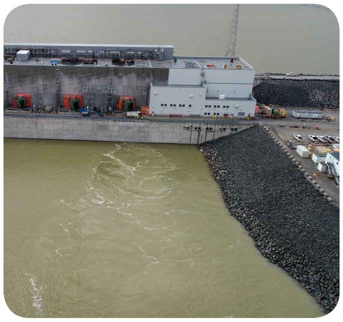
Keeyask Generation Project

Sediment Management Plan for In-stream Construction

Sediment Management Plan Report

SMP-2021-01



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KEEYASK

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2020 - 2021

KEEYASK GENERATION PROJECT

SEDIMENT MANAGEMENT PLAN FOR IN-STREAM

REPORT #SMP-2021-01

ANNUAL REPORT

April 2020 – March 2021: Year 7 Construction

Prepared by

Manitoba Hydro

June 2021

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SUMMARY

This *Sediment Management Plan for In-stream Construction* (SMP) was developed for the construction phase of the Keeyask Generation Project (the Project) to minimize the impacts of in-stream sediment generated from construction activities on the Nelson River. Excessive amounts of sediment generated during construction could change the water quality and be harmful to fish and fish habitat.

Sediment in the river is measured every minute at locations up and downstream of the construction site using an automated system to track sediment changes during major in-stream work, such as removing cofferdams from the river. The readings are sent to a computer where personnel watch and compare the amount of sediment between up and downstream in real time. The change in sediment observed is compared to predetermined action levels, which were determined by the Keeyask Hydropower Limited Partnership in consultation with provincial and federal regulators. Should the action levels be exceeded, site personnel would work with the contractor to reduce the amount of sediment entering the river during the particular construction activity, for example, slowing down the removal of the cofferdam material to reduce the amount of sediment produced.

Sediment monitoring has been conducted in accordance with the SMP since the Project began in July 2014. The sole exceedences of action levels to date were due to commissioning of the first spillway gates in 2018.

Additional monitoring conducted to measure the change in sediment suspended during the first flows through Unit 1 in the Powerhouse showed less sediment was picked up and carried downstream than was predicted for the first flow. However, the additional monitoring at that time detected a bigger increase in sediment in the water caused by removal of the Tailrace Cofferdam than was predicted within the low flow area adjacent to the main river flow. Overall, as a whole, the downstream effects of the project activities carried out in 2020/2021 on in-stream TSS were minor to negligible, as predicted.

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1.0 INTRODUCTION

The Keeyask Generation Project (the Project) is a 695-megawatt (MW) hydroelectric generating station at Gull Rapids on the lower Nelson River in northern Manitoba. The Project is approximately 725 kilometres (km) northeast of Winnipeg, 35 km upstream of the existing Kettle Generating Station, where Gull Lake flows into Stephens Lake, 60 km east of the community of Split Lake, 180 km east-northeast of Thompson and 30 km west of Gillam. Construction of the Project began in July 2014.

The principal structures for the Keeyask Generating Station are:

- North and South Dykes;
- North, Central and South Dams;
- Powerhouse complex including the intake and tailrace channels; and
- Spillway including an approach channel and discharge channel.

The *Keeyask Generation Project: Response to EIS Guidelines*, (EIS) completed in June 2012, provides a summary of predicted effects and planned mitigation for the Project. The *Sediment Management Plan for In-stream Construction* (SMP) (KHLP 2014) was developed for the construction phase of the Project, to minimize the impacts of in-stream sediment from construction activities in the Nelson River. It describes the monitoring and management of Total Suspended Solids (TSS) inputs into the waterway that may occur because of shoreline erosion, in-stream construction, river management, and commissioning of the Spillway and the Powerhouse. The SMP comprises a real-time sediment monitoring program, which is being implemented for in-stream construction activities in the Nelson River, throughout construction.

This report summarizes the results for the sediment monitoring that took place during in-stream construction in the Nelson River from April 2020 to March 2021.

1.1 CONSTRUCTION SUMMARY

Construction of the Keeyask GS began in mid-July 2014 with the construction of cofferdams in the north and central channels of Gull Rapids. These cofferdams resulted in the dewatering of the north and central channels and the diversion of all flow to the south channel. Construction of the Spillway Cofferdam (SWCD), which extends into the south channel of Gull Rapids, was completed in 2015. The rock placement for the inner and outer groins of the Tailrace Cofferdam (TRCD) started in late 2016 and the impervious fill placement was completed in fall 2017. The spillway was commissioned between August 3 and 7, 2018. Closing the south channel with the upstream South Dam Cofferdam (SDCD) commenced at the beginning of August 2018 and river closure was achieved on August 16. This closure and the work that continued to seal the cofferdam forced the entire river flow through the spillway.

In the spring and summer of 2020, many temporary structures were removed. Figure 1 shows the location of these structures. Work carried on from the previous reporting year to remove the Tailrace Cofferdam, as well as the North Channel Rock Groin. The North Channel Rock Groin removal was complete on April 9th, while work on the Tailrace Cofferdam continued through to May 14th. The work halted for the DFO Northern Manitoba timing window for summer spawning fish (such as Sturgeon), which is May 15 to July 15. Work to remove the Tailrace Cofferdam resumed on July 29th and it was complete by October 14th.

The G3 causeway was removed between July 20 and August 1 and the N5 causeway was removed between August 1 and August 27th. During removal of the causeways, rocky shoal habitat for fish was constructed on the lateral sides of both.

Removal of a portion of the Island Cut-off Groin and shaping of the Central Dam Cofferdam commenced on August 3 and continued until it was complete on August 31, 2020.

In addition to Earthworks structure removal in the 2020 reporting year, the Keeyask forebay was impounded beginning on August 31st to a water level elevation of around 156.8m, and it reached the full supply level on September 6th when the forebay reached 158.9m (Figure 1). The first turbine (Unit 1) in the Powerhouse was commissioned starting on August 31 and was fine tuned over several months until it went into commercial service on February 16, 2021.

1.2 FLOWS AND WATER LEVELS

From October 2019 to October 2020 the calculated Split Lake outflow ranged between 2,600 m^3/s in October 2019 and 5,900 m^3/s in May 2020. Flows increased from about 2,600 m^3/s in October 2019 to about 4,000 m^3/s in December 2019 and remained fairly steady between 4,000–4,400 m^3/s until the end of April 2020. In summer the flows were high and ranged between 5,000–6,000 m^3/s from May through August before dropping in September through October until it reached 3,500 m^3/s, slightly above the existing environment average flow.

Water levels on Gull Lake generally varied with flow and ice conditions between October 2019 and February 2020. Levels on Gull Lake rose from a low of about 153.5 m to 156 m from October to December and remained near that level until February while upstream levels varied with flow and ice conditions. From February to April, water-up activities at the construction site caused Gull Lake levels to rise about 0.3 m. After water-up, the spillway gates were used to keep levels relatively steady between about 156.3–156.8 m until the end of August prior to impoundment. The Keeyask reservoir was impounded to its operating level (158 to 159 m) from August 31 to September 5. During this period, Gull Lake was raised about 2 m to a maximum level of 158.9 m, 0.1 m below the full supply level. Upstream of Gull Lake the water level increase diminished with distance, with increases of about 0.8 m and 0.2 m immediately below and above Birthday Rapids while no increases occurred at the water level gauges immediately below and on Clark Lake. Gull Lake has since been held near 158.8 m while upstream levels vary with flow. With impoundment the Keeyask reservoir has entered its operating condition. Water levels on Gull Lake and upstream areas within the project's open water hydraulic zone of influence, which extends to about 3 km below Clark Lake, will now be permanently elevated relative to pre-project conditions.

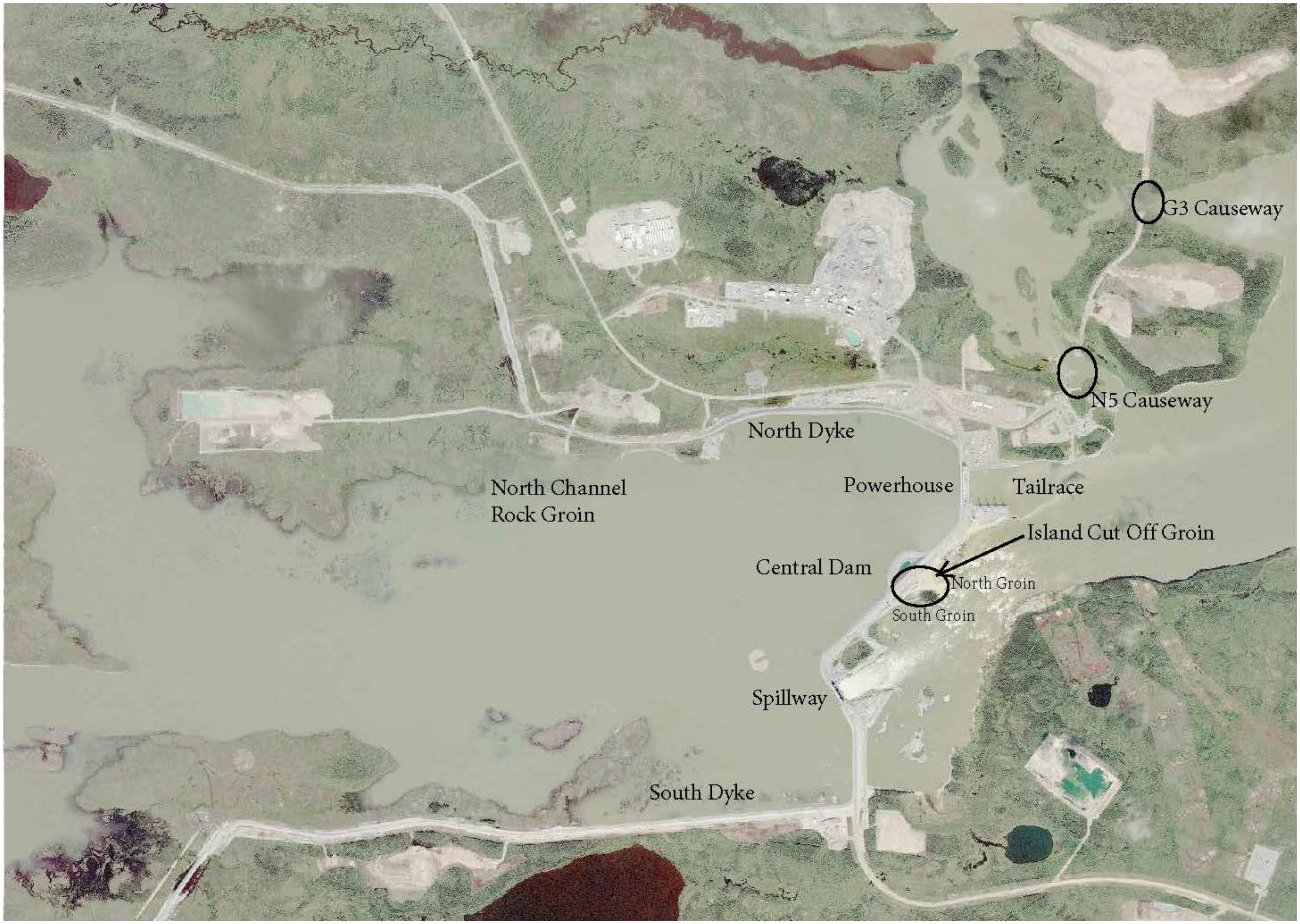

Figure 1: Map of the Keeyask Generating Station site following impoundment, September 2020.

2.0 SEDIMENT MONITORING PROGRAM

As part of the Keeyask Generation Station Project, a detailed real-time sediment monitoring program was developed for the construction phase to monitor sediment inputs from in-stream construction activities in the Nelson River. The *Keeyask Generation Project Sediment Management Plan for In-stream Construction* (SMP) (KHLP 2014) outlines the monitoring and management of total suspended solids (TSS) that could occur because of in-stream construction, and from the first flush of water that passes through the Spillway and the Powerhouse.

Turbidity (Tu) is monitored using turbidity loggers at three locations (with a total of five monitoring stations). The turbidity data are converted to TSS values based on the derived relationship between Tu and TSS, as explained in the SMP. Monitoring locations are discussed in more detail in sections 2.1, 2.2, and 2.3.

The monitoring locations are consistent with the baseline monitoring sites that were used in the environmental assessment studies. While it is intended that monitoring be undertaken at these locations, the actual locations may be adjusted in the field based on factors such as the safety of personnel and equipment, accessibility, and ambient conditions (*e.g.*, high river flow, high water velocity, unsafe ice).

2.1 OPEN WATER MONITORING STATIONS

During the month of June 2020, the open water monitoring stations were installed on the Nelson River. Five monitoring stations (SMP-1, SMP-2L & SMP-2R, SMP-3L & SMP-3R) were deployed as outlined in the SMP to collect turbidity data for the Project. A backup station (SMP-1A) was installed near SMP-1 as a precaution, so background data would be continuously available if SMP-1, which is the sole upstream monitoring station, failed or became damaged. At each station, sensors were installed two meters below the water's surface (designated as TSSS) and two meters above the bottom of the channel (designated as TSSB) (Figure 2).

- SMP-1 is located upstream of all construction activities in the Nelson River and monitors ongoing background conditions.
- SMP-2 is located approximately 1.5 km downstream of the Powerhouse. Data loggers are installed on the left and right sides of the channel (SMP-2L and SMP-2R). This location was chosen, as it is a near-field location within the mixing zone prior to fully mixed conditions.
- SMP-3 is located approximately 9 km downstream from the construction site in the fully mixed zone of the primary flow channel, along the deepest part of the river. This location was chosen because most of the flow passes through this south channel and it is where increases in TSS will most likely be detected. Data loggers are installed on both the left and right sides of the channel at this location (SMP-3L & SMP-3R).

The SMP indicates that more substantial increases in TSS would be expected to occur when water was first passed through the Powerhouse. Therefore, a plan was developed for this specific event and included measuring TSS at extra locations in addition to those described above.

Sediment plume modelling was undertaken prior to Unit 1 commissioning to fine tune TSS monitoring in advance. Based on the modelling results, SMP-2L and SMP-2R were re-located approximately 300 m upstream of their original location, on August 1, 2020. SMP-2L was located to monitor the middle of the predicated plume, while SMP-2R would capture the edge (Figure 3).

Figure 4 shows that three additional sites, K-PHCOMM-1, 2, and 3 were installed near the newly positioned SMP-2 monitoring stations during commissioning of Unit 1 to measure any effects of initial flow through the Powerhouse. They were in operation from August 29 to September 17-19 and placed in strategic locations to measure TSS generated during changing flows from the Powerhouse. These sites consisted of a sonde suspended in the water column 2m below the surface, which took turbidity readings every two minutes for the duration of wet commissioning activities in September.

2.1.1 DETECTING SEDIMENT PLUMES IN THE MIXING ZONE

To confirm the SMP-2 stations (*i.e.* left and right locations) were positioned such that the deployed loggers would detect an increase in turbidity from a passing sediment plume, turbidity measurements were taken along a cross section of the river. Transects were conducted using two different methods over the summer of 2020:

- Method 1 involved taking turbidity readings along a transect near SMP-2 (shown as grey circles in Figure 5) at three different depths. Turbidity readings were measured along this transect twice during the open water season: once prior to in-stream work occurring, on July 18; and once during in stream work, on August 19. The results are provided in Table 2 & Table 3, respectively.
- Method 2 was followed during first flows through the Powerhouse (Unit 1). A boat towed a sonde from the North shore and travelled south across the river. Two passes were made along the transect on September 2, 2021; they are shown in Figure 6.

Figure 2: Open water monitoring stations for the Keeyask Sediment Management Plan.

Figure 3: SMP2L and SMP2R (shown in green) were moved on August 1 from their original locations (shown in yellow) after modelling indicated the best position to capture a sediment plume during Unit 1 commissioning.

Monitoring site	Easting	Northing
SMP-2L	365900	6247450
SMP-2R	365900	6247350
SMP-3L	373770	6247260
SMP-3R	373840	6245450
K-PHCOMM-1	365900	6247800
K-PHCOMM-2	365900	6247550
K-PHCOMM-3	365100	6247375

Figure 4: Location of monitoring sites for first flows of water through the Powerhouse during commissioning.

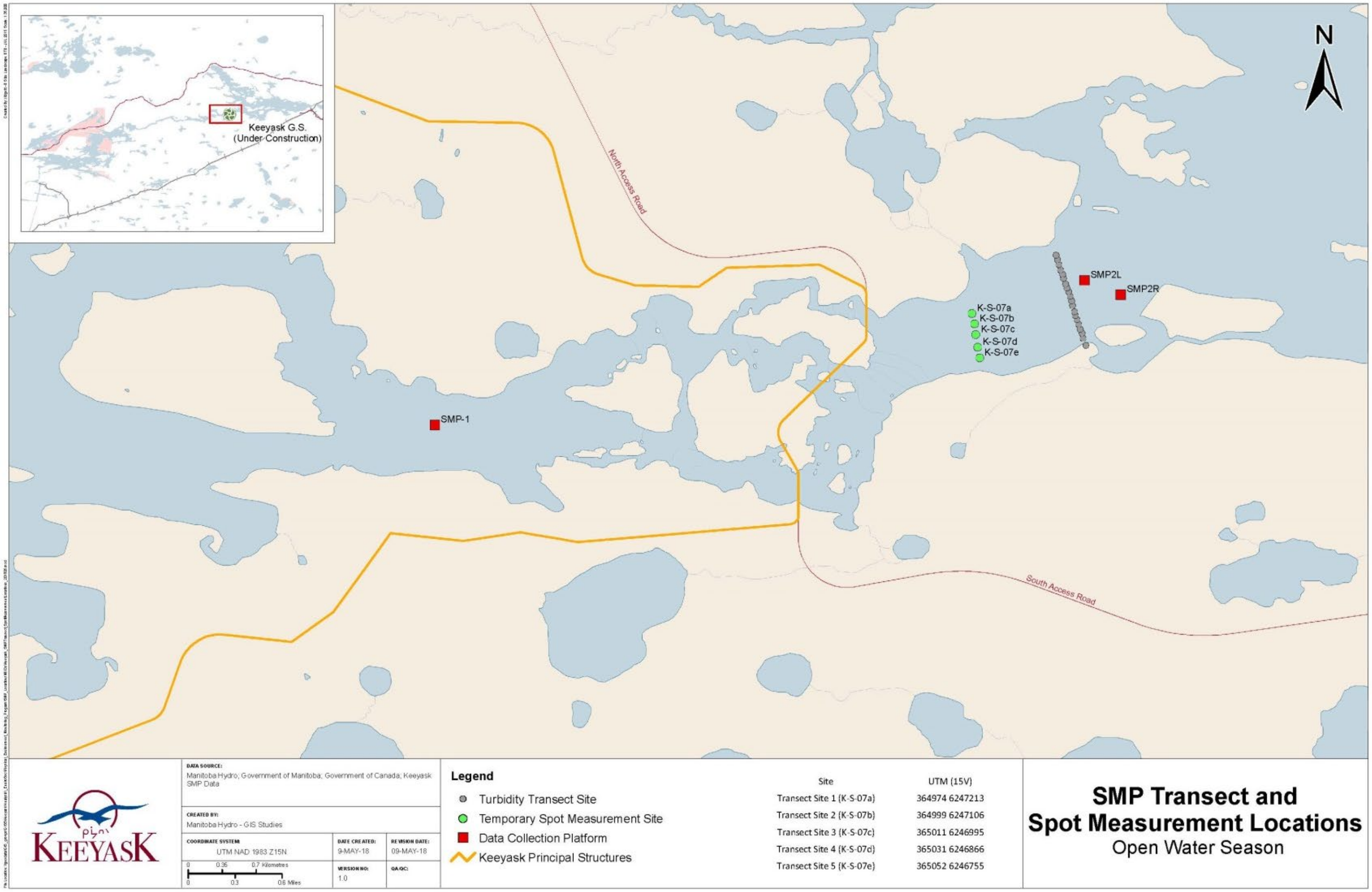

Figure 5: Map of turbidity measurements for cross-section of the Nelson River at SMP-2 sites and spot measurement sites (K-S-07) between Gull Rapids and the SMP-2 sites.

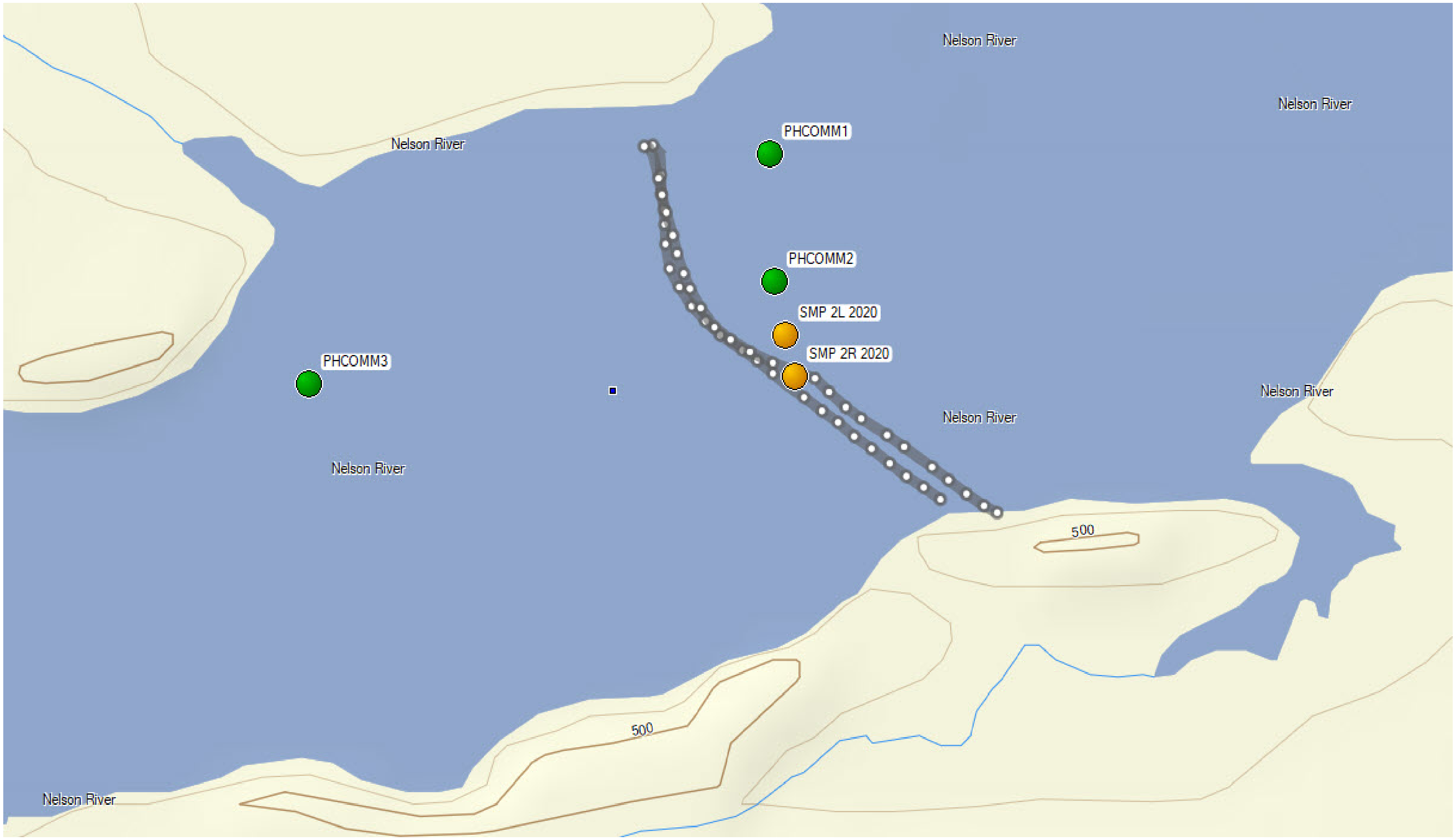

Figure 6: Map of the turbidity transects followed during first flows through the Powerhouse turbidity transects in relation to SMP-2L and SMP-2R.

2.2 SHOULDER SEASON MONITORING

Shoulder season monitoring was not implemented in 2020 and will not be implemented in future years; efforts in previous years to monitor TSS during the ice on and off transition periods have not been successful. Each year, moving ice has destroyed the communication cables between the in-stream turbidity sensors and the data loggers installed on shore. There are no possible adaptations to the monitoring station layout to prevent this from occurring during the shoulder seasons. Furthermore, frazil ice produced in the Nelson River between Clarke Lake and Gull Rapids has caused interference and damaged the turbidity monitoring sensors in previous years, which produced unreliable data.

2.3 WINTER MONITORING STATIONS

Monitoring stations were not installed in Winter 2021 because no in-stream work occurred over the winter months.

2.4 ACTION AND TARGET LEVELS

As outlined in the SMP, the management of TSS levels during construction incorporates two action levels measured in the mixing zone at SMP-2:

1. Four, consecutive, 15-minute averaged measurements over 25 mg/L above background TSS at monitoring site SMP-1; and
2. One, 15-minute averaged increase of 200 mg/L above background TSS at monitoring site SMP-1.

Both action levels are below acutely lethal thresholds of TSS for freshwater fish, which range from hundreds to hundreds of thousands of mg/L. The action levels at SMP-2 are set such that action is initiated to reduce construction sediment inputs to maintain a 24-hour average (measured as a rolling average) increase of 25 mg/L or less at SMP-3, relative to the 24 hour rolling average at SMP-1 (background TSS).

An exceedance of these action levels initiates an investigation to identify the source of the TSS, implement secondary mitigation strategies for unanticipated events, and/or modify in-stream construction procedures as outlined in the SMP.

2.5 TURBIDITY /TSS RELATIONSHIP VALIDATION

As outlined in the SMP, the *in-situ* turbidity logger data measured at each monitoring site and the relationship used to calculate TSS from turbidity were confirmed through manual monitoring of turbidity using handheld loggers and collecting water samples for TSS analysis at the same time.

Manual sampling in the summer season began in June and ended in late-September of 2020. Turbidity measurements and TSS samples were collected near the surface, middle, and bottom of the water column near each SMP monitoring station. The results of the manual sampling conducted are provided in Table 1.

Table 1 shows the relationship used to calculate real-time TSS using turbidity as a proxy is appropriate, as laboratory TSS analysis results are generally close to the calculated TSS values.

3.0 IN-STREAM WORK

3.1 NORTH CHANNEL ROCK GROIN

The North Channel Rock Groin (NCRG) was constructed in 2014 (refer to Figure 1 for the location). Removal of the NCRG continued from the previous reporting year, occurring between March 21 and April 9, 2020 (Figure 7).

Figure 7: Excavation of the NCRG. Photo taken facing northwest on April 1, 2020.

There were no visible sediment plumes observed while the NCRG was being removed and no detectable change in the TSS measured by the SMP sensors as a consequence of this work (Figure 8 and Figure 9).

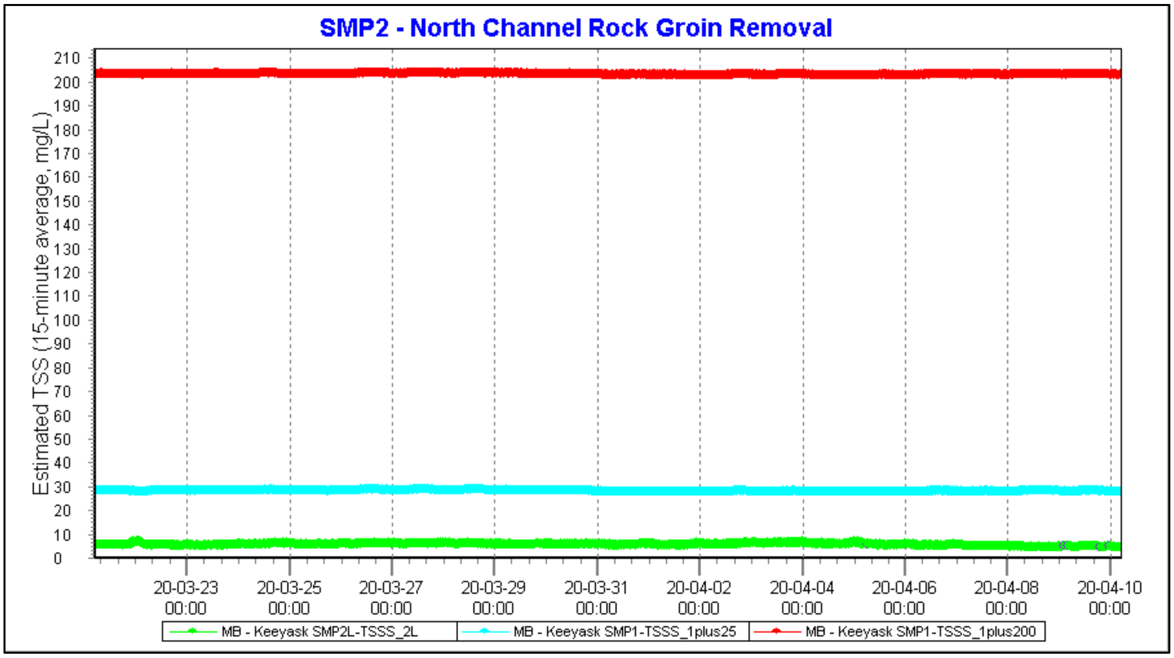

Figure 8: **Total suspended solids (TSS) values (15-minute average, mg/L) from March 22, 2020 through April 10, 2020 at monitoring station SMP-2L compared with the action levels, which are shown in light blue and red.**

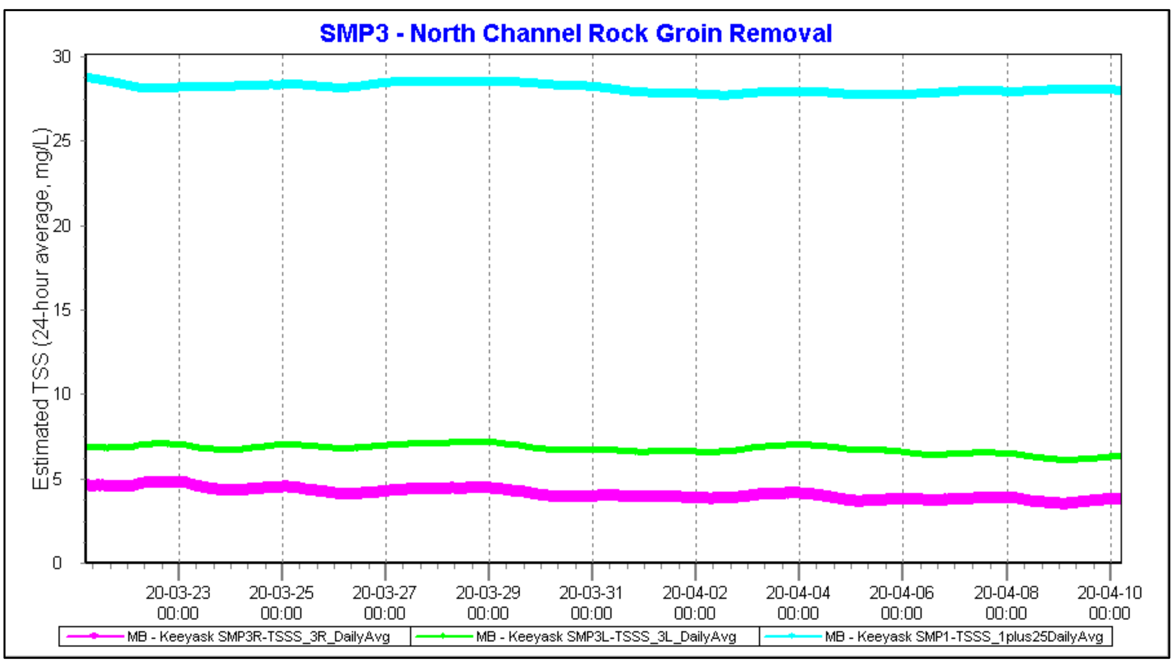

Figure 9: **Total suspended solids (TSS) values (24-hour rolling average, mg/L) from March 22, 2020 through April 10, 2020 at monitoring station SMP-3L and SMP-3R compared with the action level, which is shown in light blue.**

3.2 TAILRACE COFFERDAM

Work was conducted within the confines of the Tailrace Cofferdam (TRCD) after its construction in 2018, and included the Powerhouse Cofferdam removal, construction of the tailrace sturgeon spawning shoals and shaping the tailrace discharge channel in accordance with final design specifications.

The TRCD was comprised of an inner and outer rock groin, and between the groins was a central core of semi-pervious and impervious material (fine clay and silt). Prior to removing the cofferdam, water levels were equalized on both sides of it by pumping water into the area bound by the TRCD utilizing sumps installed in the turnouts. Removal of the TRCD started in the 2020 reporting year and continued through the spring until May 14th, which is referred to as "Phase 1" "Phase 2" work to remove the remainder of the TRCD resumed on July 29th and was completed on October 14th.

Until the latter part of the excavation work, the core was excavated first, followed by the removal of the outer groins to mitigate sediment suspension into Stephens Lake (Figure 10 & Figure 11). No measurable changes in the river TSS levels were detected at the downstream SMP-2 or SMP-3 sensors as a consequence of the TRCD's removal. (The spike in TSS that was observed at SMP-3R in the middle of September (Figure 15) was the result of interference caused by the station disconnecting from its anchor and running ashore.) Three additional TSS sensors were installed in advance of turbine commissioning (see Section 2.1) to detect changes in the TSS while passing the first flows of water through Unit 1 in the Powerhouse (see Section 3.7). Data from these extra sensors showed there was a change in the TSS in the low flow area adjacent to the main flow attributed to removing the TRCD.

The SMP stations were removed prior to completion of the Tailrace Cofferdam removal but based on the TSS levels measured at the SMP sensors constantly during both phases of the activity, it is unlikely an exceedance of the action levels at SMP-2 or SMP-3 would have been observed.

Figure 10: Removal in the wet of the TRCD core material. A small sediment plume can be seen on the right side of the photo. Photograph taken facing west, May 14, 2020 (Phase 1).

Figure 11: Final stages of removal of the TRCD, facing north towards the Powerhouse. October 5, 2020 (Phase 2).

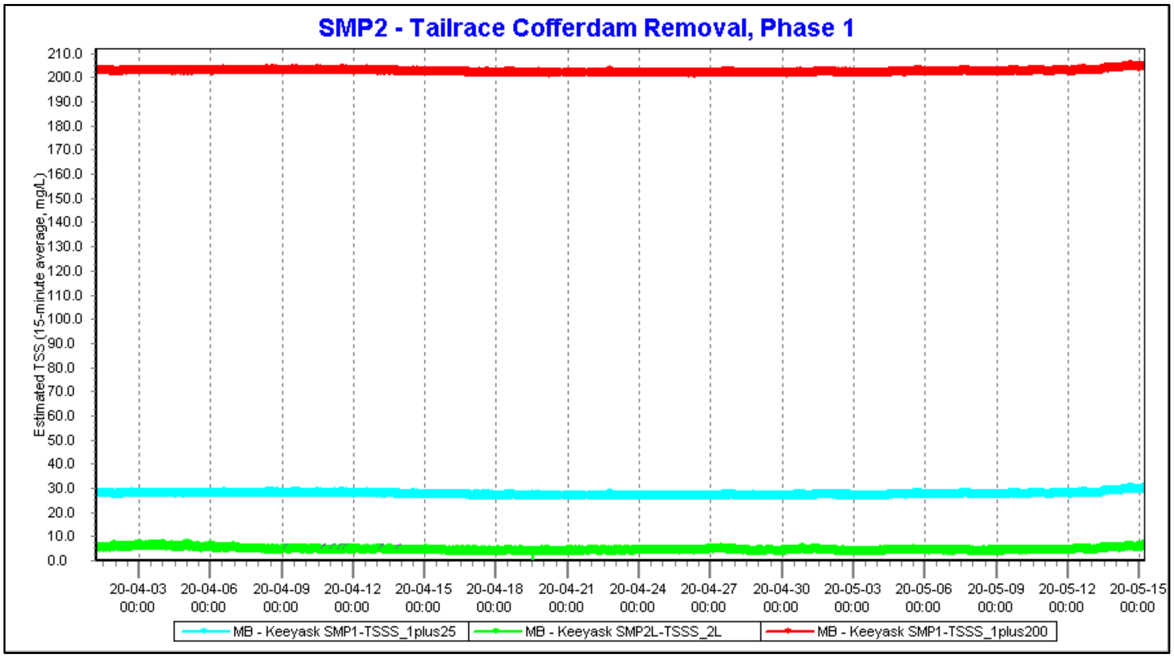

Figure 12: **Total suspended solids (TSS) values (15-minute average, mg/L) from April 1, 2020 through May 15, 2020 at monitoring station SMP-2L compared with the action levels, which are shown in light blue and red.**

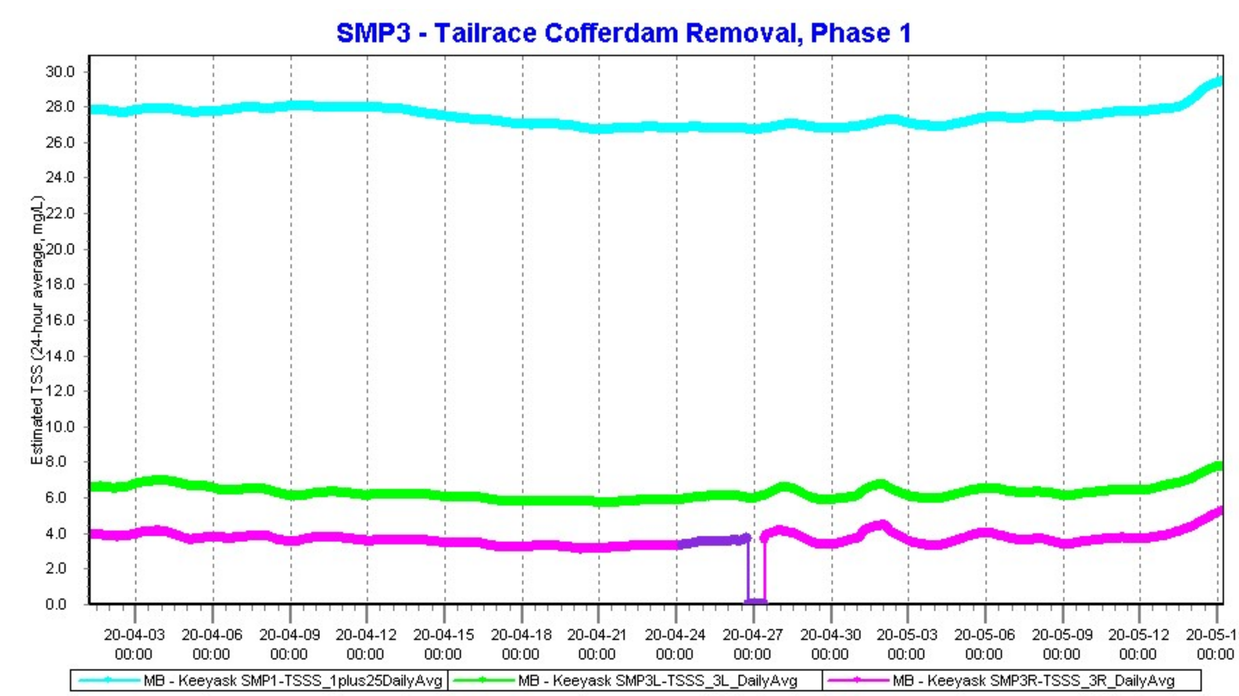

Figure 13: **Total suspended solids (TSS) values (24-hour rolling average, mg/L) from April 1, 2020 through May 15, 2020 at monitoring stations SMP-3L and SMP-3R compared with the action level, which is shown in light blue.**

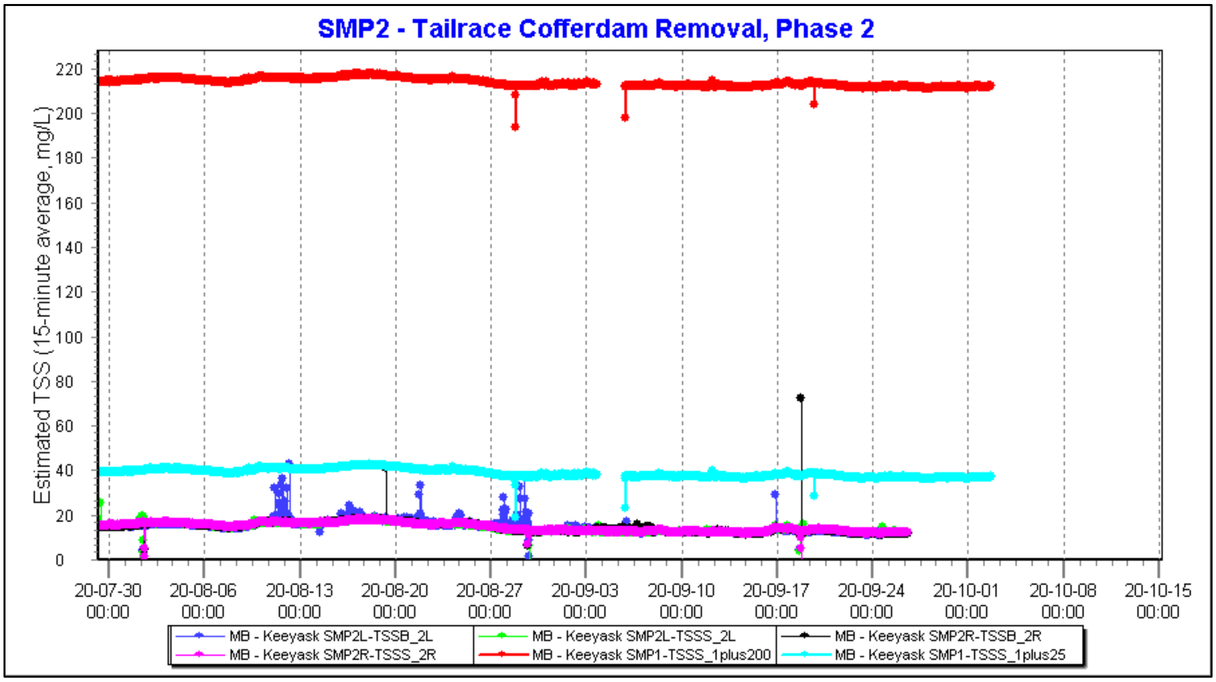

Figure 14: **Total suspended solids (TSS) values (15-minute average, mg/L) from July 29, 2020 through October 15, 2020 at monitoring station SMP-2L compared with the action levels, which are shown in light blue and red.**

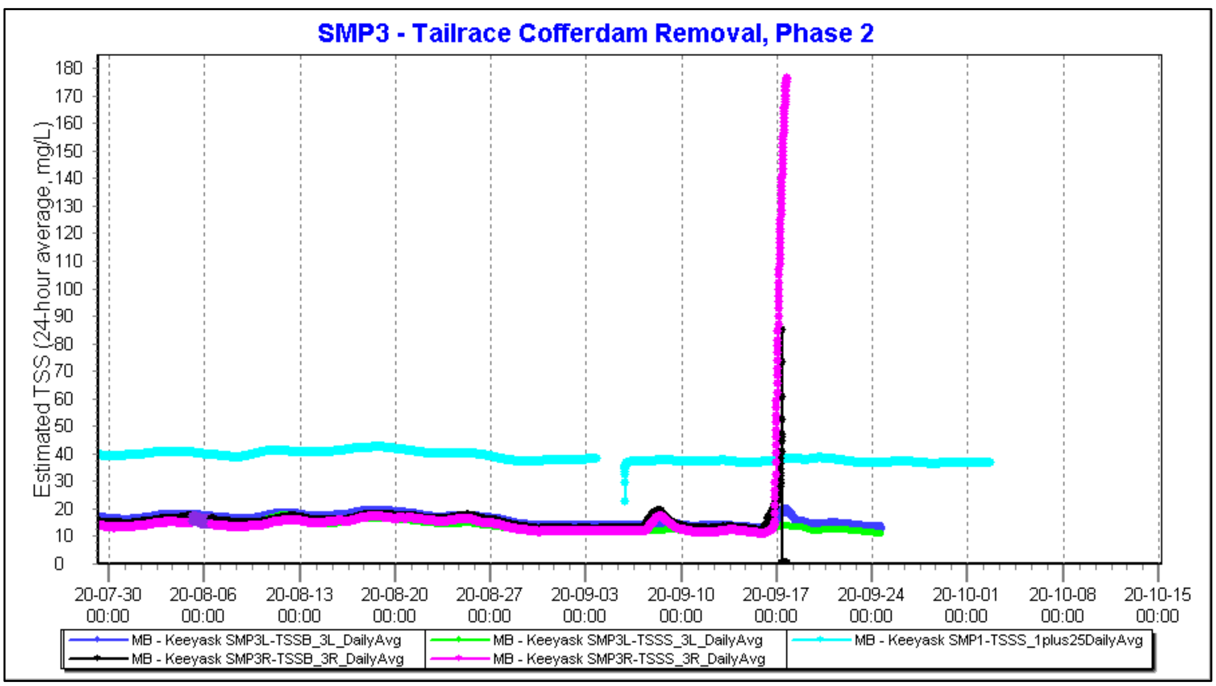

Figure 15: **Total suspended solids (TSS) values (24-hour rolling average, mg/L) from July 29, 2020 through October 14, 2020 at monitoring stations SMP-3L and SMP-3R compared with the action level, which is shown in light blue.**

3.3 G3 CAUSEWAY REMOVAL

In order to access fine granular material located on two islands in Stephens Lake to the northeast of the project site, two causeways were constructed (Figure 1). The first causeway to the G3 borrow pit was constructed during the summer of 2015 and remained in use until its removal in the summer of 2020.

Work to remove the causeway began on July 20th and was complete on August 1st (Figure 16). During the causeway's removal, sections of rocky shoal habitat for fish use were created by spreading material laterally out from the causeway (Figure 17). During removal, no measurable change in the river TSS levels were detected downstream at the SMP sensors (Figure 18 & Figure 19).

Figure 16: Removal of the G3 causeway, facing west. A small plume is visible in the photo, but no change in TSS was detected at the SMP sensors downstream. July 23, 2020.

Figure 17: Rocky shoal habitat being constructed out from the G3 causeway prior to removal. Photo taken on July 22, 2020 facing south.

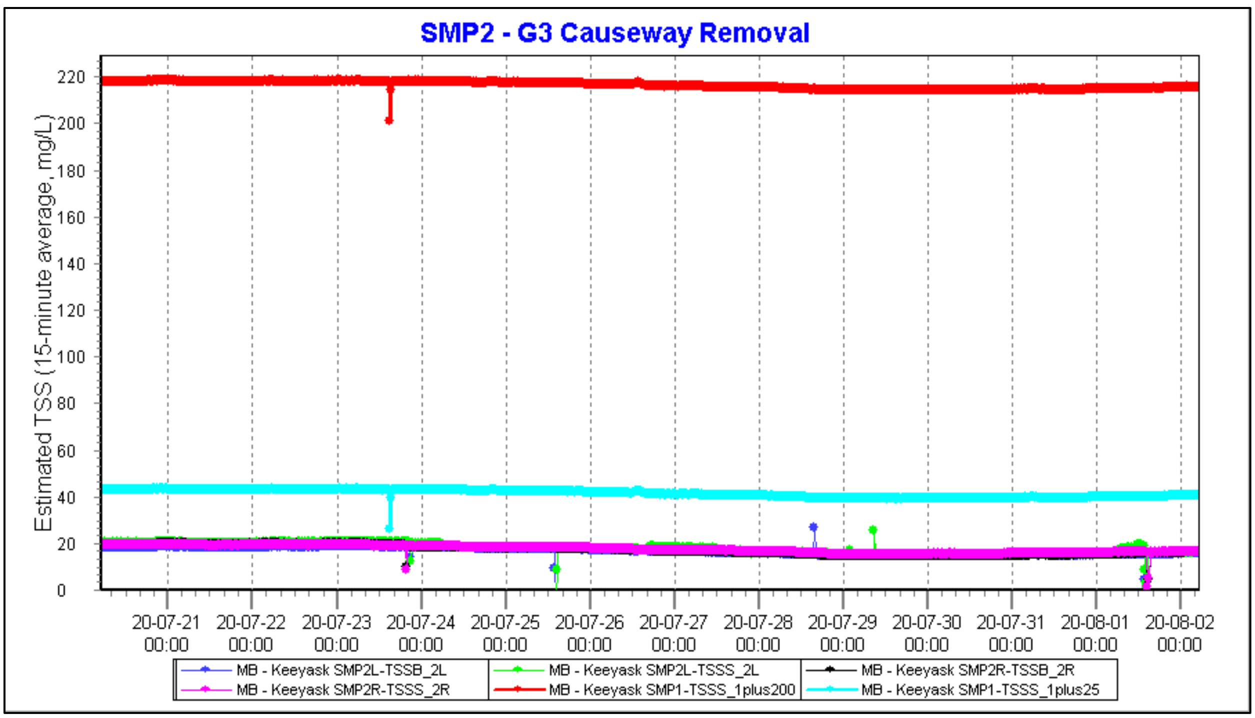

Figure 18: Total suspended solids (TSS) values (15-minute average, mg/L) from July 20, to August 1, 2020 at monitoring station SMP-2L compared to the action levels, which are shown in light blue and red.

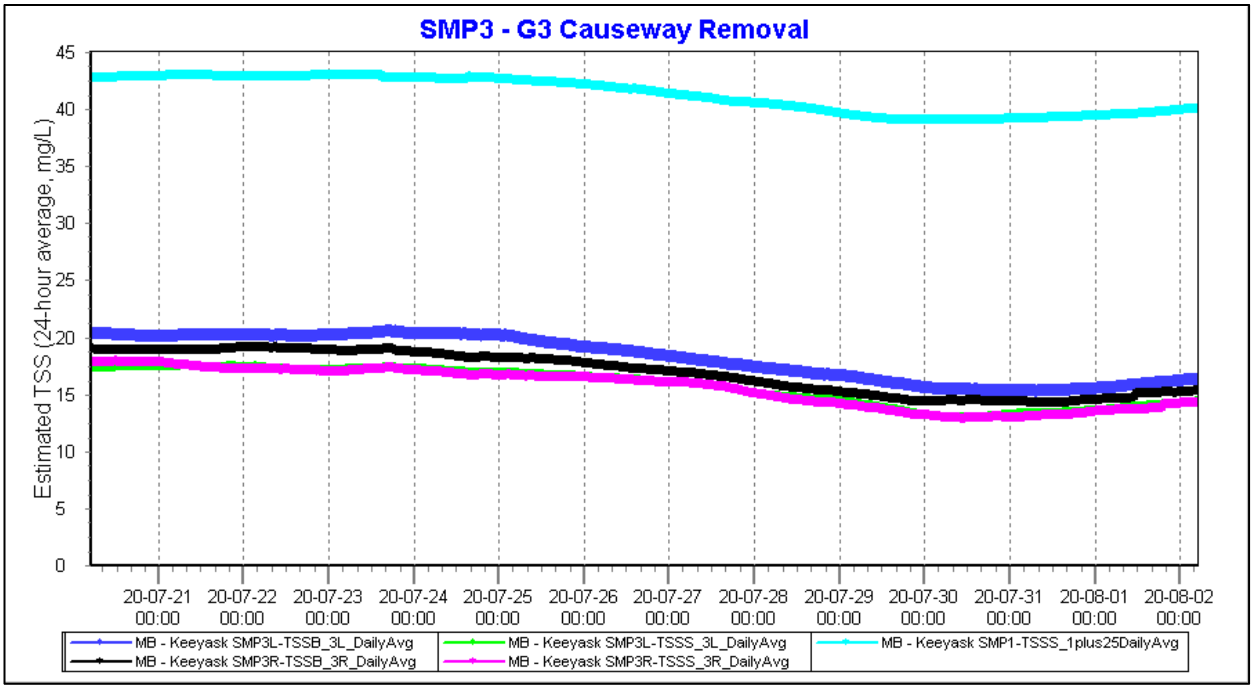

Figure 19: Total suspended solids (TSS) values (24-hour rolling average, mg/L) from July 20, to August 1, 2020 at monitoring stations SMP-3L and SMP-3R compared to the action level, which is shown in light blue.

3.4 N5 CAUSEWAY REMOVAL

Similar to the G3 causeway, the N5 causeway was constructed during the summer of 2015 in order to access and excavate fine granular materials located on islands near the Keeyask site. Following the removal of the G3 causeway on August 1st, work began to remove the N5 causeway (Figure 20); this work was completed on August 27th. Rocky shoal habitat was constructed laterally from the causeway (Figure 21) prior to it being completely removed. No change in TSS was detected at the downstream monitoring stations during the work (Figure 22 & Figure 23).

Figure 20: Excavator removes an access ramp used to construct rocky shoal habitat next to N5 causeway. Photo taken August 19, 2020.

Figure 21: Multiple excavators work on the N5 causeway removal. The excavator on the left is constructing rocky shoal habitat, while the two on the right remove the haul road from the N5 island. Photo taken August 22, 2020.

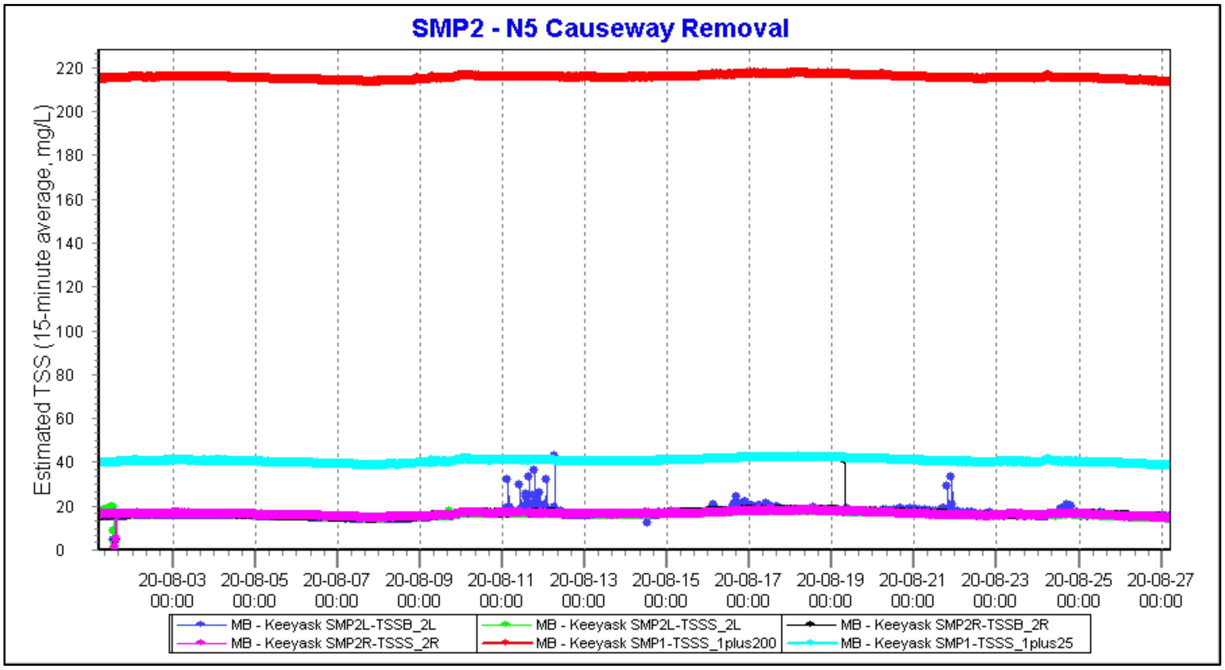

Figure 22: Total suspended solids (TSS) values (15-minute average, mg/L) from August 1, to August 27, 2020 at monitoring station SMP-2L compared to the action levels, which are shown in light blue and red.

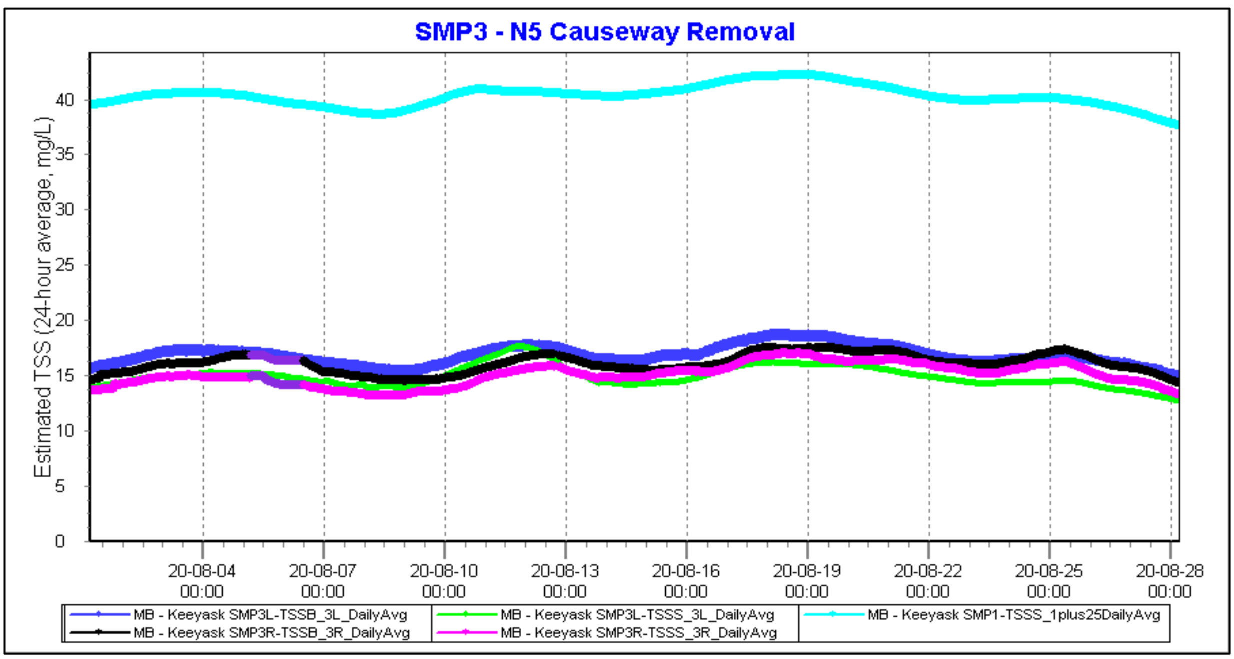

Figure 23: Total suspended solids (TSS) values (24-hour rolling average, mg/L) from August 1to August 27, 2020 at monitoring stations SMP-3L and SMP-3R compared to the action level, which is shown in light blue.

3.5 ISLAND CUT-OFF GROIN

The Central Dam Island Cut-off Groin was constructed in 2016 and consisted of two, short, rock groins that extended from the central dam lower access road to an island in the river channel located to the east of the central dam (Figure 24). Within the two rock groins, the area was filled with fine, impervious material.

Work to remove the material between the two rock groins began on May 6, 2020 and continued until May 21st. Removal resumed on August 3rd and continued within the confines of the two outer groins until the northern extension of the groin was breached on August 15th. As the northern leg was removed, the southern portion was built up and graded to the final design specifications. The southern leg of the groin will remain in place permanently as the Island Rock Groin (Figure 25). Work on the North and South sections of the groin was complete on August 23rd.

No change in TSS was detected at the downstream monitoring stations during this work (Figure 26 & Figure 27).

Figure 24: The Island Cut Off Groin on August 8, 2020. An excavator works to remove material from within the protection of the North (left) and South (right) outer groins. Photo taken facing East.

Figure 25: The completed Island Rock Groin. Excavators continue to work on the final Central Dam lower access road. Photo taken facing south toward the Spillway. August 27, 2020.

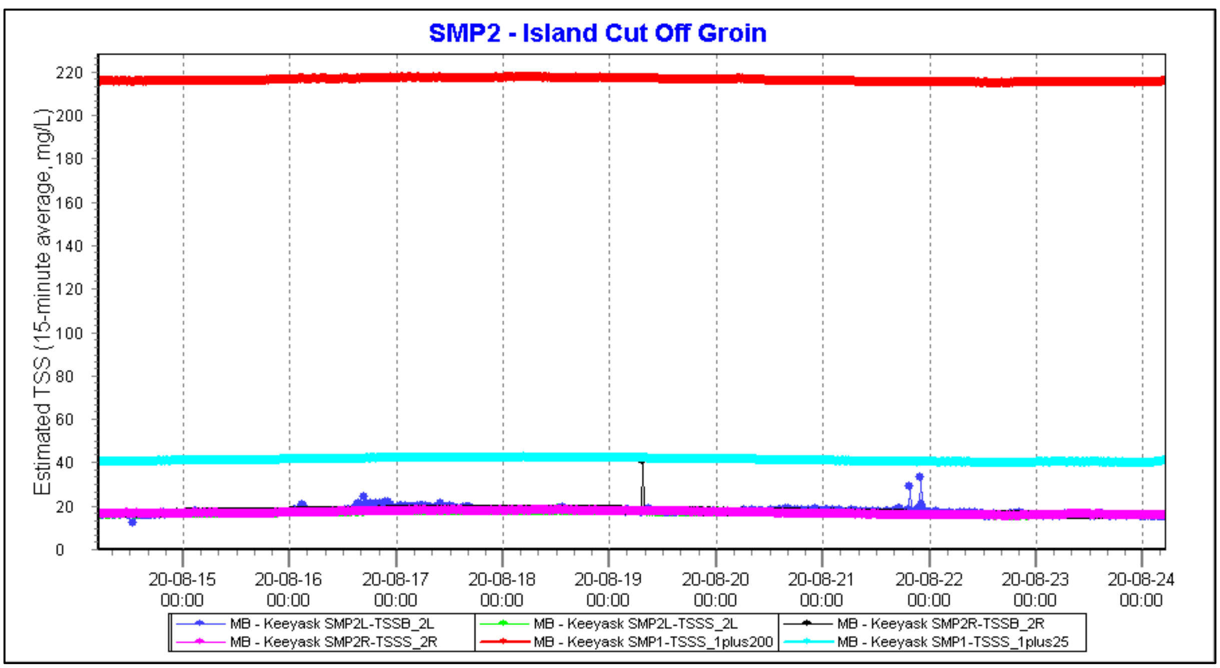

Figure 26: Total suspended solids (TSS) values (15-minute average, mg/L) from August 14 to August 23, 2020 at monitoring station SMP-2L compared to the action levels, which are shown in light blue and red.

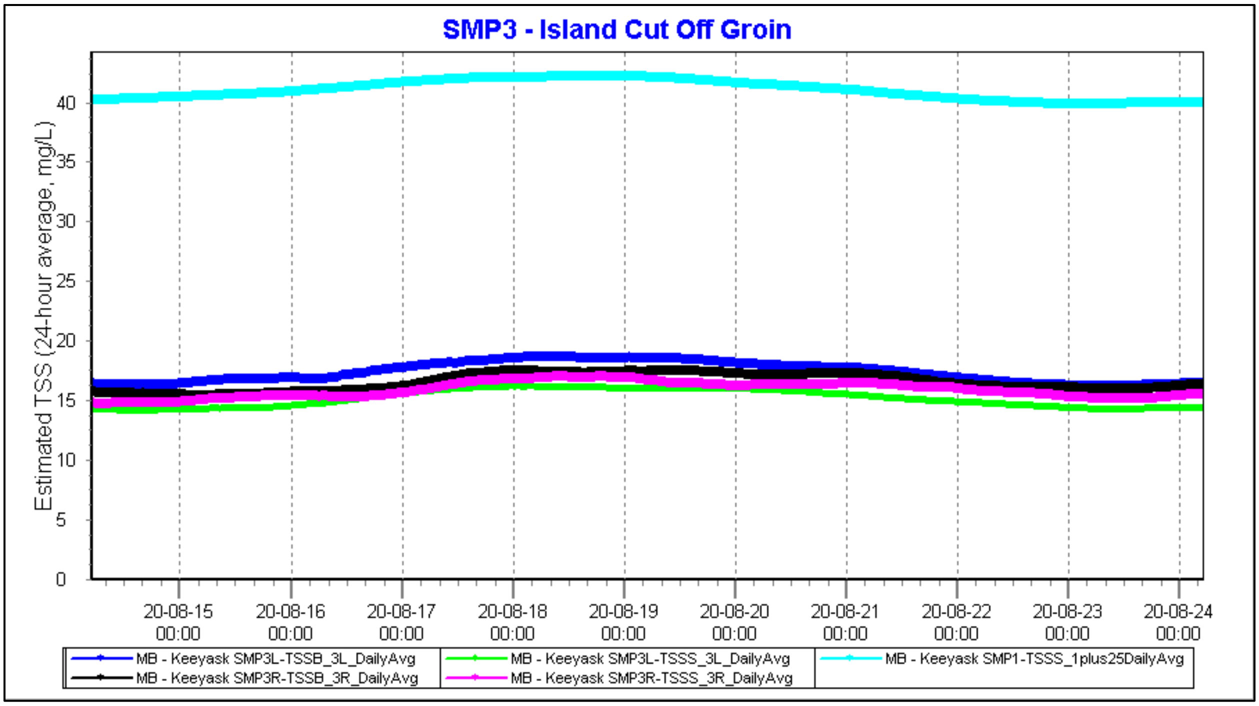

Figure 27: Total suspended solids (TSS) values (24-hour rolling average, mg/L) from August 14 to August 23, 2020 at monitoring stations SMP-3L and SMP-3R compared to the action level, which is shown in light blue.

3.6 CENTRAL DAM COFFERDAM

Following completion of work on the Island Cut-off Groin, work on the Central Dam Cofferdam proceeded. The cofferdam was constructed in 2015; it is permanent and will act as a private access road for site personnel. Between August 23rd and August 31st, work took place to complete the structure, and included removing some impervious material and placing riprap for erosion protection according to final design specifications (Figure 28).

Although a plume is visible in Figure 28, there were no changes measured at the downstream sediment monitoring sensors attributed to this work and no exceedences in the action levels, as illustrated in Figure 29 & Figure 30.

Figure 28: A pair of excavators put the finishing touches on the shoulder of the CDCD (photo taken on August 24, 2020 facing North-East).

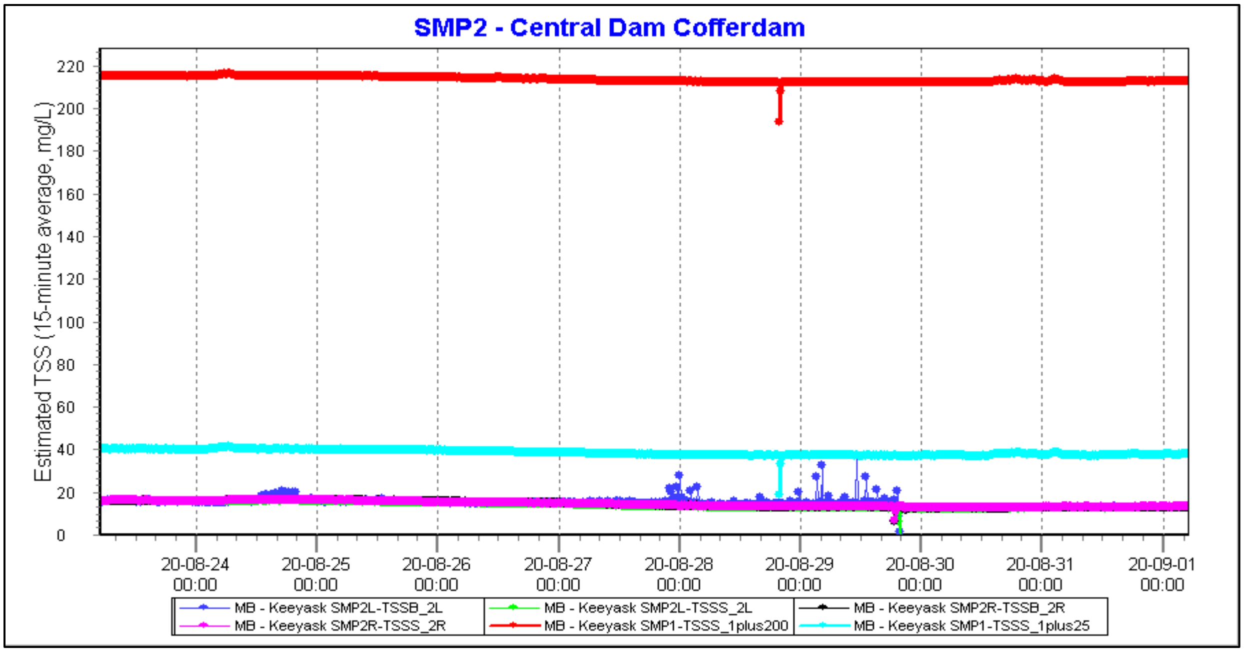

Figure 29: **Total suspended solids (TSS) values (15-minute average, mg/L) from August 23 to August 31, 2020 at monitoring station SMP-2L compared to the action levels, which are shown in light blue and red.**

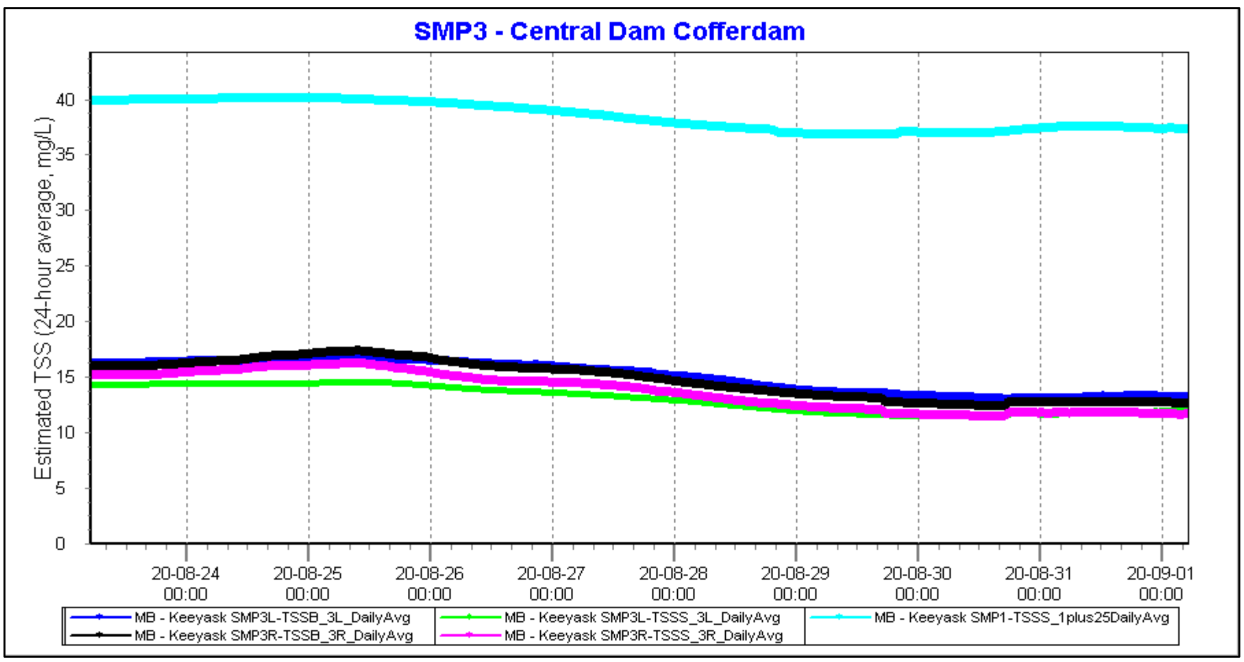

Figure 30: **Total suspended solids (TSS) values (24-hour rolling average, mg/L) from August 23 to August 31, 2020 at monitoring stations SMP-3L and SMP-3R compared to the action level, which is shown in light blue.**

3.7 FIRST FLOWS THROUGH THE POWERHOUSE

Unit 1 was officially commissioned on August 31 when the unit was “bumped” as the first water turned the turbine (created a pressure differential on the runner blades which caused them to rotate). At the start of commissioning, the units were brought up in discrete speed intervals (i.e. 25, 50, 75%), their performance was monitored, and any adjustments were made as necessary. On September 3, Unit 1 reached full speed for a few minutes.

As was described in Section 2.1.1, TSS was measured across two transects on September 2nd at approximately 14:00 and 17:00 CDT following the movement of water through Unit 1 (Figure 31). No exceedences in the action levels were observed at the SMP stations downstream during first flows through the Powerhouse (Figure 32 & Figure 33). The increase shown in Figure 33 for both sensors at SMP-3R was caused by interference associated with the sensor becoming detached from its anchor and running ashore.

Figure 31: Initial flow from Unit 1 of the Keeyask Powerhouse, September 2, 2020.

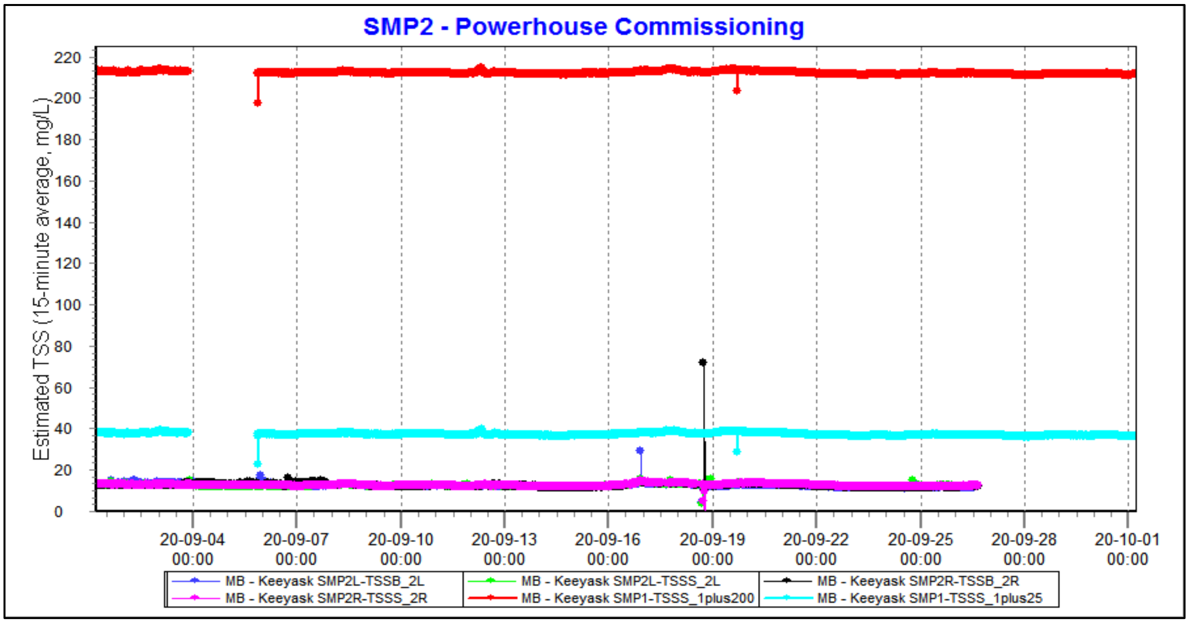

Figure 32: Total suspended solids (TSS) values (15-minute average, mg/L) from September 1 to October 1, 2020 at monitoring station SMP-2L compared to the action levels, which are shown in light blue and red.

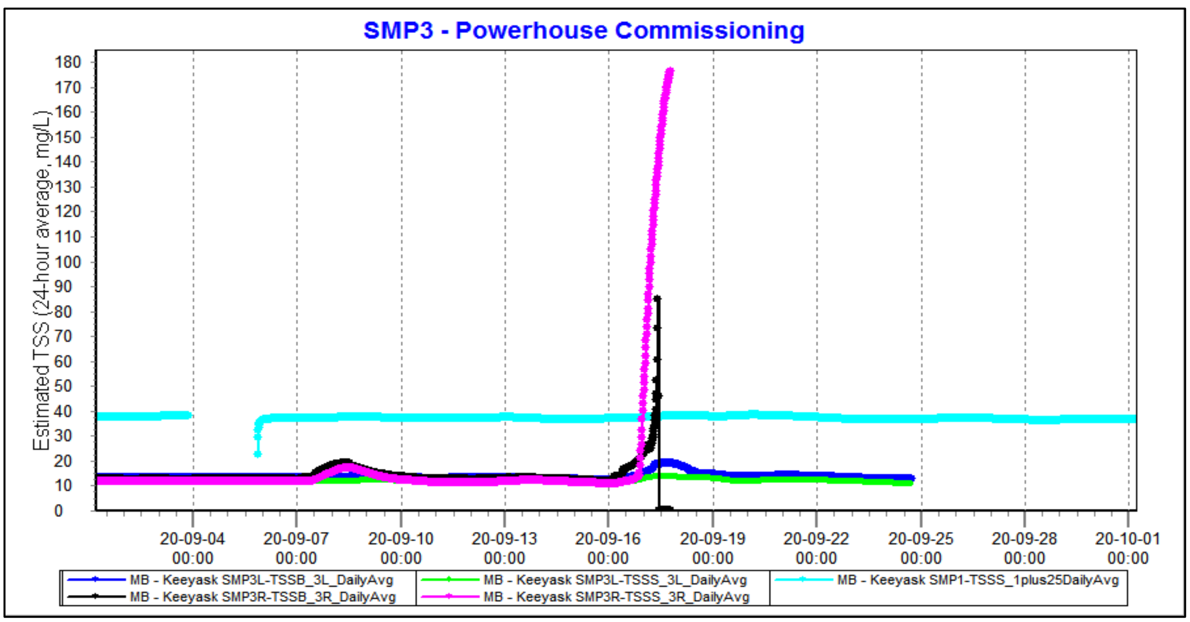

Figure 33: Total suspended solids (TSS) values (24-hour rolling average, mg/L) from September 1 to October 1, 2020 at monitoring stations SMP-3L and SMP-3R compared to the action level, which is shown in light blue. The spike in TSS that occurred at SMP-3R in the middle of September was the result of the station disconnecting from its anchor and running ashore.

4.0 PREDICTED VS. OBSERVED EFFECTS ON IN-STREAM TSS

As described in the SMP, construction activities during river management were predicted to introduce additional sediment into the Nelson River due to shoreline erosion, construction and removal of cofferdams, and commissioning of the Spillway and the Powerhouse. The predicted effects of in-stream construction presented in the SMP are presented and were based on the proposed construction timeline at the time that the analyses were performed and assumed fully mixed conditions at SMP-2 (Figure 34).

Removal of the North Channel Rock Groin, G3 and N5 causeways, and the island cut-off groin were not assessed for potential effects on in-stream TSS and are not shown on Figure 34.

The potential effects of Tailrace Cofferdam (TRCD) removal and first flows through the Powerhouse were previously assessed for the Keeyask EIS and SMP. However, the potential effects of these two activities were re-analysed and reported in a January 10, 2020, request for amendment to the Project's *Fisheries Act* Authorization when the timing of TRCD removal and Powerhouse commissioning was proposed to be changed to winter/spring 2020. The re-analysis concluded that:

- TRCD removal would result in TSS increases of greater than 5 mg/l above background in a limited area near the cofferdam while changes would decrease to less than 5 mg/l within a short distance downstream (~100m).
- Initial flow through the powerhouse during commissioning would produce the largest anticipated downstream effects TSS and at the peak could raise it about 45-50 mg/L above background for a short duration.

As described in 2.1, SMP monitoring was undertaken from the end of June to the end of September at site SMP-1 upstream and sites SMP-2 and SMP-3 downstream, although the SMP-2 sites were moved upstream to bring them into the expected plume from the initial operation of Unit 1 (Figure 3). The SMP-2 sites were located in the main flow, in the channel at the entrance to Stephens Lake.

Two additional turbidity monitoring sites (K-PHCOMM-1 & K-PHCOMM-2) were established in advance of the first flows through Unit 1 in order to check for effects of the potential sediment plume at its edge and in a back-eddy area (Figure 35).

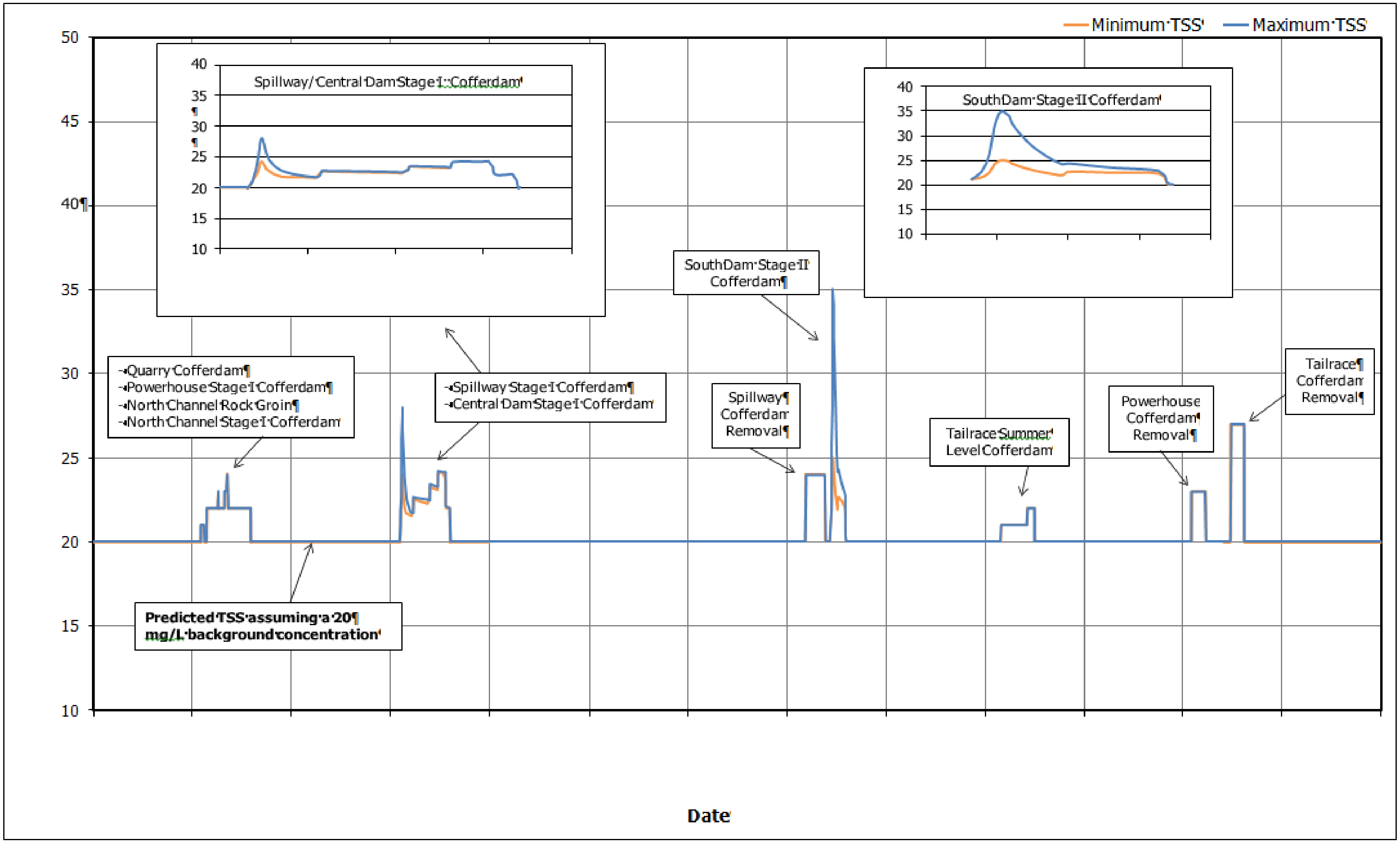

Figure 34: Fully Mixed 24-Hour Average TSS Concentration Predicted in the Proximity of Site SMP2 (mixing zone) During Construction of the Keeyask GS (based on 2012 construction schedule).

Figure 35: Downstream Turbidity Monitoring Sites at SMP-2 for first flows through the Powerhouse (Unit 1).

As discussed in Section 3.0, the comparison of calculated TSS concentrations at SMP-1 upstream and the SMP-2 sites downstream shows that there was typically little difference between TSS concentrations upstream and downstream of the Project site (Figure 36). This indicates there was no significant effect of the project within the main flow of the river downstream of the Project.

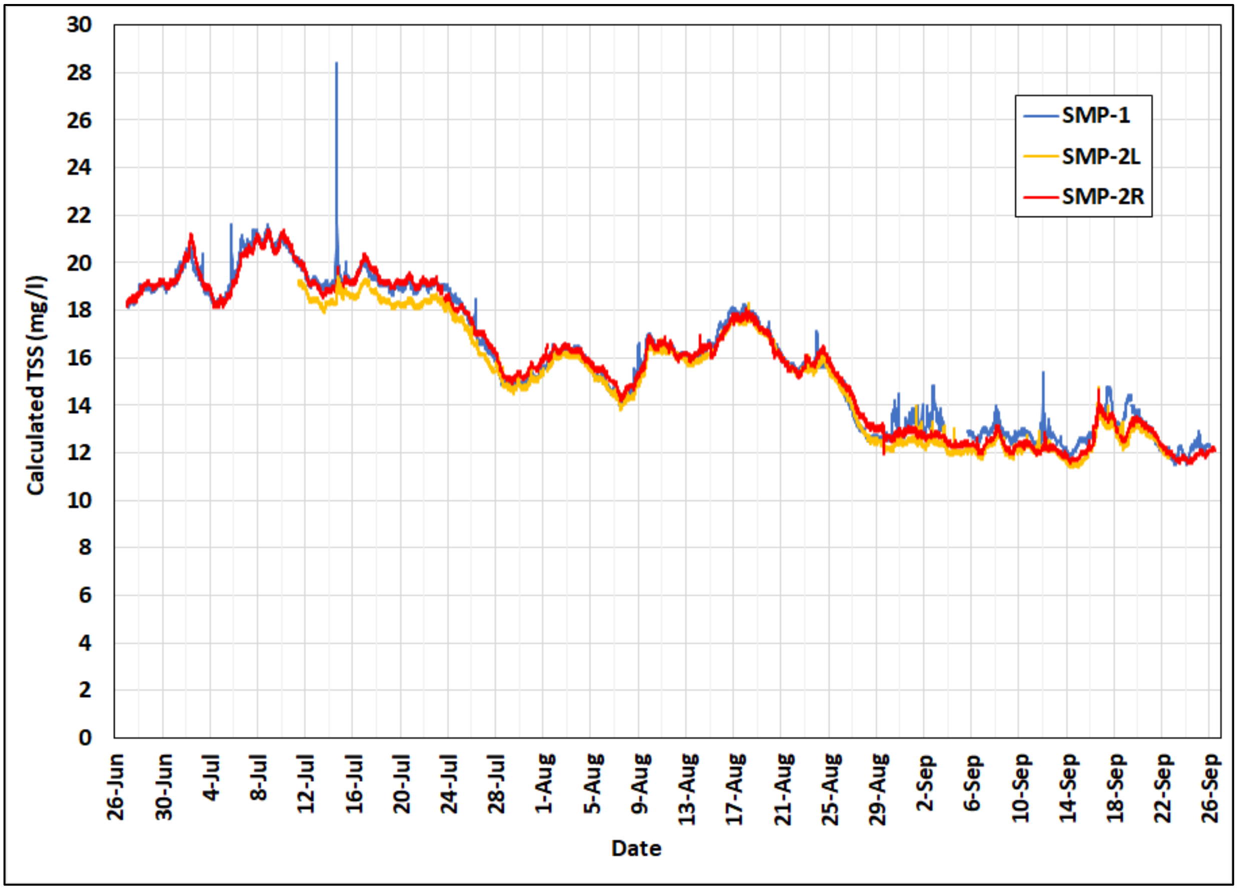

Figure 36: Summer 2020 Calculated TSS at SMP-1, SMP-2L and SMP-2R.

The K-PHCOMM-1 and K-PHCOMM-2 stations were installed during commissioning of Unit 1 to measure any effects of initial flow through the Powerhouse and were in operation from August 29 to September 17-19. These two sites measured TSS effects resulting from the removal of the TRCD while they were in operation (Figure 37) as indicated by daily increases starting in the morning that peaked at about 3-8 mg/l above background before dropping in the evening and through the night.

The pattern of increases and decreases shown in Figure 37 corresponds with daily TRCD removal activities. The daily TSS increase and decrease at K-PHCOMM-2 preceded the corresponding pattern at K-PHCOMM-1 each day because K-PHCOMM-2 was located in the plume as it came off the TRCD while K-PHCOMM-1 was in a back-eddy that swirls back around downstream of K-PHCOMM-2. This is also why the peaks at K-PHCOMM-2 are higher than at K-PHCOMM-1.

The observed effect of TRCD removal was greater than had been predicted. This likely occurred because modeling for the predicted effect assumed the fine core material would be removed while the inner and outer rock groins were in place, as was done during spillway cofferdam removal, which limited the entrainment of sediment in the flow. In the latter part of TRCD removal, the rock groin was removed at the same time as the core material, increasing the exposure of fine sediment to the flow and allowing it to be entrained.

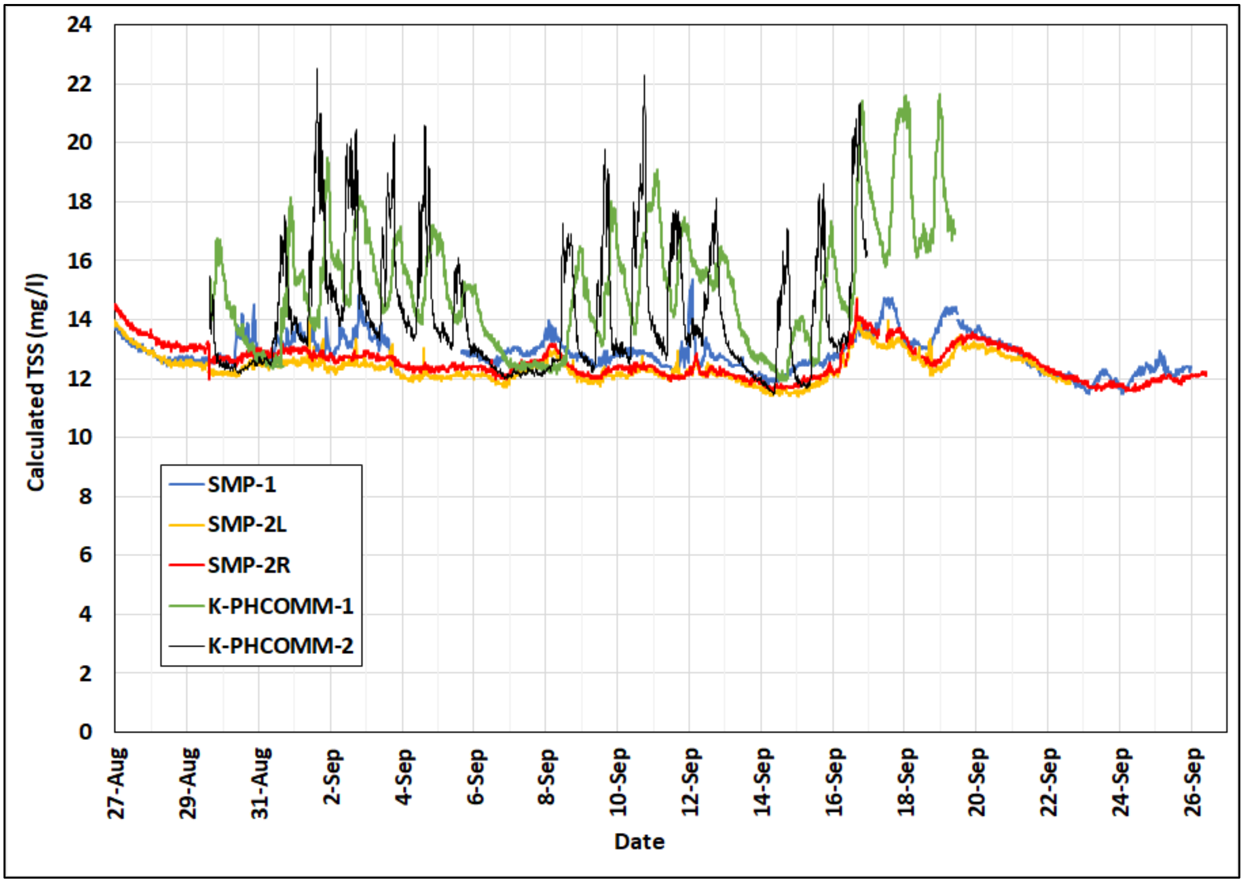

Figure 37: Calculated TSS During Initial Operations of Powerhouse Unit 1.

Note that although SMP-2L is only about 100 m south of K-PHCOMM-2 (Figure 35), there is no discernible effect of TRCD removal at SMP-2L, nor throughout the main flow of the river. The plume observed at K-PHCOMM-1 and K-PHCOMM-2 is located adjacent to the main flow of the river where SMP-2L and SMP-2R are located. It is visible in Figure 35, and persists because there is very little mixing along the edge of the main flow and in the back eddy.

TSS was calculated from two turbidity transects that were measured when Unit 1 was operated on September 2 (Figure 38). The first transect was at 2 pm when flow first started passing through Unit 1. The second was 3 hours later, at 5 pm, when any effects of Unit 1 operation would be expected to show up during monitoring at the downstream, SMP-2 monitoring sites since travel time between the Powerhouse and SMP-2 was estimated to be about 2 hours.

The results show the effects of the TRCD sediment plume north (left) of about northing 6,247,450 at 2 pm, and 6,247,400 at 5 pm (Figure 38). The main body of the plume is only about 100-150 m wide in a section of the river that is about 1,200 m wide overall and TSS is higher to the north (left) in the back-eddy area than to the south (right) in the main flow. The peak of the plume is lower and further south (right) at 5 pm than it was at 2 pm (Figure 38) and this is likely due to the Unit 1 flow, which was visually observed to improve water clarity in the plume immediately downstream of the Powerhouse when Unit 1 was operated. Rather than causing a large TSS increase as predicted, Unit 1 operation appears to have increased mixing of the TRCD plume, which would be expected. That Unit 1 did not produce a large TSS increase suggests that some of the coarser, heavier material remained in the tailrace channel than had been assumed for the model predictions. Calculated TSS at the turbidity sites (K-PHCOMM-1, K-PHCOMM-2, SMP-2L, SMP-2R) at 2 pm and 5 pm match well with the corresponding TSS values from the transects (Figure 35); however, the transects are west of the K-PHCOMM-2 and SMP-2L and the center of the plume actually passes further north of these sites, as can be seen in the satellite image in Figure 35. The K-PHCOMM-2 and SMP-2L values would correspond more with the transect values about 50-100 m further south (right) on the transects.

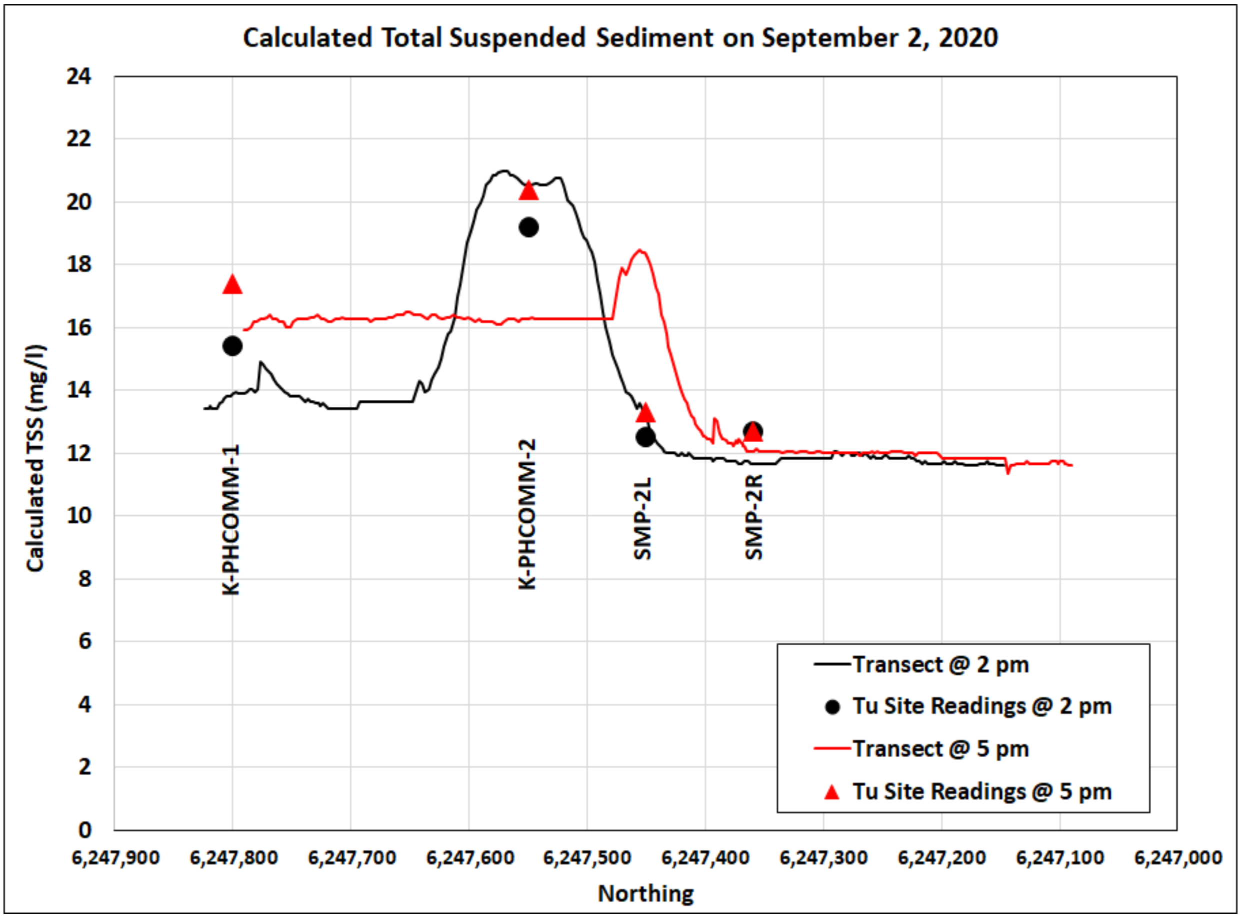

Figure 38: Calculated TSS Along Transects Measured on Sep. 2, 2020 at 2 pm & 5 pm.

For the September 2nd TSS transects, it is important to reiterate that the main body of the TRCD plume around K-PHCOMM-2 is in a low flow area, adjacent to the main flow. North of that, around K-PHCOMM-1 the flow is in the opposite direction (west instead of east) because the area is a back-eddy. The bulk of the river flow is south (right) of about SMP-2R. Thus, although the TSS is elevated in the plume from the TRCD north (left) of SMP-2L, it would represent a small fraction of the total sediment load being transported by the river at this location simply because most of the river's approximate 5,200 m^3/s flow is at background TSS conditions.

5.0 CONCLUSIONS

During the SMP monitoring period for major instream work from June 2020 to September 2020, there were no exceedances of the SMP action levels attributed to the in-stream construction activities that took place. There were some occasions when the real-time SMP sensor TSS results showed the action levels were exceeded, but further investigation proved these occurred because of interference associated with the sensors becoming detached and running aground.

Additional monitoring stations that were installed to measure changes to TSS attributable to first flows through Unit 1 in the Powerhouse showed the TSS was elevated more than what was predicted in the EIS, during removal of the TRCD. The additional monitoring also showed that the first flows from Unit 1 were not as sediment laden as was predicted through modelling.

Overall, as a whole, the downstream effects of the project activities carried out in 2020/2021 on in-stream TSS were minor to negligible, as predicted.

6.0 LITERATURE CITED

Keeyask Hydropower Limited Partnership (KHLP), 2012. Keeyask Generation Project: Physical Environment Supporting Volume. June 2012. Winnipeg, Manitoba

Keeyask Hydropower Limited Partnership. 2014. Keeyask Generation Project Sediment Management Plan for In-stream Construction. Winnipeg, Manitoba. June 2014.

Keeyask Hydropower Limited Partnership. 2014. Keeyask Generation Project, Application for Authorization Under Paragraph 35(2)(b) of the Fisheries Act Regulation. Winnipeg, Manitoba. June 2014

TABLES

Table 1: Manual sampling water quality monitoring data for the 2020 open water season.

Station ID	Date (D/M/Y)	Time (CDT)	Site Depth (m)	Sensor/Sample Depth (m)	Turbidity (NTU)	Calculated TSS* (mg/L)	Lab TSS (mg/L)
SMP-1	6/26/2020	12:00	8.3	5.6	22.4	14.84	10.6
	6/26/2020	12:00	8.3	5.6	22.4	14.84	14.3
	6/26/2020	15:00	8.3	4.0	22.3	14.76	12.0
	6/26/2020	15:00	8.3	1.9	22.7	15.07	16.8
	6/26/2020	15:00	8.3	1.9	22.7	15.07	11.5
	6/26/2020	15:00	8.3	4.0	22.3	14.76	9.9
	7/23/2020	10:43	11.2	2.1	26.5	18.08	15.0
	7/23/2020	10:43	11.2	2.1	26.5	18.08	14.6
	7/23/2020	10:45	11.2	5.4	26.0	17.68	16.2
	7/23/2020	10:45	11.2	5.4	26.0	17.68	14.5
	7/23/2020	12:47	11.2	9.3	26.7	18.23	11.0
	7/23/2020	12:47	11.2	9.3	26.7	18.23	17.8
	8/12/2020	9:00	10.0	1.9	23.2	15.47	12.8
	8/12/2020	9:00	10.0	1.9	23.2	15.47	12.4
	8/12/2020	10:00	10.0	5.0	23.3	15.55	11.3
	8/12/2020	10:00	10.0	5.0	23.3	15.55	10.8
	8/12/2020	10:00	10.0	8.0	23.0	15.31	11.7
	8/12/2020	10:00	10.0	8.0	23.0	15.31	13.0
	8/28/2020	14:40	11.2	2.1	17.6	11.04	7.1
	8/28/2020	14:42	11.2	2.5	17.7	11.12	8.1
	8/28/2020	14:43	11.2	5.3	17.7	11.12	9.1
	8/28/2020	14:44	11.2	5.3	17.7	11.12	7.1
	8/28/2020	14:45	11.2	9.4	17.8	11.20	6.0
	8/28/2020	14:46	11.2	9.2	17.6	11.04	8.2
	9/19/2020	12:02	14.0	2.0	18.5	11.76	7.4
	9/19/2020	12:04	13.0	2.0	18.5	11.76	7.1
	9/19/2020	12:05	13.0	6.5	19.1	12.23	6.0
	9/19/2020	12:06	13.0	6.7	18.5	11.76	7.1
	9/19/2020	12:07	13.0	10.3	19.5	12.55	6.2
	9/19/2020	12:08	13.0	10.3	18.7	11.91	10.2
SMP-2L	7/11/2020	11:00	14.0	12.0	27.1	18.55	16.6
	7/11/2020	11:00	14.0	7.2	26.6	18.15	18.8
	7/11/2020	11:00	14.0	2.1	26.8	18.31	17.1
	7/11/2020	11:00	14.0	7.2	26.6	18.15	15.5
	7/11/2020	11:00	14.0	12.0	27.1	18.55	17.7
	7/11/2020	11:00	14.0	2.1	26.8	18.31	14.1
	7/23/2020	15:34	14.0	2.4	25.5	17.29	14.9

Station ID	Date (D/M/Y)	Time (CDT)	Site Depth (m)	Sensor/Sample Depth (m)	Turbidity (NTU)	Calculated TSS* (mg/L)	Lab TSS (mg/L)
SMP-2L	7/23/2020	15:35	14.0	2.3	25.2	17.05	11.1
	7/23/2020	15:37	14.0	6.7	25.5	17.29	10.0
	7/23/2020	15:37	14.0	6.4	25.6	17.36	11.6
	7/23/2020	15:39	14.0	12.0	25.6	17.36	11.3
	7/23/2020	15:41	14.0	11.8	25.7	17.44	15.7
	8/12/2020	16:00	13.0	2.0	23.2	15.47	10.5
	8/12/2020	16:00	13.0	11.0	23.4	15.63	9.7
	8/12/2020	16:00	13.0	11.0	23.4	15.63	9.3
	8/12/2020	16:00	13.0	6.5	23.0	15.31	14.0
	8/12/2020	16:00	13.0	2.0	23.2	15.47	12.3
	8/12/2020	16:00	13.0	6.5	23.0	15.31	12.9
	8/29/2020	14:09	13.7	1.8	8.0	3.46	8.2
	8/29/2020	14:10	13.7	2.1	17.3	10.81	7.3
	8/29/2020	14:12	13.7	6.5	17.8	11.20	7.0
	8/29/2020	14:12	13.7	6.4	17.7	11.12	9.0
	8/29/2020	14:14	13.7	11.7	18.3	11.60	6.8
	8/29/2020	14:14	13.7	11.0	18.5	11.76	9.6
	9/18/2020	11:50	14.0	2.0	17.0	10.57	7.0
	9/18/2020	11:52	14.0	2.1	16.8	10.41	7.0
	9/18/2020	11:53	14.0	7.1	17.9	11.28	7.3
	9/18/2020	11:55	14.0	7.1	17.0	10.57	5.7
	9/18/2020	11:56	14.0	11.5	17.2	10.73	6.9
	9/18/2020	11:58	14.0	11.6	17.2	10.73	6.9
SMP-2R	7/11/2020	12:00	15.1	2.0	25.7	17.44	16.0
	7/11/2020	12:00	15.1	13.2	26.1	17.76	15.6
	7/11/2020	12:00	15.1	2.0	25.7	17.44	12.4
	7/11/2020	12:00	15.1	13.2	26.1	17.76	16.4
	7/11/2020	12:00	15.1	7.1	26.2	17.84	17.5
	7/11/2020	12:00	15.1	7.1	26.2	17.84	17.5
	7/23/2020	14:58	15.0	2.3	25.7	17.44	16.8
	7/23/2020	14:59	15.0	2.4	26.2	17.84	9.8
	7/23/2020	15:00	15.0	7.5	25.9	17.60	13.4
	7/23/2020	15:00	15.0	7.4	25.9	17.60	12.0
	7/23/2020	15:01	15.0	12.8	26.1	17.76	12.2
	7/23/2020	15:02	15.0	12.8	26.2	17.84	17.0
	8/12/2020	16:00	12.0	10.0	23.2	15.47	13.0
	8/12/2020	16:00	12.0	2.0	22.8	15.15	12.5
	8/12/2020	16:00	12.0	6.0	22.0	14.52	10.9
	8/12/2020	16:00	12.0	6.0	22.0	14.52	9.6
	8/12/2020	16:00	12.0	2.0	22.8	15.15	13.0

Station ID	Date (D/M/Y)	Time (CDT)	Site Depth (m)	Sensor/Sample Depth (m)	Turbidity (NTU)	Calculated TSS* (mg/L)	Lab TSS (mg/L)
SMP-2R	8/12/2020	16:00	12.0	10.0	23.2	15.47	14.8
	8/29/2020	13:55	12.6	1.8	17.6	11.04	9.7
	8/29/2020	13:56	12.6	2.5	17.6	11.04	6.8
	8/29/2020	13:58	12.6	6.4	17.8	11.20	9.3
	8/29/2020	13:59	12.6	5.9	17.9	11.28	7.8
	8/29/2020	14:01	12.6	10.3	18.1	11.44	8.1
	8/29/2020	14:01	12.6	9.9	18.0	11.36	8.7
	9/18/2020	12:24	14.0	2.0	16.6	10.25	6.2
	9/18/2020	12:26	14.0	2.0	17.0	10.57	5.8
	9/18/2020	12:27	14.0	7.1	16.9	10.49	7.1
	9/18/2020	12:29	14.0	6.6	16.9	10.49	5.6
	9/18/2020	12:31	14.0	12.0	16.8	10.41	6.8
	9/18/2020	12:32	14.0	12.1	16.9	10.49	5.9
SMP-3L	7/11/2020	13:00	18.6	9.3	26.4	18.00	12.5
	7/11/2020	13:00	18.6	2.0	26.8	18.31	15.2
	7/11/2020	13:00	18.6	16.1	26.6	18.15	16.6
	7/11/2020	13:00	18.6	16.1	26.6	18.15	16.4
	7/11/2020	13:00	18.6	2.0	26.8	18.31	14.7
	7/11/2020	13:00	18.6	9.3	26.4	18.00	15.9
	7/23/2020	13:58	17.7	2.1	24.8	16.73	8.9
	7/23/2020	13:59	17.7	2.1	24.8	16.73	14.6
	7/23/2020	14:00	17.7	8.9	25.4	17.21	15.5
	7/23/2020	14:00	17.7	8.9	25.0	16.89	12.0
	7/23/2020	14:02	17.7	15.8	26.3	17.92	15.5
	7/23/2020	14:02	17.7	15.2	26.2	17.84	12.1
	8/12/2020	15:00	20.0	10.0	23.0	15.31	8.5
	8/12/2020	15:00	20.0	2.0	22.0	14.52	11.4
	8/12/2020	15:00	20.0	18.0	23.6	15.78	10.0
	8/12/2020	15:00	20.0	2.0	22.0	14.52	11.0
	8/12/2020	15:00	20.0	18.0	23.6	15.78	12.4
	8/12/2020	15:00	20.0	10.0	23.0	15.31	9.1
	8/29/2020	12:59	20.0	2.4	18.2	11.52	9.0
	8/29/2020	13:00	20.0	2.4	18.1	11.44	6.6
	8/29/2020	13:01	20.0	10.3	18.3	11.60	9.8
	8/29/2020	13:01	20.0	10.1	18.0	11.36	7.3
	8/29/2020	13:03	20.0	17.8	18.3	11.60	6.5
	8/29/2020	13:03	20.0	18.0	18.3	11.60	9.9
	9/18/2020	10:26	20.0	2.1	18.3	11.60	6.7
	9/18/2020	10:27	20.0	2.1	18.1	11.44	9.7
	9/18/2020	10:28	20.0	10.0	19.7	12.70	8.0

Station ID	Date (D/M/Y)	Time (CDT)	Site Depth (m)	Sensor/Sample Depth (m)	Turbidity (NTU)	Calculated TSS* (mg/L)	Lab TSS (mg/L)
SMP-3L	9/18/2020	10:30	20.0	10.0	18.7	11.91	10.9
	9/18/2020	10:32	20.0	17.3	18.9	12.07	8.6
	9/18/2020	10:33	20.0	17.3	18.7	11.91	8.6
SMP-3R	7/11/2020	13:00	13.4	11.1	26.1	17.76	14.5
	7/11/2020	13:00	13.4	11.1	26.1	17.76	11.6
	7/11/2020	13:00	13.4	2.0	24.6	16.57	9.3
	7/11/2020	13:00	13.4	6.2	24.9	16.81	13.7
	7/11/2020	13:00	13.4	2.0	24.6	16.57	13.8
	7/11/2020	13:02	13.4	6.2	24.9	16.81	13.5
	7/23/2020	13:37	17.5	1.7	23.7	15.86	11.9
	7/23/2020	13:38	17.5	1.5	23.3	15.55	9.0
	7/23/2020	13:40	17.5	8.0	24.6	16.57	8.4
	7/23/2020	13:41	17.5	8.7	24.8	16.73	12.0
	7/23/2020	13:42	17.5	15.6	24.6	16.57	10.4
	7/23/2020	13:43	17.5	15.4	24.2	16.26	10.0
	8/12/2020	15:00	13.0	1.9	21.4	14.05	8.2
	8/12/2020	15:00	13.0	11.0	22.2	14.68	12.5
	8/12/2020	15:00	13.0	6.5	22.5	14.92	11.2
	8/12/2020	15:00	13.0	11.0	22.2	14.68	12.4
	8/12/2020	15:00	13.0	6.5	22.5	14.92	8.8
	8/12/2020	15:00	13.0	2.0	21.4	14.05	9.4
	8/29/2020	12:23	14.4	1.8	18.2	11.52	6.5
	8/29/2020	12:23	14.4	2.1	18.5	11.76	8.1
	8/29/2020	12:25	14.4	7.1	18.7	11.91	6.2
	8/29/2020	12:26	14.4	7.1	18.7	11.91	8.0
	8/29/2020	12:27	14.4	12.6	18.6	11.83	9.6
	8/29/2020	12:28	14.4	12.6	18.4	11.68	9.2

*Turbidity/TSS Relationship where TSS = [0.79 x Turbidity] – 2.86

Table 2: Manual sampling water quality monitoring data for a monitoring transect near SMP-2, collected on July 18, 2020.

Site	UTM (15V)	Site Depth (m)	Sensor Depth (m)	Time (CDT)	Water Temp (°C)	Turbidity (NTU)	Calculated TSS* (mg/L)	Dissolved Oxygen (mg/L)
1	366145	6.5	4.756	10:10	18.85	26.5	18.08	9.99
	6246883		3.382	10:11	18.85	25.9	17.60	9.95
			1.977	10:15	18.86	25.4	17.21	9.92
2	366118	5.5	3.566	11:10	18.89	25.7	17.44	9.96
	6246957		2.797	11:13	18.89	25.7	17.44	9.93
			2.078	11:13	18.89	25.4	17.21	9.93
3	366104	8	6.063	11:19	18.89	24.6	16.57	9.82
	6247011		4.025	11:20	18.89	25.4	17.21	9.91
			2.008	11:22	18.9	25.1	16.97	9.94
4	366086	8.5	6.43	11:24	18.89	25.6	17.36	9.77
	6247050		4.233	11:25	18.9	25.4	17.21	9.9
			2.169	11:26	18.89	25.4	17.21	9.94
5	366073	12	10.103	11:34	18.89	25.8	17.52	9.94
	6247100		5.584	11:35	18.89	26.1	17.76	9.96
			2.092	11:36	18.89	25.9	17.60	9.97
6	366055	12	9.367	11:39	18.89	26.4	18.00	9.97
	6247150		6.109	11:40	18.91	26	17.68	9.96
			2.142	11:40	18.91	25.9	17.60	9.99
7	366036	13	10.871	11:43	18.9	26.4	18.00	9.93
	6247192		6.229	11:46	18.9	26.4	18.00	9.95
			2.104	11:47	18.91	26.6	18.15	9.97
8	366028	13	11.347	11:49	18.9	26.4	18.00	9.89
	6247230		6.318	11:50	18.91	26.5	18.08	9.96
			1.81	11:51	18.92	26.5	18.08	9.97
9	366008	13	11.001	11:52	18.91	25.9	17.60	9.82
	6247295		6.732	11:54	18.91	26.4	18.00	9.96
			2.043	11:55	18.91	26.3	17.92	10
10	365997	13	10.762	11:59	18.91	26.1	17.76	9.96
	6247342		5.781	12:02	18.91	25.9	17.60	9.98
			1.988	12:02	18.92	26.4	18.00	10.01
11	365984	12	9.752	12:03	18.91	26.5	18.08	10.01
	6247390		6.393	12:05	18.91	26.8	18.31	10.01
			1.947	12:06	18.92	26.2	17.84	10.02
12	365969	13	10.261	12:07	18.92	27.2	18.63	9.97
	6247439		6.68	12:09	18.92	27.2	18.63	9.97
			1.931	12:09	18.92	26.7	18.23	10.04
13	365950	14	12.114	12:10	18.92	26	17.68	10
	6247475		6.807	12:12	18.92	26.3	17.92	10.01
			2.033	12:12	18.93	26.6	18.15	10.03

Site	UTM (15V)	Site Depth (m)	Sensor Depth (m)	Time (CDT)	Water Temp (°C)	Turbidity (NTU)	Calculated TSS* (mg/L)	Dissolved Oxygen (mg/L)
14	365935	13.5	11.806	12:17	18.95	25.2	17.05	9.95
	6247519		6.623	12:19	18.95	26.7	18.23	9.97
			2.128	12:20	18.96	26.5	18.08	9.99
15	365915	14	11.757	12:20	18.94	26.1	17.76	9.99
	6247574		7.217	12:24	18.94	26.2	17.84	9.95
			2.15	12:24	18.96	26.6	18.15	9.95
16	365906	14	12.022	12:25	18.9	26.6	18.15	9.92
	6247617		7.386	12:27	18.91	26	17.68	9.91
			2.03	12:27	18.95	26	17.68	9.94
17	365885	14	12.004	12:28	18.76	24.2	16.26	9.77
	6247661		6.99	12:30	18.78	24.3	16.34	9.79
			1.877	12:31	18.93	24	16.10	9.84
18	365867	12	10.068	12:33	18.73	24.1	16.18	9.8
	6247717		6.117	12:36	18.81	24.3	16.34	9.79
			2.011	12:36	18.99	24.1	16.18	9.82
19	365796**	12	9.971	12:51	18.71	24	16.10	9.77
	6247901		6.095	12:53	18.72	24	16.10	9.78
			2.02	12:54	18.75	24	16.10	9.77
20	365852	13	10.835	12:38	18.71	24.7	16.65	9.79
	6247766		6.688	12:42	18.71	24.5	16.50	9.77
			1.963	12:42	18.78	24.4	16.42	9.79
21	365837	11	9.347	12:47	18.7	24	16.10	9.83
	6247813		5.543	12:49	18.72	24.1	16.18	9.8
			2.016	12:50	18.75	24.3	16.34	9.81

*Turbidity/TSS Relationship where TSS = [0.79 x Turbidity] – 2.86

** Location of Site 19 was improvised by field crew. Located approximately 100m north and west of Site 21

Table 3: Manual sampling water quality monitoring data for a monitoring transect near SMP-2 collected on August 19, 2020.

Station ID	Date (M/D/Y)	Time (CDT)	Site Depth (m)	Sensor/Sample Depth (m)	Turbidity (NTU)	Calculated TSS* (mg/L)	Lab TSS (mg/L)	Dissolved Oxygen (mg/L)
1	366145	4.6	2.712	11:40	19.32	23.6	15.78	9.74
	6246883	4.6	2.382	11:45	19.32	24	16.10	9.76
		4.6	2.119	11:45	19.32	23.8	15.94	9.75
2	366118	6.3	4.454	11:35	19.32	22.4	14.84	9.75
	6246957	6.3	3.143	11:39	19.32	24	16.10	9.81
		6.3	2.173	11:40	19.32	24	16.10	9.83
3	366104	5.5	3.205	11:31	19.29	26.7	18.23	9.65
	6247011	5.5	2.867	11:34	19.31	24.7	16.65	9.79
		5.5	2.121	11:34	19.31	24.4	16.42	9.8
4	366086	7.6	5.714	11:28	19.22	28.7	19.81	9.36
	6247050	7.6	3.677	11:30	19.3	25.7	17.44	9.67
		7.6	2.104	11:31	19.31	25.1	16.97	9.76
5	366073	8.8	7.066	11:24	19.28	17.6	11.04	9.68
	6247100	8.8	4.547	11:27	19.31	21.9	14.44	9.82
		8.8	2.241	11:27	19.33	23.6	15.78	9.84
6	366055	10.9	9.085	11:20	19.31	22.1	14.60	9.77
	6247150	10.9	5.633	11:23	19.31	22.5	14.92	9.79
		10.9	1.987	11:23	19.31	22.5	14.92	9.79
7	366036	12.3	10.348	11:17	19.28	15.6	9.46	9.75
	6247192	12.3	5.927	11:19	19.31	22.2	14.68	9.85
		12.3	2.453	11:20	19.31	23.8	15.94	9.86
8	366028	13.5	11.202	11:12	19.29	16.6	10.25	10.22
	6247230	13.5	6.711	11:16	19.31	22.5	14.92	10.14
		13.5	2.176	11:16	19.32	23.6	15.78	10.02
9	366008	13.6	11.829	11:08	19.29	19.8	12.78	9.63
	6247295	13.6	6.876	11:11	19.31	23.2	15.47	9.74
		13.6	2.371	11:12	19.31	24.9	16.81	9.82
10	365997	13	10.628	11:03	19.3	24.9	16.81	9.71
	6247342	13	6.886	11:07	19.3	24.5	16.50	9.79
		13	2.29	11:07	19.3	24.4	16.42	9.8
11	365984	13.4	11.694	10:58	19.26	16.5	10.18	9.48
	6247390	13.4	6.297	11:02	19.29	24.2	16.26	9.78
		13.4	2.232	11:02	19.29	24.9	16.81	9.81
12	365969	12.8	10.578	10:54	19.27	24.1	16.18	9.61
	6247439	12.8	6.191	10:58	19.29	24.3	16.34	9.76
		12.8	2.459	10:58	19.29	24.3	16.34	9.76
13	365950	13.2	11.171	10:49	19.28	24.4	16.42	9.81

Station ID	Date (M/D/Y)	Time (CDT)	Site Depth (m)	Sensor/Sample Depth (m)	Turbidity (NTU)	Calculated TSS* (mg/L)	Lab TSS (mg/L)	Dissolved Oxygen (mg/L)
13	6247475	13.2	6.775	10:53	19.28	24.4	16.42	9.81
		13.2	2.346	10:53	19.28	24.4	16.42	9.81
14	365935	14	12.176	10:46	19.27	25.1	16.97	9.86
	6247519	14	7.24	10:48	19.27	25.1	16.97	9.86
		14	1.874	10:49	19.28	24.9	16.81	9.85
15	365915	13.7	11.852	10:43	19.26	29.2	20.21	9.61
	6247574	13.7	6.682	10:45	19.27	26.8	18.31	9.74
		13.5	2.28	10:45	19.27	26.5	18.08	9.79
16	365906	13.5	11.403	10:39	19.25	26	17.68	9.47
	6247617	13.5	6.828	10:41	19.26	26.1	17.76	9.61
		13.5	2.476	10:41	19.26	26.3	17.92	9.71
17	365885	14.4	11.945	10:36	19.25	25.6	17.36	9.56
	6247661	14.4	7	10:38	19.25	25.7	17.44	9.56
		14.4	2.27	10:38	19.26	26.4	18.00	9.72
18	365867	13.5	11.518	10:33	19.22	24.6	16.57	9.5
	6247717	13.5	7.086	10:35	19.23	24.9	16.81	9.58
		13.5	2.238	10:35	19.23	24.7	16.65	9.66
20	365852	12.5	10.155	10:31	19.25	24.8	16.73	9.97
	6247766	12.5	6.359	10:31	19.25	24.7	16.65	9.85
		12.5	2.419	10:32	19.27	24.5	16.50	9.76
21	365837	12.7	11.222	10:18	19.27	24.6	16.57	9.9
	6247813	13	6.886	11:07	19.3	24.5	16.50	9.7
		13	2.29	11:07	19.3	24.4	16.42	9.6

*Turbidity/TSS Relationship where TSS = [0.79 x Turbidity] – 2.86