	117.7612	5/16/2018	10/16/2018
LL0	Long Lake sampling site 0, at RM 32.66	47.8339	117.8349	5/16/2018	10/16/2018
LLTR	On left downstream bank, at water pump house approximately 0.6 mile downstream from Long Lake Dam.	47.8375	117.8503	1/1/2018	10/31/2018
54A070	Approximately 0.6 mile downstream of Long Lake Dam, at the Highway 231 Bridge and RM 33.3.	47.8391	117.8525	Not Available	

Table 3-1: Spokane River at Nine Mile Bridge (54A090) Temperature Monitored in 2018.

Date	Maximum Daily Water Temperature (°C)
01/09/18	5.3
02/06/18	5.0
03/06/18	4.8
04/10/18	7.5
05/08/18	11.7
06/05/18	16.0
07/10/18	18.3
08/07/18	16.6
09/11/18	14.5
10/16/18	10.7
11/06/18	10.3

Notes:

On February 8, 2019, accessed preliminary data from Ecology's website: https://apps.ecology.wa.gov/eim/search/Eim/EIMSearchResults.aspx?ResultType=EIMTabs&LocationUserId=54A090&LocationUserIdSearchType=Contains&LocationUserIDAliasSearchFlag=True&LocationUserIds=54A090&FieldActivityDateRangeBeginning=1%2f1%2f2018+12%3a00%3a00+AM&FieldActivityDateRangeEnding=12%2f31%2f2018+12%3a00%3a00+AM.

The 20.0°C criterion was not exceeded at this monitoring location in 2018.

Table 3-2: Little Spokane River Upstream of Lake Spokane (55B070) Temperature Monitored in 2018.

Date	Maximum Daily Water Temperature (°C)
01/09/18	6.8
02/06/18	6.0
03/06/18	6.3
04/10/18	9.1
05/08/18	15.4
06/05/18	14.7
07/10/18	15.9
08/07/18	15.4
09/11/18	12.2
10/16/18	8.3
11/06/18	8.9

Notes:

On February 8, 2019, accessed preliminary data from Ecology's website: https://apps.ecology.wa.gov/eim/search/Eim/EIMSearchResults.aspx?ResultType=EIMTabs&LocationUserId=55B070&LocationUserIdSearchType=Contains&LocationUserIDAliasSearchFlag=True&LocationUserIds=55B070&FieldActivityDateRangeBeginning=1%2f1%2f2018+12%3a00%3a00+AM&FieldActivityDateRangeEnding=12%2f31%2f2018+12%3a00%3a00+AM.

The 20.0°C criterion was not exceeded at this monitoring location in 2018.

Table 3-3: LL5 Temperature Vertical Profiles in 2018.

Depth (meters)	Water Temperature (°C)									
	5/17/2018	6/7/2018	6/20/2018	7/11/2018	7/24/2018	8/8/2018	8/29/2018	9/13/2018	9/26/2018	10/17/2018
0.5	13.6	16.0	16.1	17.1	**21.4**	**24.3**	19.2	14.0	13.3	10.3
1.0	13.7	16.0	16.0	17.0	19.2	**22.7**	15.5	13.9	13.0	10.2
2.0	13.7	16.0	15.9	16.9	17.4	17.1	14.4	13.9	13.0	10.2
3.0	13.7	16.0	15.8	16.9	17.3	16.8	14.4	13.7	12.9	10.2
4.0	13.7	16.0	15.7	16.8	17.3	16.6	14.4	13.7	12.9	10.1
5.0	13.7	16.0	15.7	16.8	17.3	16.5	14.4	13.7	12.9	10.1
Max Change (°C/m)[1]	0.2	0.0	0.2	0.2	**4.4**	**5.6**	**7.4**	0.2	0.6	0.2
Depth of Max Change (m)[2, 3]	0.75	N/A	0.75	0.75	0.75	1.50	0.75	2.50	0.75	0.75

Notes:

Data from field duplicates are averaged.

Shaded and bold values indicate an exceedance of the 20.0°C criterion.

1. The change in °C per meter of depth was calculated for each pair of adjacent measurement intervals in the table. This value represents the maximum value of the calculated change in °C per one meter of depth for each pair of adjacent measurement intervals. Bold values are >1.0°C per meter depth.
2. Depth of Max Change (m) = the shallowest depth where the greatest temperature gradient occurs.
3. N/A = not applicable (dates with 0.0°C max change)

Table 3-4: LL4 Temperature Vertical Profiles in 2018.

Depth (meters)	Water Temperature (°C)									
	5/17/2018	6/7/2018	6/20/2018	7/11/2018	7/24/2018	8/8/2018	8/29/2018	9/13/2018	9/26/2018	10/17/2018
0.5	13.8	16.3	18.2	**22.4**	**24.3**	**25.3**	**21.0**	18.5	17.2	10.5
1.0	13.8	16.0	16.7	**22.1**	**24.2**	**25.0**	**20.9**	18.5	17.0	10.3
2.0	13.8	15.9	16.0	**22.2**	**24.0**	**24.5**	**20.6**	18.4	16.8	10.2
3.0	13.8	15.9	15.9	**21.3**	**23.8**	**24.5**	**20.5**	18.3	16.5	10.1
4.0	13.8	15.8	15.9	19.8	**21.4**	**24.1**	19.9	17.1	15.4	10.1
5.0	13.8	15.8	15.8	18.0	17.9	**20.8**	17.2	14.6	13.5	10.1
6.0	13.8	15.8	15.8	18.0	17.6	17.4	14.9	14.4	13.4	10.1
7.0	13.8	15.8	15.7	17.9	17.6	17.2	14.7	14.3	13.3	10.1
8.0	13.8	15.8	15.7	17.9	17.5	17.2	14.7	14.3	13.3	10.1
Max Change (°C/m)[1]	0.0	0.6	**3.0**	**1.8**	**3.5**	**3.4**	**2.7**	**2.5**	**1.9**	0.4
Depth of Max Change (m)[2, 3]	N/A	0.75	0.75	4.50	4.50	5.50	4.50	4.50	4.50	0.75

Notes:

Data from field duplicates are averaged.

Shaded and bold values indicate an exceedance of the 20.0°C criterion.

1. The change in °C per meter of depth was calculated for each pair of adjacent measurement intervals in the table. This value represents the maximum value of the calculated change in °C per one meter of depth for each pair of adjacent measurement intervals.
2. Depth of Max Change (m) = the shallowest depth where the greatest temperature gradient occurs.
3. N/A = not applicable (dates with 0.0°C max change)

Table 3-5: LL3a Temperature Vertical Profiles in 2018.

Depth (meters)	Water Temperature (°C)									
	5/17/2018	6/7/2018	6/20/2018	7/11/2018	7/24/2018	8/8/2018	8/29/2018	9/13/2018	9/26/2018	10/17/2018
0.5	14.2	19.3	**20.2**	**22.6**	**24.5**	**24.4**	**21.0**	19.0	17.5	12.7
1.0	14.2	18.8	19.7	**22.5**	**24.4**	**24.3**	**20.6**	19.0	17.4	12.7
2.0	14.2	17.6	18.6	**22.4**	**24.4**	**24.2**	**20.4**	19.0	17.4	12.7
3.0	14.2	17.4	18.1	**22.3**	**24.0**	**24.1**	**20.4**	19.0	17.3	12.6
4.0	14.1	17.1	17.8	**22.1**	**22.9**	**23.7**	**20.3**	19.0	17.3	12.6
5.0	14.1	16.4	16.9	**21.2**	**21.4**	**22.5**	19.9	18.9	17.3	12.6
6.0	14.2	16.4	16.3	**20.6**	19.6	**21.4**	19.6	18.9	17.2	12.3
7.0	14.1	16.3	15.9	19.5	19.0	**20.1**	19.2	18.8	17.2	11.8
8.0	14.1	16.2	15.6	18.5	18.4	19.6	18.7	18.2	16.9	11.6
9.0	14.1	16.2	15.5	18.3	18.3	18.8	17.7	17.3	16.5	11.1
10.0	14.1	16.2	15.5	18.2	18.3	18.1	17.3	15.8	15.5	10.9
12.0	14.1	16.2	15.5	18.0	18.1	17.7	15.6	15.2	14.2	10.6
15.0	14.1	16.2	15.5	17.8	17.8	17.6	15.0	15.0	13.9	10.5
18.0	14.1	16.2	15.5	17.7	17.2	17.5	15.0	14.9	13.9	10.5
18.5	14.1	16.2	15.5	17.8	17.1	17.5	15.0	14.9	13.9	10.5
Max Change (°C/m)[1]	0.1	**1.2**	**1.1**	**1.1**	**1.8**	**1.3**	1.0	**1.5**	1.0	0.5
Depth of Max Change (m)[2, 3]	3.50	1.50	1.50	6.50	5.50	6.50	8.50	9.50	9.50	6.50

Notes:

Data from field duplicates are averaged.

Shaded and bold values indicate an exceedance of the 20.0°C criterion.

1. The change in °C per meter of depth was calculated for each pair of adjacent measurement intervals in the table. This value represents the maximum value of the calculated change in °C per one meter of depth for each pair of adjacent measurement intervals.

2. Depth of Max Change (m) = the shallowest depth where the greatest temperature gradient occurs.

3. N/A = not applicable (dates with 0.0°C max change)

Table 3-6: LL3 Temperature Vertical Profiles in 2018.

Depth (meters)	Water Temperature (°C)									
	5/17/2018	**6/7/2018**	**6/20/2018**	**7/11/2018**	**7/24/2018**	**8/8/2018**	**8/29/2018**	**9/13/2018**	**9/26/2018**	**10/17/2018**
0.5	14.1	19.3	**20.1**	**22.7**	**24.5**	**24.7**	**20.5**	19.1	17.3	13.1
1.0	14.1	19.3	19.8	**22.6**	**24.5**	**24.5**	**20.4**	19.1	17.3	13.1
2.0	14.1	18.2	18.7	**22.6**	**24.4**	**24.3**	**20.4**	19.1	17.2	13.0
3.0	14.1	17.8	18.1	**22.5**	**24.0**	**24.2**	**20.3**	19.1	17.2	12.9
4.0	14.1	17.3	18.1	**22.3**	**22.7**	**23.9**	**20.3**	19.1	17.2	12.9
5.0	14.1	17.1	17.5	**21.3**	**21.8**	**22.0**	**20.3**	19.1	17.1	12.9
6.0	14.1	16.9	17.2	**20.3**	19.7	**20.8**	**20.1**	18.7	17.1	12.8
7.0	14.1	16.8	16.8	19.7	19.0	20.0	19.4	18.3	17.1	12.4
8.0	14.0	16.5	16.4	19.3	18.6	19.3	18.9	18.0	17.0	12.4
9.0	14.0	16.4	16.1	19.0	18.4	18.9	18.4	17.8	16.9	12.1
10.0	14.0	16.4	16.0	18.3	18.3		18.0	16.0	16.6	11.7
12.0	14.0	16.4	16.0	17.9	18.2	17.9	17.2	15.6	15.2	11.4
15.0	14.0	16.3	15.8	17.6	17.9	17.6	15.4	15.5	14.2	10.8
18.0	14.0	16.2	15.6	17.4	17.2	17.6	15.2	15.3	14.1	10.8
18.5	14.0	16.2		17.3		17.6		15.3	14.1	
19.0			15.6				15.2			10.7
19.5					17.1					
Max Change (°C/m)[1]	0.1	**1.1**	**1.1**	1.0	**2.1**	**1.9**	0.7	**1.8**	0.7	0.4
Depth of Max Change (m)[2, 3]	7.50	1.50	1.50	4.50	5.50	4.50	6.50	9.50	11.00	6.50

Notes:

Data from field duplicates are averaged.

Shaded and bold values indicate an exceedance of the 20.0°C criterion.

1. The change in °C per meter of depth was calculated for each pair of adjacent measurement intervals in the table. This value represents the maximum value of the calculated change in °C per one meter of depth for each pair of adjacent measurement intervals.

2. Depth of Max Change (m) = the shallowest depth where the greatest temperature gradient occurs.

3. N/A = not applicable (dates with 0.0°C max change)

Table 3-7: LL2b Temperature Vertical Profiles in 2018.

Depth (meters)	Water Temperature (°C)									
	5/17/2018	6/7/2018	6/20/2018	7/11/2018	7/24/2018	8/8/2018	8/29/2018	9/13/2018	9/26/2018	10/17/2018
0.5	14.1	18.6	19.0	**22.5**	**24.2**	**24.6**	**20.7**	19.2	17.4	13.2
1.0	14.1	18.4	19.0	**22.5**	**24.3**	**24.3**	**20.7**	19.2	17.4	13.2
2.0	14.1	18.4	18.4	**22.4**	**24.3**	**24.2**	**20.6**	19.2	17.3	13.2
3.0	14.1	18.1	17.9	**22.4**	**23.9**	**24.2**	**20.6**	19.2	17.3	13.2
4.0	14.1	17.7	17.9	**22.2**	**22.8**	**23.3**	**20.6**	19.2	17.3	13.2
5.0	14.1	17.6	17.7	**21.6**	**21.2**	**21.8**	**20.5**	19.3	17.3	13.1
6.0	14.1	17.4	17.2	**21.5**	**20.1**	**20.8**	**20.3**	19.2	17.3	13.1
7.0	14.1	16.9	17.1	19.9	19.0	19.8	19.6	18.5	17.2	13.1
8.0	14.1	16.7	17.0	18.9	18.8	19.3	18.8	17.7	16.9	13.1
9.0	14.1	16.4	16.2	18.8	18.6	18.9	18.2	17.3	16.5	13.0
10.0	14.1	16.3	16.1	18.2	18.5	18.5	18.0	16.9	16.4	12.9
12.0	14.1	16.3	16.0	17.8	18.3	18.3	17.7	16.1	15.8	12.5
15.0	14.1	16.3	15.9	17.4	18.0	17.7	15.8	15.7	14.2	11.0
18.0	14.1	16.3	15.8	16.9	17.2	17.6	15.3	15.5	14.0	10.8
20.0	14.0	16.3	15.8	16.7	16.8	17.5	15.3	15.4	14.0	10.8
Max Change (°C/m)[1]	0.0	0.5	0.8	**1.6**	**1.6**	**1.5**	0.8	0.8	0.5	0.5
Depth of Max Change (m)[2,3]	N/A	6.50	8.50	6.50	4.50	4.50	7.50	7.50	13.50	13.5

Notes:

Data from field duplicates are averaged.

Shaded and bold values indicate an exceedance of the 20.0°C criterion.

1. The change in °C per meter of depth was calculated for each pair of adjacent measurement intervals in the table. This value represents the maximum value of the calculated change in °C per one meter of depth for each pair of adjacent measurement intervals.

2. Depth of Max Change (m) = the shallowest depth where the greatest temperature gradient occurs.

Table 3-8: LL2a Temperature Vertical Profiles in 2018.

Depth (meters)	Water Temperature (°C)									
	5/16/2018	6/6/2018	6/19/2018	7/10/2018	7/23/2018	8/7/2018	8/28/2018	9/12/2018	9/25/2018	10/16/2018
0.5	15.2	19.4	18.4	**22.6**	**24.8**	**24.9**	**20.9**	20.0	17.7	13.7
1.0	15.2	19.1	18.0	**22.6**	**24.6**	**24.6**	**20.8**	19.8	17.7	13.7
2.0	15.1	18.8	17.9	**22.6**	**24.5**	**24.4**	**20.7**	19.7	17.5	13.4
3.0	15.0	18.5	17.8	**22.6**	**24.3**	**24.3**	**20.4**	19.6	17.5	13.4
4.0	14.7	18.1	17.7	**22.5**	**22.4**	**24.2**	**20.4**	19.6	17.4	13.4
5.0	14.6	17.8	17.7	**22.1**	**21.4**	**22.6**	**20.3**	19.5	17.4	13.4
6.0	14.5	17.4	17.6	**21.0**	19.5	**21.0**	**20.2**	19.5	17.3	13.4
7.0	14.3	17.1	17.1	20.0	19.1	**20.3**	19.4	19.3	17.2	13.3
8.0	14.2	16.9	16.9	18.5	18.9	19.4	18.8	18.3	17.2	13.3
9.0	14.2	16.9	16.8	18.0	18.8	19.0	18.2	17.9	16.7	13.3
10.0	14.2	16.9	16.3	18.0	18.7	18.7	17.9	17.4	16.5	13.2
12.0	14.1	16.7	16.0	17.6	18.2	18.2	17.6	16.6	15.8	13.0
15.0	13.9	16.6	15.9	17.3	17.7	17.9	17.3	16.0	14.7	12.4
18.0	13.8	16.4	15.8	16.7	17.1	17.8	16.3	15.9	14.2	11.6
21.0	13.8	16.4	15.8	16.4	16.8	17.7	16.0	15.7	14.1	11.3
22.5	13.8									
23.5		16.3	15.8	16.3	16.5	17.6	16.0	15.5	14.1	
24.0										11.3
Max Change (°C/m)[1]	0.3	0.6	0.8	**1.5**	**1.9**	**1.6**	0.8	1.0	0.5	0.3
Depth of Max Change (m)[2, 3]	3.50	0.75	0.75	7.50	3.50	5.50	6.50	7.50	8.50	1.5

Notes:

Data from field duplicates are averaged.

Shaded and bold values indicate an exceedance of the 20.0°C criterion.

1. The change in °C per meter of depth was calculated for each pair of adjacent measurement intervals in the table. This value represents the maximum value of the calculated change in °C per one meter of depth for each pair of adjacent measurement intervals.

2. Depth of Max Change (m) = the shallowest depth where the greatest temperature gradient occurs.

Table 3-9: LL2 Temperature Vertical Profiles in 2018.

Depth (meters)	Water Temperature (°C)									
	5/16/2018	6/6/2018	6/19/2018	7/10/2018	7/23/2018	8/7/2018	8/28/2018	9/12/2018	9/25/2018	10/16/2018
0.5	14.7	18.6	18.2	**22.3**	**24.4**	**24.3**	**20.7**	19.7	18.0	13.6
1.0	14.6	18.3	18.0	**22.3**	**24.2**	**24.3**	**20.7**	19.6	17.6	13.6
2.0	14.6	18.2	17.8	**22.2**	**24.0**	**24.2**	**20.4**	19.5	17.6	13.6
3.0	14.5	18.1	17.8	**22.0**	**23.9**	**24.1**	**20.4**	19.4	17.5	13.6
4.0	14.4	18.0	17.8	**21.8**	**23.9**	**24.0**	**20.3**	19.3	17.5	13.2
5.0	14.4	18.0	17.8	**20.8**	**22.4**	**23.3**	**20.3**	19.2	17.4	13.5
6.0	14.3	18.1	17.7	19.9	**20.9**	**21.4**	**20.1**	19.2	17.4	13.5
7.0	14.3	18.0	17.7	19.4	19.3	19.9	18.6	19.1	17.3	13.5
8.0	14.3	17.8	17.6	18.5	19.0	19.3	18.3	17.6	17.2	13.5
9.0	14.3	17.6	17.4	18.0	18.7	18.8	18.1	17.4	17.1	13.5
10.0	14.2	17.5	17.0	17.7	18.6	18.5	17.9	17.1	16.1	13.5
12.0	14.1	16.7	16.5	17.5	18.4	18.3	17.7	16.7	15.7	13.4
15.0	14.0	16.6	16.1	17.2	17.9	18.1	17.4	16.4	15.4	12.6
18.0	14.0	16.5	15.9	16.8	17.3	17.8	16.9	16.0	14.5	11.6
21.0	13.8	16.4	15.8	16.5	16.8	17.7	16.3	15.7	14.1	11.5
24.0	13.5	16.3	15.8	16.2	16.5	16.6	16.3	15.5	14.0	11.4
25.0	12.9	16.3	15.8	16.1	16.4	16.5	16.2	15.4	14.0	11.4
Max Change (°C/m)[1]	0.6	0.6	0.4	1.0	**1.6**	**1.9**	**1.5**	**1.5**	1.0	0.4
Depth of Max Change (m)[2, 3]	24.50	0.75	0.75	4.50	6.50	5.50	6.50	7.50	9.50	3.5

Notes:

Data from field duplicates are averaged.

Shaded and bold values indicate an exceedance of the 20.0°C criterion.

1. The change in °C per meter of depth was calculated for each pair of adjacent measurement intervals in the table. This value represents the maximum value of the calculated change in °C per one meter of depth for each pair of adjacent measurement intervals.

2. Depth of Max Change (m) = the shallowest depth where the greatest temperature gradient occurs.

Table 3-10: LL1a Temperature Vertical Profiles in 2018.

Depth (meters)	Water Temperature (°C)									
	5/16/2018	6/6/2018	6/19/2018	7/10/2018	7/23/2018	8/7/2018	8/28/2018	9/12/2018	9/25/2018	10/16/2018
0.5	14.8	18.3	18.5	**22.3**	**24.3**	**24.0**	**20.5**	19.4	17.3	13.6
1.0	14.7	18.3	18.3	**22.2**	**24.1**	**24.0**	**20.4**	19.4	17.3	13.7
2.0	14.7	18.1	18.0	**22.2**	**23.8**	**24.0**	**20.4**	19.2	17.3	13.6
3.0	14.4	18.0	17.9	**22.0**	**23.7**	**23.9**	**20.3**	19.1	17.2	13.6
4.0	14.3	18.0	17.9	**21.6**	**23.7**	**23.9**	**20.3**	19.1	17.2	13.6
5.0	14.3	18.0	17.8	**20.8**	**21.9**	**22.5**	**20.3**	19.1	17.2	13.6
6.0	14.2	18.0	17.8	19.9	**20.4**	**21.1**	**20.3**	19.1	17.2	13.6
7.0	14.1	17.9	17.8		19.7	19.9	**20.1**	19.0	17.2	13.6
8.0	14.1	17.9	17.7	18.6	19.4	19.3	18.8	18.6	17.2	13.6
9.0	14.0	17.3	17.4	18.3	19.0	18.9	18.3	17.8	17.2	13.6
10.0	14.0	17.2	17.2	17.9	18.8	18.5	18.0	17.3	17.0	13.5
12.0	14.0	16.7	16.9	17.6	18.5	18.4	17.7	16.8	15.9	13.5
15.0	13.8	16.5	16.2	17.1	17.9	18.1	17.4	16.4	15.6	13.5
18.0	13.6	16.3	16.1	16.8	17.4	17.9	17.1	16.0	15.1	12.5
21.0	13.6	16.0	15.9	16.6	16.9	17.4	16.9	15.8	14.6	11.9
24.0	13.4	15.9	15.9	16.5	16.5	16.8	16.4	15.7	14.2	11.7
27.0	13.1	15.6	15.8	16.2	16.3	16.4	16.3	15.4	14.1	11.7
29.0	12.5	15.6	15.8	16.1	16.2	16.2	16.3	15.4	14.1	11.7
Max Change (°C/m)[1]	0.3	0.6	0.4	0.9	**1.8**	**1.4**	**1.3**	0.8	0.6	0.3
Depth of Max Change (m)[2, 3]	28.00	8.50	0.75	5.50	4.50	4.50	7.50	8.50	11.00	16.50

Notes:

Data from field duplicates are averaged.

Shaded and bold values indicate an exceedance of the 20.0°C criterion.

1. The change in °C per meter of depth was calculated for each pair of adjacent measurement intervals in the table. This value represents the maximum value of the calculated change in °C per one meter of depth for each pair of adjacent measurement intervals.

2. Depth of Max Change (m) = the shallowest depth where the greatest temperature gradient occurs.

Table 3-11: LL1 Temperature Vertical Profiles in 2018.

Depth (meters)	Water Temperature (°C)									
	5/16/2018	6/6/2018	6/19/2018	7/10/2018	7/23/2018	8/7/2018	8/28/2018	9/13/2018	9/25/2018	10/16/2018
0.5	15.0	18.1	18.5	**22.2**	**23.9**	**23.9**	**20.3**	19.2	17.2	13.7
1.0	14.7	18.1	18.3	**22.0**	**23.8**	**23.9**	**20.3**	19.2	17.2	13.7
2.0	14.7	18.0	18.2	**21.9**	**23.7**	**23.7**	**20.3**	19.0	17.2	13.7
3.0	14.3	17.9	18.2	**21.4**	**23.7**	**23.7**	**20.3**	19.0	17.2	13.7
4.0	14.3	17.8	18.1	**20.8**	**23.2**	**23.5**	**20.3**	18.9	17.2	13.7
5.0	14.2	17.8	18.1	**20.5**	**22.0**	**23.3**	**20.2**	18.9	17.1	13.7
6.0	14.2	17.7	18.1	19.9	**20.3**	**22.1**	**20.2**	18.9	17.1	13.7
7.0	13.9	17.6	18.0	19.2	19.6	**20.5**	**20.2**	18.9	17.1	13.7
8.0	13.7	17.6	18.0	18.6	19.3	19.5	20.0	18.5	17.1	13.7
9.0	13.7	17.1	18.0	18.3	19.1	18.9	18.6	17.8	17.1	13.7
10.0	13.6	16.9	17.7	18.0	18.8	18.7	18.3	17.6	17.0	13.7
12.0	13.6	16.5	17.3	17.3	18.5	18.4	18.0	17.1	16.0	13.6
15.0	13.5	16.3	16.4	17.1	17.9	18.1	17.5	16.6	15.7	13.3
18.0	13.3	16.2	16.3	16.8	17.5	18.0	17.2	16.3	15.4	12.7
21.0	13.1	16.1	16.1	16.6	17.1	17.4	16.9	16.0	14.8	12.1
24.0	12.7	15.8	16.0	16.4	16.6	16.9	16.6	15.9	14.5	11.9
27.0	12.2	15.6	15.9	16.3	16.4	16.4	16.3	15.7	14.3	11.9
30.0	11.9	15.6	15.9	16.2	16.2	16.2	16.2	15.5	14.2	11.8
33.0	11.6	15.5	15.9	16.1	16.1	16.1	16.2	15.4	14.2	11.8
Max Change (°C/m)[1]	0.6	0.5	0.4	0.7	**1.7**	**1.6**	**1.4**	0.7	0.5	0.2
Depth of Max Change (m)[2,3]	0.75	8.50	0.75	6.50	5.50	6.50	8.50	8.50	11.00	16.50

Notes:

Data from field duplicates are averaged.

Shaded and bold values indicate an exceedance of the 20.0°C criterion.

1. The change in °C per meter of depth was calculated for each pair of adjacent measurement intervals in the table. This value represents the maximum value of the calculated change in °C per one meter of depth for each pair of adjacent measurement intervals.

2. Depth of Max Change (m) = the shallowest depth where the greatest temperature gradient occurs.

Table 3-12: LL0 Temperature Vertical Profiles in 2018.

Depth (meters)	Water Temperature (°C)									
	5/16/2018	6/6/2018	6/19/2018	7/10/2018	7/23/2018	8/7/2018	8/28/2018	9/13/2018	9/25/2018	10/16/2018
0.5	15.0	18.1	18.8	**21.7**	**23.0**	**23.0**	**20.1**	18.9	16.8	13.6
1.0	14.5	17.8	18.7	**21.7**	**22.9**	**23.0**	**20.1**	18.9	16.8	13.6
2.0	14.3	17.8	18.7	**21.4**	**22.8**	**23.0**	**20.1**	18.8	16.8	13.6
3.0	14.0	17.7	18.6	**21.2**	**22.8**	**23.0**	**20.1**	18.8	16.8	13.6
4.0	13.9	17.6	18.5	**21.1**	**22.5**	**23.0**	**20.1**	18.7	16.8	13.6
5.0	13.8	17.5	18.2	**20.6**	**21.9**	**21.0**	**20.1**	18.7	16.8	13.6
6.0	13.8	17.2	18.0	**20.2**	**20.7**	**20.1**	**20.1**	18.7	16.8	13.6
7.0	13.6	17.1	17.9	19.2	19.9	19.6	**20.1**	18.1	16.8	13.6
8.0	13.4	17.1	17.8	18.6	19.3	19.1	19.2	17.9	16.8	13.6
9.0	13.3	17.1	17.6	18.1	19.0	18.7	18.6	17.8	16.7	13.6
10.0	13.2	16.9	17.5	17.9	18.6	18.5	18.2	17.5	16.5	13.6
12.0	13.1	16.7	17.1	17.5	18.1	18.2	17.8	17.2	16.2	13.6
15.0	13.1	16.4	16.4	17.1	17.2	18.0	17.4	16.9	15.8	13.2
18.0	13.0	15.9	16.2	16.8	17.0	17.7	17.2	16.4	15.3	12.9
21.0	13.0	15.9	16.1	16.4	16.8	17.2	16.9	16.0	15.1	12.5
24.0	12.9	15.8	16.0	16.3	16.5	16.9	16.6	15.8	14.9	12.3
27.0	12.8	15.7	16.0	16.2	16.4	16.5	16.3	15.8	14.9	12.3
30.0	12.6	15.7	16.0	16.0	16.2	16.2	16.2	15.8	14.8	12.3
33.0	12.5	15.7	15.9	16.0	16.1	16.1	16.1	15.8	14.8	12.2
36.0	12.3	15.7	15.9	15.9	15.9	16.0	15.9	15.7	14.8	12.2
39.0	12.3	15.6	15.9	15.8	15.8	15.8	15.7	15.7	14.8	12.2
42.0	12.2	15.6	15.9	15.7	15.7	15.7	15.6	15.6	14.8	12.2
45.0	12.1	15.6	15.8	15.7	15.6	15.6	15.5	15.6	14.8	12.2
47.0	11.9	15.6	15.8	15.7	15.6	15.6	15.5	15.6	14.8	12.2
Max Change (°C/m)[1]	1.0	0.6	0.3	1.0	**1.2**	**2.0**	0.9	0.6	0.2	0.1
Depth of Max Change (m)[2, 3]	0.75	0.75	4.50	6.50	5.50	4.50	7.50	6.50	9.50	13.50

Notes:

Data from field duplicates are averaged.

Shaded and bold values indicate an exceedance of the 20.0°C criterion.

1. The change in °C per meter of depth was calculated for each pair of adjacent measurement intervals in the table. This value represents the maximum value of the calculated change in °C per one meter of depth for each pair of adjacent measurement intervals. Bold values are >1.0°C per meter depth.

2. Depth of Max Change (m) = the shallowest depth where the greatest temperature gradient occurs.

Table 3-13: LLTR Daily Maximum Temperature in 2018.

Day	Water Temperature (°C)									
	January	February	March	April	May	June	July	August	September	October
1	3.9	4.6	2.9	6.2	9.8	17.3	17.7	19.5	18.2	16.0
2	3.9	4.6	3.0	6.3	9.8	17.5	17.3	19.5	18.4	15.7
3	3.8	4.7	3.2	6.3	9.8	17.3	17.7	19.0	18.1	15.2
4	3.6	4.8	3.3	6.5	10.3	17.0	18.3	19.6	18.3	15.3
5	3.6	4.9	3.5	6.8	10.9	16.7	18.3	19.7	17.7	14.9
6	3.6	4.9	3.8	7.0	11.3	16.7	18.2	19.4	17.7	14.9
7	3.6	5.0	3.9	6.8	11.6	16.9	17.6	19.4	18.0	14.7
8	3.7	5.4	4.1	6.7	12.0	17.1	18.2	19.4	18.2	14.6
9	3.6	5.4	4.4	6.6	12.1	16.7	18.3	19.4	17.8	14.4
10	3.4	5.4	4.5	6.6	12.2	16.7	18.4	19.4	17.5	14.3
11	3.2	5.3	4.7	6.8	12.6	16.7	18.4	19.2	17.2	14.1
12	3.2	5.1	4.9	6.7	12.7	17.0	18.5	19.3	17.3	13.9
13	3.4	4.9	5.4	6.8	12.9	17.0	19.0	19.4	17.3	13.7
14	3.6	4.7	5.5	6.9	13.1	16.8	18.4	19.4	17.0	13.6
15	4.1	4.1	5.4	6.9	13.4	16.8	18.5	19.3	17.3	13.4
16	4.3	3.9	5.5	6.8	14.0	17.0	18.9	19.5	17.2	13.2
17	4.4	3.7	5.5	6.6	14.4	17.9	19.1	19.5	16.8	13.1
18	4.6	3.7	5.9	6.5	14.3	17.6	18.9	19.3	17.0	13.0
19	4.5	3.6	5.9	6.7	14.4	17.3	19.1	19.2	16.7	12.7
20	4.5	3.5	6.2	7.0	14.3	17.2	18.9	**20.3**	16.7	12.7
21	4.6	3.4	6.3	6.9	14.4	17.3	18.8	**20.2**	16.6	12.4
22	4.6	3.4	6.6	7.3	14.7	17.3	19.5	19.0	16.5	12.2
23	4.6	3.3	6.5	8.1	15.1	17.4	19.3	19.2	16.1	12.1
24	4.7	3.0	6.4	8.2	15.1	17.7	19.4	18.6	16.1	12.1
25	4.7	2.9	6.1	8.1	15.5	17.4	19.4	18.5	16.2	12.0
26	4.7	2.9	6.1	8.0	16.1	17.5	19.4	18.4	16.0	12.0
27	4.6	2.8	6.1	8.7	16.5	18.0	19.4	18.5	15.9	12.0
28	4.6	2.9	6.3	9.0	16.9	18.0	19.4	18.5	16.5	11.8
29	4.6		6.3	9.2	17.0	17.9	19.6	18.6	16.4	11.5
30	4.6		6.4	9.9	17.1	17.9	19.7	18.6	16.3	11.4
31	4.6		6.2		17.2		19.7	18.5		11.3

Notes:

#NA= not enough days to calulate the daily maximum.
Shaded and bold values indicate an exceedance of the 20.0°C criterion.
Data collected as part of Avista's Washington Total Dissolved Gas Monitoring Plan and Detailed DO Phase II Feasibility and Implementation Plan.

Table 5-1: Comparison of LLTR 2018 Values to Spokane Tribe WQ Standards.

Day	Water Temperature (°C)									
	January	February	March	April	May	June	July	August	September	October
1	0.0	4.6	3.0	6.3	9.7	17.2	17.8	**19.5**	**18.4**	**15.9**
2	0.0	4.7	3.1	6.4	9.9	17.2	17.8	**19.5**	**18.3**	**15.7**
3	0.0	4.7	3.2	6.5	10.2	17.1	17.9	**19.5**	**18.1**	**15.5**
4	3.7	4.8	3.4	6.6	10.5	17.1	17.9	**19.4**	**18.1**	**15.2**
5	3.7	4.9	3.5	6.6	10.8	17.0	17.9	**19.4**	**18.0**	**15.0**
6	3.7	5.0	3.7	6.7	11.1	16.9	18.1	**19.4**	**18.0**	**14.8**
7	3.6	5.1	3.9	6.7	11.5	16.8	18.2	**19.5**	**17.9**	**14.7**
8	3.5	5.2	4.1	6.8	11.8	16.8	18.2	**19.4**	**17.7**	**14.5**
9	3.5	5.2	4.3	0.0	12.1	16.8	18.2	**19.4**	**17.7**	**14.4**
10	3.4	5.2	4.6	0.0	12.3	16.9	18.3	**19.4**	**17.6**	**14.2**
11	3.4	5.2	4.8	0.0	12.5	16.9	18.4	**19.4**	**17.5**	**14.1**
12	3.5	5.0	5.0	0.0	12.7	16.8	18.5	**19.3**	**17.3**	**13.9**
13	3.6	4.8	5.1	0.0	13.0	16.8	**18.6**	**19.4**	**17.3**	**13.7**
14	3.7	4.5	5.3	0.0	13.3	17.0	**18.7**	**19.4**	**17.1**	**13.6**
15	3.9	4.3	5.4	0.0	**13.5**	17.2	**18.8**	**19.4**	**17.1**	**13.4**
16	4.1	4.1	5.6	0.0	**13.8**	17.2	**18.8**	**19.4**	**17.0**	**13.2**
17	4.3	3.9	5.7	0.0	**14.0**	17.2	**18.8**	**19.5**	**16.9**	**13.1**
18	4.4	3.7	5.8	6.8	**14.2**	17.3	**18.9**	**19.6**	**16.9**	**12.9**
19	4.5	3.6	6.0	6.8	**14.4**	17.4	**19.0**	**19.6**	**16.8**	**12.7**
20	4.5	3.5	6.1	7.0	**14.5**	17.4	**19.1**	**19.5**	**16.6**	**12.6**
21	4.6	3.4	6.2	7.2	**14.6**	17.4	**19.1**	**19.4**	**16.5**	**12.4**
22	4.6	3.3	6.3	7.5	**14.8**	17.4	**19.2**	**19.3**	**16.4**	**12.3**
23	4.6	3.2	6.3	7.6	**15.0**	17.4	**19.2**	**19.2**	**16.3**	**12.2**
24	4.6	3.1	6.3	7.9	**15.4**	17.5	**19.3**	**18.9**	**16.2**	**12.1**
25	4.6	3.0	6.3	8.2	**15.7**	17.6	**19.4**	**18.7**	**16.2**	**12.0**
26	4.6	3.0	6.3	8.5	**16.0**	17.7	**19.4**	**18.6**	**16.2**	**11.9**
27	4.6	2.9	6.2	8.7	**16.3**	17.8	**19.5**	**18.5**	**16.2**	**11.8**
28	4.6	2.9	6.2	8.9	**16.6**	17.8	**19.5**	**18.5**	**16.2**	**11.7**
29	4.6		6.2	9.2	**16.9**	17.7	**19.5**	18.5	**16.1**	**N/A**
30	4.6		6.3	9.4	**17.1**	17.8	**19.5**	18.5	**16.0**	**N/A**
31	4.6		6.3		**17.2**		**19.5**	18.4		**N/A**

Notes:

#NA= not enough days to calulate the 7-DADM
Shaded and bold values indicate an exceedance of the 20.0°C criterion.
Data collected as part of Avista's Washington Total Dissolved Gas Monitoring Plan and Detailed DO Phase II Feasibility and Implementation Plan.

FIGURES

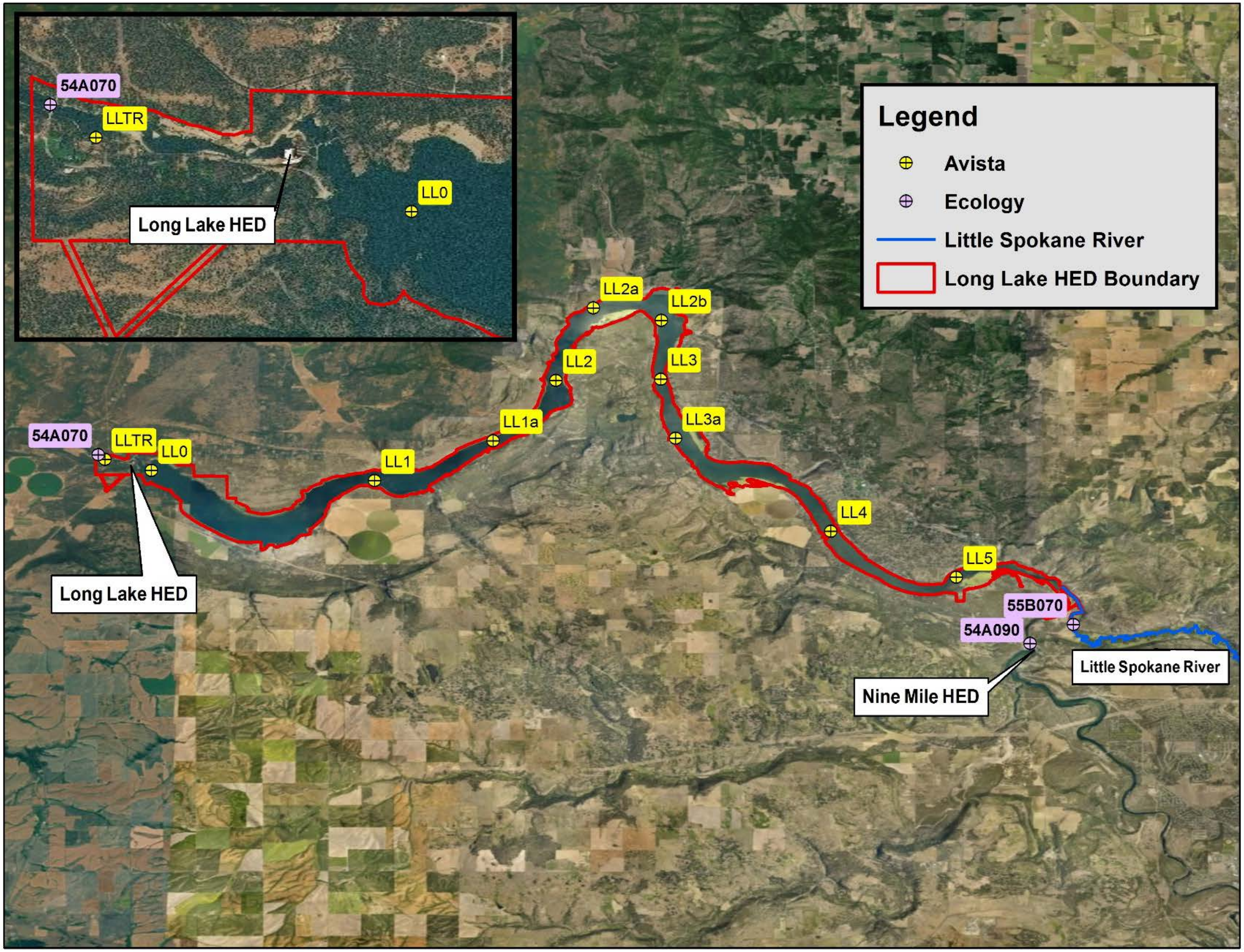

Figure 2-1: Long Lake HED 2018 Temperature Monitoring Stations.

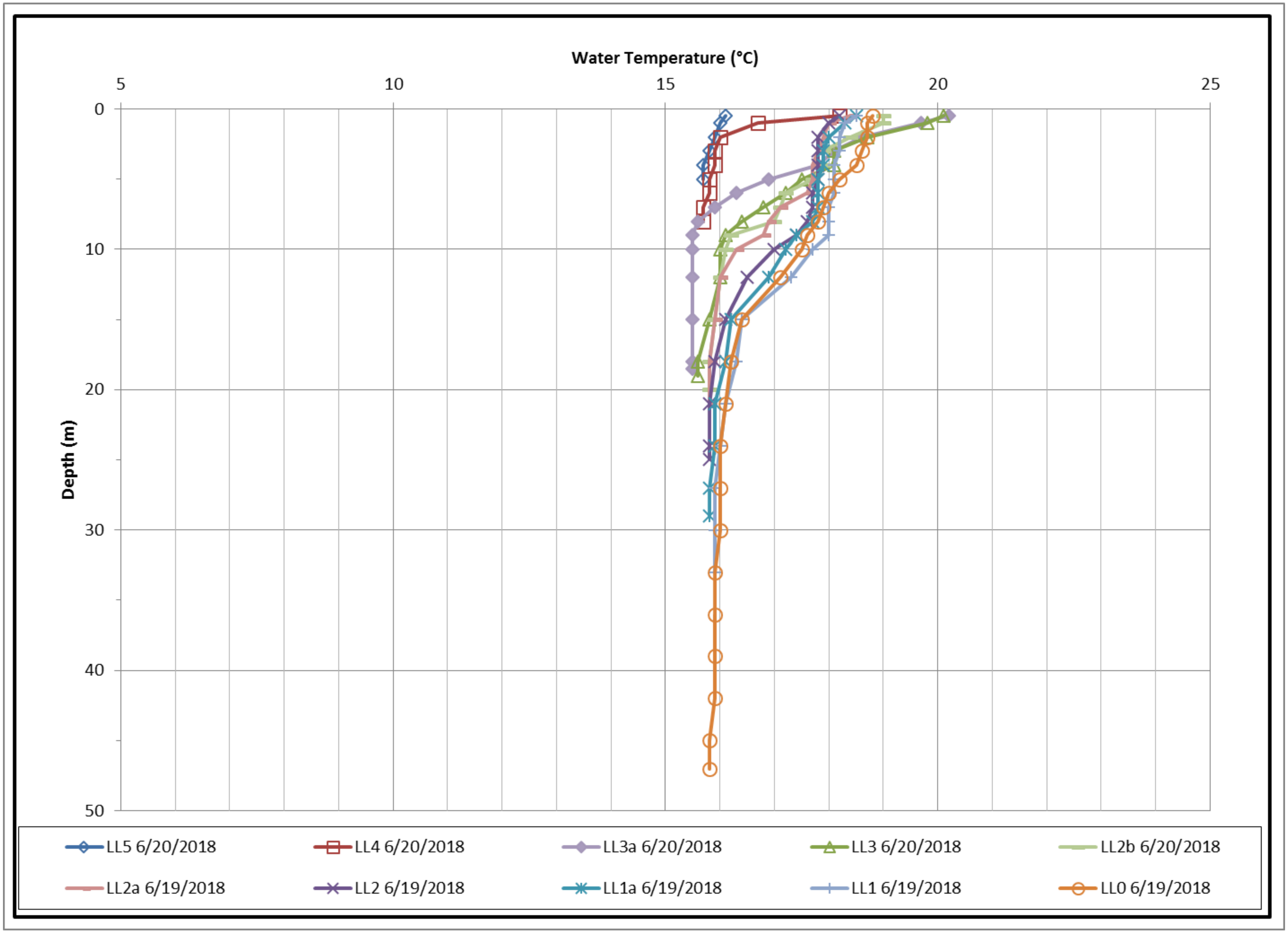

Figure 3-1: Lake Spokane Temperature Vertical Profiles, Late June 2018.

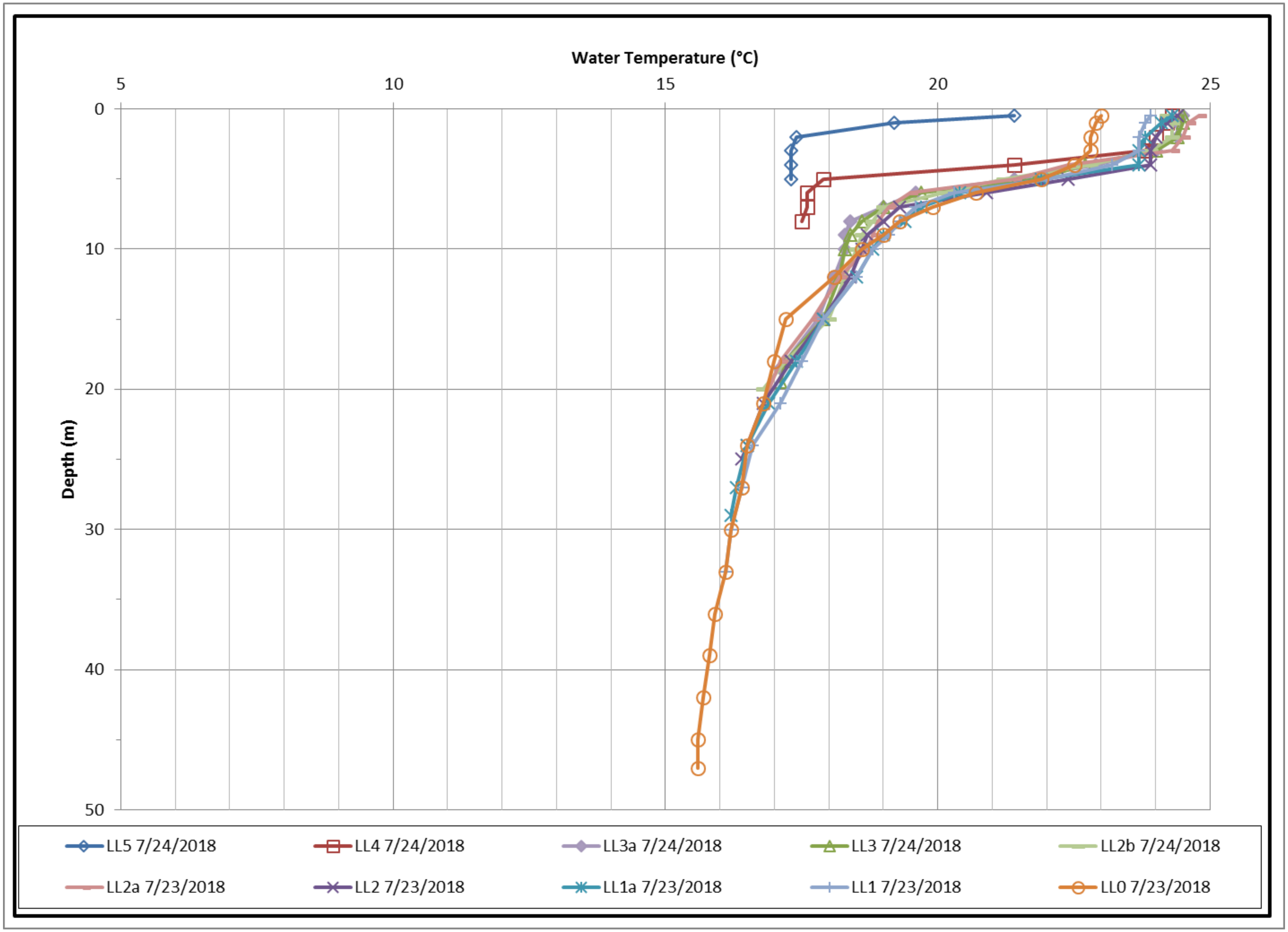

Figure 3-2: Lake Spokane Temperature Vertical Profiles, Late July 2018.

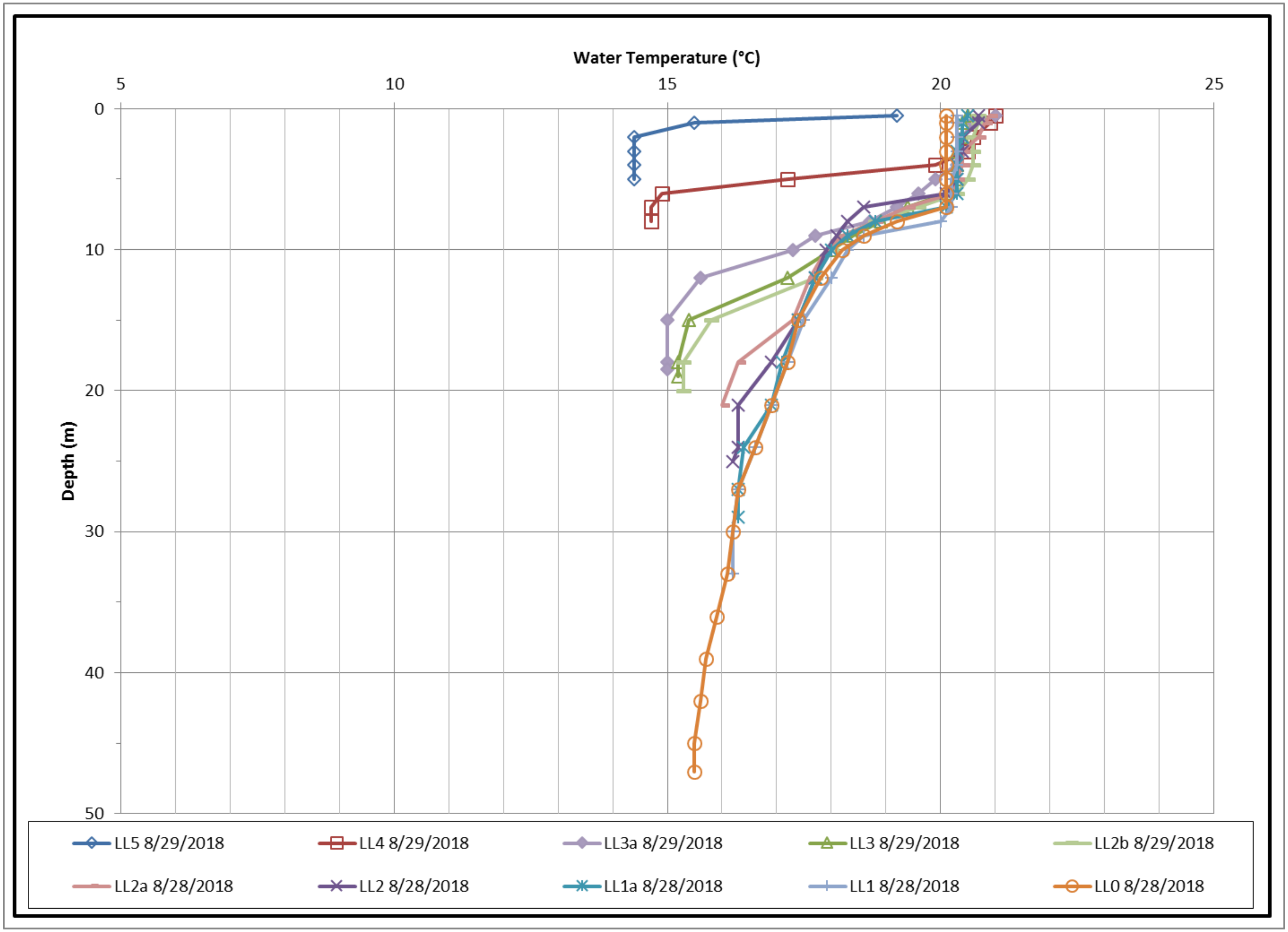

Figure 3-3: Lake Spokane Temperature Vertical Profiles, Late August 2018.

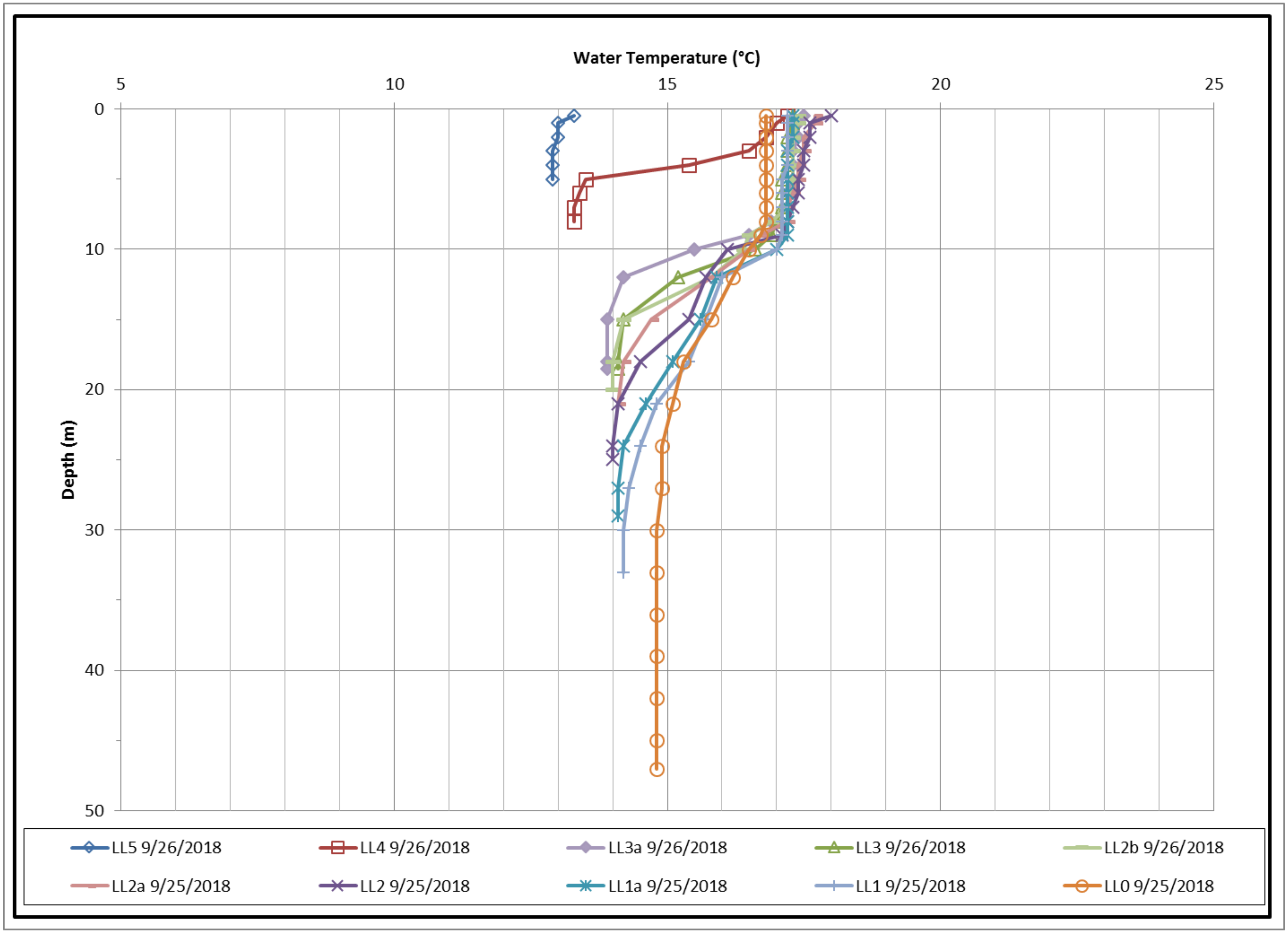

Figure 3-4: Lake Spokane Temperature Vertical Profiles, Late September 2018.

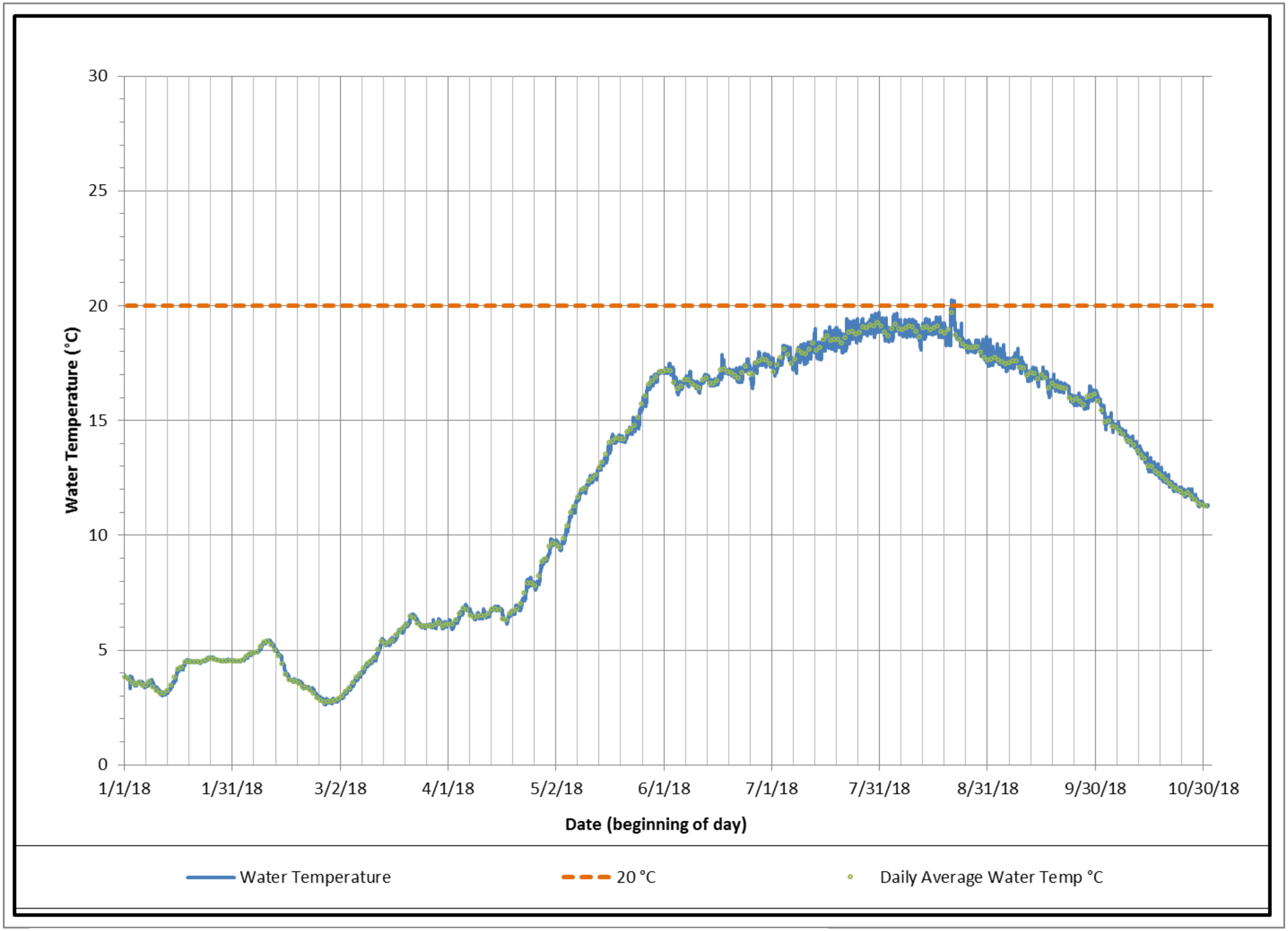

Figure 3-5: LLTR Temperature Time Series, 2018.

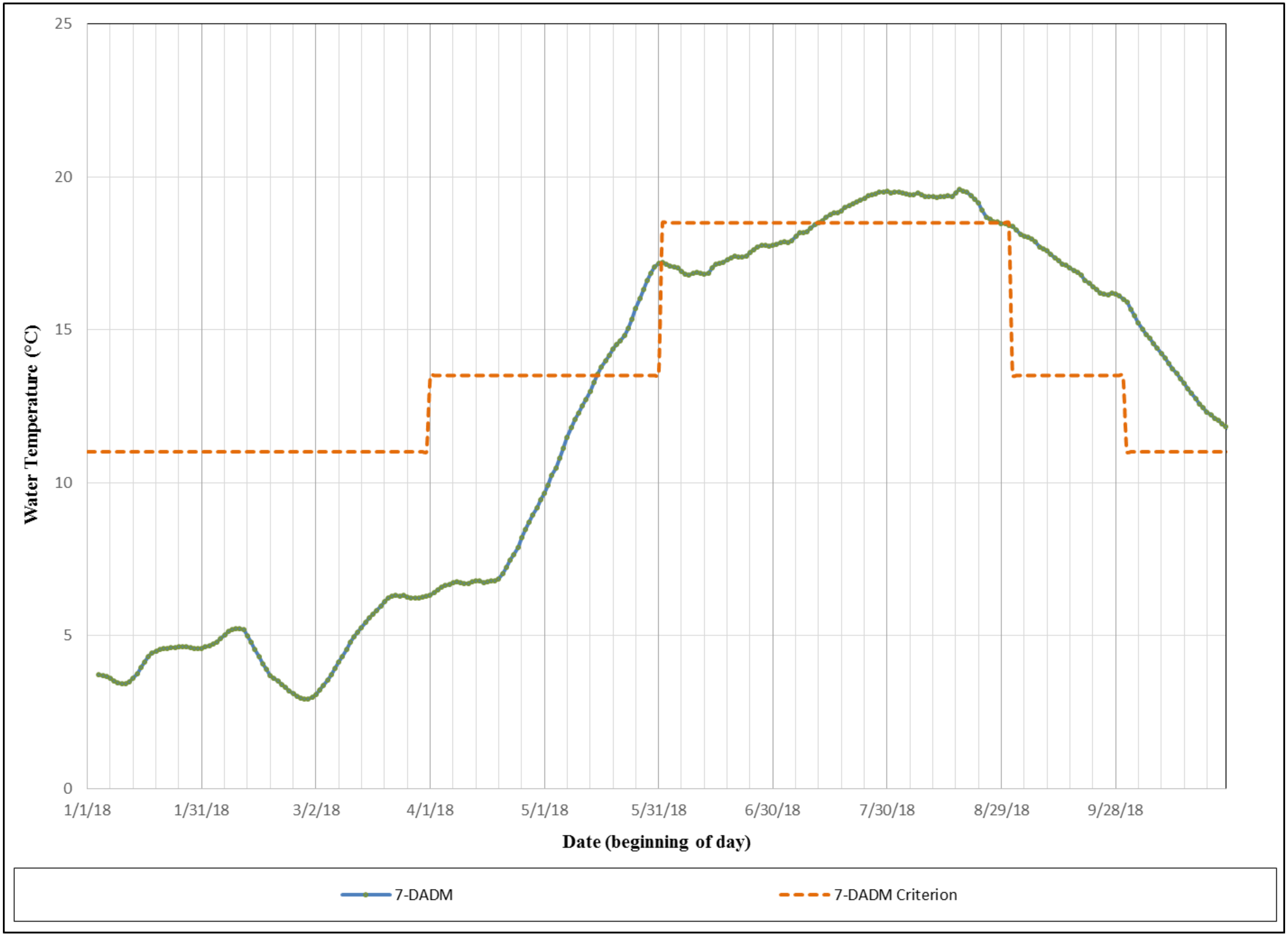

Figure 5-1: LLTR 7-DADM Time Series, 2018.

APPENDIX A

CONSULTATION RECORD

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

February 28, 2019

Patrick McGuire, Water Quality Program
Washington Department of Ecology
Eastern Regional Office
4601 N Monroe Street
Spokane, WA 99205-1295

Subject: Spokane River Hydroelectric Project, FERC Project No. 2545
2018 Long Lake Hydroelectric Development Temperature Monitoring Report

Dear Pat:

I have enclosed the 2018 Long Lake Hydroelectric Development Temperature Monitoring Report (Temperature Monitoring Report) for your review and approval. The Temperature Monitoring Report was completed in accordance with the Long Lake Dam Reservoir and Tailrace Temperature Water Quality Attainment Plan, which was required by the Federal Energy Regulatory Commission (FERC) Spokane River Hydroelectric Project License Appendix B, Section 5.5.B.

We request your review and approval by **March 29, 2019**. This will allow us time to incorporate your comments and recommendations as appropriate, and submit the Temperature Monitoring Report to FERC by April 15, 2019.

Please feel free to call me at (509) 495-4084 or Meghan Lunney at (509) 495-4643 if you have any questions about the Temperature Monitoring Report.

Sincerely,

Chris Moan
Fisheries Habitat Biologist

Enclosure (1)

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

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
4601 N Monroe Street • Spokane, WA 99205-1295 • 509-329-3400

March 27, 2019

Chris Moan
Fisheries Habitat Biologist
Avista Corporation
1411 East Mission Avenue, MSC-1
Spokane, WA 99220-3727

RE: Request for Ecology Review and Approval – *2018 Long Lake HED Temperature Monitoring Report.*
Spokane River Hydroelectric Project No. P-2545

Dear Chris Moan:

The Department of Ecology (Ecology) has reviewed the *2018 Long Lake HED Temperature Monitoring Report* sent to Ecology on February 28, 2019. The report is a requirement in FERC License Appendix B, Section 5.5.B.

Ecology APPROVES the *2018 Long Lake HED Temperature Monitoring Report* as submitted.

Please contact me at (509) 329-3567 or pmcg461@ecy.wa.gov if you have any questions.

Sincerely,

Patrick McGuire
Eastern Region FERC License Coordinator
Water Quality Program

PDM:red

cc: Meghan Lunney, Avista
Chad Atkins, Ecology

ECOLOGY COMMENTS AND AVISTA RESPONSES

Ecology Comment
Ecology acknowledged that the information provided in the *2018 Long Lake HED Temperature Monitoring Report* is a requirement in FERC License B. Section 5.5B.

Avista Response
Comment noted

Ecology Comment
Ecology approves the *2018 Long Lake HED Temperature Monitoring Report* as submitted.

Avista Response
Avista appreciates Ecology's approval of the *2018 Long Lake HED Temperature Monitoring Report.*

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

February 28, 2019

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

Subject: Spokane River Hydroelectric Project, FERC Project No. 2545
2018 Long Lake Hydroelectric Development Temperature Monitoring Report

Dear Brian:

I have enclosed the 2018 Long Lake Hydroelectric Development Temperature Monitoring Report (Temperature Monitoring Report) for your review and approval. The Temperature Monitoring Report was completed in accordance with the Long Lake Dam Reservoir and Tailrace Temperature Water Quality Attainment Plan, which was required by the Federal Energy Regulatory Commission (FERC) Spokane River Hydroelectric Project License Appendix B, Section 5.5.B.

Per the October 2008 Settlement Agreement between Avista and the Spokane Tribe, we would like to receive any comments that you may have on the Temperature Monitoring Report by **March 29, 2019**. This will allow us time to incorporate your comments as appropriate, and submit the Temperature Monitoring Report to FERC by April 15, 2019.

Please feel free to call me at (509) 495-4084 or Meghan Lunney at (509) 495-4643 if you have any questions about the Temperature Monitoring Report.

Sincerely,

Chris Moan
Fisheries Habitat Biologist

Enclosure (1)

cc: Patrick McGuire, Ecology
Meghan Lunney, Avista

The Spokane Tribe did not provide comments on the *2018 Long Lake HED Temperature Monitoring Report.*