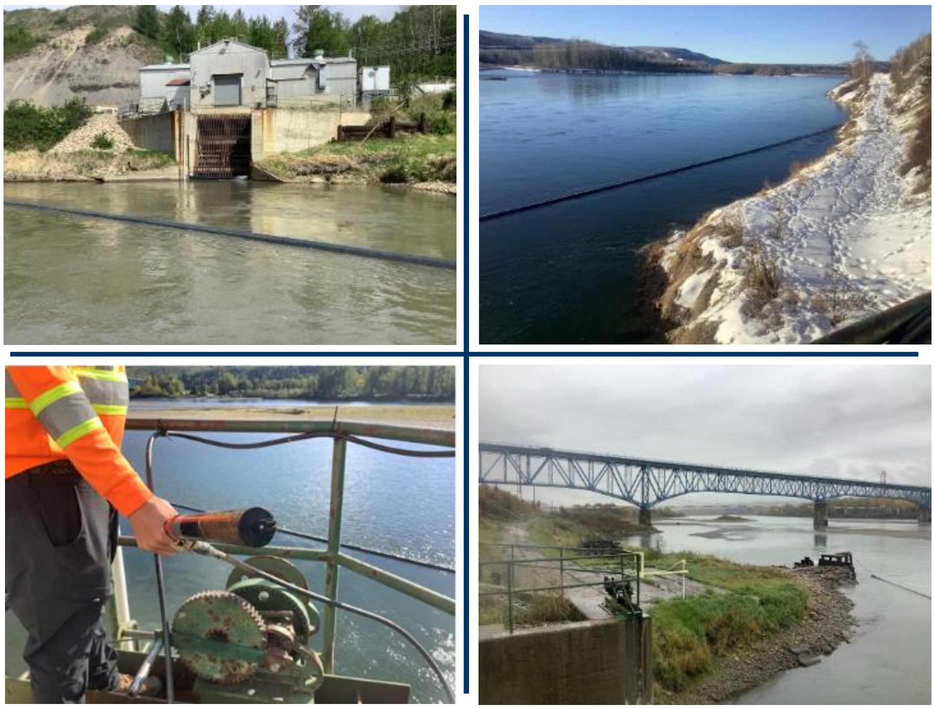
Site C Clean Energy Project

Oil, Gas, and Energy Monitoring – 2024 Annual Report



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Project Director, Senior Environmental Scientist

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1. INTRODUCTION

The Site C Clean Energy Project (the "Project") near Fort St. John, British Columbia (BC) (Map 1) is the third dam and hydroelectric generating station to be built on the Peace River in northeast BC. The Project has an earth-fill dam that is approximately 1,050 m in length and 60 m high above the riverbed. The reservoir is approximately 83 km long and is, on average, two to three times the former width of the river (BC Hydro 2013). Project construction commenced on July 27, 2015; Phase 2 of Project construction commenced following diversion of the Peace River at the Site C dam site on October 3, 2020. Site C reservoir filling began on August 25, 2024; the first turbine came into operation on October 28, 2024, and the second turbine came into operation on December 16, 2024; the remaining four turbines will come online one by one until mid-2025. We acknowledge this work is being conducted on the traditional territory of Treaty 8 First Nations of Dunne Zaa, Cree, and Tse'khene cultural descent.

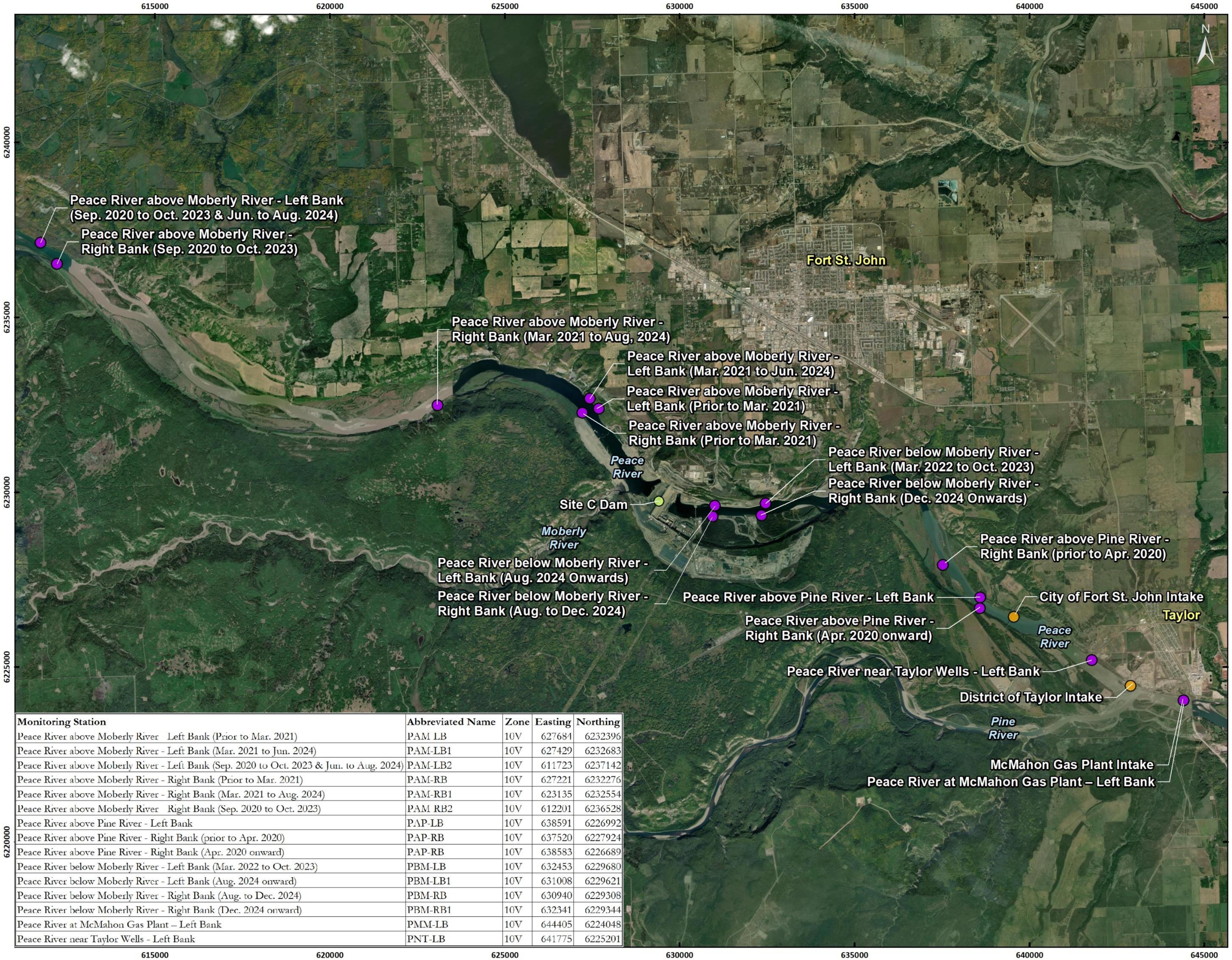
Construction of the Project required in-river work in the Peace River within and immediately upstream and downstream of the dam footprint. In-river excavation equipment and methods included aquatic excavators, excavators working from a barge or temporary constructed platform, suction dredgers, grab/bucket dredgers, and drag-line excavation. When there was active in-river work, it was expected that there would be an increase in the concentration of total suspended solids (TSS), and hence turbidity, in the Peace River downstream of the work. In-river works began on October 14, 2015 and continued through late 2024. Now that the reservoir is full and water is passing through the powerhouse, there is the potential for changes to the downstream suspended sediment and water temperature regimes in the Peace River relative to pre-construction conditions.

Continuous turbidity, TSS, and water temperature monitoring of the Peace River at the McMahon Gas Plant intake (PMM-LB; Map 1) ~17.6 km downstream of the Site C dam has been ongoing since June 2013. In June 2017, Ecofish Research Ltd. (Ecofish) was retained by BC Hydro to maintain BC Hydro's continuous monitoring stations that collect these data. In 2020, Aski Reclamation LP took over management of the contract under which this work is completed, and work since 2020 has been done in partnership with Ecofish.

The Environmental Impact Statement (EIS) (BC Hydro 2013) identified potential concerns around suspended sediment and water temperature at the water intake at the McMahon Gas Plant with respect to construction and operation of Site C. These concerns led to development of Condition #32 in the Environmental Assessment Certificate (EAC) (BC EAO 2014). EAC Condition #32 specifies monitoring of the effects of increased sedimentation at the McMahon Gas Plant intake during construction, and effects of increased water temperature and sedimentation during operations. EAC Condition #32 specifies that this monitoring must be conducted for a period of 10 years after the commencement of operations. Note that Spectra Energy which is referred to in EAC Condition #32 is no longer the owner of the McMahon Gas Plant; at the time of writing it is owned by NorthRiver Midstream.

Condition #32 of the EAC also specifies that BC Hydro must develop an Oil, Gas, and Energy Monitoring and Follow-up Program as it relates the McMahon Gas Plant's surface water intake on the Peace River ~17.6 km downstream of Site C (BC EAO 2014). This program is defined in Ganshorn (2025), which summarizes the potential Project-related concerns around the McMahon gas plant's intake and defines what is entailed in a monitoring and follow-up program to meet Condition 32 of the EAC.

The objective of this monitoring report is to provide BC Hydro with a data report that they can provide to owner of the McMahon Gas Plant beginning 180 days following commencement of operations (i.e., April 25, 2025). EAC Condition #32 specifies that monitoring must be conducted for a period of 10 years after the commencement of operations (i.e., October 28, 2034). During this monitoring period, reports will be provided to the owner of the McMahon Gas Plant annually.



Monitoring Station	Abbreviated Name	Zone	Easting	Northing
Peace River above Moberly River Left Bank (Prior to Mar. 2021)	PAM LB	10V	627684	6232396
Peace River above Moberly River - Left Bank (Mar. 2021 to Jun. 2024)	PAM-LB1	10V	627429	6232683
Peace River above Moberly River - Left Bank (Sep. 2020 to Oct. 2023 & Jun. to Aug. 2024)	PAM-LB2	10V	611723	6237142
Peace River above Moberly River - Right Bank (Prior to Mar. 2021)	PAM-RB	10V	627221	6232276
Peace River above Moberly River - Right Bank (Mar. 2021 to Aug. 2024)	PAM-RB1	10V	623135	6232554
Peace River above Moberly River Right Bank (Sep. 2020 to Oct. 2023)	PAM RB2	10V	612201	6236528
Peace River above Pine River - Left Bank	PAP-LB	10V	638591	6226992
Peace River above Pine River - Right Bank (prior to Apr. 2020)	PAP-RB	10V	637520	6227924
Peace River above Pine River - Right Bank (Apr. 2020 onward)	PAP-RB	10V	638583	6226689
Peace River below Moberly River - Left Bank (Mar. 2022 to Oct. 2023)	PBM-LB	10V	632453	6229680
Peace River below Moberly River - Left Bank (Aug. 2024 onward)	PBM-LB1	10V	631008	6229621
Peace River below Moberly River - Right Bank (Aug. to Dec. 2024)	PBM-RB	10V	630940	6229308
Peace River below Moberly River - Right Bank (Dec. 2024 onward)	PBM-RB1	10V	632341	6229344
Peace River at McMahon Gas Plant – Left Bank	PMM-LB	10V	644405	6224048
Peace River near Taylor Wells - Left Bank	PNT-LB	10V	641775	6225201

SITE C CLEAN ENERGY PROJECT

Peace River Turbidity, TSS, and Water Temperature Monitoring Station Locations - 2024

Legend

- Monitoring Stations: Turbidity, TSS, Water Temperature
- Water Intake
- Site C Dam

MAP SHOULD NOT BE USED FOR LEGAL OR NAVIGATIONAL PURPOSES

0 0.5 1 2 3 4 5 km

Scale: 1:105,000

NO.	DATE	REVISION	BY
1	2025-01-16	1200_TurbidityMonStations_7076_20250116	BRM
2			
3			
4			
5			

Date Saved: 2025-01-16
Coordinate System: NAD 1983 UTM Zone 10N

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Map 1

Path: M:\Projects-Active\1200_SiteC\MXD\Turbidity\1200_TurbidityMonStations_7076_20250116.mxd

2. METHODS

2.1. Station Description

Knight Piésold established the station at the McMahon Gas Plant on June 8, 2013 (KPL 2014). The continuous monitoring station at the intake of the McMahon Gas Plant consists of an Observator Instruments Analite NEP395 turbidity sensor that is installed in a PVC pipe attached to the upstream wingwall of the McMahon Gas Plant intake forebay (Figure 1). The sensor is mounted below the normal annual low water level elevation. The sensor is connected via a waterproof power and communications cable to a Unidata Neon Remote Terminal data logger and cellular telemetry transmitter. The station is powered by two 12-volt, 33-amp hour batteries, which are connected to a 30-watt solar panel. The station's data logger, telemetry, and power equipment are housed within a locked aluminium case mounted on the intake structure; the solar panel is mounted adjacent to the aluminum case. Turbidity and water temperature data are logged every 15 minutes, and the logged data are transmitted hourly.

The turbidity sensor also measures the temperature of the sensor, which reflects the temperature of the water if the body of the sensor remains continuously and completely submerged. The temperature data collected by Analite turbidity sensors typically need to have an offset applied to correct the time series, and this requires substantial post-processing effort. Accordingly, a stand-alone water temperature sensor that is known to be more accurate (rarely ever requiring offsets to be applied) is installed in the same PVC pipe as the turbidity sensor. The stand-alone water temperature sensors that have been used at this station are Onset TidbiTs (model V2 Part # UTBI-001, or model MX2203). A TidbiT was first installed in 2017, and water temperature data are collected with it every 15 minutes.

Figure 1. PVC pipe attached to the upstream wingwall of the McMahon Gas Plant intake forebay which contains the Analite turbidity sensor and the TidbiT water temperature sensor.

2.2. Turbidity QA/QC

In-river works began on October 14, 2015. The turbidity data collected prior to the commencement of in-river works at the McMahon Gas Plant intake from the date of station installation on June 8, 2013 to the commencement of in-river works on October 14, 2015, and during Project construction and early Project operations have been QA/QC'd. The QA/QC process ensures that any suspect or unreliable data were excluded from presentation.

Turbidity calibration standards of 0 NTU, 40 NTU, 100 NTU, 400 NTU, 1,000 NTU, 3,000 NTU, and 5,000 NTU were used to perform calibration checks of the instream turbidity sensors, and to provide equations to convert raw turbidity data to calibration-corrected turbidity data. AQUARIUS software (Aquatic Informatics Inc.) was used to review data on an on-going basis. Turbidity data from PMM-LB were compared to turbidity data from other stations that are part of the monitoring network (Map 1), as well as to Water Survey of Canada (WSC) provisional discharge data, where available, from the following stations: Peace River above Pine River (07FA004), Halfway River near Farrell Creek (07FA006), and Moberly River near Fort St. John (07FB008).

For real-time data, the AQUARIUS software is used to identify and remove periods of erroneous turbidity data. An automated spike filter is applied to the real-time data; the filter removes spikes that deviate more than 200% from the moving average based on the three data points preceding and following the data point being assessed. Small data gaps created from the removal of erroneous data were filled using the AQUARIUS linear interpolation tool, and larger gaps were filled using a simple linear regression relationship with an applicable nearby station.

For baseline turbidity data collected in 2013, the QA/QC procedures are documented in KPL (2014). They are similar to those described above for the remaining turbidity data. No adjustments were made to the 2013 QA/QC'd turbidity data presented in KPL (2014); however, data from 2014 to 2016 were QA/QC'd following the same methods applied to subsequent data as described above. All data depicted herein are daily averages of data that were originally recorded at a 15-minute time step.

2.3. Water Temperature QA/QC

In-river works began on October 14, 2015. The water temperature data collected prior to the commencement of in-river works at the McMahon Gas Plant intake from the date of station installation on June 8, 2013 to the commencement of in-river works on October 14, 2015, and during Project construction and early Project operations have been QA/QC'd. The QA/QC process ensures that any suspect or unreliable data were excluded from presentation. Data were excluded whenever the sensor was out-of-water/dry, buried in sediment, being serviced, or not functioning correctly, after which remaining outliers from the time series were identified and removed. This was done for PMM-LB by comparing water temperature data to spot measurements collected at PMM-LB, to water temperature data from nearby stations, and to water temperature data from two WSC stations in the Peace River (Peace River above Alces (07FD010) and Peace River near Taylor (07FD002)). When needed, offsets of different magnitudes were applied to correct negative temperatures recorded during freezing events to 0°C (assuming no supercooling occurred). Where sensors were confirmed to be wetted and recording slightly negative temperatures (e.g., up -0.16°C) during periods of extreme cold air temperatures, negative water temperatures were left uncorrected and supercooled conditions were assumed to be present. Small data gaps created by the removal of erroneous data were filled using the AQUARIUS linear interpolation tool, while larger gaps were filled using by applying offsets to data obtained over the missing period from a nearby gauge.

KPL (2014) stated that for baseline water temperature data collected in 2013 "No postprocessing adjustments were made to the temperature records, other than the deletion of periods when the sensor was known to be damaged or malfunctioning (i.e., when both the turbidity and temperature data streams were affected)". Accordingly, Ecofish applied postprocessing adjustments to the 2013 to 2016 water temperature time series using the same approach described above, except for 2013-2016 data which were not compared to nearby WSC stations in the Peace River.

2.4. Sensor Calibrations

From April 2024 to October 2024 three turbidity sensor calibrations were performed at PMM-LB (specific dates are provided in Section 2.5) during which turbidity the sensor is pulled from the Peace River, visually inspected, cleaned, calibrated, and reinstalled. Additional inspections and sensor cleaning were performed opportunistically and on an "as needed" basis, while turbidity sensor wipers are replaced when warranted during inspections.

2.5. Station Maintenance

Station maintenance activities performed in 2024 at the McMahon Gas Plant are summarized below.

- On January 4, 2024, the turbidity sensor was cleaned and redeployed.
- On February 1, the turbidity sensor began reading high relative to other stations. On February 8 the sensor was cleaned, and the satellite Neon datalogger was replaced with a cellular Neon unit.
- On March 14, the turbidity sensor (s/n 108133) was replaced (s/n 97344) due to a damaged seal at the connection between the turbidity sensor and cable. The TidbiT temperature logger was also found to be missing and was replaced.
- On April 22, the turbidity sensor was cleaned, calibrated and redeployed, the TidbiT temperature logger was downloaded, and TSS samples were collected.
- TSS samples were collected on May 13, May 21, June 3, and June 10, and June 20.
- On May 28, the turbidity sensor was reading high relative to other stations. Maintenance was performed to remove biofouling from the inside of the sensor standpipe, and the sensor was cleaned and redeployed.
- On July 9, the turbidity sensor and standpipe were cleaned of biofouling.
- On July 23, the turbidity sensor was cleaned, calibrated, and redeployed, the TidbiT temperature logger was downloaded, and TSS samples were collected.
- The turbidity sensor was cleaned to remove biofouling and redeployed on September 10, and September 18.
- On October 4, the turbidity sensor was cleaned, calibrated, and redeployed, and the TidbiT temperature logger was downloaded.
- On October 6, a TSS sample was collected.
- On December 12, the turbidity sensor was reading high relative to other stations. Maintenance was performed to remove biofouling from the inside of the sensor standpipe, and the sensor was cleaned and redeployed.
- On January 8, 2025, maintenance was performed to remove biofouling from the inside of the sensor standpipe, and the turbidity sensor was cleaned and redeployed. The TidbiT temperature logger was also downloaded.

2.6. Characterization of TSS:Turbidity Relationship

The relationship between TSS concentration (mg/L) and turbidity (NTU) is used to convert real-time continuous turbidity data to corresponding real-time continuous TSS concentration. The relationship can be dynamic, depending upon a variety of factors including snowmelt and precipitation driven changes in the relative contributions of various sediment sources, as well as hydrology driven changes in the sediment carrying capacity of the Peace River. As such, a TSS:turbidity relationship has been developed and is reassessed regularly to ensure it reflects the best available data.

For this relationship, data have been collected from 13 monitoring stations in the Peace River (the six decommissioned Peace River above Moberly River stations, the decommissioned Peace River below Moberly River stations on the left bank and right banks, one (the left bank) of the two active Peace River below Moberly River stations, the two Peace River above Pine River stations, Peace River at the McMahon Gas Plant Intake, and at Peace River near Taylor Wells). Real-time turbidity data were continuously collected at these stations, while TSS samples are collected for laboratory analysis periodically during station servicing visits and over the course of freshet when the Peace River experiences its full range of suspended sediment conditions. The same method of sample collection employed during baseline sampling (KPL 2014) was employed for samples collected in 2017-2024.

Real-time turbidity data are paired with laboratory analyzed TSS values to determine the TSS:turbidity ratio of individual samples at the time of their collection. These individual sample ratios are then plotted over time to identify major shifts in the relationship, such that an appropriate period can be selected for further analysis to determine the more precise relationship. Data from the selected period are combined and the TSS:turbidity ratio is determined using either a linear model with station specific interactions (if Tukey post hoc tests shows that this ratio differs amongst stations) or if there is no clear evidence of station-specific interactions, then a single common relationship is determined for the Peace River using linear regression.

2.7. Remote Monitoring of Turbidity Sensor Functionality

a) Data from each station are received multiple times per day. When new data are received, they are automatically scanned by an automated email alarm program.

b) Automated email alarms are in place to monitor station data for signs that maintenance may be required, including:

   a. Flat-lines in the data;

   b. Low battery voltage;

   c. Data transmission delays;

   d. Wiper motor current exceeded; and

   e. Wiper time exceeded.

The data are also manually reviewed at a minimum on a weekly basis to look for signs of problems with the stations (e.g., signs of biofouling, erroneous short-term spikes caused by debris floating past the sensor or by debris being temporarily hung up on the installation thereby affecting readings).

3. RESULTS

3.1. Characterization of TSS:Turbidity Relationship

In annual reports prior to 2024, the TSS:turbidity relationship for the 2013 baseline data that was developed by KPL (2014) was applied to convert the 2013 turbidity data to TSS data. This relationship was 0.5815:1 ($R^2 = 0.94$ for all stations combined) based on a total of 39 collected TSS samples. Closer examination of the data provided in KPL (2014) indicates that the TSS:turbidity relationship for 2013 was determined based on TSS:turbidity pairings which preferentially utilized handheld turbidity meter measurements even when real-time turbidity gauge readings were available. Re-analysis of the KPL relationship with a preference for gauge turbidity over handheld turbidity readings yields a TSS:turbidity relationship of 0.66, which overlaps strongly with TSS:turbidity values in Ecofish's database outside of a high ratio period in 2017 (between July 29 and October 31). Subsequent inclusion of KPL's 2013 sample data in Ecofish's database result in no change to the TSS:turbidity relationship of 0.71 which has been applied to data from November 1, 2017 onwards. Therefore, it was decided to apply a TSS:turbidity ratio of 0.71 to convert turbidity data to TSS outside of the high-ratio period discussed below.

For 2017 – 2024, analysis found that the TSS:turbidity ratio was elevated from July 29 – October 31, 2017, but was otherwise lower and more consistent with what was observed under baseline conditions (KPL 2014) and what was observed after November 1, 2017. Thus, data from July 29 – October 31, 2017 were analyzed separately to inform the ratio during this "high ratio period", whereas otherwise the available data (KPL's 2013 data and December 15, 2017 through December 31, 2024) were used to inform TSS:turbidity ratios for the remaining portion of the data set ("low ratio period").

The analysis for the high ratio period (July 29 – October 31, 2017) relied on 20 samples collected across six stations during this period. These samples represented turbidity conditions ranging from 5 to 52 NTU and TSS conditions from 9 mg/L to 129 mg/L. No significant station interactions were found within this dataset, so a single common linear TSS:turbidity relationship was determined to be 2.54:1 (Figure 2, top panel).

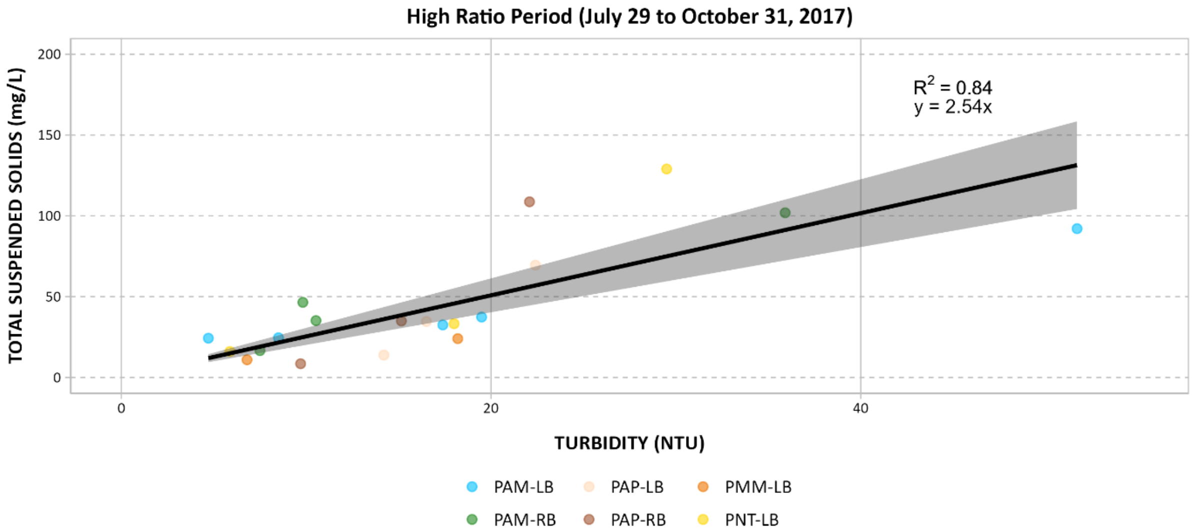
The analysis for the low ratio periods relied on 349 samples collected across 13 stations in 2013 and from December 15, 2017 through December 31, 2024. Eight of these samples were identified as outliers and were omitted from the analysis. These data encompass a wide range of turbidity (1.7 NTU to 2,618 NTU) and TSS (2 mg/L to 1,710 mg/L) observations. Turbidity values of 3,830 NTU and 4,303 NTU were recorded in 2022; however, due to their disproportional influence on the overall TSS:turbidity relationship, they were not included in the analysis.

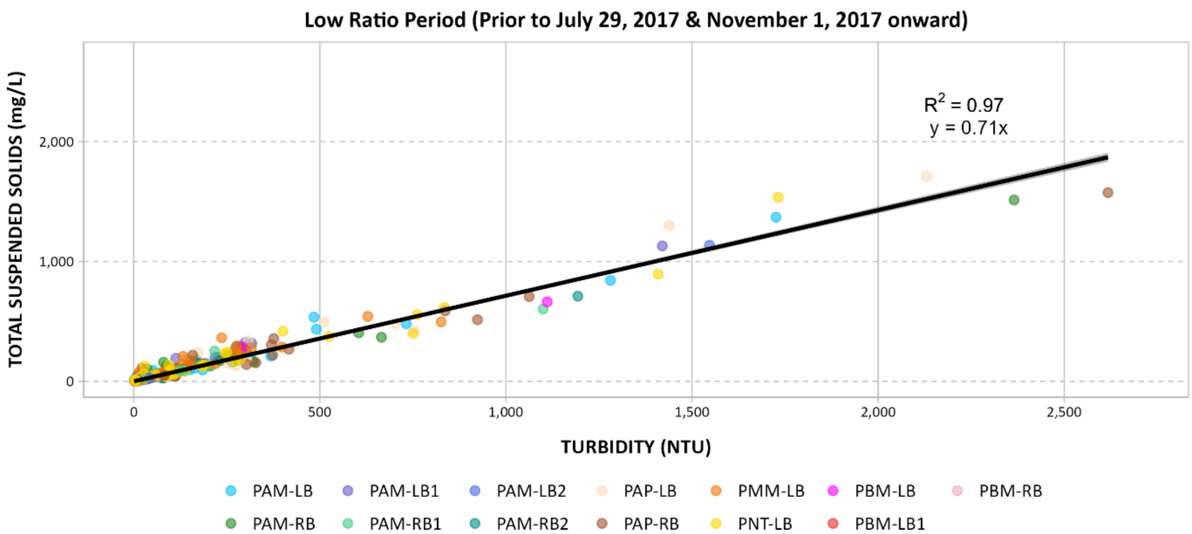
Paired turbidity and TSS data were analyzed using a linear model which assessed station-specific interactions to determine whether the TSS:turbidity relationship differed across stations. Post hoc

Tukey tests found that TSS:turbidity relationship varied from 0.61:1 to 0.82:1 across all stations excluding PBM-LB1 and PBM-RB, which were not tested given there was only one sample in 2024 from each station. The results indicate that the slope of the relationship at stations on the right bank of the Peace River was significantly lower than at stations on the left bank. To determine the influence of the small number of high turbidity samples on the relationship between sites, Tukey post hoc tests were applied to all turbidity samples less than 1,000 NTU. Results from these tests indicate no significant differences between sites. Given the uncertainty associated with the relatively few high turbidity samples, the decision was made to continue with a single combined relationship for the Peace River until stronger evidence of site-specific differences is available.

Proceeding with a linear model common to all stations in the Peace River, a combined TSS:turbidity relationship of 0.73:1 was initially found (i.e., TSS = 0.73*Turbidity) for the low ratio period prior to November 1, 2017, with good agreement amongst the data (R^2 = 0.97). This relationship was found to change slightly over time (ranging from 0.71 to 0.73) with the inclusion of additional TSS samples. The current combined TSS:turbidity relationship of 0.71:1 (R^2 = 0.97; Figure 2, bottom panel), has been applied to turbidity data collected outside of the July 29 to October 31, 2017 high ratio period. Although TSS and turbidity data from all 13 stations were used to develop the TSS:turbidity relationship, only TSS and turbidity data from PMM-LB are reported herein.

Figure 2. **TSS:turbidity ratios used to calculate TSS in the Peace River during the high ratio period (top panel, applied from July 29, 2017 to October 31, 2017), and low ratio period (bottom left, applied prior to July 29, 2017 and from November 1, 2017 – December 31, 2024). Shaded areas are 95% confidence intervals.**





3.2. Continuous Time Series Data

The Peace River flows eastward from the Dinosaur Reservoir to the Peace Canyon Dam located near Hudson's Hope, BC, before reaching the Site C dam located approximately 85 km downstream of the Peace Canyon Dam near Fort St. John, BC. Site C has been operational as of October 28, 2024. Downstream of Site C, flows in the Peace River are controlled by BC Hydro, and fluctuate depending on power demand. Tributaries deliver large inputs of suspended sediment to the Peace River/Site C reservoir during seasonal high flows, and particularly during peak flow (freshet) and rain events (KPL 2014). Prior to existence of the Site C reservoir, the sediment plumes from the tributaries that flow into what is now the Site C reservoir did not fully mix across the width of the Peace River for several kilometres downstream of the confluences (KPL 2014). Three key tributaries that flow into the Peace River/Site C reservoir between the Peace Canyon Dam and the McMahon Gas Plant intake are:

- The Halfway River flows into the Site C reservoir from the North (left bank) approximately 40 km upstream of the Site C dam. Prior to construction of the Site C dam, when the Halfway River was delivering suspended sediment to the Peace River, it was expected to influence turbidity and TSS data collected at all monitoring stations discussed in this report, though to a lesser extent at the Peace above Moberly right bank stations prior to diversion of the Peace River in late September/early October 2020.
- The Moberly River flows into the Site C reservoir from the South (right bank) approximately 1 km upstream of the Site C dam. Since river diversion took place in late September/early October 2020, the Moberly River and Halfway River became fully mixed with the Peace River as water from all three rivers passed through the Site C diversion tunnels or Site C powerhouse. Prior to construction of the Site C dam, when the Moberly River was delivering suspended sediment to the Peace River, it was expected to influence turbidity data collected at the monitoring stations near Taylor and at the McMahon Gas Plant intake.
- Regarding sediment transport under operational conditions, KPL (2012) states:
    - "In the operations phase, the reservoir would trap a portion of the sediment delivered from tributaries, while the remainder (mostly clay) would be transported out of the reservoir and down the Peace River. Wind-driven waves in the reservoir would erode the valley slopes and create a new source of sediment to the reservoir/river system. A portion of this sediment would be trapped in the reservoir, while the remainder (mostly clay) would pass through the dam and travel down the Peace River. In terms of mean annual suspended sediment load, the sediment trapping of the reservoir would outweigh the new sediment sources on the reservoir shoreline. The mean annual outflux of suspended sediment from the reservoir would be 46% of the baseline suspended sediment load in the Peace River at the Site C dam site."

  - "The reduction in suspended sediment load would occur primarily during baseline peak events (spring snowmelt and summer rainstorms). Due to reservoir attenuation and the additional sediment inputs from shoreline erosion, the median daily concentration downstream of the dam would actually increase in summer, autumn, and winter (by a small amount from low baseline values), and would only decline in the spring (by a larger amount from higher baseline values)."

- The Pine River flows into the Peace River from the south (right bank) approximately 16 km downstream of the Site C dam, and 1.6 km upstream of the McMahon Gas Plant intake on the left bank of the Peace River. When the Pine River is delivering suspended sediment to the Peace River, it is expected to only potentially influence turbidity data collected at the monitoring station at the McMahon Gas Plant intake. However, aerial imagery, and turbidity data collected to date, suggest that flow from the Pine River is kept to the right bank of the Peace River between the confluence of the two rivers and the McMahon Gas Plant intake.

Daily average turbidity data at the McMahon Gas Plant intake (PMM-LB) collected during baseline monitoring in 2013 and 2014 and during construction of the Site C project (2016 – 2024) are shown in Figure 3. Daily average TSS data at PMM-LB collected during baseline monitoring (2013 and 2014) and during construction of the Site C project (2016 – 2024) are shown in Figure 4. Patterns in the data are discussed below for turbidity; a separate discussion is not provided for TSS as the temporal patterns are identical to those for turbidity. Note that turbidity data are unavailable for parts of 2014 and 2016 and for all of 2015 due to infrequent maintenance during this period of time.

Baseline turbidity data in 2013 and 2014 demonstrate that these tributaries contribute large amounts of suspended sediment to the Peace River in the Site C project area during seasonal high flows, particularly during peak flow (i.e., freshet) events in spring, and during rainstorm events between the end of spring freshet and early fall. Data in 2013 and 2014 demonstrate the interannual variability in the magnitude of sediment delivery to the Peace River during freshet and rain events. Baseline turbidity was low in early fall (outside of rainstorms), during the winter months, and through early spring.

Consistent with baseline data in 2013 and 2014, turbidity data from 2016 to 2024 demonstrate temporal linkages between Peace River turbidity and tributary inflows. The data also demonstrate interannual variability in the timing of the onset of freshet and the magnitude of sediment delivery to the Peace River from tributaries during both freshet and rain events. From 2017 to 2024 turbidity was low throughout the winter and early spring months at PMM-LB (November to March or late April, depending on the year), turbidity then increased with the onset of freshet in early April to mid-May, depending on the year. After freshet, turbidity continues to decline throughout the summer (July and August) and remains low until the next spring freshet aside from intermittent moderate or large increases in turbidity associated with rain events and associated higher discharge from sediment-laden tributaries. As under baseline conditions in 2013 and 2014, in most years from 2016 to 2024 notable increases in Peace River turbidity occurred on several occasions during summer and early fall months in response to increases in discharge from the Halfway River, which is a significant source of suspended sediment in the study area (see Figure 3). 2021 to 2024 were comparatively dry years, and there was a notable reduction of the number of rainfall-driven increases in turbidity in these years compared to other years. In 2022, notable increases in turbidity also occurred in response to rain in late May, June, and to a reduced extent in August. In late May 2022, daily turbidity exceeded 5,000 NTU following a precipitation event from May 28 to 29, 2022. Prior to 2022, daily turbidity had only ever exceeded 5,000 NTU in June of 2020.

In 2023 and 2024, the Peace region received below average snowfall over the winter, followed by low rainfall throughout the summer and fall. In 2024, elevated turbidity through mid-to-late June were driven by elevated flow conditions associated with freshet and rainfall in mid-June. However, turbidity increases in 2024 were small relative to 2023, and much smaller relative to 2022. Turbidity remained low from July until the end of 2024.

Note that the discharge data shown in figures in this report were obtained from WSC gauges and consist of "approved" daily average data for 2013 to 2023, and "provisional" daily average data in 2024.

Daily average water temperature data at the McMahon Gas Plant intake (PMM-LB) collected during baseline monitoring in 2013 and 2014 and construction of the Site C project (2016 – 2024) are shown in Figure 5. In each year of monitoring, seasonal water temperature patterns were similar. Temporal variability in the water temperatures was driven by changing seasons. Throughout the year, the coldest water temperatures are observed from January to February, where water temperature often dips to 0°C. Water temperatures were periodically higher at PMM-LB during winter months because warm water is released to prevent ice from forming across the McMahon Gas Plant intake, particularly in 2023 and 2024 (Figure 5). Water temperature then rises from March until July, with the warmest temperatures observed typically during the months of July and August. In all years of monitoring (2013 – 2024) the peak summer daily average water temperatures were similar (~14°C to 16°C). During the summer months (July and August), water temperature varies within a range of approximately 8°C to 16°C. Beginning in roughly early September (and in August in some years), water temperature steadily declines over time with the water temperature toward the end of December being similar to what is observed in January and February. The warmest fall water temperatures observed in the period of record occurred in 2024 during and following filling of the Site C reservoir.

Figure 3. **Daily average turbidity in the Peace River at McMahon Gas Plant Intake (left bank, PMM-LB) and discharge at Water Survey Canada Halfway River near Farrell Creek station (07FA006) in 2013, 2014, and 2016 to 2024 (descending order). The shaded area represents minimum and maximum turbidity recorded at PMM-LB during other study years, while the white line represents average mean daily values over the same period.**

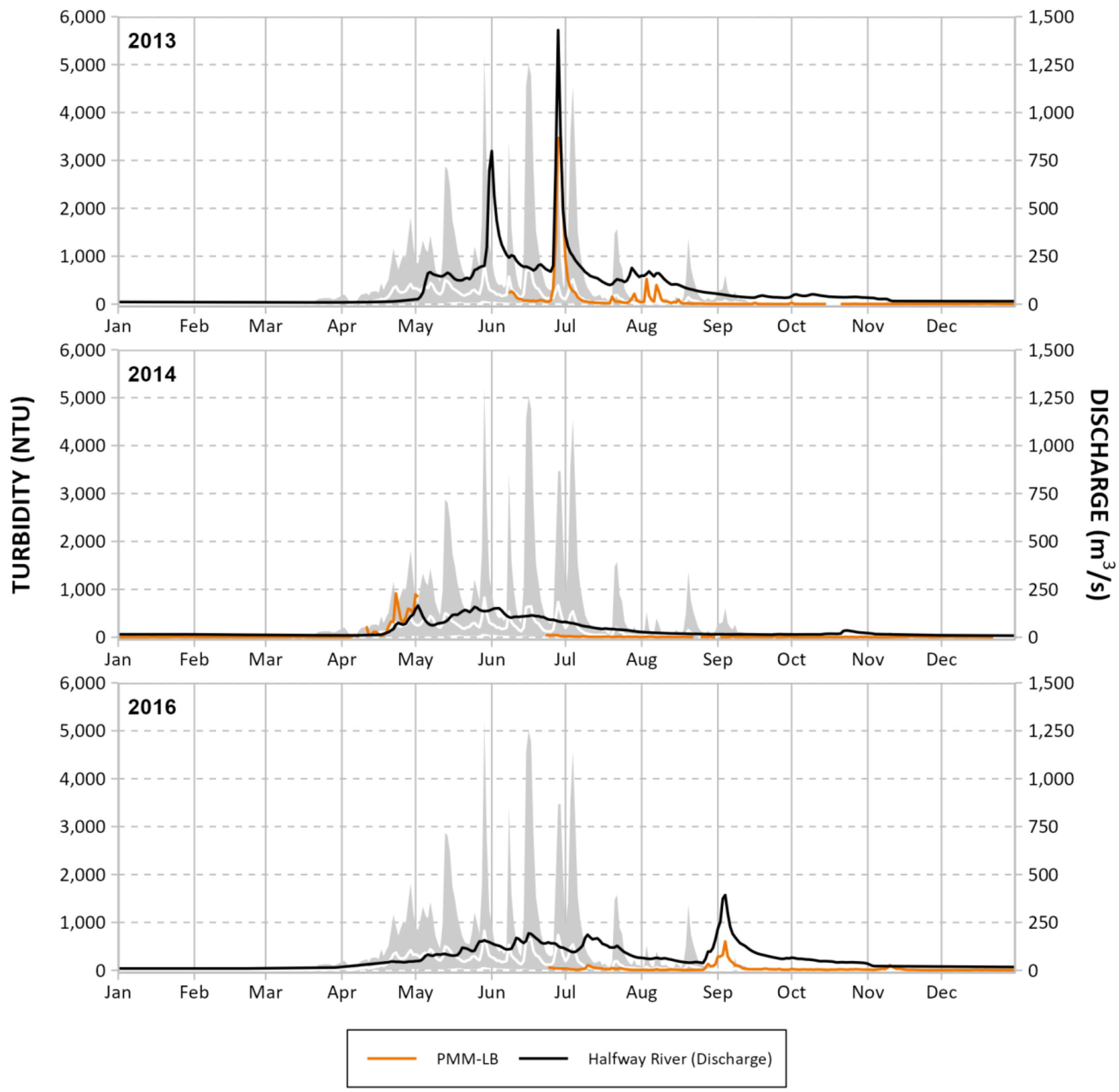


Figure 3. Continued.

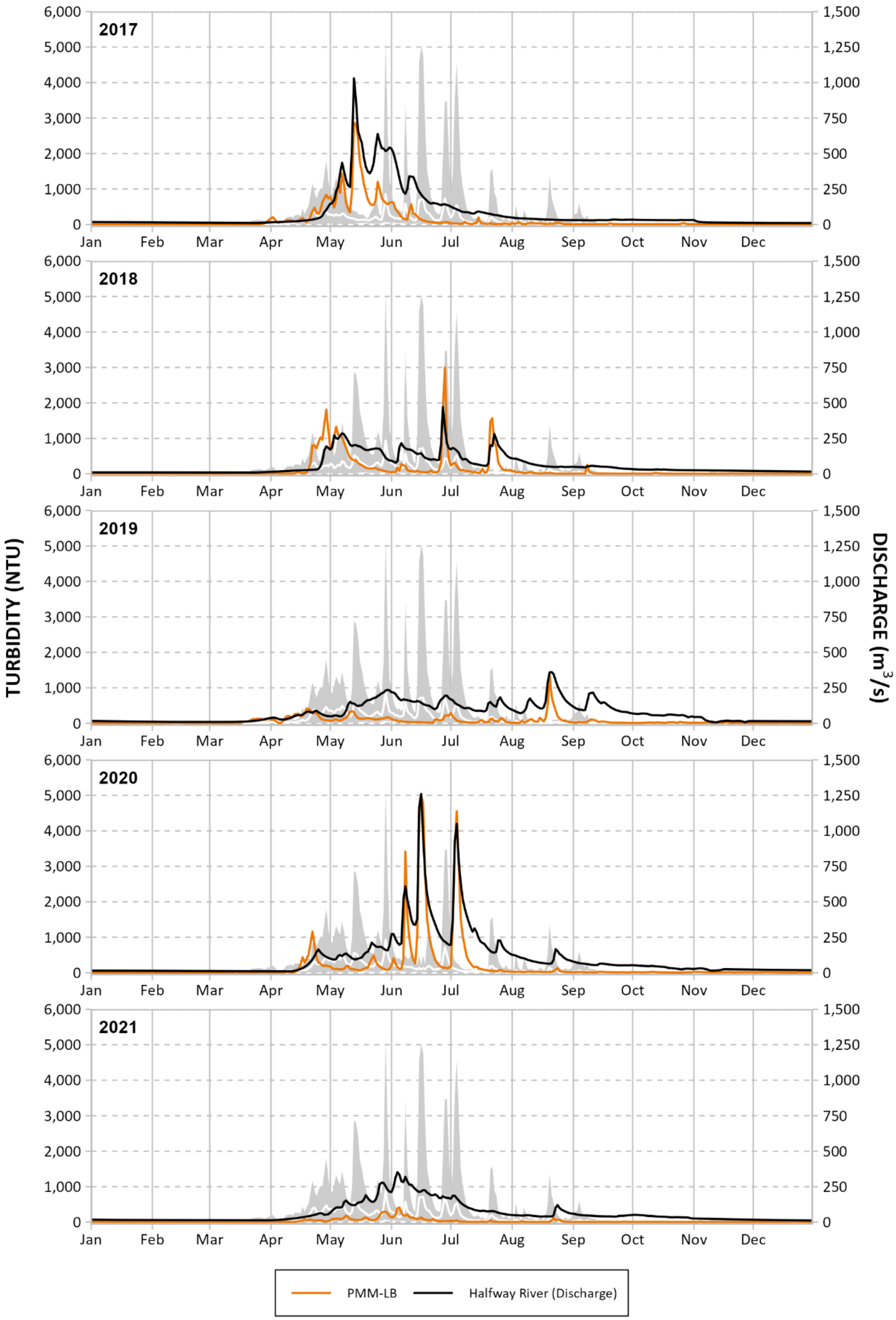


Figure 3. Continued.

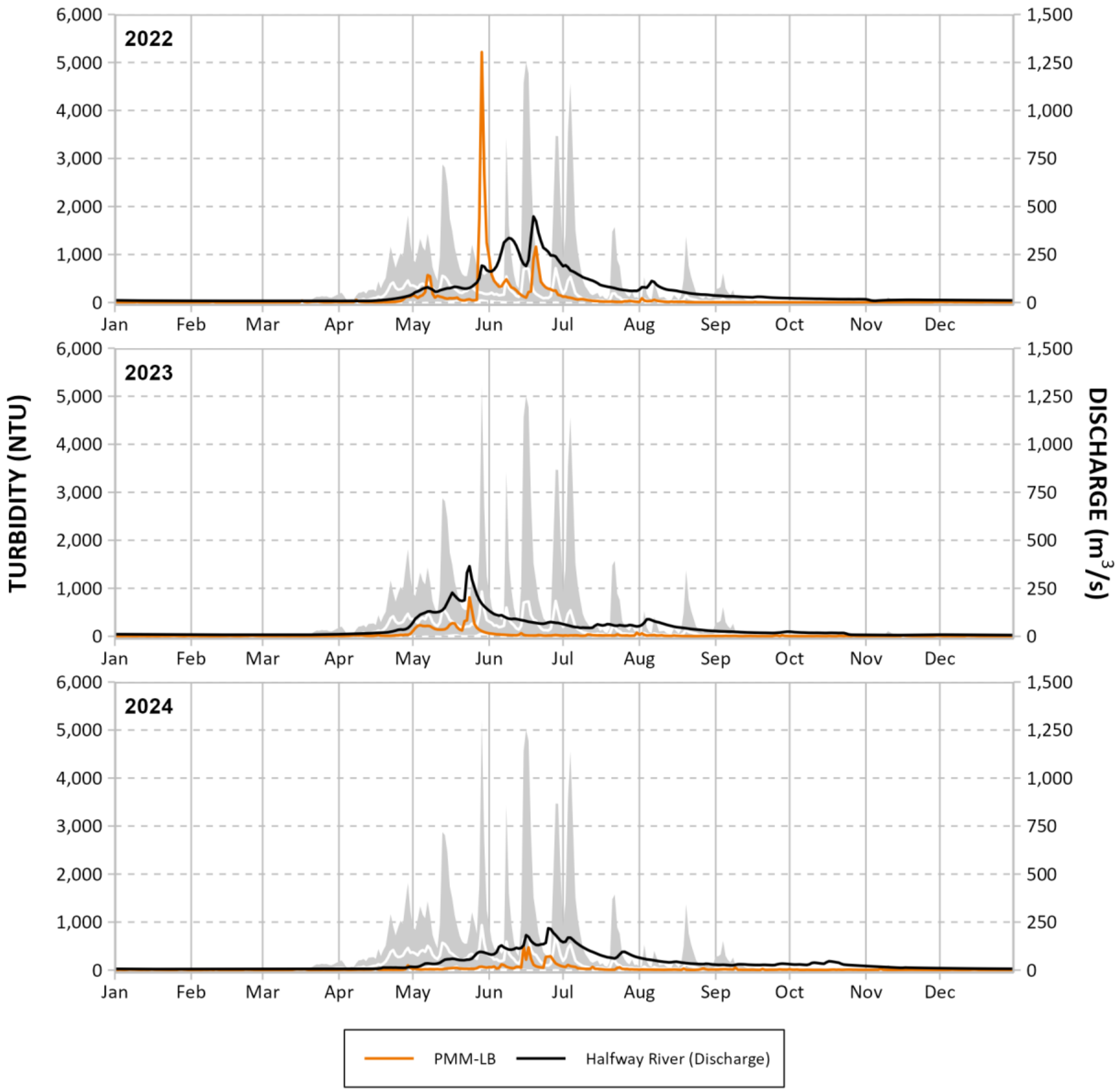


Figure 4. **Daily average TSS in the Peace River at McMahon Gas Plant Intake (left bank, PMM-LB) and discharge at Water Survey Canada Halfway River near Farrell Creek station (07FA006) in 2013, 2014, and 2016 to 2024 (descending order). The shaded area represents minimum and maximum TSS recorded at PMM-LB during other study years, while the white line represents average mean daily values over the same period.**

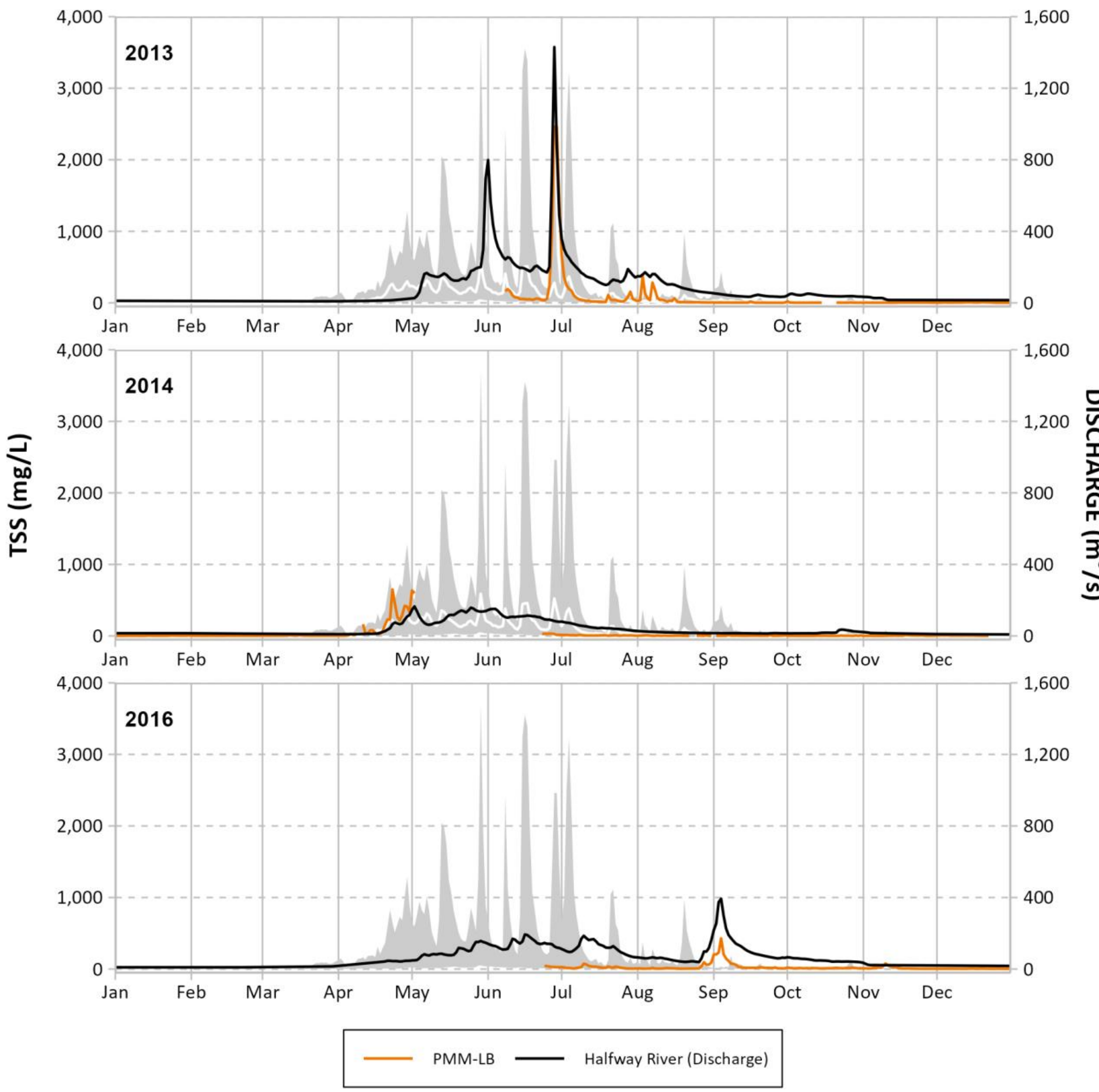


Figure 4. Continued.

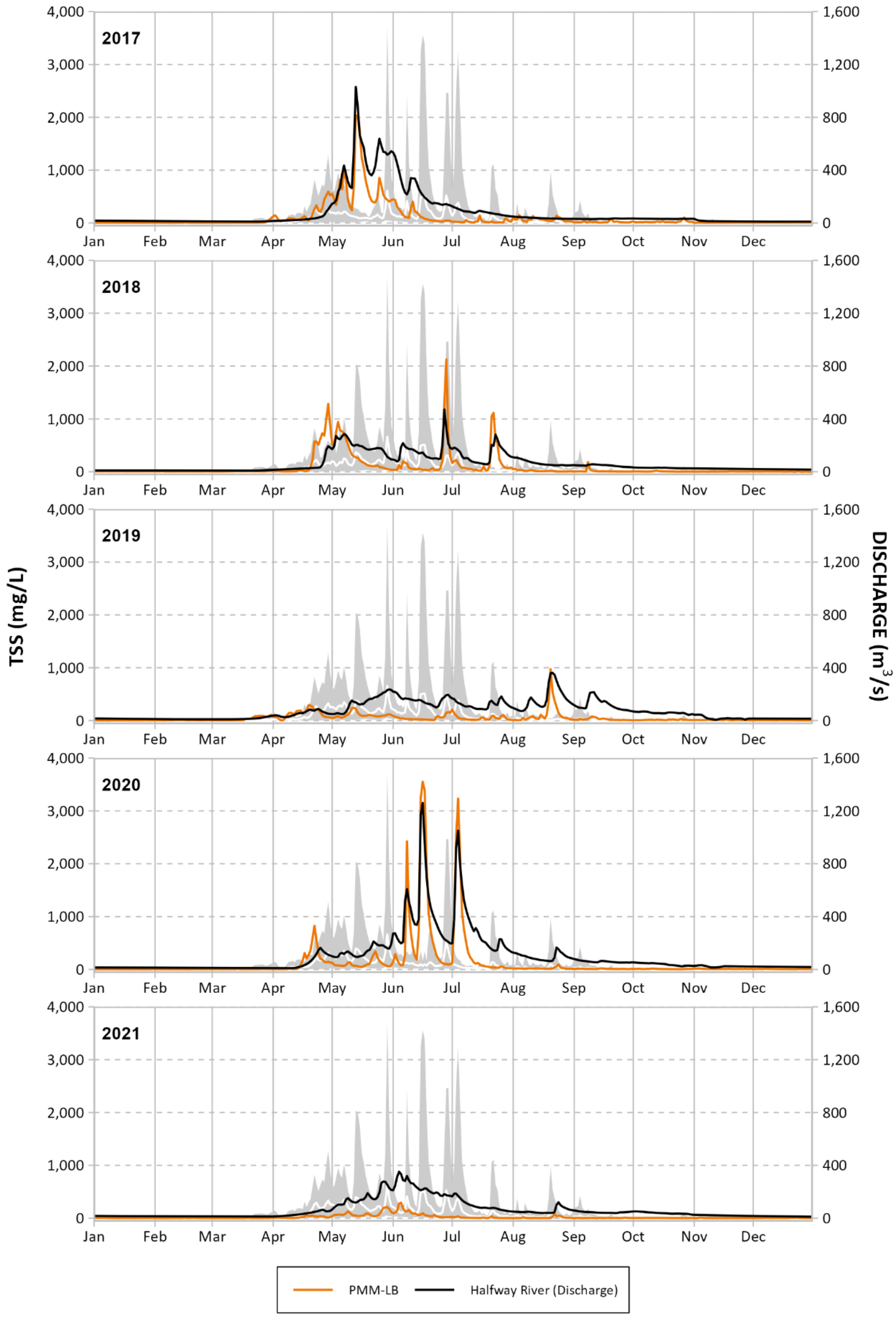


Figure 4. Continued.

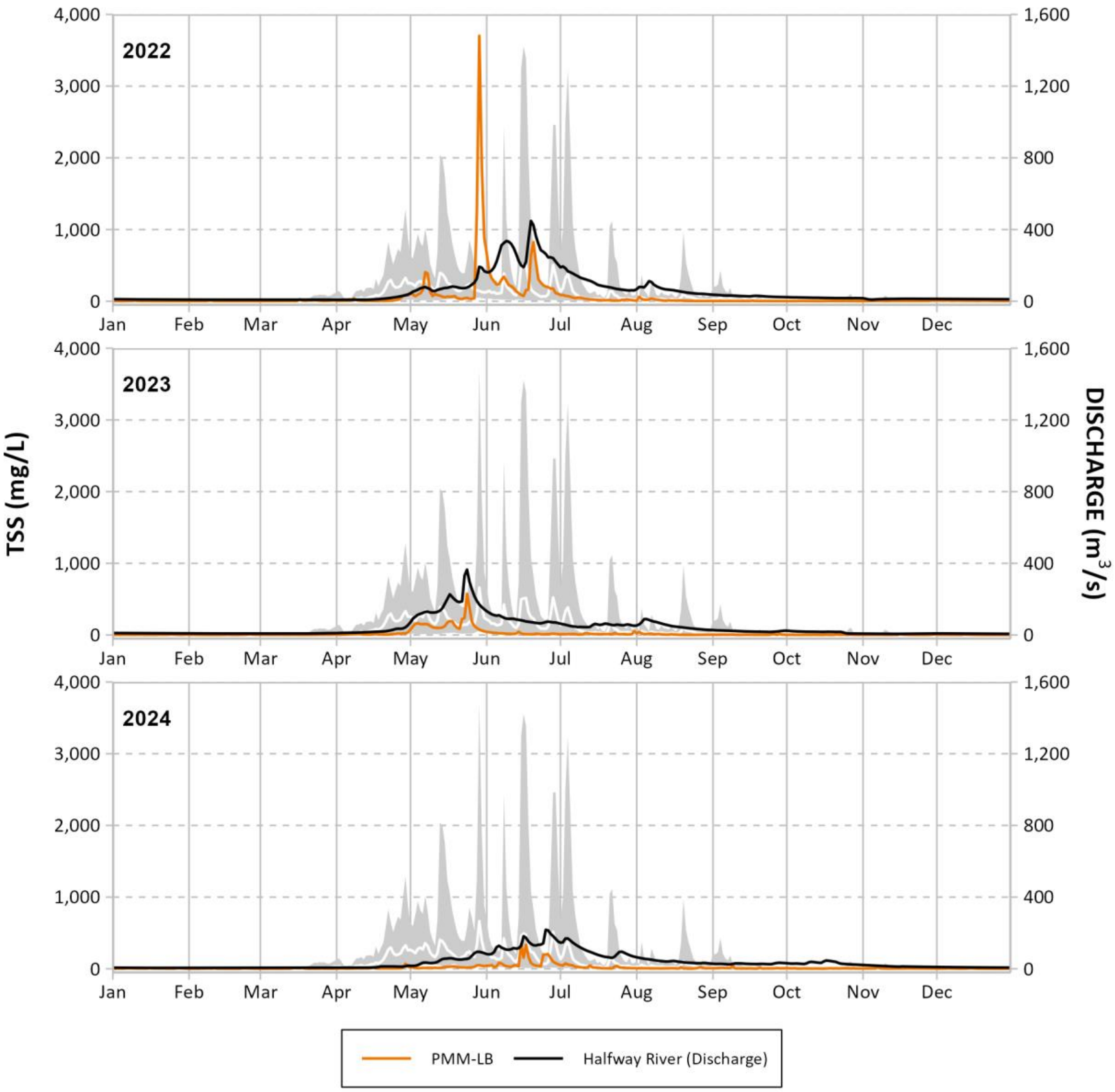


Figure 5. **Daily average water temperature in the Peace River at McMahon Gas Plant Intake (left bank, PMM-LB) in 2013, 2014, and 2016 to 2024 (descending order). The shaded area represents minimum and maximum water temperature recorded at PMM-LB during other study years, while the white line represents average mean daily values over the same period.**

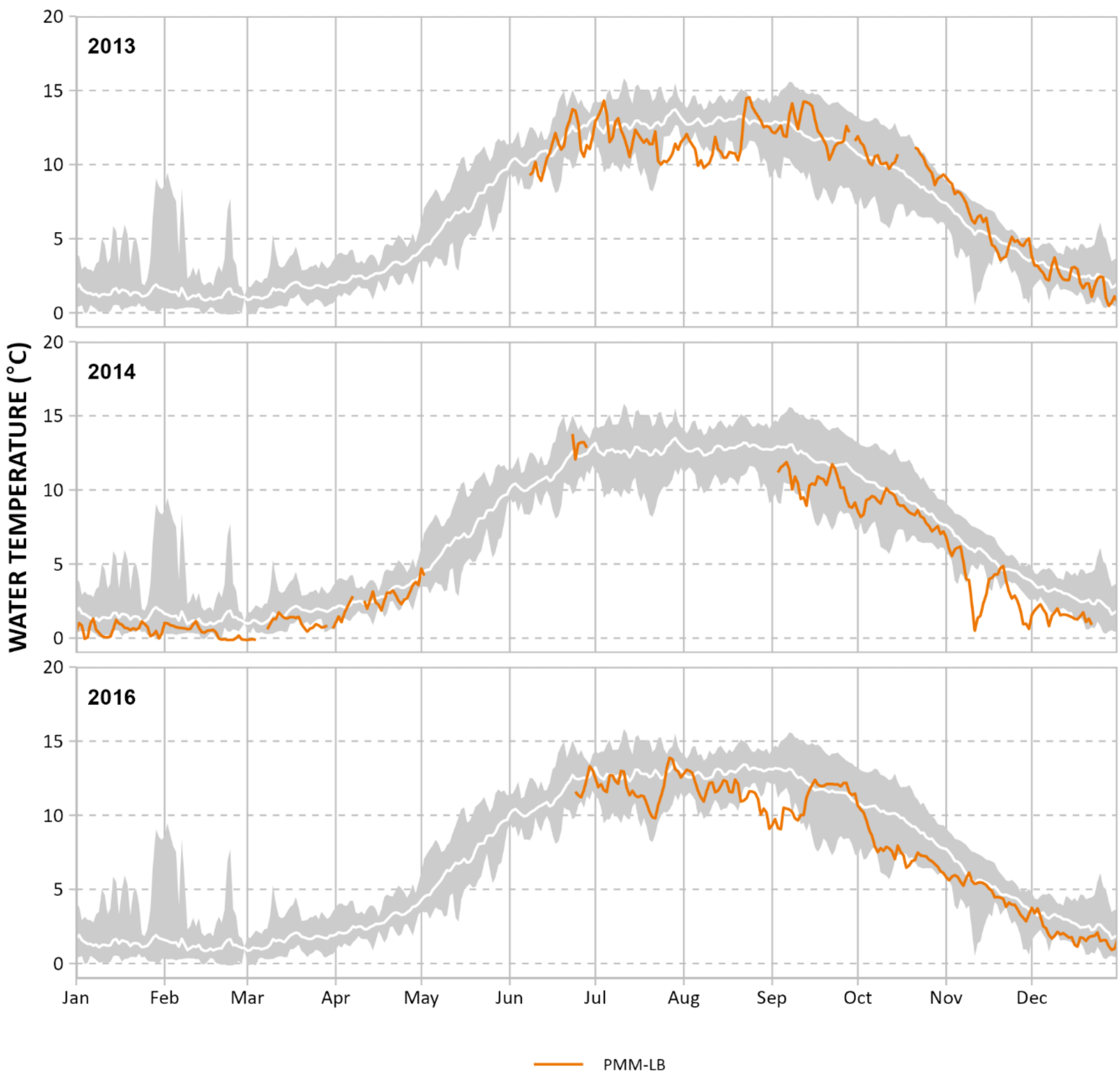


Figure 5. Continued.

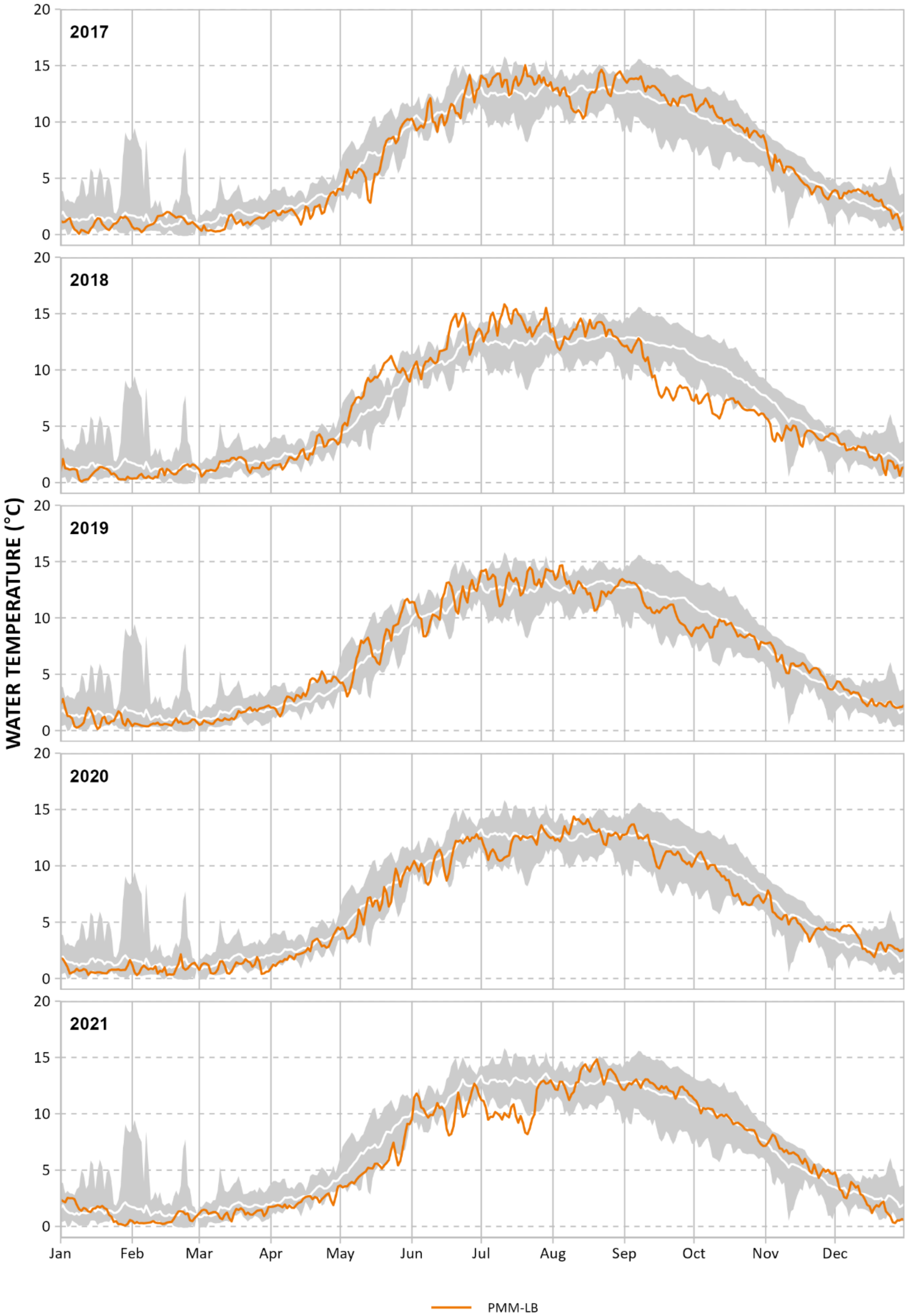
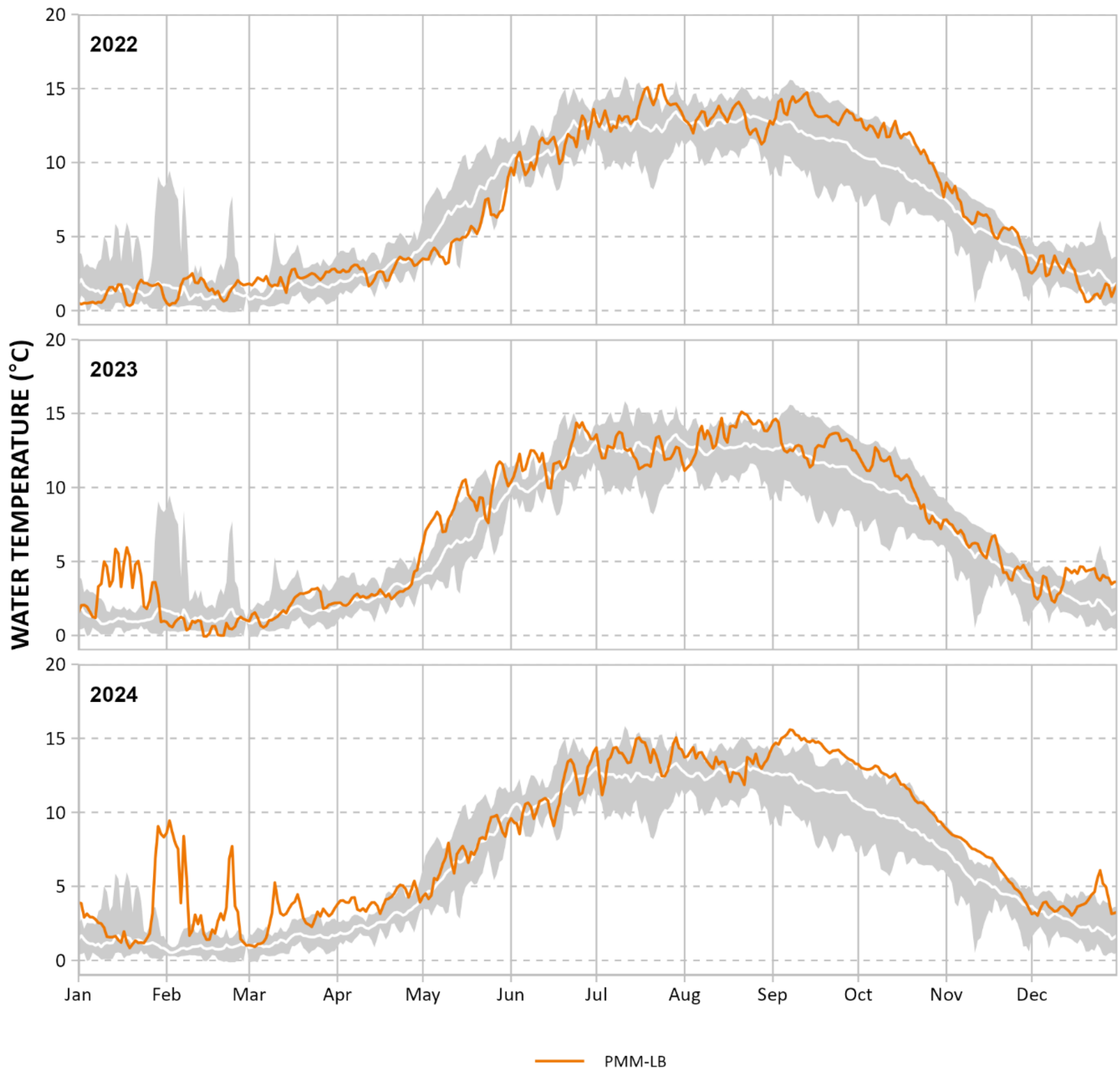


Figure 5. Continued.



4. CLOSURE

We trust that this document meets BC Hydro's requirements with respect to the provision of turbidity, TSS, and water temperature monitoring material for incorporation into reports issued by BC Hydro to the owner of the McMahon Gas Plant.

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