CMD 25-H12.1-Ref12

Date: 2026-01-12

Reference from NexGen Energy Ltd.

Référence de NexGen Energy Ltd

In the matter of

À l'égard de

NexGen Energy Ltd.

NexGen Energy Ltd.

Licence application to prepare a site for and construct its Rook 1 uranium mine and mill project

Demande de permis concernant la préparation de l'emplacement et la construction de son projet de mine et d'usine de concentration d'uranium Rook I

Commission Public Hearing Part 2

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Volume 2, Part 2: Rook I Project Environmental Impact Statement Baseline Annexes

Rook I Project

Environmental Impact Statement

Annex IV: Hydrology Baseline Road Map

HYDROLOGY BASELINE ROAD MAP FOR THE ROOK I PROJECT

Prepared for:

NexGen Energy Ltd.

Prepared by:

WSP Canada Inc.

May 2023

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1.0 INTRODUCTION

This road map provides an overview of the hydrology baseline program undertaken by NexGen Energy Ltd. (NexGen) for the Rook I Project (Project). Section 2.0, Hydrographic Setting, describes the location of the proposed Project in relation to its watershed and drainage network. Section 3.0, Indigenous Group Feedback, provides context on NexGen's approach to engagement and where feedback related to the hydrology baseline from the Joint Working Group (JWG) meetings can be found. Section 4.0, Hydrology Baseline Document Map, provides information on the scope of each baseline report and identifies where key topics associated with the hydrology baseline program can be found in the reports appended to this road map or in baseline reports for other disciplines (e.g., aquatic environment).

The characterization of baseline hydrology for the Project was based on field studies, feedback from First Nations and Métis Groups (collectively referred to as Indigenous Groups), and desktop analyses. The various baseline reports, presented as Annex IV.1 through Annex IV.5, are part of the comprehensive baseline program that documents different aspects of the hydrological environment in the anticipated area of the Project. These reports include data collected within the hydrology study area, in addition to data from a wider region in northern Saskatchewan and Alberta (Annex IV.1) to compare local data with long-term data from regional climate and hydrometric stations as well as with modelled meteorological data for the hydrology baseline program. Annexes are presented in order of descending spatial scale from regional-scale studies to local-scale results for smaller areas:

- Annex IV.1: Regional Meteorological and Hydrological Characterization Report
- Annex IV.2: Hydrometric Monitoring Characterization Report
- Annex IV.3: Geomorphology Characterization Report
- Annex IV.4: Patterson Lake Currents Assessment Report
- Annex IV.5: Forrest Lake Mixing Study Report

All hydrological baseline reports were completed by Golder Associates Ltd. (Golder) and are complementary studies to inform the Project design and the environmental assessment. Regional historical data was supplemented by field data collected in the areas surrounding the Project from 2018 to 2021 to develop an accurate understanding of the local meteorological and hydrological regime.

2.0 HYDROGRAPHIC SETTING

Hydrography is the arrangement and connectivity of waterbodies and watercourses which provides important context for Project location and how the Project would interact with the receiving environment. The proposed Project would be located adjacent to Patterson Lake, within the Patterson Lake watershed near the headwaters of the Clearwater River watershed. The Clearwater River flows from the area near Broach Lake through a series of lakes including Patterson, Forrest, Beet, and Naomi lakes in order from upstream to downstream. The upper Clearwater River, which flows an approximate distance of 40 km from Broach to Naomi lakes, is dominated by glaciolacustrine terrain with a channel that is shallow, flat, and meandering (Annex IV.3). From Naomi Lake, the Clearwater River flows an additional 20 km southeast before reaching the Mirror River confluence. Below the Mirror River confluence, the Clearwater River deepens and receives higher flow volumes from the Mirror River, and the channel form changes to meandering within a well-defined river valley.

Farther downstream, the Clearwater River flows through Lloyd Lake, which is just upstream of the Clearwater River Provincial Park; the downstream end of the park is at the Saskatchewan-Alberta border. The Clearwater River flows into the Athabasca River at the city of Fort McMurray, Alberta, which flows north into the west end of Lake Athabasca through the Peace-Athabasca delta. Water from the Clearwater River ultimately flows to the Arctic Ocean through the Slave River, Great Slave Lake, and the Mackenzie River.

Regional hydrography in the vicinity of the proposed Project is shown in Figure 1.

LEGEND

- ● POPULATED PLACE
- WATERCOURSE
- MACKENZIE RIVER BASIN
- MAJOR SUB-BASIN
- WATERBODY
- ▲ PROJECT LOCATION

0 200 400
1:8,000,000 KILOMETRE

PROJECT
NexGen Energy Ltd.

ROOK I PROJECT

TITLE

PROJECT REGIONAL-SCALE HYDROGRAPHY

CONSULTANT	PROJECT	20144150	PHASE	3314 - 6
wsp	DESIGN	JV	2020-03-13	SCALE AS SHOWN	REV. 0
	GIS	PMT	2023-03-01	FIGURE 1
	CHECK	RP		
	REVIEW	MM		

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
3. TOPOGRAPHIC MAP © ESRI AND ITS LICENSORS. USED UNDER LICENSE, ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B 25mm 0

3.0 INDIGENOUS GROUP FEEDBACK

Since exploration at the Project site commenced in 2013, NexGen has engaged regularly and established relationships with local Indigenous Groups and northern communities, specifically those closest and with greatest access to the proposed Project.

An important component of engagement to date has been the establishment of JWGs to support the gathering and incorporation of Indigenous Knowledge throughout the Environmental Assessment (EA) process. A summary of feedback from JWGs related to the hydrology baseline program is presented in Appendix A of this memorandum, and includes feedback from the Birch Narrows Dene Nation, Buffalo River Dene Nation, Clearwater River Dene Nation, and Métis Nation – Saskatchewan. Participant questions and comments demonstrated an interest in the regional and local drainage systems and the hydrology of lakes and streams near the area of the Project. In addition, participants inquired about details of the baseline studies completed and associated results. Indigenous and Local Knowledge was also included, where appropriate, from Project-specific studies completed by Indigenous Groups, which included Traditional Land Use and Occupancy studies, Traditional Knowledge and Use studies, Indigenous Rights and Knowledge studies (henceforth referred collectively as Indigenous Knowledge and Traditional Land Use [IKTLU] Studies[1]) (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V: CRDN; TSD VI: YNLR).

4.0 HYDROLOGY BASELINE DOCUMENT MAP

Table 1 provides a summary of key topics related to the hydrology baseline program and cross references to where analysis and discussion of key topics are located within the individual hydrology baseline reports. The topics in Table 1 are listed in roughly descending order of spatial scale from regional spatial scale to smaller areas, consistent with the order of the hydrology baseline reports. Section 4.1 through Section 4.5 provide context and direction to where information related to key hydrology topics can be found.

Key topics from these baseline studies may also overlap with baseline studies for other disciplines (e.g., aquatics); this information is also provided in Table 1 to assist in comprehensive review.

[1] Referred to as TLU Studies in the baseline reports.

Table 1: Hydrology Baseline Key Topic Location Summary

Key Topic	Baseline Report Title	Baseline Report Section Reference	Approach to Topic[1]
Climate	Annex I: Atmospheric Baseline Report	Section 5.1 Climate Section 5.2 Weather	Primary data source
	Annex IV.1: Regional Meteorological and Hydrological Characterization Report	Section 5.1 Climate Conditions	Primary and applied data source
	Annex IV.2: Hydrometric Monitoring Characterization Report	Section 4.3 Local Meteorological Data (Methods) Section 4.4 Snow Surveys (Methods) Section 5.1 Meteorological Data (Results) Section 5.2 Snow Surveys (Results)	Primary data source
	Annex IV.4: Patterson Lake Currents Assessment Report	Section 5.1 Meteorological Observations	Primary and applied data source
Lake morphometry (i.e., shape and dimensions)	Annex IV.4: Patterson Lake Currents Assessment Report	Section 4.0 Methods Section 5.3 Patterson Lake Currents Observations (Results)	Primary and applied data source
	Annex V.3: Naomi Lake Bathymetry Report	All	Primary data source
	Annex V.1: Aquatic Environment Baseline Report	Section 2.0 Lake Morphometry	Primary data source
Lake level	Annex IV.2: Hydrometric Monitoring Characterization Report	Section 4.5 Hydrometric Monitoring (Methods) Section 5.3 Hydrometric Monitoring (Results)	Primary data source
Lake currents	Annex IV.4: Patterson Lake Currents Assessment Report	All	Primary and applied data source
	Annex IV.5: Forrest Lake Mixing Study Report	All	Primary and applied data source
Streamflow	Annex IV.1: Regional Meteorological and Hydrological Characterization Report	Section 5.2 Historical Hydrometric Data	Applied data source
	Annex IV.2: Hydrometric Monitoring Characterization Report	Section 4.5 Hydrometric Monitoring (Methods) Section 5.3 Hydrometric Monitoring (Results)	Primary data source
	Annex IV.3: Geomorphology Characterization Report	Section 5.3 Clearwater River Below Patterson Lake	Applied data source
	Annex IV.5: Forrest Lake Mixing Study Report	Section 5.2 Forrest Lake Inflow and Outflow	Primary and applied data source
Hydrogeology	Annex III: Hydrogeology Baseline Report	All	Primary data source
Sediment and erosion potential	Annex IV.2: Hydrometric Monitoring Characterization Report	Section 4.6 Sediment (Methods) Section 5.4 Sediment (Results)	Primary data source
	Annex IV.3: Geomorphology Characterization Report	All	Primary data source
	Annex V.1: Aquatic Environment Baseline Report	Section 4.0 Sediment Quality	Primary data source

[1]Approach to Topic is noted as either primary data source or applied data source. Primary data source refers to field data collected for the Project. Applied data source refers to modelling, analysis or characterization of conditions informed by primary and second-hand data sources (e.g., government).

4.1 Climate

Climate is the meteorology (i.e., weather) of a place over a long period of time and provides information on normal conditions, normal variation seasonally and inter-annually, and the normal range of weather extremes. Climate is an important control on hydrology and geomorphology. The Regional Meteorological and Hydrological Characterization Report (Annex IV.1) used published historical data from regional climate stations in combination with spatially distributed data, remote sensing data, and site-specific meteorological event data to characterize expected climate for the Project. Short-term meteorological observations were also applied in other baseline reports to support interpretation of lake levels and streamflows (Annex IV.2) and lake current patterns (Annex IV.4 and Annex IV.5).

4.2 Lake Morphometry

Lake morphometry provides basic physical information on waterbodies, including bathymetry and water level–surface area–volume relationships. Lake morphometry influences physical, chemical, and biological characteristics of waterbodies in the study areas and provides valuable supporting information for calculating lake water balances and hydrological modelling. The primary sources for lake morphometry information are the Aquatic Environment Baseline Report (Annex V.1) and the Naomi Lake Bathymetry Report (Annex V.3). Most lake bathymetry surveys were conducted during the open-water period in 2018 as part of the Aquatic Environment Baseline Report (Annex V.1). Naomi Lake bathymetry was collected the following winter from 21 March 2019 to 25 March 2019 using ground penetrating radar surveys, and results are provided in Annex V.3. Lake morphometry information was also used to support interpretation of the focused studies in Patterson Lake (Annex IV.3 and Annex IV.4) and Forrest Lake (Annex IV.5). Lake bathymetry was observed to influence Patterson Lake currents differently in different locations (Annex IV.3).

4.3 Lake Level

Lake levels vary over time in response to changes in in-lake storage, weather, streamflows, and other physical changes in the environment. Natural variation in levels of waterbodies was a key consideration of the hydrology baseline in characterizing existing hydrological conditions and provided the basis for evaluating potential effects as part of the EA. The primary source of measured lake levels is the hydrometric monitoring report (Annex IV.2), which provides detailed data collection methods and results for the eight waterbodies measured between 2018 and 2020.

4.4 Lake Currents

Lake current assessments were completed for Patterson Lake (Annex IV.4) and Forrest Lake (Annex IV.5). These assessments were used to determine the mixing zones and potential effects from Project discharges.

4.5 Streamflow

Streamflow varies over time in response to changes in weather and other physical changes in the environment. Natural variation of streamflow in water courses was a key consideration of the hydrology baseline program in characterizing existing hydrological conditions and provided the basis for evaluating potential effects as part of the EA. The hydrometric monitoring report (Annex IV.2) is the primary source for measured streamflow data and provides detailed data collection methods and results for 12 watercourses sampled from 2018 to 2020. Hydrology baseline information related to streamflows are referenced in four baseline studies per Table 1 (Annex IV.1, Annex IV.2, Annex IV.3, and Annex IV.5).

4.6 Hydrogeology

Groundwater and surface waters are connected and must be integrated into the overall water management of a Project to protect water resources. Hydrogeology baseline studies were completed to understand the groundwater regime around the Project (Annex III). Groundwater modelling results informed the water balance and were incorporated into the water quality modelling for the assessment of effects.

4.7 Sediment and Erosion Potential

Sediment physical properties and sediment transport are important factors in understanding the morphometry and geomorphological processes in waterbodies and watercourses. Fluvial (i.e., in a river) sediment transport is an important function of a watercourse and is influenced by streamflows, wind on lakeshores, and the physical environment. Sediment transport and particle size distribution of the streambeds were characterized at three monitoring locations along the Clearwater River downstream of the Project in the hydrometric monitoring report (Annex IV.2). These measurements support the understanding of the natural fluvial sediment transport regime over a range of hydrological conditions and provide a basis for evaluating changes to the sediment transport regime as a result of changes to hydrology. Particle size results for sediment sampled from the lakebed of numerous waterbodies, and the Clearwater River in the hydrology regional study area, are included in the Aquatic Environment Baseline Report (Annex V.1).

APPENDIX A

Joint Working Group Feedback Applicable to Hydrology Baseline

Table A-1 presents the comments and feedback NexGen has received from members of local Indigenous communities through established JWG meetings. Where appropriate, feedback from local Indigenous communities was considered within the baseline and/or EA processes or tracked as issues or concerns for resolution. NexGen continues to engage with communities, and the feedback presented in Table A-1 reflects comments and feedback received through March 2020 that were related to baseline hydrology or the comprehensive baseline program generally.

Table A-1: Joint Working Group Feedback Related to Baseline Hydrology

Community	Comment
Birch Narrows Dene Nation (BNDN)	Where is Bolton Lake in relation to the project?
	Are you aware of any huge adverse environmental impacts in any of the current mine sites?
	Important topics for the JWG moving forward are Indigenous knowledge, traditional land use, the species discussion, water quality, environmental monitoring, employment, and business opportunities
	The water changes every year.
	Could we ask that you take samples here? That way we can see changes into the future. Even if it isn't affected by the mine. Respectfully, I request that samples are taken here.
	Are the little lakes in between tested?
	Who's responsible for the modelling of the water?
	What is the average depth of the lake?
	Respect the land, the water, the trees. Don't clear-cut the small trees – they take 50 years to grow back. (inaudible) water in one big lake, trout, everything, – just grass there now. They didn't put the water back. Didn't fix it. It used to be a big lake, but now there's nothing there.
Buffalo River Dene Nation (BRDN)	Have you gone to communities to show what you are doing? If so, what was the feedback?
	It's important to explain the Project to Elders in a way that they can then explain it to other Elders in the communities.
	Water is the main thing that people worry about.
	It'll be important to explain to the community that waterways and rivers are natural filters, and peat moss.
	The old guys know there are underground river flows through different areas, in muskeg and sandstone. They stepped through a muskeg and found flowing water.
	Please explain the natural filter systems – the river filters out lots of stuff- rocks, gravel. The Elders think whatever goes into the water will carry all the way down here.
	Our water in these big lakes is all coming from the muskeg, not the river, that's why it's clear. You can see the bottom, and the fish
	In 2001 in Dillon, the water was shallow. Since then it never went down; still going up. This lake is still full here. In Dillon the water is just about full now. But a lot of things are going to change; there are signs of acid rain from Alberta – changes to trees. Half of the trees are different colours. Every time it rains, the trees look a little but different.
	They [beaver dams] break open; lots of logs and everything coming out, running all the stale water that has been sitting.
	One of the Elders was telling us that there's a little lake on our traditional territory where in spring when it's starting to melt, the water that sits on top of the ice, there's nothing that tastes so good. He goes there just to have that water every year. Fresh melt water. I would think in Dillon I could drink the water on top of the ice, but he said in that little lake it's totally different.

Table A-1: Joint Working Group Feedback Related to Baseline Hydrology

Community	Comment
Clearwater River Dene Nation (CRDN)	Water is always the key issue back home.
	Remember we're trying to implement a plain speak document because of visual concepts of understanding. That is what the chief is talking about.
	In terms of baseline studies, are there any opportunities for community involvement with any of your residual baseline work, from fish, terrestrial, etc.?
	And we will eventually throw in our environmental monitors. I don't know if you knew that. We want to train our own people because of lack of trust of government and industry.
	The interim CRDN Rights and Knowledge study will come out of the CRDN-definitive initial list of [valued components] VCs that we want to talk to you about. As we go through there may be additional ones. We know there's a certain window, but we'll try to be as comprehensive as possible. It may not be as linear as moose; it might be having undisturbed places on waterbodies. They might be more complex.
	And our people? We use that water quite a bit. It goes into the Clearwater and all the way down. [CRDN member] picks up water from the Clearwater.
	Not on the old or existing mines that are sitting there?
	Golder does the same thing – hires three or four band members to do the interviews, then takes the notes and puts the document together. When you find the stuff it's not always based on the relationship to the stuff. It's based on what the government's qualifications are on the environmental assessment's impacts, and not the actual concerns of it. I'm trying to reach what [CRDN member] is saying between traditional and modern ways.
	When we started looking at the strategy process, there's that interpretation of cumulative effects. Then we define and introduce an interpretation for that. It's not just one side, western science, we're doing the traditional side as well. That's what the Chief is referring to.
	Both traditional and western science are very important.
	Which lakes are those?
	Will we see the results of those studies?
	You said there was a couple of watersheds – can you talk about that selection process?
	When you're talking about testing the water, are other studies being done on the Alberta side with the Clearwater system? Do they do their own studies?
	How many other projects are in that square box (referring to map)?
	Do other companies have mineral holdings in that box on the map – like for oil and gas?
	Did you take any sediment samples?
	Did you take any samples around the deposit that's underneath the lake? Thinking you should take sediment samples before and after mining activity starts.
	I think it's really important to compare Cluff Lake to what's happening in the baseline studies. It's a good question.
	Regarding Cluff Lake: were there tests being done then and now, and can you see if the water is changed? Would Cluff's watershed flow into this one?
	With global warming, each year we won't have the same amount of snowfall, so you will see the water drop.
	How do you monitor evaporating water? That has a big effect as summer progresses.
	How far north of the Project is the water flowing back into the Patterson area?

Table A-1: Joint Working Group Feedback Related to Baseline Hydrology

Community	Comment
Clearwater River Dene Nation (CRDN)	But there's another river system further north – the Douglas River – that's also flowing west like the Clearwater. We went all the way to Lake Athabasca on the Douglas River system.
	You're sampling at Hodge, you said? How is the water?
	Do any rivers flow east from this area?
	On La Loche Lake we have one island. On the north side of that island, just near the reserve, we set nets. The next morning, we went back and the nets were gone. They were dragged way out into the middle of the lake. There were other times when there were huge holes in the nets in that same area.
	They have pictures at a museum in Drumheller, Alberta. When I saw the picture, I said isn't this what people have been describing in the lake back home? I asked if the water connected to Fort Mac [McMurray], to see if it might have come from there. Who knows?
	This is mostly surface water you're talking about? I see a note about diffusion through groundwater – where does that come from?
	This is something we heard about Cluff Lake, and we don't have a great understanding about it – we don't have our own hydrologist. I heard there's still materials leaching out of that facility through the groundwater, at a glacial rate but there is a slow release of materials; is that what you're talking about? That's what I'm trying to understand in terms of your baseline monitoring – how are you measuring what the baseline groundwater movement is? It's quite difficult in the short timespan you're looking at.
	Community members mentioned every year the water level's going down. If there's lack of oxygen the fish could die off too. Have you come across anything?
	Each year, when anyone goes up north, we get snowfall and rain. On some lakes you see water levels low, and they never recover. On others, it's up again the next year. Some lakes will never recover. One lake up by Douglas River – a few years ago there was a drilling company there and we saw a pump in the water. The water levels dropped so much that it will never recover. They were set up at an old gravel pit.
	When we built the community hall back home, there was an underground stream that was flowing like a river. I figured there could be fish going through there
	What's the purpose of trying to gather all this information?
Métis Nation of Saskatchewan (MN-S)	We have to understand all living and non-living things.
	We are seeing lots of effects from the oil sands – water is changing, plants and animals are dying.
	Are any community members involved in the establishment of the baseline for environmental monitoring, so can they verify their accuracy?
	Would the results be released and reviewed by the community?
	From a trust point of view, our people will want to know that those numbers are accurate now, not later. Just a comment to think about.
	How would this group know – is there a way for the people involved in the studies to inform the group of what they saw and if they are confident they are accurate? Once the stuff hits the EIS, how do we know that it's good? If community folks that were involved in that process and they can validate the results, that brings comfort to community members.
	How often are you monitoring?
	How many locals do you have working with you? You guys talk, but we won't hear anything about water sampling in La Loche.

Table A-1: Joint Working Group Feedback Related to Baseline Hydrology

Community	Comment
Métis Nation of Saskatchewan (MN-S)	It's that validation we're looking for. When I had to involve community members in monitoring, I would get them to write a report if they couldn't speak to the broader community in general. If they didn't feel like writing it, they could talk so someone who would transcribe it. That report could give a summary of how things went, what they saw, were the readings accurate; that could come back to this group, if they couldn't present themselves. The point [MN-S member's] trying to make is, we need some connection to that community resource that's out there doing the monitoring and seeing this stuff. We know who they are, and we're confident in the results. That builds trust.
	Do you have instruments or people taking samples? What does an instrument look like?
	What he's getting at is simply - you can put a box in there, but if you open the box, is there anything in it? It measures, turbidity, flow, pH balance, all the different man chemicals, natural chemicals in there. Then you have a true baseline. If we look at it and say yes, they have a measuring apparatus there, it's nothing. We want to know what it does and how.
	When did you start studying snow?
	Last year it was a foot deep, this year 2".
	How do you know it comes from here and not there?
	What about the little lakes on the side?
	Just south of the Clearwater is the Great Divide [Methy Portage] - the other side of the divide drains from La Loche Lake to the Churchill. So we have a number of different drainage systems. All we are showing here drains into the Clearwater.
	You're on the far end of that drainage system. A lot of water will be draining through.
	Are you testing underground water also? Are you aware if there's any aquifers – most lakes have aquifers that come and go, especially lakes these sizes.
	It was brought up that some of the leftovers [tailings] will be put down underground. In order to really understand everything, you have to have to understand how water moves underground.
	I normally used groundwater all my life. I used to drink La Loche lake water, but today, you can't do it. Been fishing on Patterson, and on a far lake where I have a cabin. We drink the water right from the lake without boiling it; I'm afraid we will lose that.
	The studies we did a few years back, these guys don't want to use them. That's what I heard.
	I had feedback on community engagement, and I'm trying to figure out how we can move forward in a responsible way where people have their input without being offended. We're working towards a bigger goal than what is currently perceived. We need a discussion on how we can approach it. I can offer some high-level thinking to help bring my community around.
	We should have more of these meetings with other companies like this. I'd like to get a Métis community member to work side by side with you guys and report the environmental side to the community instead of you guys doing it, so we know where we are and how much damage is being done to the land.
	This is general – the same information will come back to all the JWGs?
	We are the world's water purifying system – the swamps and muskegs break down all kinds of pollutants and turns it back to normal. That's one of the benefits of our north; we are the filter for most of the world's water. Each forest plays a role in everything, like rainforest in B.C.
	It gets you one way or another. The height of land changes at Wasagamio; everything flows from the Clearwater to Fort Chipewyan. We're lucky on the Churchill River that we don't get that flow coming our way. Yet we get the westerly winds coming over us
	It's not just natural evaporation; they're adding to it, which increases rainfall and erosion, and destruction of habitat.
	It's mainly the food, for everything. We put seeds out, all kinds of birds come. Food is the main item of why things move around; water's the second one. Because of the Let it Burn policy, fire destroyed their food habitat. It's gone, and I don't know what I could tell you to change that. Go and find caribou moss is the simplest solution I could tell you. In the NWT, pipelines affect them – they are a big barrier.

Rook I Project

Environmental Impact Statement

Annex IV.1: Regional Meteorological and Hydrological Characterization Report

REGIONAL METEOROLOGICAL AND HYDROLOGICAL CHARACTERIZATION REPORT FOR THE ROOK I PROJECT

Prepared for:

NexGen Energy Ltd.

Prepared by:

Golder Associates Ltd.

March 2022

Executive Summary

The regional meteorological and hydrological characterization study was completed as part of the hydrology program to establish baseline conditions to support an Environmental Assessment (EA) of the Rook I Project (Project). The objective of the study was to provide long-term regional meteorology and hydrology records to characterize conditions at the Project as local monitoring data available to characterize meteorological and hydrological conditions were limited in duration. To achieve this objective, monitoring data were compiled from regional desktop data sources to compare with and extend the available local records and represent a wider range of conditions.

Meteorological monitoring at the Project began in 2015, and the Rook I Meteorological Station was expanded in 2018 to include additional parameters. A long-term meteorological record for the Project was developed for the years 1979 to 2017 using a combination of data from meteorological stations near the Project as well as global re-analysis products including European Re-analysis Interim (ERAI) data sourced from a numerical weather prediction system. Historical meteorological data were compiled from Environment and Climate Change Canada (ECCC) stations within 225 km of the Project including Fort McMurray, Cree Lake, Key Lake, and Cluff Lake. These observations were used to test the accuracy of ERAI data in the region by comparing total precipitation and air temperature for concurrent time periods at the location of each ECCC station. Given that the ERAI data agreed well with historical observations at regional meteorological stations on a monthly time step, ERAI data were used to compile long-term monthly records of total precipitation, air temperature, solar radiation, and dew point temperature. Using these data, monthly records of evaporation, evapotranspiration, and sublimation were developed.

Over the 40-year record, ERAI annual total precipitation ranged from 399 mm to 695 mm with a mean of 531 mm. In an average year, the total precipitation consists of 144 mm falling as snow and 387 mm falling as rain. The annual snowfall was range from 83 mm to 209 mm in the historical record. For the same 40-year period, annual lake evaporation loss was estimated to be 514 mm using the Penman Combined method (Dingman 2002), and terrestrial evapotranspiration was estimated to be 262 mm using the Granger and Gray (1989) model; input data for atmospheric loss calculations were based on ERAI data.

Historical hydrometric records were compiled for the regional watersheds that were found to best represent conditions along the Clearwater River near the Project. The hydrometric station on the Douglas River near Cluff Lake was identified as the best analogue for flows in the upper Clearwater River (to the confluence with the Mirror River) and has been in operation from 1975 to present. The hydrometric station on the Clearwater River at the outlet of Lloyd Lake outlet was identified as the best analogue for flows farther downstream along the Clearwater River within Saskatchewan and was in operation from 1973 to 1995. Annual water yield in the Clearwater River at the outlet of Lloyd Lake ranged from 120 mm to 199 mm, and averaged 171 mm. Annual water yield in the Douglas River ranged from 103 mm to 292 mm, and averaged 175 mm.

This report summarizes climatic variability and the streamflow regime for the Project. The baseline meteorological and hydrological characterization study achieved study objectives, including describing historical meteorological and hydrological conditions in the baseline study area to support the EA and related studies such as hydrological modelling.

If referencing this report, please use for the following citation:

Golder (Golder Associates Ltd.). 2022. Regional Meteorological and Hydrological Characterization Report for the Rook I Project. Prepared for NexGen Energy Ltd.

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TABLES

FIGURES

APPENDICES

Abbreviations and Units of Measures

Abbreviation	Definition
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
ECMWF	European Centre for Medium-Range Weather Forecasts
ERAI	European Re-analysis Interim
GlobSnow	Global Snow Monitoring for Climate Research
Golder	Golder Associates Ltd.
ID	identification
IDF	intensity-duration-frequency
LSA	local study area
MLE	maximum likelihood estimation
MLM	method of L-moments
MOM	method of moments
NexGen	NexGen Energy Ltd.
NHC	Northwest Hydraulic Consultants Ltd.
PMP	probable maximum precipitation
Project	Rook I Project
RSA	regional study area
SWE	snow water equivalent
TLU	Traditional Land Use
WSC	Water Survey of Canada

Unit	Definition
%	percent
°	degree
°C	degrees Celsius
km	kilometre
km^2	square kilometre
$L/s/km^2$	litres per second per square kilometre
m	metre
m^3/s	cubic metres per second
mm	millimetre
mm/h	millimetres per hour
W/m^2	watts per square metre

1.0 INTRODUCTION

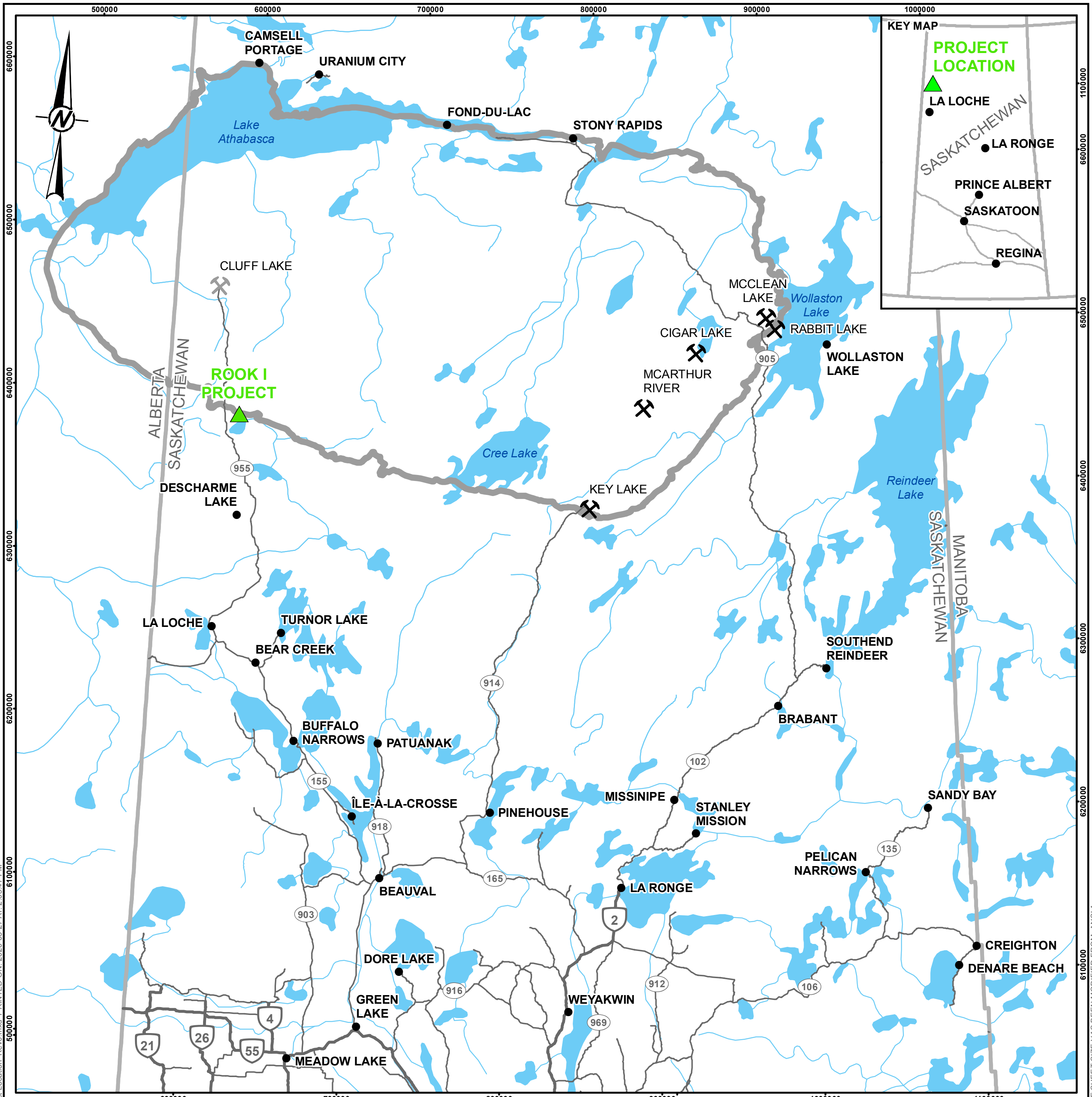
The Rook I Project (Project) is a proposed new uranium mining and milling operation that is 100% owned by NexGen Energy Ltd. (NexGen). The Project would be located in northwestern Saskatchewan, approximately 40 km east of the Saskatchewan-Alberta border, 130 km north of the town of La Loche, and 640 km northwest of the city of Saskatoon (Figure 1). The Project would reside within Treaty 8 territory and within the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, and along the upper Clearwater River system (Figure 2). Access to the Project would be from an existing road off Highway 955. The Project would include underground and surface facilities to support the extraction and processing of uranium ore from the Arrow deposit, a land-based, basement-hosted, high-grade uranium deposit.

The regional meteorological and hydrological baseline report represents a component of a comprehensive baseline program that documents the natural and socio-economic environments in the anticipated area of the Project. The hydrological baseline program, of which the regional meteorological and hydrological baseline study is a part, was undertaken to provide context from which Project environmental hydrological effects could be assessed in the Environmental Impact Statement.

Since exploration at the Project commenced in 2013, NexGen has engaged regularly and established relationships with local First Nation and Métis Groups (collectively referred to as Indigenous Groups) and northern communities, specifically those closest and with greatest access to the proposed Project. NexGen respects the rights of Indigenous Peoples and the unique relationship Indigenous Peoples have with the environment, and recognizes the importance of full and open discussion with interested or potentially affected Indigenous communities regarding the development, operation, and decommissioning of the proposed Project. Engagement activities to date, as well as future planned engagement activities, reflect the value NexGen places on meaningful engagement with Indigenous Groups and northern communities who could be potentially affected by the proposed Project. Engagement mechanisms have included, but are not limited to: meetings with leadership, workshops and community information sessions, Project site tours, establishing Joint Working Groups to support the gathering and incorporation of Indigenous and Local Knowledge throughout the Environmental Assessment (EA) process, and providing funding for Traditional Land Use (TLU) Studies[1] to understand how the proposed Project may interact with the Indigenous communities' traditional use of the anticipated area of the Project.

Feedback received during engagement activities was documented for contribution to the EA for the Project; examples of feedback received include discussion of concerns, interests, potential adverse effects, mitigation, and design alternatives. Many baseline studies were initiated in advance of formal engagement on the EA for the Project; however, engagement during the execution of baseline studies has helped inform the understanding of baseline conditions and confirmed components of the natural and socio-economic environments that required study. A summary of feedback related to the hydrometric monitoring baseline program is presented in Appendix A of the Hydrology Road Map (Annex IV).

[1] Traditional Land Use (TLU) Studies include all land use studies developed by the Project's affected Indigenous Groups, including Traditional Land Use and Occupancy studies, Traditional Knowledge and Use studies, and Indigenous Rights and Knowledge studies, henceforth referred collectively as TLU Studies.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- ATHABASCA BASIN BOUNDARY
- PROJECT LOCATION

0 100 200

1:3,500,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

LOCATION OF THE ROOK I PROJECT, SASKATCHEWAN

CONSULTANT

GOLDER

YYYY-MM-DD	2020-03-27
DESIGNED	SS
PREPARED	NO/AK
REVIEWED	JMC
APPROVED	MM

PROJECT NO.	PHASE	REV.	FIGURE
19114981		0	1

PATH: I:\CLIENTS\NexGen\19114981\Mapping\Products\General\Baseline_General\19114981_Fig1_RookI-Project-Location_Rev0.mxd PRINTED ON: 2020-03-27 AT: 2:05:47 PM

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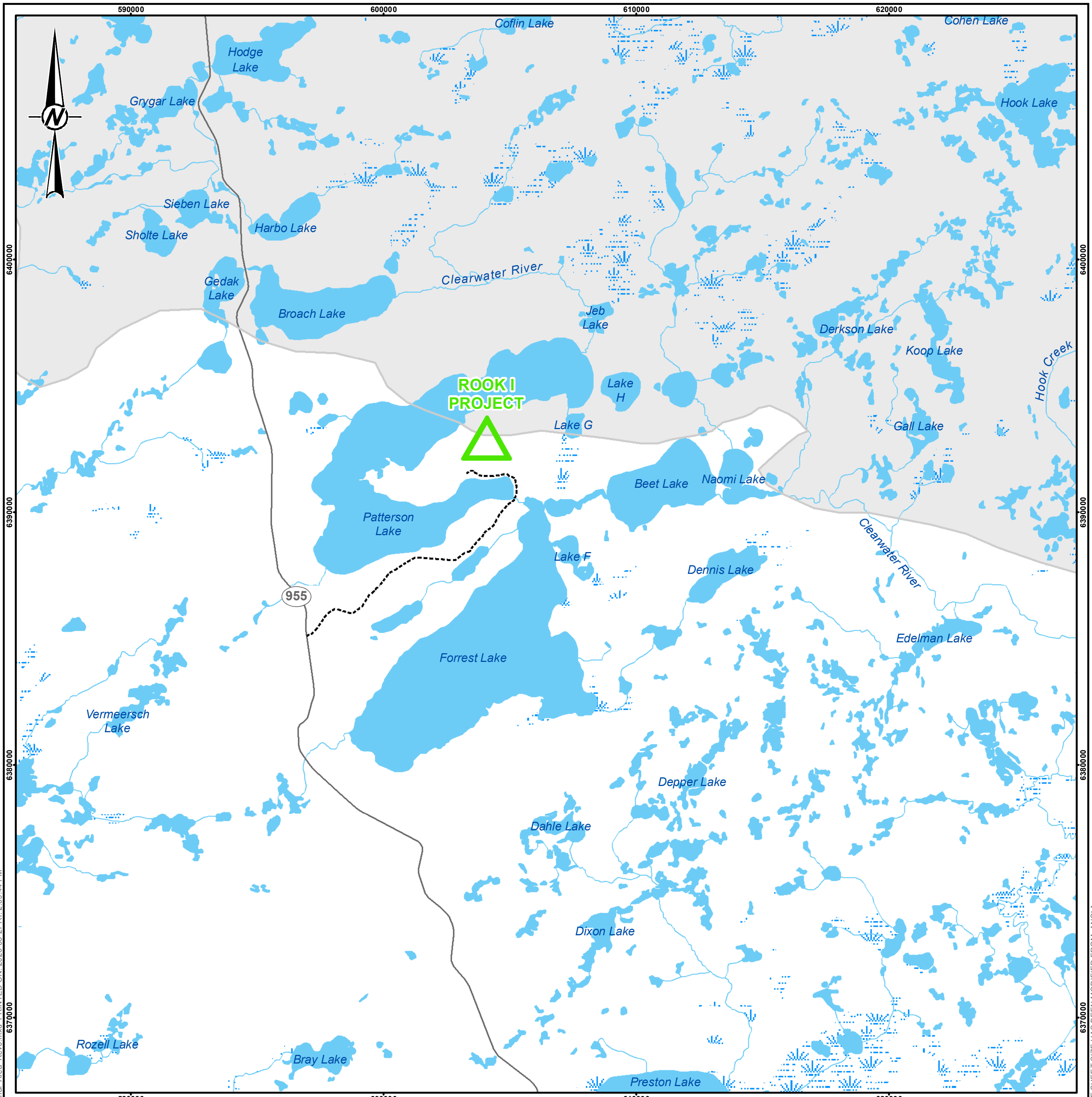


LEGEND

- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- WETLAND
- ATHABASCA BASIN
- PROJECT LOCATION
- EXISTING ACCESS ROAD

0 5,000 10,000

1:225,000 METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

REGIONAL AREA OF THE ROOK I PROJECT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-03-27
DESIGNED	JMC
PREPARED	NO/AK
REVIEWED	JMC
APPROVED	MM

PROJECT NO.	PHASE	REV.	FIGURE
19114981		0	2

2.0 STUDY OBJECTIVES

The overall objective of this baseline study was to describe the existing regional meteorological and hydrological conditions in the baseline study area to support the EA of the Project. Long-term meteorological and hydrological records were necessary to complete the hydrological modelling. Long-term records account for a wide range of climatic variability and, in turn, hydrological variability, and allow for the assessment of routine conditions as well as extreme runoff events.

The specific objectives of the study were to:

- characterize the natural variability of climate in the region and the anticipated area of the Project;
- characterize the natural variability of flows in regional watersheds with published long-term data records to provide an estimate of the expected variability of flows in the Clearwater River;
- develop a long-term baseline record of hydro-meteorological variables to support the quantitative assessment of changes in surface water quantity; and
- acquire accurate baseline information that supports the Project EA.

3.0 STUDY AREAS

The baseline study areas considered in the hydrological baseline program include the following and are shown on Figure 3:

- local study area (LSA): the Clearwater River watershed to the outlet of Naomi Lake; and
- regional study area (RSA): the Clearwater River watershed above the confluence with the Mirror River.

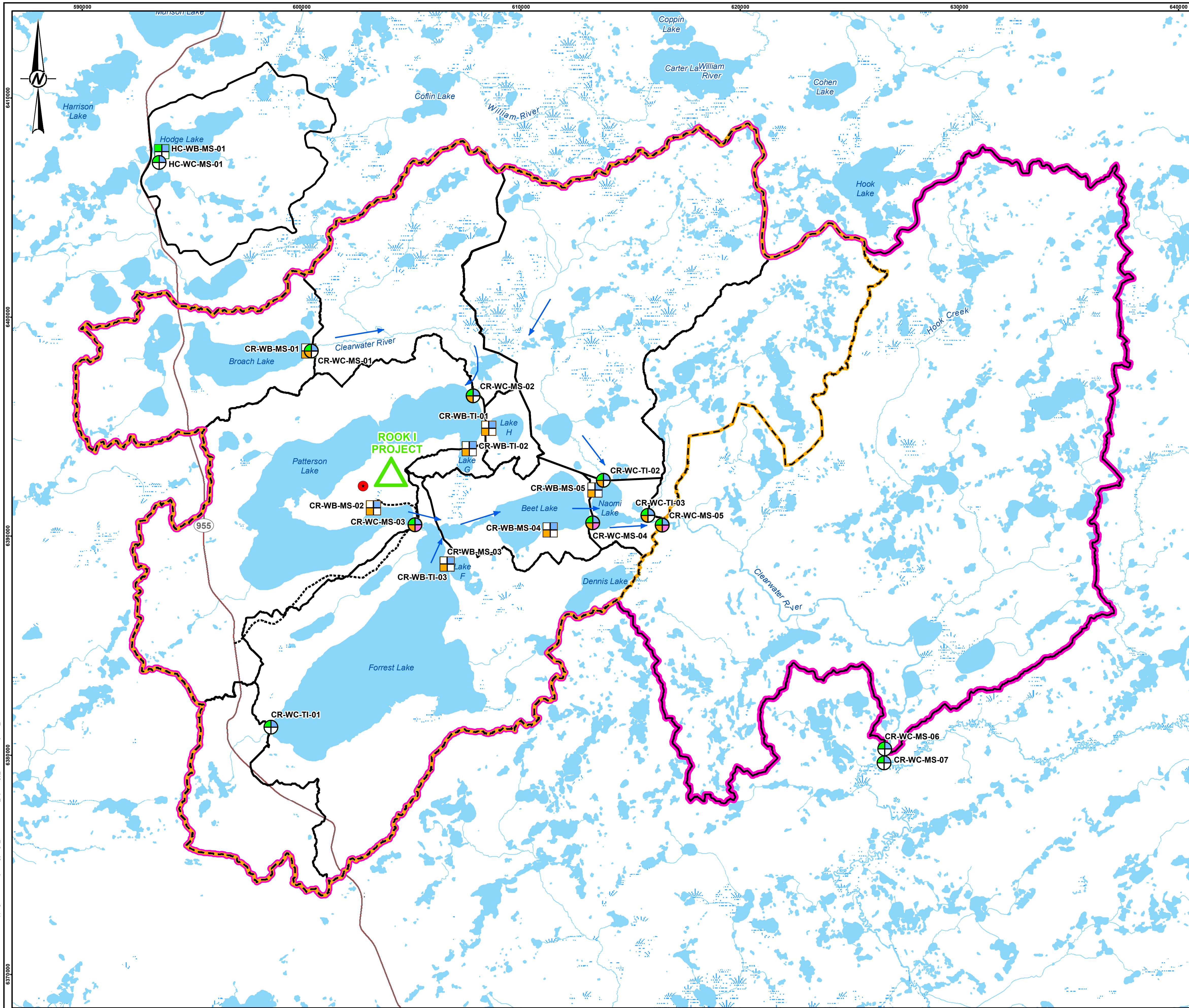
The proposed Project would be located adjacent to Patterson Lake, which is in the upper portion of the Clearwater River system at Broach Lake. The Clearwater River upper reach flows from Broach Lake through a series of lakes including Patterson Lake, Forrest Lake, Beet Lake, and Naomi Lake (listed in order from upstream to downstream). From Naomi Lake, the Clearwater River flows 20 km southeast before reaching the Mirror River confluence. Below the Mirror River confluence, the river deepens with higher flow volumes from the Mirror River, and the channel form changes to meandering within a well-defined river valley. Farther downstream, the Clearwater River flows through Lloyd Lake, which is immediately upstream of Clearwater River Provincial Park; the downstream end of the park is at the Saskatchewan-Alberta border.

Hydrological baseline studies focused on the Clearwater River watershed upstream of the Patterson Lake outlet and along the main lake chain downstream, including Forrest Lake, Beet Lake, Naomi Lake, and the reaches of the Clearwater River separating these lakes.

Based on the potential effects of the Project and hydrologic characteristics of the region, the LSA is defined as the Clearwater River watershed to the Naomi Lake outlet (Figure 3). The Clearwater River watershed above the Naomi Lake outlet drains an area of 685 km^2. Seven waterbody monitoring locations are included in the LSA. Five of the monitored waterbodies are along the main lake chain: Broach Lake, Patterson Lake, Forrest Lake, Beet Lake, and Naomi Lake. The remaining waterbodies, Lake G and Lake H, may be influenced by Project activities. There are eight watercourse monitoring locations in the LSA: Broach Lake outflow, Patterson Lake inflow, Patterson Lake outflow, Beet Lake outflow, Naomi Lake, and three tributaries that flow into the Clearwater River mainstem (Figure 3).

The RSA for hydrology includes waterbodies and watercourses within the Clearwater River watershed above the Mirror River confluence, which includes the LSA. The Clearwater River watershed above the Mirror River confluence drains an area of 1,070 km^2. The spatial extent of the Clearwater River watershed above the Mirror River confluence is expected to provide an ecologically relevant RSA for the EA. The RSA spans an area that provides habitat requirements for a discernible population unit for large-bodied fish species where cumulative effects may occur. The hydrometric stations in the RSA are shown in Figure 3.

There are three hydrometric stations at locations of interest downstream of the RSA boundary; these are referred to as far-field stations. These locations contribute valuable information about hydrological variation in the upper Clearwater River and include the Clearwater River below Mirror River confluence, at the outlet of Lloyd Lake, and above Warner Rapids. Locations and watershed boundaries for the three far-field hydrometric stations relevant to the hydrology baseline program are shown in Figure 4.



LEGEND

- FLOW DIRECTION
- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- WETLAND

PROJECT FEATURES

- EXISTING ACCESS ROAD
- PROJECT LOCATION

- METEOROLOGICAL STATION

WATERBODY HYDROMETRIC STATIONS

- DISCHARGE
- SURVEYED BENCHMARK (GEODETIC DATUM)
- TOTAL SUSPENDED SOLIDS AND BEDLOAD
- WATER SURFACE ELEVATION

WATERCOURSE HYDROMETRIC STATIONS

- DISCHARGE
- SURVEYED BENCHMARK (GEODETIC DATUM)
- TOTAL SUSPENDED SOLIDS AND BEDLOAD
- WATER SURFACE ELEVATION

- HYDROLOGY LOCAL STUDY AREA
- HYDROLOGY REGIONAL STUDY AREA
- WATERSHED

0 3,500 7,000
1:175,000 METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. WATERSHEDS DELINEATED BY GOLDER USING GREENKENUE SOFTWARE BASED ON CANADIAN DIGITAL ELEVATION DATA AND NATIONAL HYDROGRAPHIC NETWORK WATERCOURSES.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT
NexGen Energy Ltd.

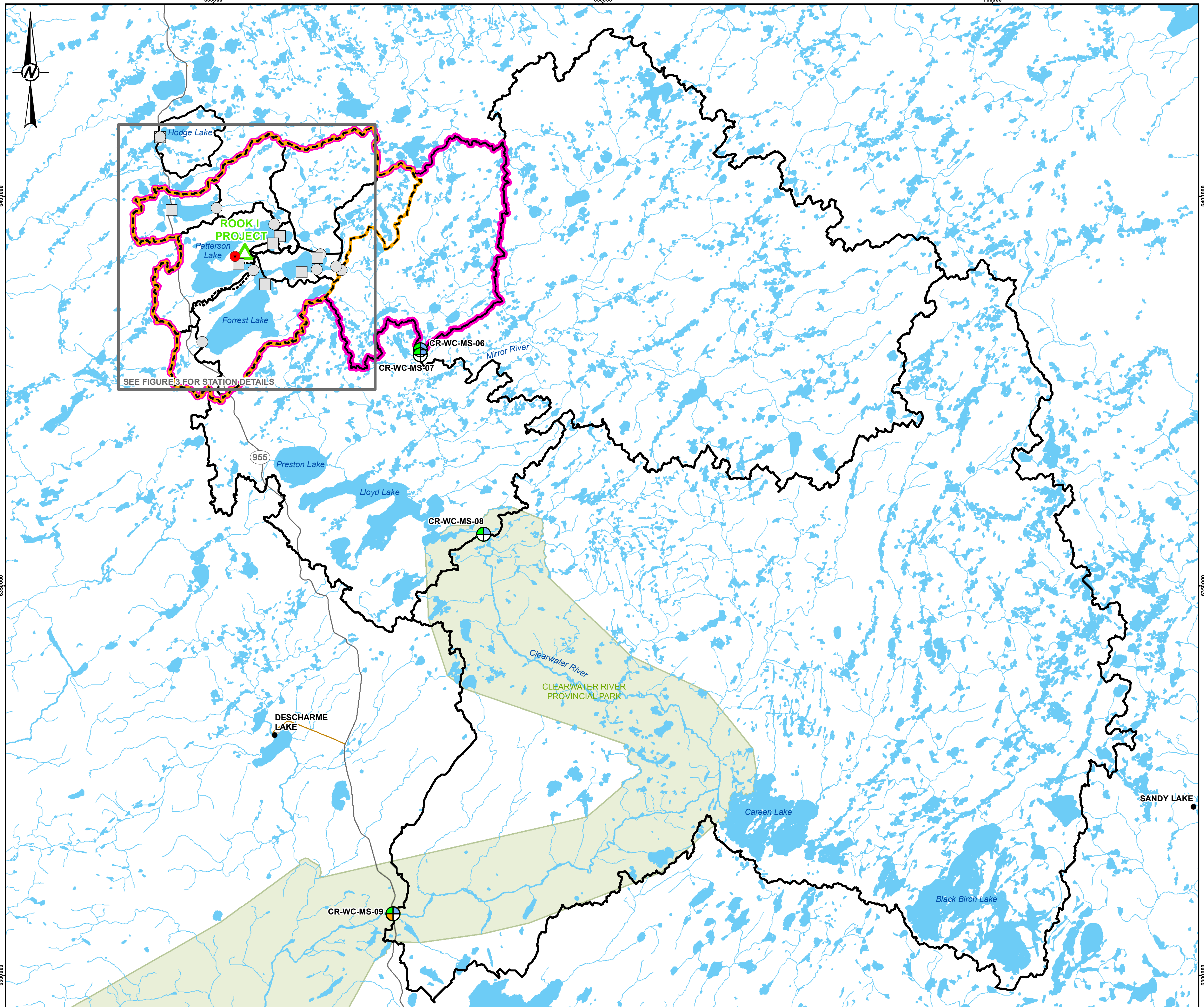
PROJECT
ROOK I PROJECT

TITLE
HYDROLOGY BASELINE STUDY AREAS

CONSULTANT
GOLDER

YYYY-MM-DD	2022-02-17
DESIGNED	JH
PREPARED	NO
REVIEWED	RP
APPROVED	KS

PROJECT NO.	PHASE	REV.	FIGURE
20138965	1000	0	3



LEGEND

- POPULATED PLACE
- SECONDARY HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- PARK
- WATERBODY

PROJECT FEATURES

- EXISTING ACCESS ROAD
- PROJECT LOCATION
- METEOROLOGICAL STATION

WATERBODY HYDROMETRIC STATIONS

- DISCHARGE
- SURVEYED BENCHMARK (GEODETIC DATUM)
- TOTAL SUSPENDED SOLIDS AND BEDLOAD
- WATER SURFACE ELEVATION

WATERCOURSE HYDROMETRIC STATIONS

- DISCHARGE
- SURVEYED BENCHMARK (GEODETIC DATUM)
- TOTAL SUSPENDED SOLIDS AND BEDLOAD
- WATER SURFACE ELEVATION
- HYDROLOGY LOCAL STUDY AREA
- HYDROLOGY REGIONAL STUDY AREA
- WATERSHED

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, OCTOBER 28, 2019.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
3. WATERSHEDS DELINEATED BY GOLDER USING GREENKENUE SOFTWARE BASED ON CANADIAN DIGITAL ELEVATION DATA AND NATIONAL HYDROGRAPHIC NETWORK WATERCOURSES.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT
NexGen Energy Ltd.

PROJECT
ROOK I PROJECT

TITLE
FAR-FIELD HYDROMETRIC STATIONS

CONSULTANT
GOLDER

YYYY-MM-DD	2022-02-17
DESIGNED	JH
PREPARED	NO
REVIEWED	RP
APPROVED	NS

PROJECT NO.	PHASE	REV.	FIGURE
20138965		0	4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

4.0 METHODS

4.1 Review of Existing Information

Northwest Hydraulic Consultants Ltd. (NHC) completed a desktop hydrology and geomorphology analysis to assess the likely changes to receiving waters from the proposed Project (NHC 2016). The NHC assessment assumed that annual treated effluent discharge from the proposed Project would be about 0.13 m^3/s, with maximum discharge rates that could be an order of magnitude higher. Five potential effluent discharge sites were assessed in terms of their estimated assimilation capacity and potential geomorphological changes from increased discharge. The sites were in various watersheds surrounding the anticipated area of the Project, including Rozell Lake, Vermeersche Lake, the Davidson River tributary, Patterson Lake, and the William River. The NHC (2016) report recommended Patterson Lake as a preferred treated effluent discharge site due to proximity to the proposed Project, high percentage of lake coverage in the watershed, and the highest year-round flows compared to other potential locations (NHC 2016).

Northwest Hydraulic Consultants (NHC 2016) recommended three active Water Survey of Canada (WSC) hydrometric stations to represent the hydrology of the anticipated area of the Project: Station 07QC008 Charlot River at the Webb Lake outlet, Station 07DA018 Beaver River north of the Syncrude project, and Station 07MA003 Douglas River near Cluff Lake. The lattermost station (WSC Station 07MA003) is carried forward as an analogue for the hydrology RSA due to its advantages of having a long period of record (i.e., 1975 to present), similar terrain as the Patterson Lake watershed (i.e., being typical of the Athabasca Sedimentary Basin geology), and closer proximity.

Previous hydrology baseline studies have been completed at other locations in the Athabasca Sedimentary Basin and data collection may be ongoing, but recent data from the hydrology monitoring locations are not publicly available. Selected regional Environment and Climate Change Canada (ECCC) meteorological stations that have publicly available data were used in this study.

4.2 Establishing a Long-Term Meteorological Dataset

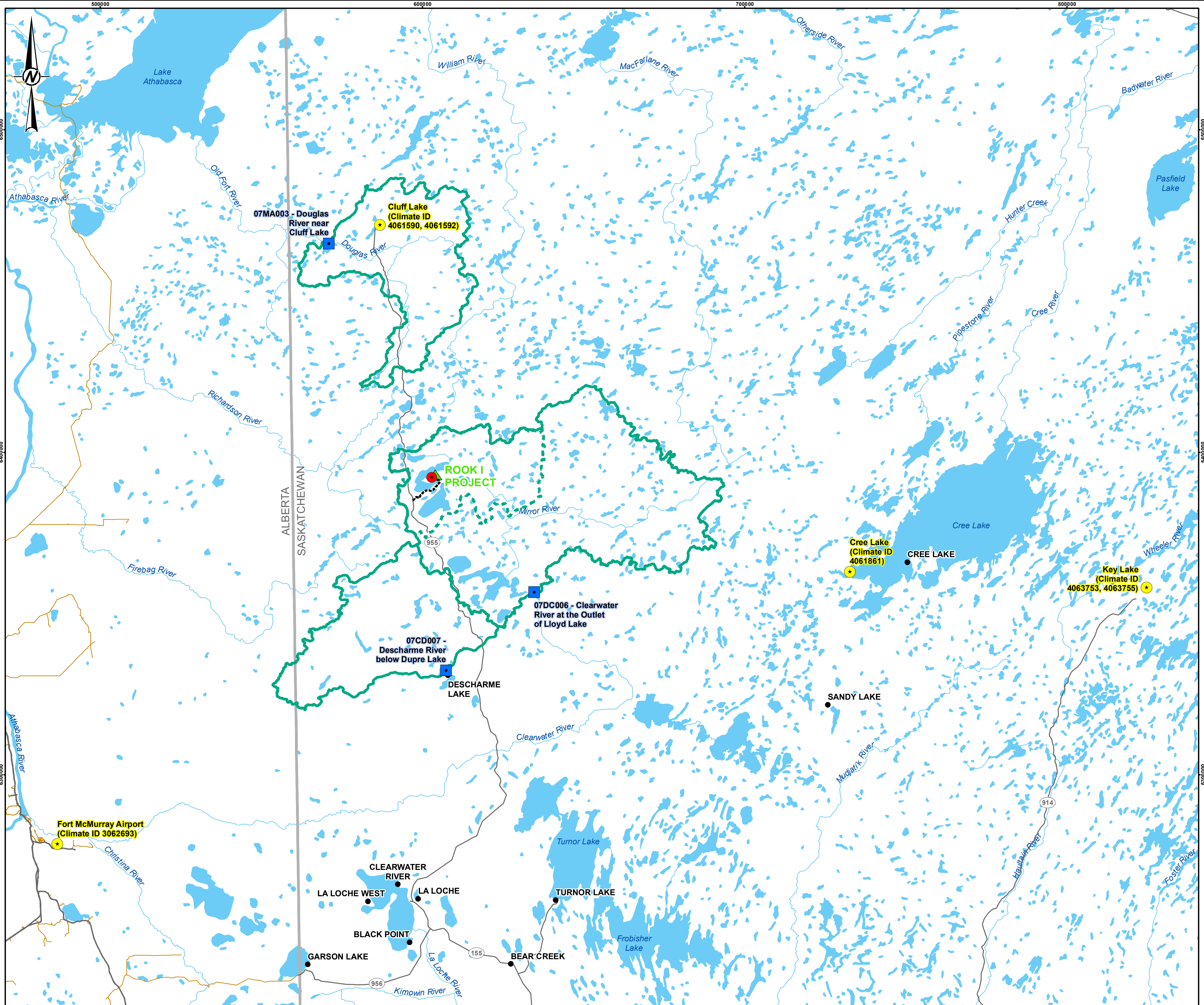
Long-term historical meteorological data are not available near the proposed Project location. Long-term historical meteorological data are available from six meteorological stations, at four locations in the region, operated by ECCC within a 225 km radius of the anticipated area of the Project. These are summarized in Table 1 and shown in Figure 5.

A continuous historical daily climate data record (1979 to 2019) was developed based on data collected in the anticipated area of the Project, relationships to regional data, and European Re-analysis Interim (ERAI) data. European Re-analysis Interim is a global climate re-analysis dataset that is available from January 1979 to August 2019, produced by the European Centre for Medium-Range Weather Forecasts (ECMWF). The details about data assimilation method, forecast model, and input dataset have been documented by the ECMWF (2007) and Dee et al. (2011). The grid-based dataset is publicly available to download with an approximate 80 km spatial resolution on 60 vertical levels from the surface up to 0.1 hectopascal. The temporal resolution of the surface level parameters such as precipitation is twice daily data or forecasts (i.e., from 00 and 12 Coordinated Universal Time). However, some parameters such as wind speed are output at six-hour frequency (i.e., four times per day).

Table 1: Regional Environment and Climate Change Canada Meteorological Stations

Station Number	Station Name[(a)]	Elevation (masl)	Distance to Project (km)	Period of Record
4061590	Cluff Lake	330.1	76	1980 to 1999
4061592	Cluff Lake Auto	330.0	76	1996 to 2005
4061861	Cree Lake	494.6	145	1969 to 1996
4063753	Key Lake Airport	513.9	222	2010 to present
4063755	Key Lake	509.0	225	1953 to present
3062693	Fort McMurray Airport	369.1	170	1976 to present

masl = metres above sea level. a) All stations are or were operated by Environment and Climate Change Canada.



LEGEND

- POPULATED PLACE
- SECONDARY HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- WATERBODY
- HYDROMETRIC STATION - ENVIRONMENT CANADA
- METEOROLOGICAL STATION - ENVIRONMENT CANADA
- METEOROLOGICAL STATION - ROOK I
- WATERSHED
- CLEARWATER RIVER ABOVE THE MIRROR RIVER

PROJECT FEATURES

- EXISTING ACCESS ROAD
- PROJECT LOCATION

0 25 50

1:1,200,000 KILOMETRES

REFERENCE(S)

1. BASE DATA, WATERSHEDS, REGIONAL STATIONS OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

LOCATION OF REGIONAL METEOROLOGICAL AND HYDROMETRIC STATIONS

CONSULTANT

GOLDER

YYYY-MM-DD	2022-02-17
DESIGNED	RP
PREPARED	LMS
REVIEWED	RWP
APPROVED	NPS

PROJECT NO.	PHASE	REV.	FIGURE
19114981	7000	0	5

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Data Comparison

To test the validity of ERAI data for the anticipated area of the Project, ERAI total precipitation and air temperature data were compiled for the regional ECCC meteorological stations and compared to historical observations for the overlapping time period. Accumulated precipitation data over 12-hour intervals from 1 January 1979 to 31 August 2019 were downloaded from the ECMWF data server using the Python program. Data extraction and processing were completed using MATLAB (The Mathworks 2021). The desired area to download meteorological data was bounded by four points (i.e., longitude [long] -112°, latitude [lat] 59°; long -105°, lat 59°; long -105°, lat 56°; long -112°, lat 56°) and targeted the location of the regional ECCC meteorological stations at Cluff Lake, Cree Lake, Fort McMurray, Key Lake, and the anticipated area of the Project.

A statistical summary of ERAI total precipitation data for the regional ECCC meteorological stations is presented in Table 2, along with ECCC's published Climate Normals for the years 1981 to 2010 (ECCC 2019a). The ERAI data were also compiled for the same period (i.e., 1981 to 2010) for comparing Climate Normals between the two datasets.

Table 2: Annual Total Precipitation Compiled for the Locations of Regional Meteorological Stations (1981 to 2010) Compared to Climate Normals (1981 to 2010)

Summary Statistic		Annual Total Precipitation (mm)				
		Cree Lake	Fort McMurray	Cluff Lake	Key Lake	Project
ERAI Statistics	Minimum	394.5	341.2	358.1	360.4	399
	25th percentile	454.8	451.8	437.4	457.6	464.6
	Median	502.4	503.8	469.4	505.5	520.8
	75th Percentile	578	545.8	546.9	574.1	596.7
	Maximum	713.3	663.5	669.6	766.2	695.4
	Mean	521.5	503.4	486.6	517.6	531
	Mean during Climate Normals Period (1981-2010)	527	498.7	490.9	523.4	535.4
ECCC 1981 to 2010 Climate Normals		n/a	418.6	451.0	482.5	n/a
ERAI / Climate Normal		n/a	119%	109%	108%	n/a

ECCC = Environment and Climate Change Canada; ERAI = European Re-analysis Interim; n/a = not applicable.

Total precipitation derived from ERAI data was plotted against concurrent daily, monthly, and annual observations made at the regional ECCC meteorological stations. The correlation between ERAI total precipitation and ECCC observed precipitation was generally highest on a monthly time step, with correlation of daily values being relatively poor (Figure 6). The monthly correlation is more important in the context of hydrology in the RSA and the influence of poor daily correlation on RSA hydrology appears to be low as runoff response is attenuated by slower runoff pathways and lake storage. The ERAI air temperature was plotted against daily, monthly, and annual observations at the regional ECCC meteorological stations. The correlation between ERAI data and ECCC observations was good at all the assessed time intervals (Figure 7).

Data Analysis

Frequency analyses were conducted for total annual precipitation using a Golder Associates Ltd. (Golder) frequency analysis software tool, which is similar to the ECCC Consolidated Frequency Analysis but with enhanced methods. The Golder frequency analysis software tool was used for flood frequency analyses, as well as statistical tests for independence (i.e., not serially correlated), trend, randomness, and homogeneity that were used in turn to determine the quality of the annual flood or low flow series. The Golder software tool includes modern boot strapping and estimation of confidence intervals.

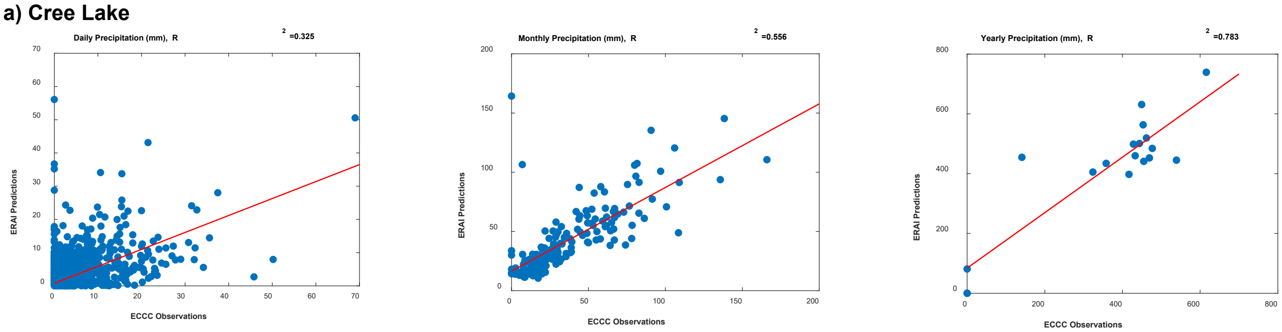
The following probability distributions were analyzed with selected parameter estimation methods (i.e., method of moments [MOM], maximum likelihood estimation [MLE], and method of L-moments [MLM]) using the methods outlined in Pilon and Harvey (1993):

- Three-Parameter Log Normal (MLE, or MOM if MLE fails);
- Generalized Extreme Value Distribution that includes extreme value 1, 2, and 3 distributions (MLM);
- Log Pearson Type III (MLE, or MOM if MLE fails); and
- Weibull (MOM).

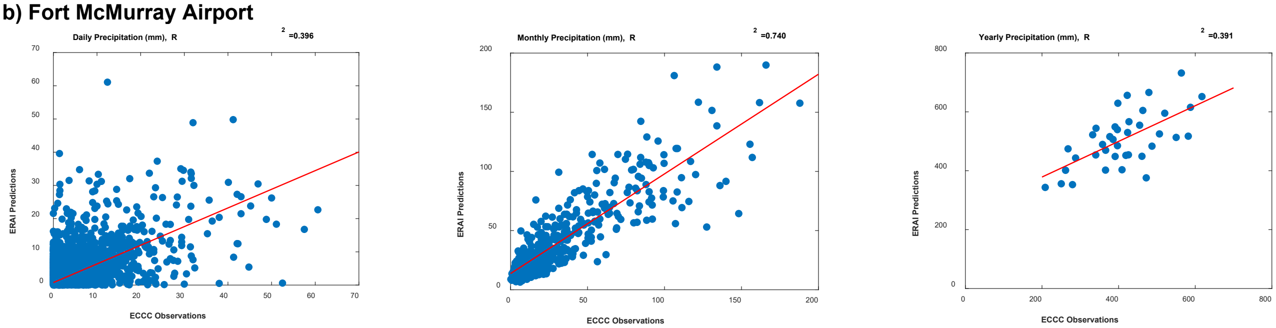
Numerical goodness-of-fit tests were performed including the non-parametric Anderson-Darling test (Stephens 1974) and a least-squares test. A probability distribution was chosen that best fit the data based on the goodness-of-fit tests and/or the best graphical fit at the flood or low flow values that were of interest.

Figure 6: European Re-analysis Interim Data Compared to Concurrent Daily, Monthly, and Annual (Yearly) Total Precipitation Observations

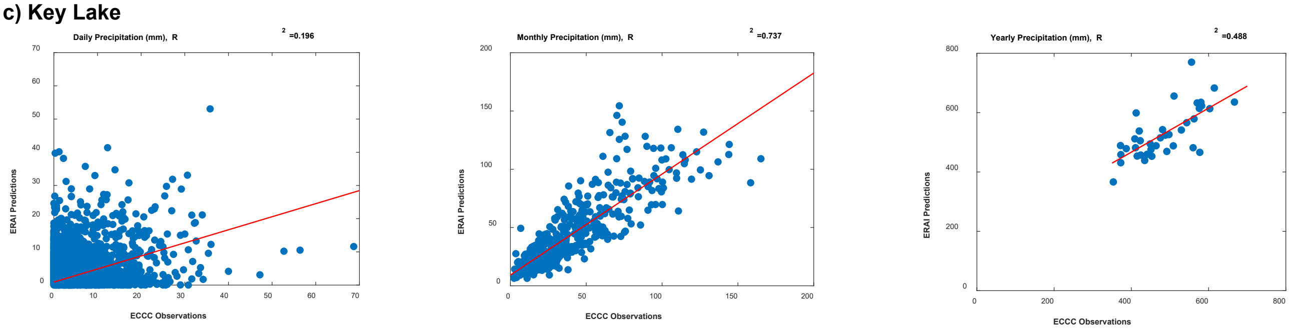
a) Cree Lake



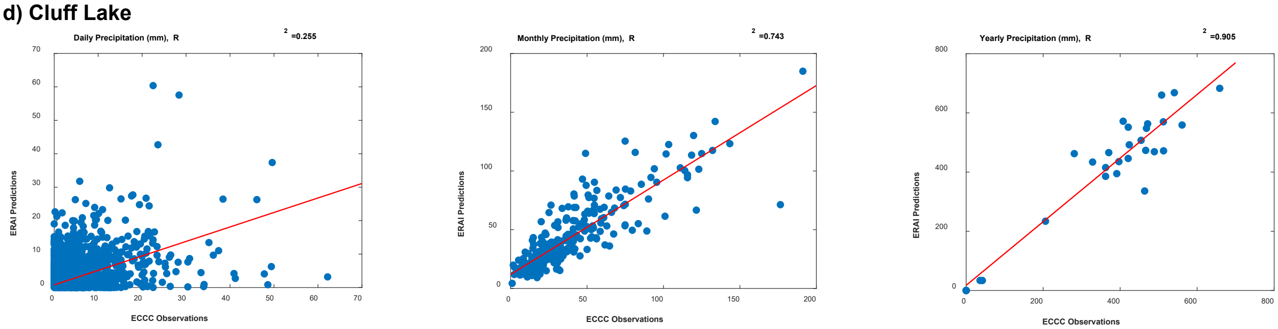
b) Fort McMurray Airport



c) Key Lake



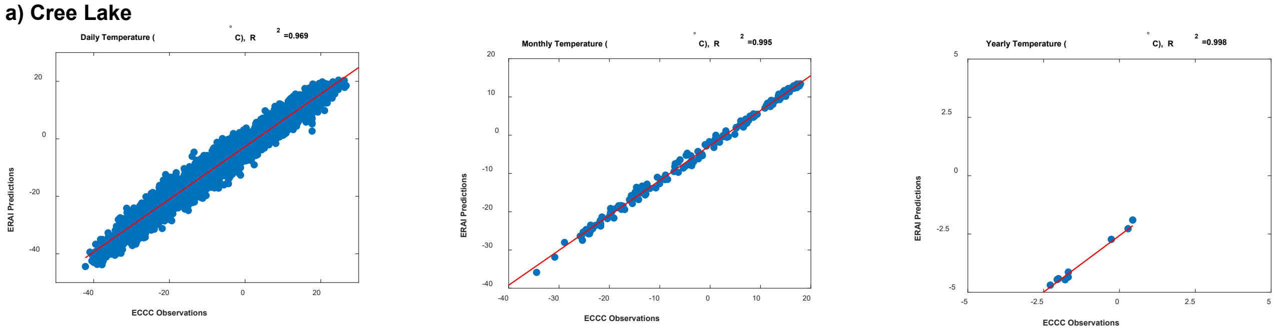
d) Cluff Lake



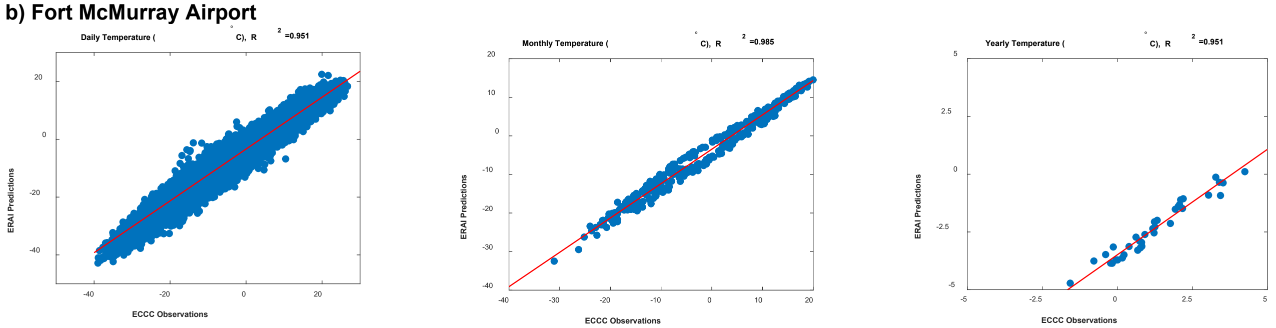
ECCC = Environment and Climate Change Canada; ERAI = European Re-analysis Interim.

Figure 7: European Re-analysis Interim Data Compared to Concurrent Daily, Monthly, and Annual (Yearly) Air Temperature Observations

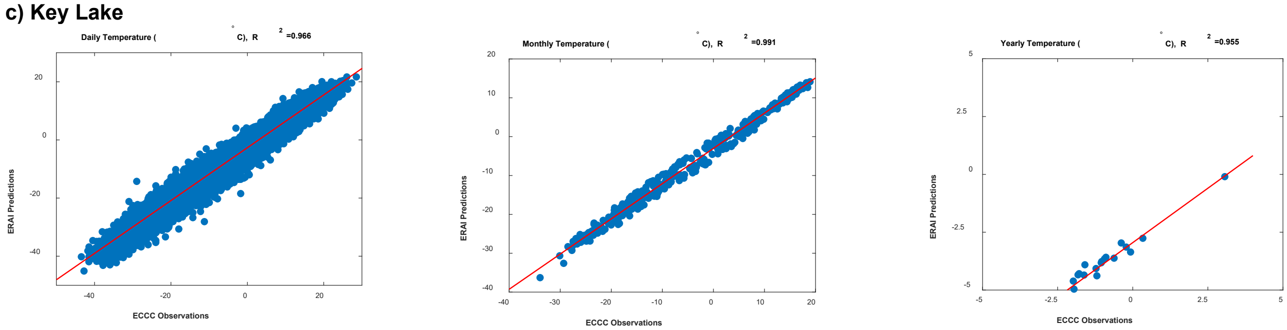
a) Cree Lake



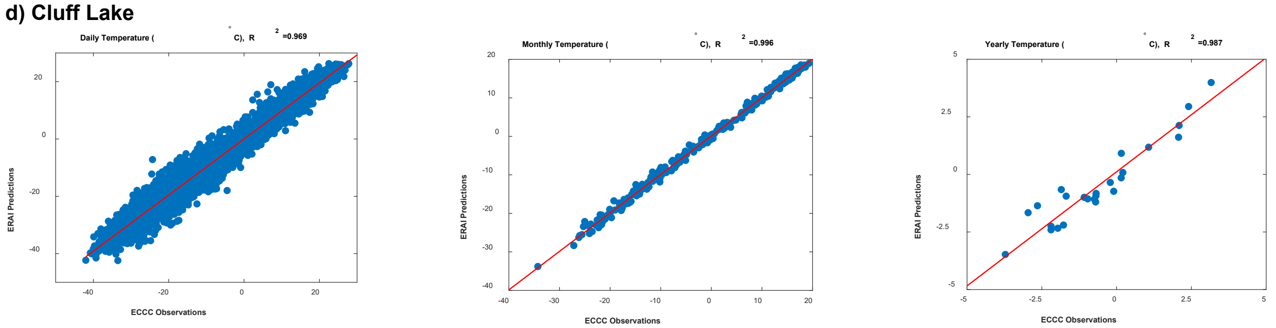
b) Fort McMurray Airport



c) Key Lake



d) Cluff Lake



ECCC = Environment and Climate Change Canada; ERAI = European Re-analysis Interim.

4.3 Regional Data Sources

4.3.1 Long-Term Snowfall Data

Undercatch-corrected snowfall data are available for the ECCC station at Cree Lake (Climate ID 4061861) between 1962 and 1993 (Mekis and Vincent 2011). Adjusted snowfall data provide more reliable records for water balance studies than data not corrected for gauge undercatch; the amount of undercatch also varies with wind speed during snowfall events. The station is located 145 km east of the proposed Project and adequately represents the general climate conditions for the area, based on the similarities in ERAI annual precipitation statistics for the two locations (Table 2), elevation, and latitude. Over the period of 1962 to 1993, annual snowfall ranged from a low of 104 mm to a high of 272 mm. The mean annual snowfall was 183 mm and the median was 187 mm (Table 3). Daily snowfall amounts and snow depth on the ground are available at most ECCC climate stations.

Table 3: Summary of Undercatch-Corrected Snowfall Recorded for Cree Lake, 1962 to 1993

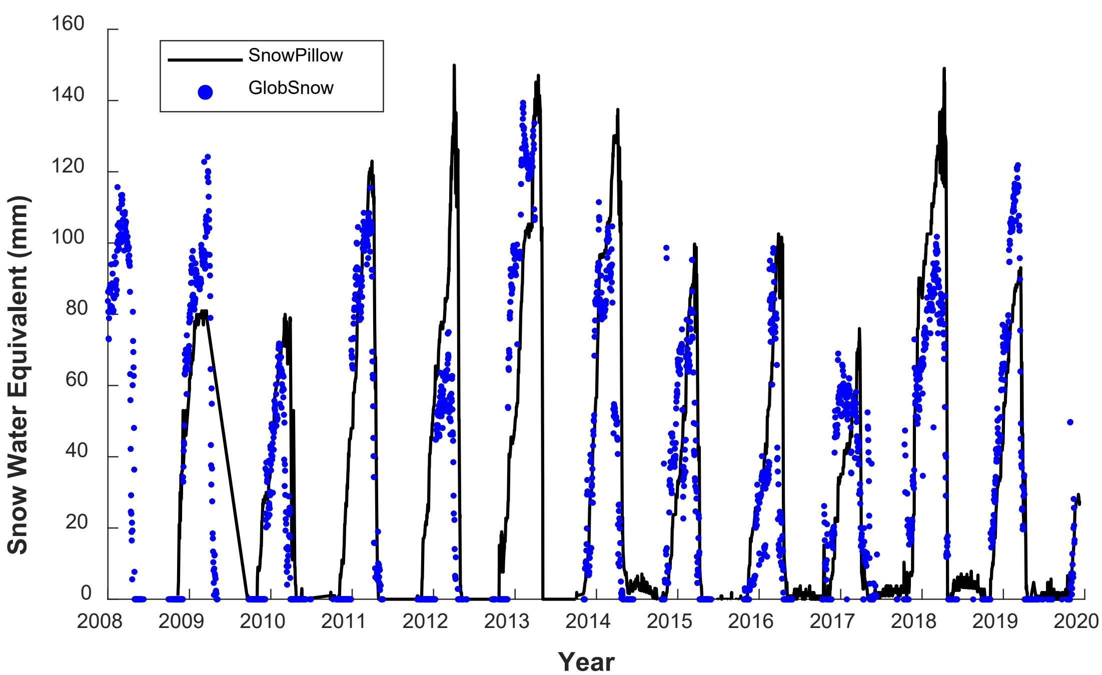
Statistic	Undercatch-Corrected Snowfall (mm)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	25.8	21.9	22.5	20.0	5.8	0.4	0.0	0.1	4.8	19.9	33.1	29.8	183
Minimum	10.9	4.3	5.9	0.7	0.0	0.0	0.0	0.0	0.0	1.8	12.8	12.5	104
25th Percentile	19.6	14.5	13.1	12.0	0.4	0.0	0.0	0.0	0.1	9.7	20.3	21.5	156
Median	25.4	19.5	23.0	18.7	2.6	0.0	0.0	0.0	1.2	17.3	24.7	26.5	187
75th Percentile	30.2	28.4	27.2	25.2	7.4	0.2	0.0	0.0	2.2	28.6	48.5	35.3	209
Maximum	46.5	50.7	55.5	53.7	31.2	4.4	0.0	0.6	67.5	55.3	81.4	51.9	272

Source: Mekis and Vincent 2011.

4.3.2 Snow on the Ground

Snow on the ground measured as snow water equivalent (SWE) is one of the most important hydrological processes in the region as snowmelt usually dominates the annual hydrograph. Long-term direct observations are not available to characterize annual variability for the anticipated area of the Project. However, daily estimates of SWE are available for the northern hemisphere at a coarse spatial resolution (25 km by 25 km grid cells) from the Global Snow Monitoring for Climate Research (GlobSnow) project operated by the European Space Agency and the Finnish Meteorological Institute. The SWE data (ESA 2019) are derived using a combination of ground-based data and satellite microwave radiometer measurements. The suitability of the GlobSnow SWE dataset for the Project was evaluated by comparing the estimates to a nearby regional snow pillow station (Station 07CE801) at Gordon Lake Lookout from 2008 to 2019 (Government of Alberta 2019). The comparison is shown in Figure 8. There were only a few years when GlobSnow underestimated (i.e., 2012 and 2018) or overestimated (i.e., 2009 and 2019) peak SWE relative to snow pillow observations at Gordon Lake Lookout. Overall, GlobSnow datasets captured seasonal and inter-annual variability reasonably well, with the exception of peak values for the four years already mentioned (i.e., 2009, 2012, 2018, and 2019). The GlobSnow data are expected to provide an acceptable representation of SWE characteristics for the anticipated area of the Project.

Figure 8: Comparison of Snow Water Equivalent between Snow Pillow and GlobSnow Datasets at Gordon Lake, Alberta



4.3.3 Short-Duration and Probable Maximum Precipitation

For short-duration rainfall storm events, data were reviewed from intensity-duration-frequency (IDF) curves published by ECCC (2019b) for Buffalo Narrows, Cluff Lake, and Cree Lake in Saskatchewan and for Fort McMurray Airport in Alberta. Cree Lake was carried forward as the most representative of the anticipated area of the Project, based on similar latitude, elevation, ERAI annual total precipitation data, and similar isolines for a probable maximum precipitation (PMP) event (Hopkinson 1999). Cree Lake has an IDF data record of 24 years compared to 16 years for Cluff Lake and 41 years for Buffalo Narrows.

The PMP is the greatest depth of precipitation for a given duration that is meteorologically possible for a storm area at a given location and time of year. The PMP is dependent on the maximum persisting dew point in the atmosphere; both are highest during the warmest periods of the year. The PMP is commonly used as a design criterion of extremely high-risk water impoundment structures such as tailings dams. Hopkinson (1994) developed point PMP estimates for northern Saskatchewan with a focus on the Collins Bay region and the Cameco Rabbit Lake operation. The assessment was expanded to provide estimates of point PMP, with an area in the order of 1.0 km^2 and rainfall duration of 1, 6, and 24 hours for the prairie provinces (Hopkinson 1999).

4.3.4 Long-Term Atmospheric Losses

Water in its liquid form is lost to the atmosphere from the terrestrial environment mainly through evapotranspiration and from the aquatic environment or surface water mainly through evaporation. These losses are important components of the hydrology water balance for waterbodies and watersheds and were calculated on a daily time step in the hydrology model for the Project (Appendix 9A, Hydrological Modelling Summary Report). Data inputs for both methods included air temperature, dew point temperature, and wind speed. Daily net radiation was required to calculate actual evapotranspiration, while short and longwave radiation data were required for lake evaporation. These data were compiled for January 1979 to August 2019 based on ERAI data.

Actual evapotranspiration from terrestrial surfaces was estimated using the Granger and Gray (1989) model. Lake evaporation was estimated on a daily time step using the Penman Combined method (Dingman 2002) modified for lake evaporation estimation by considering change in heat storage in the waterbody (McJannet et al. 2013). The heat storage term was calculated as a function of Julian day, net shortwave radiation, and net longwave radiation following the method outlined in Jensen (2010).

Snow evaporation or sublimation is an important component of winter water budget. Data inputs for the sublimation model included air temperature, wind speed, and outgoing longwave radiation, which were based on ERAI data for January 1979 to August 2019. Sublimation loss from the snowpack was estimated on a daily time step using the Kuchment and Gelfan (1996) model. This model is based on vapour pressure deficit, which is estimated by air and snow temperatures. The required snow surface temperature was back calculated from outgoing longwave radiation using the Stefan-Boltzman relationship assuming an emissivity of 1 (Vionnet et al. 2012).

4.3.5 Long-Term Hydrometric Data

Interpretation of long-term hydrometric data from publicly available sources can provide valuable estimates of past hydrological conditions in the RSA when hydrometric records from the RSA are not available. The WSC operates a network of hydrometric stations in northern Saskatchewan. The hydrometric stations in the network are few, geographically sparse, and most have watershed areas much larger than the RSA. Comparisons between WSC stations and the RSA are more relevant if the WSC station watershed is similar in terms of watershed topography and size, landcover characteristics, and attenuation characteristics.

Two distinct geographic areas were defined for the purposes of this baseline study to account for differences in watershed that would influence selection of a similar WSC station watersheds: the RSA, which is the Clearwater River watershed upstream of the Mirror River confluence; and watersheds located downstream of the RSA including the far-field stations referenced in Section 3.0 located on the Clearwater River below the confluence with the Mirror River (Figure 4). Below the confluence, the river deepens with higher flow volumes from the Mirror River, and the channel form changes to meandering within a well-defined river valley. Long-term characteristics of the Clearwater River flow regime closer to the anticipated area of the Project (i.e., upstream of the confluence with the Mirror River) will be analyzed differently than farther downstream, mainly due to the large increase in watershed area below the confluence of the Clearwater and Mirror rivers.

Hydrometric Station Selection

Three regional streamflow stations near the anticipated area of the Project were evaluated for use as possible reference stations (Table 4). Two of the stations were discontinued in 1995 but have sufficiently long records to be considered in the analysis. The third station is an active station.

The discontinued WSC station on the Clearwater River below Lloyd Lake (WSC Station 07CD006) is on the same river system as many of the Project baseline hydrometric stations. The watershed area at the hydrometric outlet of Lloyd Lake is quite large compared to most of the baseline hydrometric stations upstream of the Mirror River confluence, but this station is assumed to adequately represent flows along the Clearwater River farther downstream from the anticipated area of the Project. This station was used to represent historical flows downstream of the confluence of the Clearwater and Mirror rivers.

The Douglas River station near Cluff Lake (WSC Station 07MA003) is located north of the anticipated area of the Project and just south of the decommissioned Cluff Lake uranium mine. The Douglas River flows generally north near its headwaters and then westward within the Athabasca Sedimentary Basin. It is a tributary of the Old Fort River that empties into the south end of Lake Athabasca in Alberta. The headwaters of the Douglas River start at McEachern Lake, which is about 32 km north of Patterson Lake. The Douglas River hydrometric data provides the longest record (i.e., 1975 to present) within a similar geographical region to the anticipated area of the Project and has a smaller watershed at the gauge compared with the Clearwater River at the outlet of Lloyd Lake. This station was used to represent historical flows upstream of the confluence of the Clearwater and Mirror rivers.

The discontinued station on the Descharme River (WSC Station 07CD007) is located southwest of the anticipated area of the Project; the headwaters begin near Agar Lake about 33 km south of Patterson Lake. Although this station has a similar drainage area to the Douglas River station, it has a shorter period of record than the other two stations (i.e., 1977 to 1995) and was only used for comparison purposes as described below.

The average annual basin yield (total runoff distributed over the contributing watershed) is 175 mm for the Douglas River and 171 mm for the Clearwater River. This corresponds to an approximate unit-area discharge of 5.6 L/s/km^2 for the Douglas River, and 5.4 L/s/km^2 for the Clearwater River (Appendix B).

Table 4: Regional Hydrometric Station Information

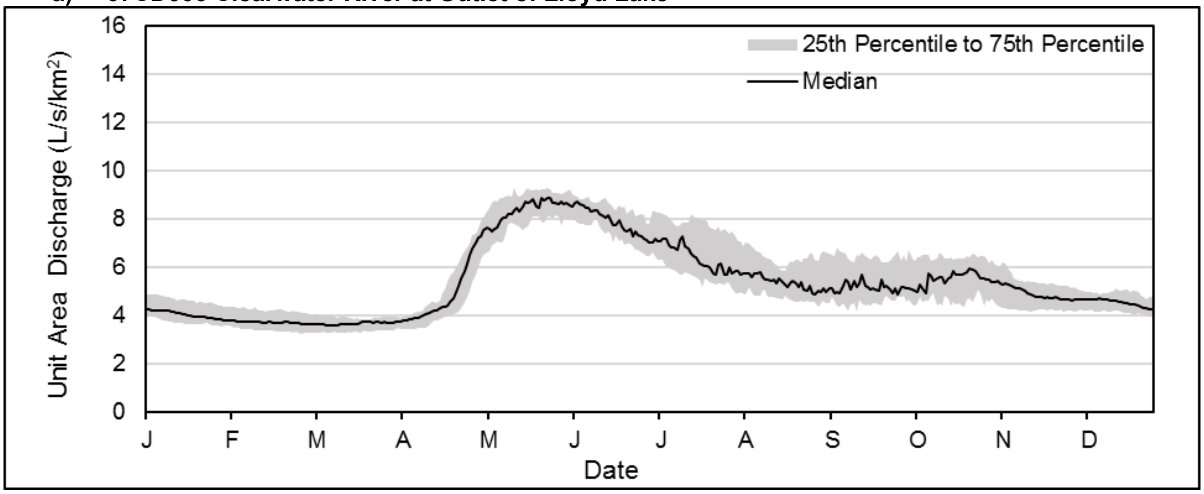
WSC Station Number	Station Name	Distance to Project (km)	Watershed Area (km^2)	Period of Record [(a)]	Average Annual Basin Yield (mm)
07CD006	Clearwater River at Outlet of Lloyd Lake	45	4,250	1973 to 1995	171
07CD007	Descharme River below Dupre Lake	60	1,690	1977 to 1995	169
07MA003	Douglas River near Cluff Lake	80	1,690	1975 to 2019	175

a) The periods of record indicated include years with partial data.
WSC = Water Survey of Canada.

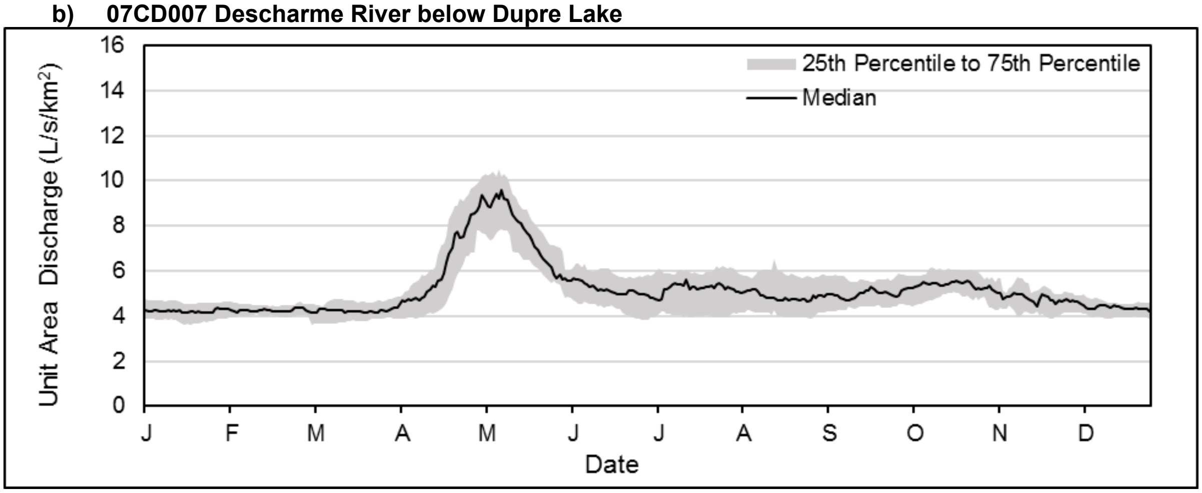
Figure 9 compares the unit-area discharge hydrographs for the Clearwater, Descharme, and Douglas rivers, respectively, based on available long-term records. The physical attributes that would influence hydrograph shape include topography, soils, land cover, and the influence of relatively large lakes in attenuating outflows. All three rivers have a similar baseflow in the winter, and the median discharge hydrographs show a similar general shape with peak flows occurring during the spring freshet in late April and May and recession during the summer and fall. The Clearwater River station hydrograph shows lower spring runoff peaks than the other two stations and is likely attenuated by water storage in Lloyd Lake and other large lakes in the watershed; this lower spring runoff may also be a function of its larger size watershed. Median and 75th percentile Douglas River station peak flows are higher than the other two stations on a unit-area basis. Thus, use of peak flows at this station to estimate flood magnitude and frequency for locations within the RSA generates higher peaks for the smaller watersheds within the RSA and results are more likely to be realistic.

Figure 9: Estimated Daily Statistical Unit-Area Discharge Hydrographs based on Reference Information from Active and Discontinued Water Survey of Canada Hydrometric Gauges

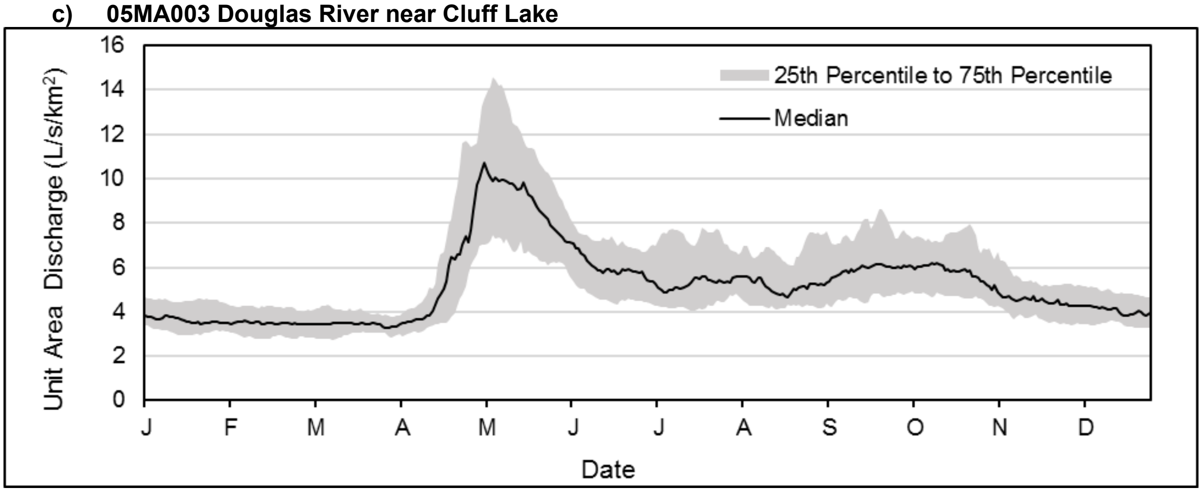
a) 07CD006 Clearwater River at Outlet of Lloyd Lake



b) 07CD007 Descharme River below Dupre Lake



c) 05MA003 Douglas River near Cluff Lake



Regional Hydrology Data Analysis

Daily mean discharge records for two regional hydrometric stations were used to characterize the flow regime for the RSA and far-field watersheds: the Douglas River station (WSC Station 07MA003), and the discontinued station on the Clearwater River at the outlet of Lloyd Lake (WSC Station 07CD006) (Figure 5). Discharge records were converted to unit-area discharge values based on the watershed areas at selected locations. The long-term discharge records based on all available data were used to calculate monthly and annual statistics, show historical average and extreme hydrographs for the calendar year, provide flood and low flow frequency, and compare long-term time series on a unit-area basis.

The maximum annual, minimum annual, and minimum seven-day average discharges were calculated for each year of the record, not including partial years' data if gaps occurred during typical spring freshet or low flow months in the late winter. Instantaneous flood peaks were not calculated, but the published instantaneous flood peaks for the Douglas River station were only 1.0% higher than daily mean peaks.

Golder frequency analysis software was used for flood frequency analyses, as well as for statistical tests for independence (i.e., not serially correlated), trend, randomness, and homogeneity that were used to determine the quality of the annual flood or low flow series. The software tool includes modern boot strapping and estimation of confidence intervals.

Probability distributions (i.e., Three-Parameter Log Normal, Generalized Extreme Value Distribution, Log Pearson Type III, and Weibull) were analyzed with selected parameter estimation methods as presented in Section 4.2. Numerical goodness-of-fit tests were performed, and probability distribution was chosen that best fit the data based on these tests and/or the best graphical fit at the flood or low flow values that were of interest.

Comparison with Baseline Hydrometric Data

Provisional WSC discharge data for the Douglas River near Cluff Lake (WSC Station 07MA003) in 2018 and 2019 were compared to statistics for the long-term record. Daily mean discharge records from August 2018 to September 2019 for a key baseline hydrometric station at the Patterson Lake outflow (Station CR-WC-MS-03) were compared with regional unit-area discharge daily flow hydrographs (converted to unit-area discharge). Discharge measured at the Clearwater River below Lloyd Lake (CR-WC-MS-08) in 2018 and spring 2019 was also compared with the long-term records of the Clearwater River (WSC Station 07CD006).

5.0 RESULTS

5.1 Climate Conditions

The proposed Project is in northwestern Saskatchewan near the headwaters of the Clearwater River system. The climate is characterized by cold winters and cool summers. The region is typical of a sub-arctic continental climate with year-round precipitation according to the Köppen classification, which is based on average monthly air temperatures and seasonal precipitation patterns (Kottek et al. 2006). The following sections describe meteorological conditions in detail. The climate conditions and specific meteorological parameters in the anticipated area of the Project were characterized using historical data from ECCC (2019a) weather stations in the region (Figure 5), as well as ERAI data (ECMWF 2019) generated for this region.

5.1.1 Precipitation

Annual and Monthly Total Precipitation

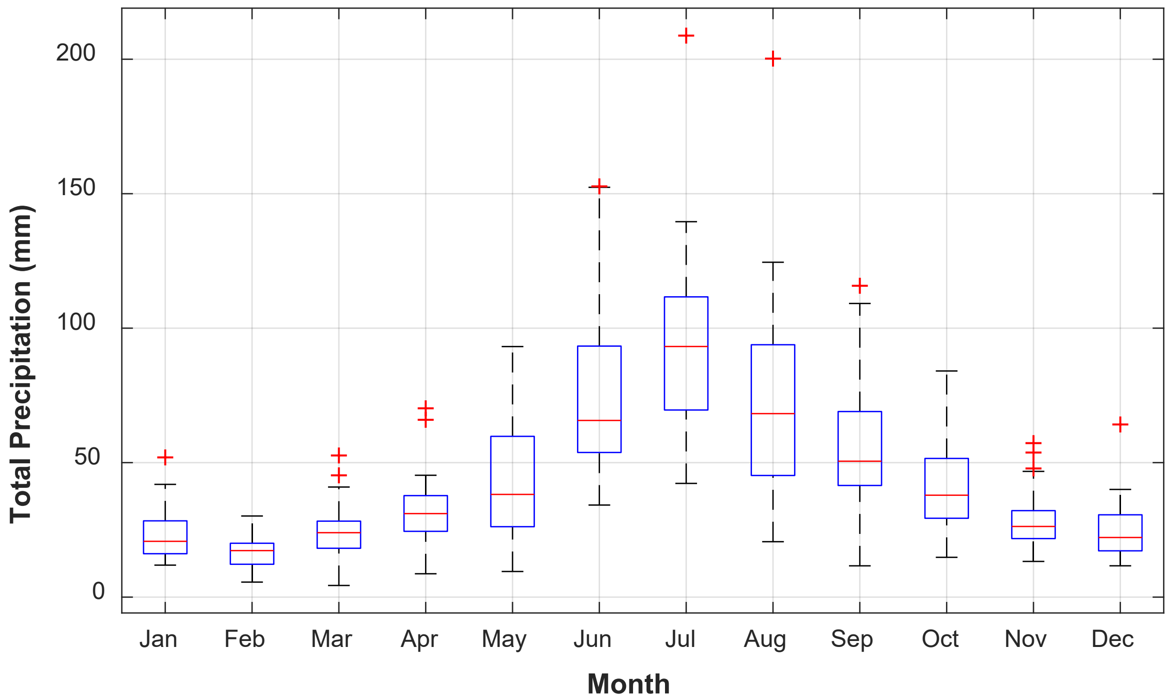
A record of total precipitation in each month was developed for the anticipated area of the Project based on ERAI data between 1979 and 2019 (Table 5). Over this period, annual precipitation ranged from 399 mm to 695 mm and averaged 531 mm. Box and whisker plots were generated to summarize the historical variability of total monthly precipitation (Figure 10). The length of the box in the plots represents the interquartile range (i.e., 25th and 75th percentiles), with the median denoted by the horizontal line within the box. The whiskers represent the minimum and maximum values of the dataset (i.e., the maximum precipitation that occurred in all the months on record). Any outliers in the data are represented by a “+” sign. Annual total precipitation in the area of the Project is expected to average 531 mm, with 144 mm falling as snow and 387 mm falling as rain (Appendix A). The annual snowfall was observed to range from 83 mm to 209 mm in the historical record, while the annual rainfall was observed to range from 259 mm to 530 mm (Appendix A). The average monthly apportioning of total precipitation as snow or rain is presented in Figure 11.

Table 5: Derived Monthly and Annual Total Precipitation Statistics for the Anticipated Area of the Project, 1979 to 2019

Total Precipitation (mm)							
Month	Minimum	25th Percentile	Median	75th Percentile	Maximum	Mean	Standard Deviation
January	11.9	16.3	20.7	28.3	51.9	22.5	9.3
February	5.6	12.6	17.3	19.9	30.2	16.7	6.3
March	4.3	18.3	24.0	28.2	52.7	24.3	10.3
April	8.7	24.5	31.0	37.6	70.2	30.5	12.9
May	9.5	26.6	38.2	59.1	93.1	41.6	21.4
June	34.2	53.9	65.7	93.2	152.7	72.6	33.2
July	42.3	70.1	93.2	111.2	208.8	91.6	34.5
August	20.6	45.3	68.2	90.9	200.2	71.3	37.0
September	11.6	42.0	50.5	68.9	115.8	55.2	24.5
October	14.8	29.5	37.9	51.0	84.1	40.5	18.8
November	13.3	21.8	26.3	32.0	57.3	27.9	10.9
December	11.6	17.2	22.2	30.2	64.2	24.1	10.2
Annual	399.0	464.6	520.8	596.7	695.4	531.0	81.5

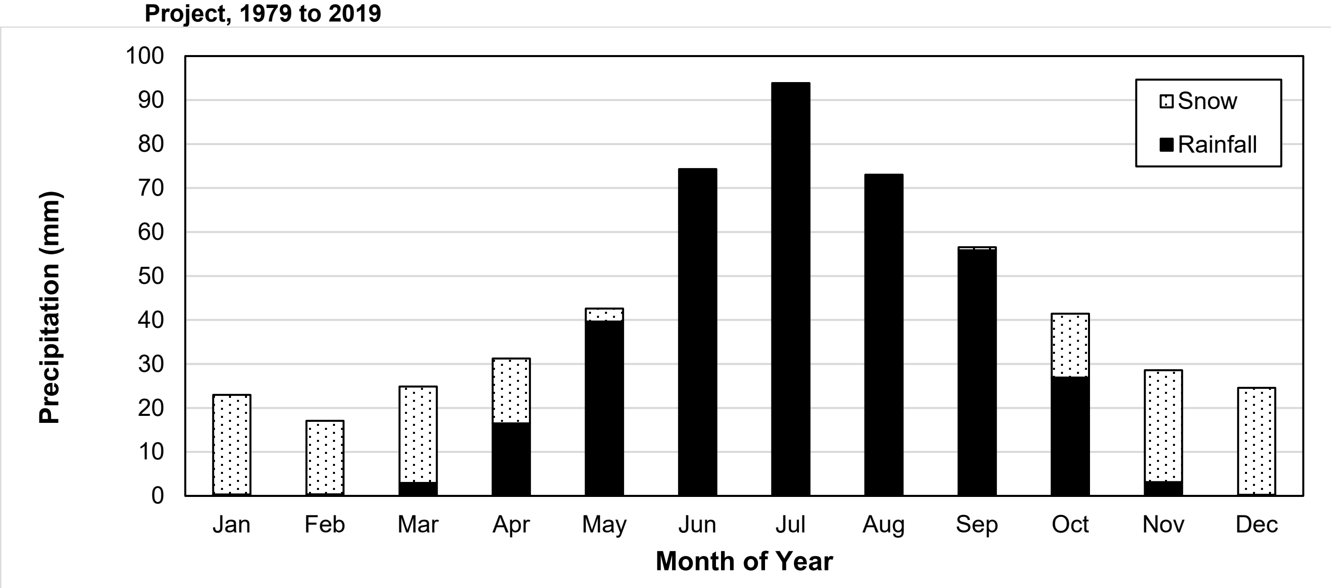
Source: ECMWF 2019.

Figure 10: Summary of Derived Historical Monthly Total Precipitation for the Anticipated Area of the Project, 1979 to 2019



Note: Outliers are denoted by "+" sign in the figure.

Figure 11: Derived Historical Monthly Total Precipitation as Snowfall and Rainfall for the Anticipated Area of the Project, 1979 to 2019



Annual Total Precipitation – Frequency Analysis

A frequency analysis was performed using annual precipitation values based on ERAI annual data for the anticipated area of the Project from 1979 to 2019 using a Weibull distribution. Other distributions (i.e., Log Pearson Type III, Three-Parameter Log Normal, and Generalized Extreme Value Distribution) were considered but screened out as the Weibull distribution had the best fit. Annual total precipitation is expected to range from 370 mm during a 200-year dry year to 763 mm during a 200-year wet year (Table 6). The mean annual precipitation is 531 mm, and the median annual precipitation is 527 mm.

Table 6: Frequency Analysis of Derived Annual Total Precipitation for the Anticipated Area of the Project, 1979 to 2019

Hydrological Condition	Average Return Period (Years)	Estimated Annual Precipitation (mm)
Wet	200	763
	100	740
	50	714
	20	676
	10	643
	5	602
Mean	n/a	531
Median	2	527
Dry	5	460
	10	430
	20	408
	50	389
	100	378
	200	370

Source: ECMWF 2019.
n/a = not applicable.

Short-Duration Rainfall

The rainfall intensities and durations associated with varying return periods of short-duration rainstorm events are available from IDF curves published by ECCC (2019b) for Cree Lake based on data from 1970 to 1993 (Table 7). Cree Lake s most representative of conditions for the anticipated area of the Project based on latitude, elevation, ERAI annual precipitation data, and isolines for the PMP (Hopkinson 1999). Cree Lake has an IDF record of 24 years, compared to 16 years for Cluff Lake and 41 years for Buffalo Narrows. The rainfall intensities associated with varying return periods are available from IDF curves published by ECCC (2019b) for Cree Lake and are presented in Table 8.

Table 7: Intensity-Duration-Frequency Rainfall Amounts for Cree Lake

Time Interval	Average Return Period Rainfall Amounts (mm)					
	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
5 minutes	5.2	9.0	11.4	14.6	16.9	19.2
10 minutes	7.5	12.6	15.9	20.1	23.2	26.3
15 minutes	9.6	17.2	22.3	28.6	33.4	38.1
30 minutes	12.3	21.2	27.2	34.6	40.2	45.7
1 hour	15.3	24.9	31.3	39.4	45.3	51.3
2 hours	18.0	29.2	36.6	45.9	52.9	59.8
6 hours	26.0	35.9	42.5	50.8	56.9	63.1
12 hours	32.9	45.7	54.2	64.9	72.8	80.6
24 hours	38.1	51.8	60.9	72.4	80.9	89.4

Source: ECCC 2019b.

Table 8: Intensity-Duration-Frequency Rainfall Intensities for Cree Lake

Time Interval	Average Return Period Rainfall Intensities (mm/h)					
	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
5 minutes	62.4	107.4	137.3	175	202.9	230.7
10 minutes	45.2	75.4	95.4	120.6	139.4	158
15 minutes	38.4	68.9	89.1	114.6	133.5	152.3
30 minutes	24.5	42.4	54.3	69.3	80.4	91.5
1 hour	15.3	24.9	31.3	39.4	45.3	51.3
2 hours	9.0	14.6	18.3	23	26.4	29.9
6 hours	4.3	6.0	7.1	8.5	9.5	10.5
12 hours	2.7	3.8	4.5	5.4	6.1	6.7
24 hours	1.6	2.2	2.5	3.0	3.4	3.7

Source: ECCC 2019b

Probable Maximum Precipitation

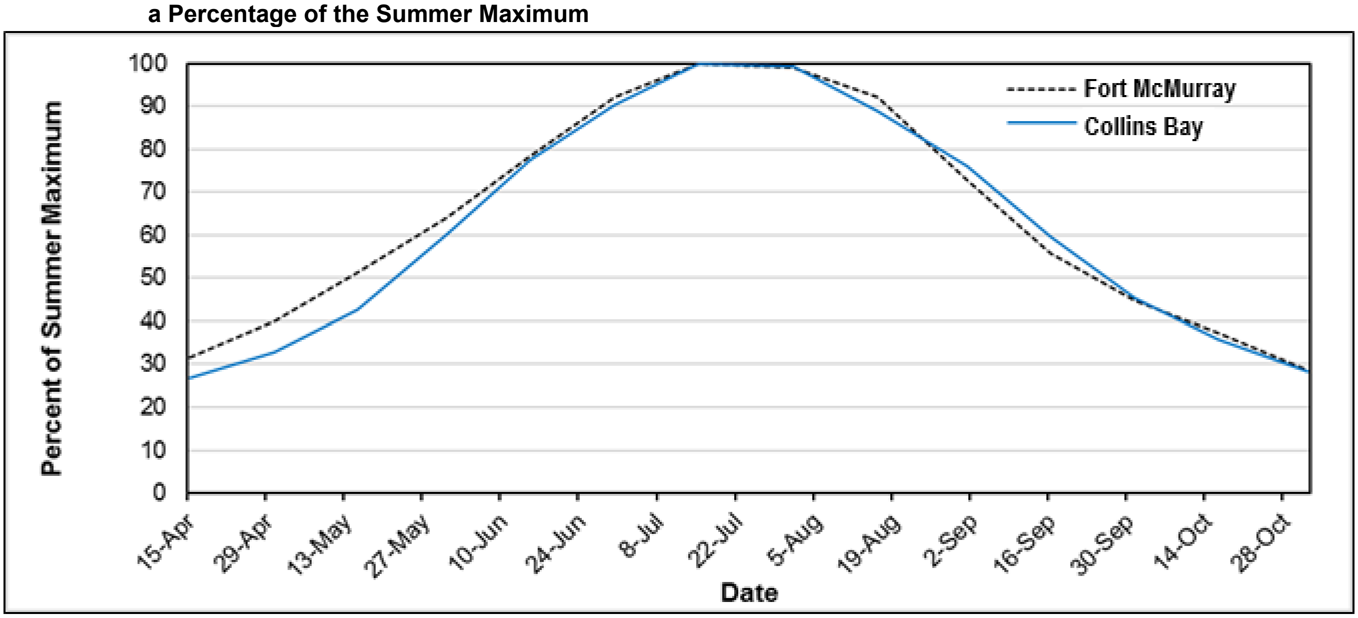
The magnitude of the PMP was derived based on isolines provided by Hopkinson (1999) that document estimates of PMP relative to a reference station located at a reference climate station at Collins Bay located at the Cameco Rabbit Lake operation. The anticipated area of the Project is expected to have 105% of the maximum precipitable water estimated for the reference climate station. The magnitude of the Point-PMP varies seasonally: The Point-PMP values listed in Table 9 are most likely to occur in July, when the persistent atmospheric dew-point temperature is highest; lower values are expected for other months. Seasonal variability of the Point-PMP was referenced for Fort McMurray, because of proximity to Rook I Meteorological Station, and checked against Collins Bay, because of it was the reference climate station. The The seasonal variation of the PMP for Collins Bay and Fort McMurray is similar, as shown in Figure 12 as a percentage of the July peak. The seasonal variation of the PMP for the anticipated area of the Project may be more like that at Fort McMurray than at Collins Bay due to its location. Point-PMP is recommended to be applied for small watersheds with an area of the order of 1 km^2 (Hopkinson 1994).

Table 9: Probable Maximum Precipitation for the Anticipated Area of the Project

Location	1-Hour PMP (mm)	6-Hour PMP (mm)	24-Hour PMP (mm)
Rook I Project	346.3	347.6	489.2
Collins Bay	329.8	331.0	465.9

Source: Estimated from Hopkinson 1999.
PMP = probable maximum precipitation.

Figure 12: Seasonal Distribution of Point Probable Maximum Precipitation for Fort McMurray and Collins Bay as a Percentage of the Summer Maximum



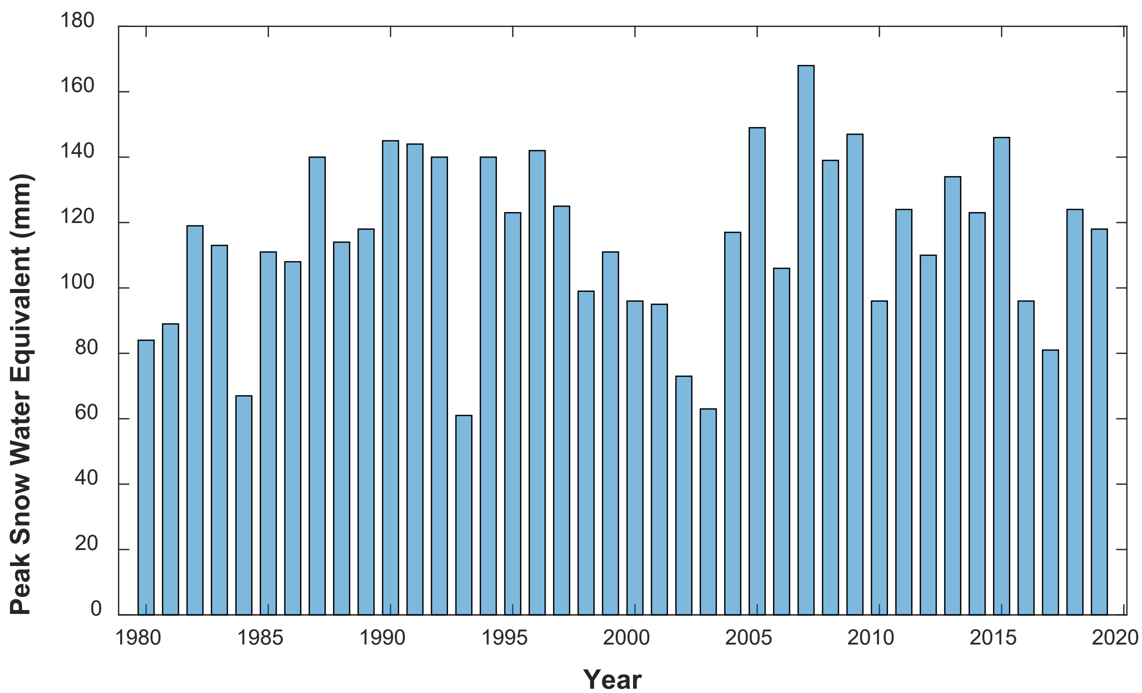
5.1.2 Snow Water Equivalent

The peak SWE estimates for the anticipated area of the Project are presented in Figure 13 based on the GlobSnow data and statistical summary provided in Table 10. A large inter-annual variability for snow accumulation was estimated over the period 1980 to 2019. The SWE ranged from 61 mm to 168 mm with an average of 115 mm.

Table 10: Statistics of Peak Snow Water Equivalent for the Anticipated Area of the Project

Summary Statistic	Minimum	25th Percentile	Median	75th Percentile	Maximum	Mean	Standard Deviation
Peak annual snow water equivalent (mm)	61	96	117	139	168	115	26

Figure 13: GlobSnow Peak Annual Snow Water Equivalent Estimate for the Anticipated Area of the Project, 1980 to 2019



5.1.3 Air Temperature

Monthly and annual statistics of air temperature (measured 2 m from the surface) for the anticipated area of the Project based on ERAI data from 1979 to 2019 are summarized in Table 11. The annual average air temperature was -1.3°C, with the coldest month, January, having an average temperature of -19.8°C and the warmest month, July, having an average temperature of 15.9°C.

Table 11: Monthly and Annual Air Temperature Statistics for the Anticipated Area of the Project, 1979 to 2019

Daily Air Temperature (°C)							
Month	**Extreme Minimum**	**25th Percentile**	**Median**	**75th Percentile**	**Extreme Maximum**	**Mean**	**Standard Deviation**
January	-41.0	-27.8	-19.3	-12.6	7.7	-19.8	9.7
February	-39.2	-24.1	-17.2	-10.0	4.3	-17.3	9.1
March	-35.1	-16.7	-9.7	-3.7	7.1	-10.7	8.5
April	-24.5	-4.7	0.1	3.5	19.8	-1.0	6.7
May	-11.7	3.7	7.3	11.0	21.7	7.3	5.3
June	1.3	11.0	13.5	16.1	26.1	13.4	3.8
July	3.0	13.9	15.8	18.0	24.7	15.9	3.0
August	2.7	11.4	14.1	16.7	24.6	14.0	3.8
September	-3.4	5.0	8.0	11.1	20.4	8.0	4.2
October	-20.3	-1.8	1.0	4.0	15.5	0.9	5.0
November	-34.7	-14.1	-8.1	-3.5	6.0	-9.2	7.2
December	-43.4	-24.5	-16.2	-10.0	4.0	-17.2	9.5
Annual Average	**-20.5**	**-5.7**	**-0.9**	**3.4**	**15.1**	**-1.3**	**6.3**

Source: ECMWF 2019.

5.1.4 Dew-Point Temperature

Monthly and annual dew-point temperature statistics for the anticipated area of the Project based on ERAI data from 1979 to 2019 are summarized in Table 12. The annual average dew-point temperature was -6.0°C with the coldest month, January, having an average dew-point temperature of -22.8°C and the warmest month, July, having an average dew-point temperature of 9.9°C.

Table 12: Monthly Dew-Point Temperature Statistics for the Anticipated Area of the Project, 1979 to 2019

Month	Daily Dew-Point Temperature (°C)						
	Minimum	25th Percentile	Median	75th Percentile	Maximum	Mean	Standard Deviation
January	-44.9	-31.4	-22.5	-14.8	0.8	-22.8	10.3
February	-43.1	-28.2	-20.5	-12.7	-0.7	-20.6	9.6
March	-40.2	-21.4	-14.0	-7.8	0.2	-15.1	8.9
April	-31.1	-11.1	-6.4	-2.9	7.1	-7.5	6.4
May	-18.9	-4.5	-0.6	3.1	13.2	-0.9	5.5
June	-7.5	3.5	6.4	9.4	18.5	6.3	4.1
July	-0.5	7.6	10.1	12.1	18.1	9.9	3.2
August	-4.2	6.7	9.1	11.4	18.3	9.0	3.5
September	-9.9	1.3	4.2	7.0	14.7	4.0	4.2
October	-24.7	-5.0	-1.6	0.9	9.4	-2.2	4.9
November	-38.3	-16.5	-10.3	-6.0	1.9	-11.7	7.5
December	-46.8	-27.7	-18.6	-11.6	-0.3	-19.8	10.1
Annual Average	**-25.9**	**-10.6**	**-5.4**	**-1.0**	**8.4**	**-6.0**	**6.5**

Source: ECMWF 2019.

5.1.5 Solar Radiation

Solar radiation is an important input to energy balance-driven hydrological processes such as snow melt and evapotranspiration. Monthly and annual statistics of solar radiation for the anticipated area of the Project based on ERAI data from 1979 to 2019 are summarized in Table 13. Average daily solar radiation ranged from 19.7 W/m^2 in December to 346.7 W/m^2 in June.

Table 13: Monthly Solar Radiation Statistics for the Anticipated Area of the Project, 1979 to 2019

Month	Daily Net Solar Radiation (W/m^2)						
	Minimum	25th Percentile	Median	75th Percentile	Maximum	Mean	Standard Deviation
January	0.9	18.2	31.0	42.6	76.6	31.7	16.8
February	3.0	58.1	80.0	104.9	165.9	81.5	33.4
March	13.7	128.6	173.3	210.7	284.1	167.1	56.9
April	8.2	222.1	280.8	321.3	405.4	264.6	78.8
May	6.4	299.3	375.3	417.7	479.5	344.9	100.0
June	11.2	291.4	373.3	427.3	490.1	346.7	108.2
July	10.2	273.4	342.4	391.1	476.2	321.4	94.7
August	1.5	215.9	284.1	329.5	416.9	267.9	85.2
September	0.6	127.1	184.5	230.3	319.5	177.8	70.8
October	4.3	57.7	92.2	129.4	210.8	94.3	47.7
November	1.3	20.6	35.5	50.7	100.8	37.6	21.1
December	0.6	11.8	19.4	28.2	43.7	19.7	9.8
Annual Average	**5.2**	**143.7**	**189.3**	**223.6**	**289.1**	**179.6**	**60.3**

Source: ECMWF 2019.

5.1.6 Atmospheric Losses

Evaporation, evapotranspiration, and sublimation are important losses in water balance calculations. Mean monthly lake evaporation and actual evapotranspiration and sublimation for the anticipated area of the Project based on ERAI data from 1979 to 2019 are summarized in Table 14. Annual precipitation and loss totals and statistics are provided in Appendix A, Meteorological Annual Totals and Statistics. The highest mean monthly lake evaporation tended to occur in July, while the highest evapotranspiration from the terrestrial environment occurred in June and July. The highest sublimation losses were usually observed in November. Snow evaporation or sublimation was estimated to remove 25% of mean annual snowfall in the anticipated area of the Project.

Table 14: Mean Monthly Lake Evaporation, Actual Evapotranspiration and Sublimation Statistics for the Anticipated Area of the Project, 1979 to 2019

Month	Lake Evaporation (mm)	Actual Evapotranspiration (mm)	Sublimation (mm)
January	0	0	5
February	0	0	4
March	0	0	4
April	0	0	2
May	86	24	0
June	107	75	0
July	130	75	0
August	106	59	0
September	60	29	0
October	21	7	6
November	0	0	9
December	0	0	6
Annual	**510**	**269**	**36**

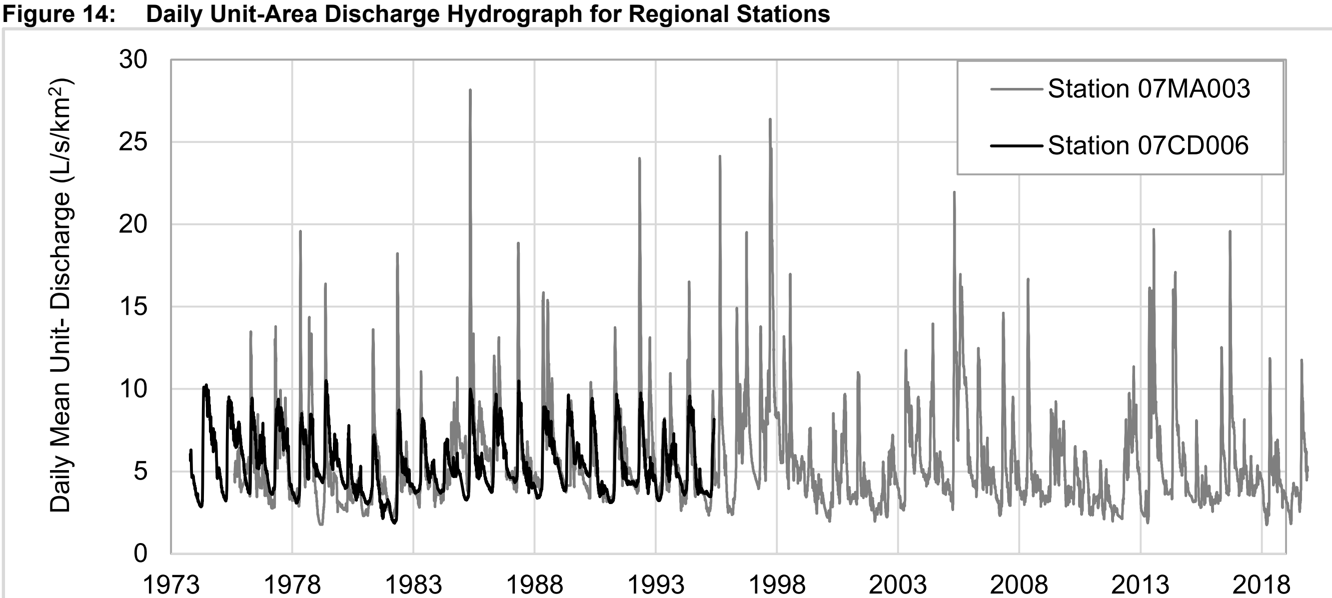
Source: ECMWF 2019.

5.2 Historical Hydrometric Data

5.2.1 Unit-Area Discharge

Historical daily mean discharge records were converted to unit-area discharge for the Douglas River near Cluff Lake (WSC Station 07MA003) and Clearwater River below Lloyd Lake (WSC Station 07CD006). Average unit-area discharge was similar for the two stations; however, peak flows were usually much higher for the Douglas River (Figure 14). Detailed annual discharge statistics for these two stations are provided in Appendix B, Table B-1 (Douglas River) and Table B-2 (Clearwater River).

Figure 14: Daily Unit-Area Discharge Hydrograph for Regional Stations



Mean monthly and annual unit-area discharge statistics for the Douglas River (WSC Station 07MA003) and Clearwater River below Lloyd Lake (WSC Station 07CD006) are provided in Table 15.

Table 15: Long-Term Unit-Area Discharge Statistics for the Hydrology Study Areas

Month	Hydrology RSA (Clearwater River above the Mirror River confluence) [(a)]			Downstream Far-Field Stations on the Clearwater River in Saskatchewan (below the Mirror River confluence) [(b)]		
	Mean (standard deviation) (L/s/km^2)	25th Percentile (L/s/km^2)	75th Percentile (L/s/km^2)	Mean (standard deviation) (L/s/km^2)	25th Percentile (L/s/km^2)	75th Percentile (L/s/km^2)
January	3.89 (1.2)	3.18	4.49	4.13 (0.66)	3.67	4.62
February	3.67 (1.1)	2.85	4.23	3.78 (0.64)	3.38	4.24
March	3.54 (0.90)	2.93	4.10	3.65 (0.60)	3.34	3.92
April	5.41 (1.9)	4.05	6.31	4.53 (0.86)	3.99	5.09
May	9.35 (3.4)	6.91	11.63	8.12 (0.99)	7.50	8.71
June	6.25 (2.1)	4.86	7.13	7.81 (1.3)	7.52	8.68
July	6.06 (2.6)	4.20	7.27	6.69 (1.4)	5.75	7.91
August	5.85 (2.4)	4.33	6.73	5.69 (1.3)	4.91	6.21
September	6.58 (2.7)	4.54	7.72	5.32 (1.2)	4.51	6.40
October	6.56 (3.0)	4.67	7.33	5.55 (1.3)	4.65	6.36
November	5.06 (1.7)	3.92	5.80	5.01 (0.96)	4.29	5.60
December	4.31 (1.2)	3.48	4.99	4.58 (0.72)	4.15	4.93
Annual [(c)]	**5.55 (1.3)**	**4.72**	**6.21**	**5.42 (0.67)**	**5.09**	**5.96**

a) Derived from long-term records for the Douglas River at Water Survey of Canada (WSC) Station 07MA003 (1975 to 2018).
b) Derived from long-term records for the Clearwater River WSC Station 07CD006 (1973 to 1995).
c) Annual statistics were calculated using data for complete years; partial years were excluded.
RSA = regional study area.

5.2.2 Annual Basin Yield

Annual water yield is the sum of annual discharge from a watershed distributed over the watershed's drainage area. Annual water yield data are available for the Douglas River near Cluff Lake between 1975 and 2018 (WSC 2019), which serves as a proxy for the RSA. Over this period, the annual basin yield ranged from 103 mm to 292 mm, with an average of 175 mm. Annual water yield data are available for the Clearwater River at the outlet of Lloyd Lake, which serves as a proxy for the far-field station watersheds between 1977 and 1995. Over this period, the annual basin yield ranged from 120 mm to 199 mm, with an average of 171 mm.

A frequency analysis was performed using annual water yield values based on ERAI annual data from 1979 to 2017 using a Log Pearson III distribution. Other distributions (i.e., Generalized Extreme Value, Three-Parameter Log Normal, and Weibull) were considered, but screened out as the Log Pearson III distribution had the best fit. Annual water yield in the RSA is expected to range from 96 mm during a 200-year dry year to 324 mm during a 200-year wet year (Table 16). Annual water yield in the far-field station watersheds is expected to range from 100 mm during the 200-year dry year to 200 mm during the 200-year wet year (Table 16).

Table 16: Frequency Analysis of Annual Water Yield for the Hydrology Study Areas

Hydrological Condition	Average Return Period (years)	Estimated Annual Water Yield (mm)	
		Regional Study Area[a]	Far-Field Watersheds[b]
Wet	200	324	200
	100	303	199
	50	282	198
	20	254	196
	10	231	194
	5	207	189
Average (Mean)	n/a	175	171
Median	2	169	170
Dry	5	139	156
	10	126	143
	20	117	132
	50	107	118
	100	101	109
	200	96	100

Note: Log Pearson III distribution used for frequency analyses.
a) Derived from long-term records for the Douglas River at WSC Station 07MA003 (1975 to 2018).
b) Derived from long-term records for the Clearwater River WSC Station 07CD006 (1973 to 1995).
n/a = not applicable.

5.2.3 Flood and Low Flow Frequency Analysis

The flood and low flow magnitude and frequency results for the Douglas River station are shown in Table 17. These results are based on daily mean flows for the period of record from 1975 to 2018. These Douglas River unit-area runoff results may be applied to the hydrology baseline monitoring stations in the upper Clearwater watershed above the Mirror River confluence. In this region, most small watersheds have relatively large coverage with lakes and permeable overburden, both of which moderate peak flows. As a result, daily mean flood peaks do not need to be adjusted upward from the unit-area flood values generated from the Douglas River with its larger watershed area.

Table 17: Flood and Low Flow Magnitude and Frequency Results for the Douglas River (WSC Station 07MA003)

Return Period (Years)	Probability of Exceedance (%)	Annual Flood Peak		Annual Minimum Flow		Annual 7-Day Average Flow	
		m^3/s	$L/s/km^2$	m^3/s	$L/s/km^2$	m^3/s	$L/s/km^2$
2	0.5	23.2	13.7	4.81	2.85	4.94	2.93
5	0.2	32.0	18.9	3.85	2.28	3.95	2.34
10	0.1	37.0	21.9	3.37	2.00	3.47	2.05
20	0.05	41.3	24.4	3.01	1.78	3.10	1.83
50	0.02	46.2	27.3	2.65	1.57	2.73	1.61

Flood and low flow magnitude and frequency results for the Clearwater River below Lloyd Lake, based on the years 1974 to 1995, are provided in Table 18. Unit-area runoff values estimated from this station provide a good representation of flows in larger watersheds. For example, these results may be applied to locations on the Clearwater River below the Mirror River confluence.

Table 18: Flood and Low Flow Magnitude and Frequency Results for the Clearwater River (WSC Station 07CD006)

Return Period (Years)	Probability of Exceedance (%)	Annual Flood Peak		Annual Minimum Flow		Annual 7-Day Average Flow	
		m^3/s	$L/s/km^2$	m^3/s	$L/s/km^2$	m^3/s	$L/s/km^2$
2	0.5	39.2	9.23	15.0	3.53	15.2	3.58
5	0.2	42.3	9.96	12.8	3.02	13.1	3.08
10	0.1	43.6	10.3	11.2	2.64	11.5	2.71
20	0.05	44.5	10.5	9.72	2.29	10.0	2.36
50	0.02	45.3	10.7	7.92	1.86	8.27	1.95
100	0.01	45.7	10.8	6.73	1.58	7.09	1.67

5.2.4 Historical Floods

Notable annual flood peaks are present in the historical record for the Douglas River near Cluff Lake (WSC Station 07MA003). The five highest annual peak daily flows with return periods exceeding 10 years are presented in Table 19. For the purposes of this study, a flood is an event with a daily peak discharge and an associated return period exceeding two years. However, for brevity, only floods with return periods exceeding 10 years are presented in Table 19. Although the flood peak is typically expected to occur in early May, extreme floods have occurred later in the year, such as in September of 1997 and August of 1995.

Table 19: Notable Flood Peaks in the Historical Record for the Douglas River near Cluff Lake (WSC Station 07MA003, 1976 to 2018)

Return Period (Years)	Annual Flood Peak		Year	Date
	m^3/s	$L/s/km^2$		
61	47.6	28.2	1985	8 May
39	44.6	26.4	1997	21 September
21	40.8	24.1	1995	28 August
21	40.6	24.0	1992	3 May
12	37.1	22.0	2005	28 April

5.2.5 Comparison with 2018 to 2019 Hydrometric Data

Figure 15 shows the unit-area discharge hydrographs for Douglas River near Cluff Lake (WSC Station 07MA003) for various flow statistics over the period of record (i.e., 1975 to 2019) compared with 2018 and 2019 unit-area discharge data. The 2018 and 2019 data are based on provisional daily mean discharge records (WSC 2019). Discharge at this station was near-normal during the open-water period in 2018, with four rainfall-runoff events spaced out regularly through the summer. Discharge was below normal from fall 2018 through the winter of 2018/2019 until August 2019. The hydrograph shows that discharge increased above the 75th percentile in late August to September 2019 due to rainfall events. In 2018, the peak daily mean discharge of 20.0 m^3/s occurred on 3 May 2018 during spring freshet. In 2019, the rainfall-runoff peak of 19.9 m^3/s occurred 25 August 2019. Both peaks were just below the 1-in-2-year flood event of 23.2 m^3/s for this station (Section 5.2.3).

Figure 15 also includes unit-area discharge hydrographs for the Patterson Lake outflow (Station CR-WC-MS-03) from August 2018 to September 2019. Similar to the Douglas River, flows at Patterson Lake outflow were below normal from August 2018 onward except for a period during early spring freshet and August 2019. However, unit-area discharge was lower at the Patterson Lake outflow than the Douglas River for 2018 until spring 2019 and did not experience a high peak flow in August 2019.

Figure 15: Unit-Area Discharge Hydrographs for the Douglas River near Cluff Lake (1975 to 2019) Compared with 2018 and 2019 Observations (WSC Station 07MA003, Station CR-WC-MS-03)

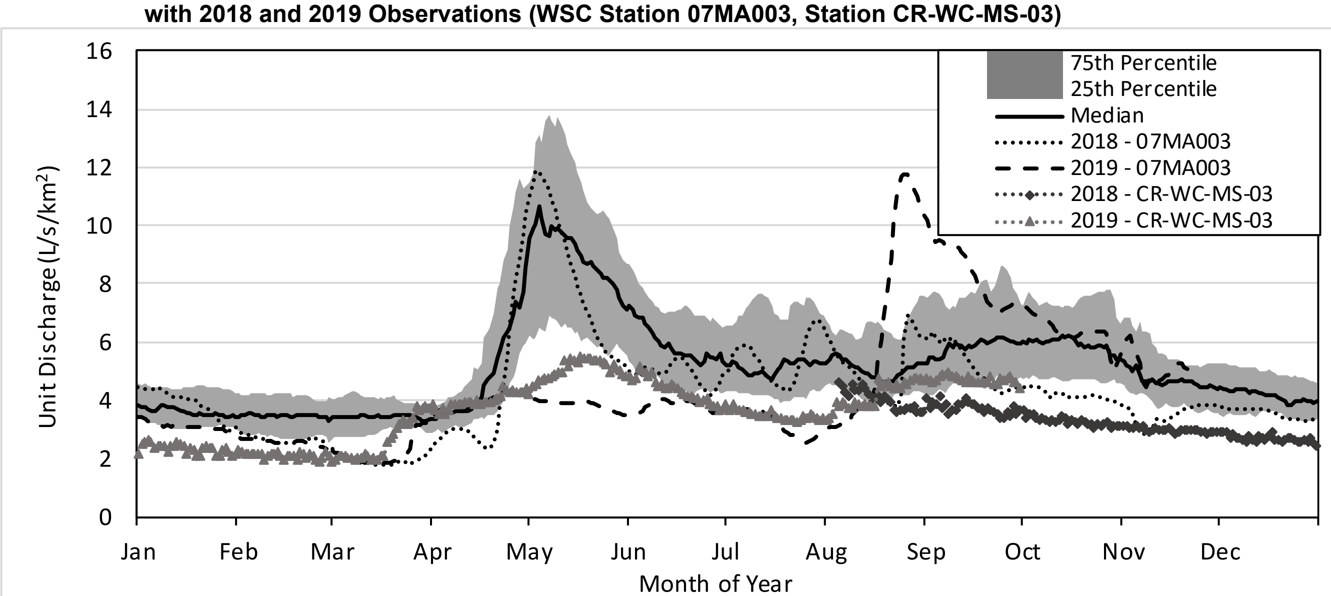
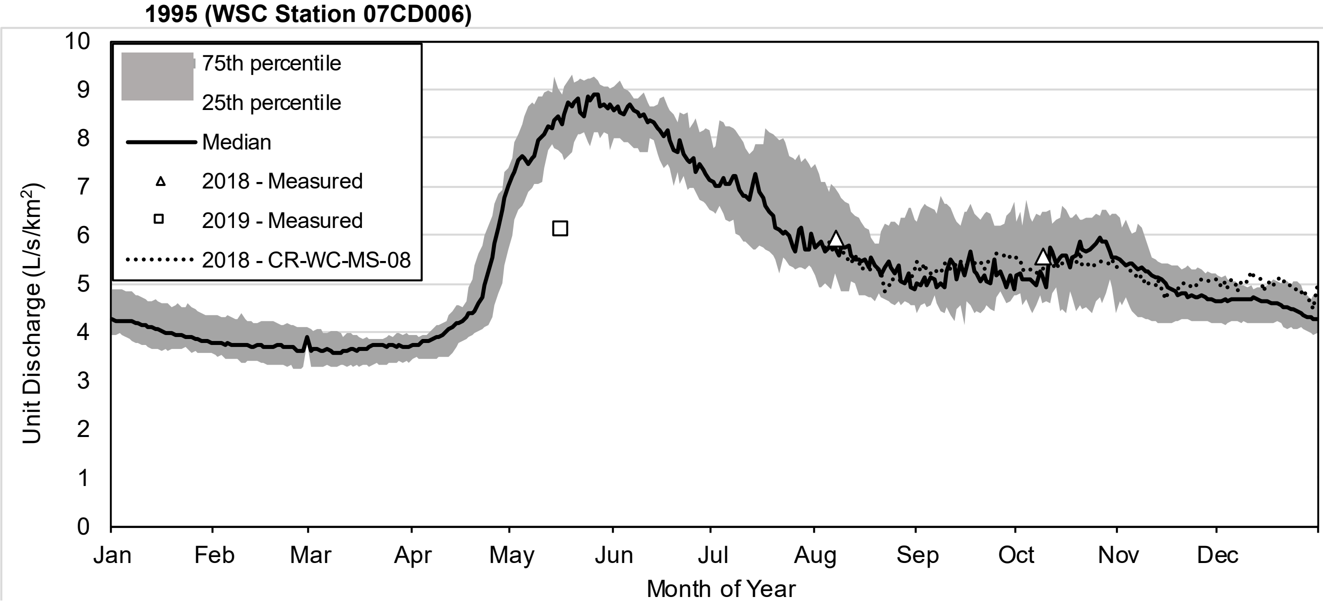


Figure 16 shows the unit-area discharge hydrographs for the Clearwater River at the outlet of Lloyd Lake (WSC Station 07CD006) for various flow statistics over the period of record from 1973 to 1995. These historical results are compared to observations at the hydrometric station CR-WC-MS-08, which was established near the WSC station in August 2018. Discharge observations in 2018 were close to median historical flows for WSC Station 07CD006 for the same time of year; however, the discharge measurement in mid-May 2019 was well below normal.

Figure 16: Comparison of 2018 and 2019 Observations at the Clearwater River below Lloyd Lake (Station CR-WC-MS-08) to Historical Observations at the Clearwater River at the Outlet of Lloyd Lake from 1974 to 1995 (WSC Station 07CD006)



6.0 SUMMARY

Long-term meteorological records were compiled from a combination of publicly available meteorological stations near the Project, as well as global re-analysis products including European Re-analysis Interim (ERAI). Publicly available meteorological station data were used to test the validity of global reanalysis data for representing local conditions. The ERAI data compiled for the locations of regional meteorological stations were compared to concurrent historical observations near the anticipated area of the Project made by Environment and Climate Change Canada (ECCC) and determined that ERAI global re-analysis provides an acceptable estimate of the meteorology in the region. Based on this conclusion, a 40-year record (i.e., 1979 to 2019) was compiled for the anticipated area of the Project.

Over the 40-year record, ERAI annual total precipitation ranged from 399 mm to 695 mm with a mean of 531 mm. In an average year, the total precipitation consisted of 144 mm falling as snow and 387 mm falling as rain. The annual snowfall was observed to range from 83 mm to 209 mm in the historical record. Annual lake evaporation loss was estimated to be 514 mm and terrestrial evapotranspiration was estimated to be 262 mm. The long-term meteorological records provide an understanding of historical climatic variability for the anticipated area of the Project and will support the Environmental Assessment (EA) and related studies such as water or lake water balance modelling. The long-term records account for a wide range of climatic variability, and in turn, hydrological variability, and allow for the assessment of routine conditions as well as extreme runoff events.

The Douglas River (Water Survey of Canada [WSC] Station 07MA003) hydrometric station was used to represent the hydrology for smaller watersheds near the anticipated area of the Project (i.e., upstream of the confluence with the Mirror River), while the discontinued station on the Clearwater River at the Lloyd Lake outlet (WSC Station 07CD006) was used to represent larger watersheds farther downstream along the Clearwater River (i.e., downstream of the confluence with the Mirror River). Annual water yield in the Clearwater River at the outlet of Lloyd Lake ranged from 120 mm to 199 mm and averaged 171 mm. Annual water yield in the Douglas River ranged from 103 mm to 292 mm and averaged 175 mm. On average, the annual runoff ratio (i.e., water yield/total precipitation) is expected to be approximately 34%. The mean annual water yield for these two stations was very similar: 171 mm for the Clearwater River and 175 mm for the Douglas River. Peak flows were much higher for the Douglas River on a unit-area basis compared to the Clearwater River at the outlet of Lloyd Lake, as peak flows were greatly attenuated downstream of Lloyd Lake.

Based on the provisional data at the Douglas River, 2018 was a near-normal flow year with a peak snowmelt runoff just above the median value. Discharge was below normal from fall 2018 through the winter of 2018/2019 until August 2019. Flows at Patterson Lake outflow were also below normal from August 2018 onward except for a period during early spring freshet in 2019 and August 2019. However, unit-area discharge was lower at the Patterson Lake outflow than the Douglas River for 2018 until spring 2019, and Patterson Lake outflow did not experience as high a peak flow response in August 2019.

The baseline meteorological and hydrological characterization study achieved the objective of describing the existing regional meteorological and hydrological conditions in the baseline study area to support the EA. Long-term meteorological and hydrological records were required to support detailed hydrological modelling and model calibration for the waterbodies and watercourses near the proposed Project.

CLOSING

Golder is pleased to submit this report to NexGen in support of the environmental assessment for the Rook I Project. For details on the limitations and use of information presented in this report, please refer to the Study Limitations section following this page. If you have any questions or require additional details related to this study, please contact the undersigned.

Golder Associates Ltd.

Prepared By:

PROFESSIONAL ENGINEER
R.W. PHILLIPS
MEMBER 22672
22 02 18
YR. MN. DAY
SASKATCHEWAN

Jaime Hogan, MSc, PGeo
Hydrologist

Ross Philips, MSc, PEng
Lead Water Resources Engineer

Reviewed By:

Nathan Schmidt, PhD
Principal, Senior Water Resources Specialist

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APPENDIX A

Meteorological Annual Totals and Statistics

Table A-1: Annual Summary and Statistics of Precipitation and Atmospheric Losses at the Project

Year	Precipitation (mm)	Rain (mm)	Snow (mm)	Lake Evaporation (mm)	Evapotranspiration (mm)	Sublimation (mm)
1979	457	329	128	527	281	36
1980	425	297	129	528	264	31
1981	454	315	139	569	297	42
1982	429	273	156	495	263	27
1983	399	285	114	494	262	34
1984	632	468	164	492	267	33
1985	515	350	165	503	260	36
1986	456	322	134	483	255	36
1987	483	300	183	512	269	51
1988	692	530	162	493	257	37
1989	500	344	156	509	269	28
1990	435	259	176	517	274	39
1991	548	391	157	499	260	32
1992	467	328	139	494	261	42
1993	521	380	141	476	250	36
1994	523	391	132	552	290	32
1995	628	475	153	503	262	33
1996	628	504	124	476	260	26
1997	695	523	172	464	250	45
1998	413	329	83	570	290	37
1999	494	360	134	518	275	37
2000	559	459	100	467	249	36
2001	530	421	108	533	285	43
2002	601	468	134	454	249	45
2003	659	530	129	489	262	30
2004	479	270	209	463	260	36
2005	629	463	166	492	257	46
2006	544	410	134	532	283	41
2007	523	393	130	509	270	31
2008	520	351	169	544	287	31
2009	595	427	168	487	264	36
2010	510	414	96	512	268	37
2011	438	316	122	559	283	33
2012	658	468	190	525	280	39
2013	548	384	164	550	285	32
2014	506	366	140	511	279	35
2015	495	363	132	537	277	35
2016	653	505	147	520	270	41
2017	552	401	152	539	280	40
2018	447	319	128	492	256	36
Min	**399**	**259**	**83**	**454**	**249**	**26**
25th Percentile	**465**	**326**	**129**	**492**	**260**	**32**
Median	**521**	**382**	**140**	**509**	**267**	**36**
75th Percentile	**597**	**460**	**164**	**529**	**279**	**39**
Max	**695**	**530**	**209**	**571**	**297**	**51**
Mean	**531**	**387**	**144**	**510**	**269**	**36**

APPENDIX B

Hydrological Annual Summary and Statistics

Table B-1: Annual Discharge Statistics for the Douglas River Hydrometric Station (07MA003)

Year	Min	7-Day Average Annual Minimum	Mean	Max	Water Yield	Min	7-Day Average Annual Minimum	Mean	Max
	Discharge (m^3/s)				mm	Unit-Area Discharge ($(L/s)/km^2$)			
1976	5.83	5.92	9.02	22.8	169	3.45	3.51	5.34	13.5
1977	4.64	4.72	9.61	23.3	179	2.75	2.79	5.68	13.8
1978	4.84	4.91	10.6	33.1	197	2.86	2.91	6.25	19.6
1979	3.00	3.00	6.99	27.7	130	1.78	1.78	4.14	16.4
1980	3.87	3.87	5.80	11.8	109	2.29	2.29	3.43	6.98
1981	3.90	3.97	7.98	23.0	149	2.31	2.35	4.72	13.6
1982	3.80	3.80	8.27	30.8	154	2.25	2.25	4.90	18.2
1983	4.74	4.81	8.02	18.7	150	2.80	2.84	4.74	11.1
1984	5.17	5.28	9.42	18.1	176	3.06	3.12	5.58	10.7
1985	6.20	6.30	13.5	47.6	251	3.67	3.73	7.96	28.2
1986	6.76	7.06	11.7	22.2	219	4.00	4.18	6.95	13.1
1987	6.30	6.34	10.1	31.9	188	3.73	3.75	5.97	18.9
1988	6.16	6.27	12.4	26.8	232	3.64	3.71	7.34	15.9
1989	6.30	6.38	9.11	15.7	144	3.73	3.77	5.39	9.29
1990	5.32	5.49	8.04	17.6	150	3.15	3.25	4.76	10.4
1991	5.57	5.64	9.95	23.2	186	3.30	3.34	5.89	13.7
1992	6.19	6.36	12.2	40.6	229	3.66	3.76	7.23	24.0
1993	5.57	5.73	9.22	18.5	172	3.30	3.39	5.46	11.0
1994	4.43	4.56	9.03	27.9	168	2.62	2.70	5.34	16.5
1995	3.92	4.06	9.61	40.8	179	2.32	2.40	5.69	24.1
1996	4.00	4.04	11.8	33.0	220	2.37	2.39	6.96	19.5
1997	6.66	6.73	15.6	44.6	292	3.94	3.98	9.25	26.4
1998	6.67	7.04	11.7	28.7	217	3.95	4.17	6.89	17.0
1999	4.12	4.24	7.39	12.9	138	2.44	2.51	4.37	7.63
2000	3.32	3.39	8.05	16.4	151	1.96	2.01	4.76	9.70
2001	4.33	4.22	7.28	18.6	136	2.56	2.50	4.31	11.0
2002	3.33	3.39	6.64	12.2	124	1.97	2.00	3.93	7.22
2003	4.46	4.59	10.5	20.9	196	2.64	2.71	6.21	12.4
2004	6.06	6.20	9.48	23.6	177	3.59	3.67	5.61	14.0
2005	4.53	4.75	15.0	37.1	280	2.68	2.81	8.88	22.0
2006	5.84	6.20	9.28	21.1	173	3.46	3.67	5.49	12.5
2007	3.89	3.98	8.99	24.7	168	2.30	2.35	5.32	14.6
2008	4.86	5.19	8.25	28.2	154	2.88	3.07	4.88	16.7
2009	4.87	5.12	9.03	15.6	168	2.88	3.03	5.34	9.23
2010	3.96	4.04	6.93	11.0	129	2.34	2.39	4.10	6.51
2011	3.30	3.59	5.51	9.6	103	1.95	2.13	3.26	5.65
2012	3.58	3.59	9.06	19.2	169	2.12	2.12	5.36	11.4
2013	3.16	3.23	11.2	33.3	208	1.87	1.91	6.61	19.7
2014	5.60	5.75	10.7	28.9	199	3.31	3.40	6.32	17.1
2015	4.31	4.69	6.39	13.7	119	2.55	2.78	3.78	8.11
2016	5.13	5.25	10.1	33.1	189	3.04	3.11	5.99	19.6
2017	5.95	6.04	7.71	13.8	144	3.52	3.58	4.56	8.17
2018	3.11	3.37	7.59	19.8	129	1.84	1.99	4.49	11.7
Mean	**4.83**	**4.96**	**9.41**	**24.2**	**175**	**2.86**	**2.93**	**5.57**	**14.3**
Minimum	**3.00**	**3.00**	**5.51**	**9.55**	**103**	**1.78**	**1.78**	**3.26**	**5.65**
25th Percentile	**3.91**	**4.01**	**8.00**	**17.8**	**147**	**2.31**	**2.37**	**4.73**	**10.6**
Median	**4.74**	**4.81**	**9.11**	**23.0**	**169**	**2.80**	**2.84**	**5.39**	**13.6**
75th Percentile	**5.84**	**5.98**	**10.5**	**29.8**	**196**	**3.45**	**3.54**	**6.23**	**17.7**
Maximum	**6.76**	**7.06**	**15.6**	**47.6**	**292**	**4.00**	**4.18**	**9.25**	**28.2**

Table B-2: Annual Discharge Statistics for the Clearwater River below Lloyd Lake (07CD003)

Year	Minimum	7-Day Average Annual Minimum	Mean	Maximum	Annual Water Yield	Minimum	7-Day Average Annual Minimum	Mean	Maximum
	Discharge (m^3/s)				mm	Unit-Area Discharge ($(L/s)/km^2$)			
1974	12.1	12.16	26.86	43.6	198	2.85	2.86	6.28	10.3
1975	13.6	13.70	25.05	40.5	199	3.20	3.22	6.32	9.5
1976	15.5	15.53	25.65	40.2	186	3.65	3.65	5.89	9.5
1977	15.3	15.30	24.03	39.9	190	3.60	3.60	6.04	9.4
1978	13.1	13.31	25.91	36.2	178	3.08	3.13	5.65	8.5
1979	18.3	18.46	18.59	44.7	192	4.31	4.34	6.10	10.5
1980	13.8	14.04	16.12	33.1	138	3.25	3.30	4.38	7.8
1981	9.07	10.02	18.65	30.7	120	2.13	2.36	3.79	7.2
1982	7.86	8.00	21.64	37.1	138	1.85	1.88	4.39	8.7
1983	15.6	15.69	20.98	34.9	161	3.67	3.69	5.09	8.2
1984	15.6	15.64	23.12	29.6	156	3.67	3.68	4.94	7.0
1985	13.9	13.96	25.62	42.5	172	3.27	3.28	5.44	10.0
1986	15.8	15.94	22.91	41.2	190	3.72	3.75	6.03	9.7
1987	15.7	17.06	25.01	44.6	170	3.69	4.01	5.39	10.5
1988	14.3	14.53	25.33	37.9	186	3.36	3.42	5.89	8.9
1989	16.2	16.27	22.73	41.0	188	3.81	3.83	5.96	9.6
1990	14.7	15.40	22.07	40.1	169	3.46	3.62	5.35	9.4
1991	13.2	13.30	22.77	41.2	164	3.11	3.13	5.19	9.7
1992	15.5	16.14	21.65	41.5	169	3.65	3.80	5.36	9.8
1993	13.7	13.81	22.62	34.6	161	3.22	3.25	5.09	8.1
1994	15.1	15.34	18.38	40.7	168	3.55	3.61	5.32	9.6
1995	14.7	14.79	26.71	34.7	56	3.46	3.48	4.32	8.2
Mean	**14.21**	**14.47**	**22.84**	**38.7**	**171**	**3.34**	**3.41**	**5.37**	**9.1**
Minimum	**7.86**	**8.00**	**16.12**	**29.6**	**120**	**1.85**	**1.88**	**3.79**	**7.0**
25th Percentile	**13.63**	**13.73**	**21.64**	**35.2**	**161**	**3.21**	**3.23**	**5.09**	**8.3**
Median	**14.7**	**15.04**	**22.84**	**40.2**	**170**	**3.46**	**3.54**	**5.37**	**9.4**
75th Percentile	**15.58**	**15.68**	**25.26**	**41.2**	**188**	**3.66**	**3.69**	**5.94**	**9.7**
Maximum	**18.3**	**18.46**	**26.86**	**44.7**	**199**	**4.31**	**4.34**	**6.32**	**10.5**

Rook I Project

Environmental Impact Statement

Annex IV.2: Hydrometric Monitoring Characterization Report

HYDROMETRIC MONITORING CHARACTERIZATION BASELINE REPORT FOR THE ROOK I PROJECT

Prepared for:

NexGen Energy Ltd.

Prepared by:

WSP Canada Inc.

April 2024

Executive Summary

The hydrometric monitoring baseline report is a component of a comprehensive baseline program that documents the natural and socio-economic environments in the anticipated area of the Rook I Project (Project). The hydrometric monitoring baseline program was undertaken to provide context from which effects on hydrological conditions from the Project can be assessed in the Rook I Environmental Impact Statement.

This report characterizes local hydrological conditions of lakes and streams in the area of the Project through detailed monitoring. No data were previously available for most of the lakes and streams included in this baseline study, and this field monitoring program therefore fills an important environmental knowledge gap in the area of the Project.

The monitoring program included the following surveys and types of monitoring:

- late winter snow surveys within Patterson Lake watershed in 2018 and 2019;
- water level monitoring at eight stations on lakes and ponds in the Clearwater River watershed;
- streamflow monitoring at 12 stations on streams and rivers in the Clearwater River watershed;
- water level and streamflow monitoring at Hodge Lake and its outflow in the Hodge Creek watershed;
- sediment sampling of channel bed substrate for particle size in the Clearwater River below Patterson, Beet, and Naomi lakes; and
- suspended sediment (i.e., particles entrained within the water column) and bed load sediment (i.e., particles moving along the streambed) sampling at three streamflow monitoring stations downstream of Patterson Lake.

Snow accumulation available for snowmelt in Patterson Lake watershed was calculated from field snow surveys conducted in 11 terrain types; these types were based on slope and aspect (i.e., the direction the slope faces), and included lake and lake-edge terrain types. Snow water equivalent (SWE) results from the field surveys were compared with weekly SWE maps provided by Environment and Climate Change Canada (ECCC) throughout the winter and with data from the European Space Agency's Global Snow Monitoring for Climate Research (GlobSnow) Project. The comparison of the 2018 and 2019 snow surveys to the GlobSnow and ECCC weekly SWE maps provided confidence that the field survey SWE results in the anticipated area of the Project could be adequately approximated using the remote sensing data for 2020.

The hydrology monitoring program included nine stations along the Clearwater River mainstem (i.e., main channel) from its headwaters at Broach Lake to a location far downstream near Highway 955 above Warner Rapids, as well as numerous tributaries close to the proposed Project. Data collection was conducted year-round at several stations and seasonally during the open-water period at most other stations. A total of 11 field visits were completed between August 2018 and December 2020, and a wide range of water level and streamflow conditions were observed. Unit-area runoff values measured at the hydrometric monitoring stations were compared with long-term statistics at regional hydrometric stations to provide an indication of whether conditions in 2018 to 2020 were drier, wetter, or near average.

The main objective of this study has been met in that a wide range of hydrological conditions were observed at 22 waterbody and watercourse hydrometric stations, which provides sufficient and detailed information to support an Environmental Assessment for the Project.

If referencing this report, please use the following citation:

WSP (WSP Canada Inc.). 2024. Hydrometric Monitoring Characterization Report for the Rook I Project. Prepared for NexGen Energy Ltd.

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APPENDIX E
Total Suspended Solids and Bed Load Laboratory Results

Abbreviations and Units of Measure

Acronym	Definition
1-D	one-dimensional
ADCP	acoustic Doppler current profiler
ADV	acoustic Doppler velocimeter
CCIN	Canadian Cryospheric Information Network
CR	Clearwater River
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
ERAI	European Re-analysis Interim
GGA	Generalized Gradient Approximation
GPS	global positioning system
HC	Hodge Creek
HEC-RAS	Hydrologic Engineering Center – River Analysis System
ID	identification
LSA	local study area
MS	main stem
NexGen	NexGen Energy Ltd.
NRCan	Natural Resources Canada
OWRC	open water rating curve
Project	Rook I Project
QA	quality assurance
QC	quality control
RSA	regional study area
RTK	real-time kinematic
SWE	snow water equivalent
TBRG	tipping bucket rain gauge
TI	tributary inflow
TLU	traditional land use
TSS	total suspended solids
UTM	Universal Transverse Mercator
WB	waterbody
WC	watercourse
WSC	Water Survey of Canada
WSE	water surface elevation

Units	Definition
%	percent
<	less than
°	degree
°C	degrees Celsius
cm	centimetre
g	gram
g/cm^3	grams per cubic centimetre
km	kilometre
km^2	square kilometre
$L/s/km^2$	litres per second per square kilometre
m	metre
m^3/s	cubic metres per second
masl	metres above sea level
mg/L	milligrams per litre
mm	millimetre
Mm^3	million cubic metres

1.0 INTRODUCTION

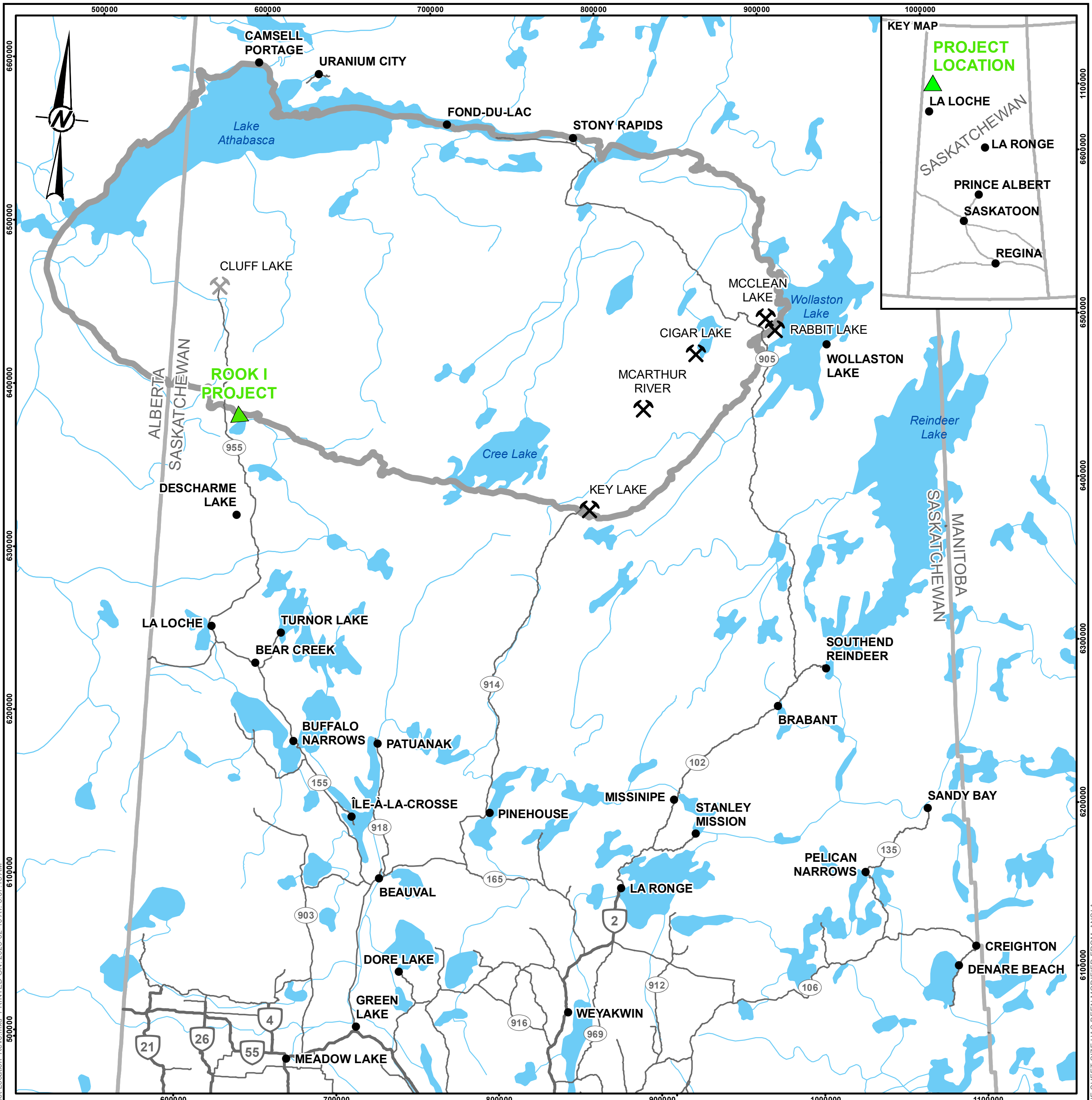
The Rook I Project (Project) is a proposed new uranium mining and milling operation that is 100% owned by NexGen Energy Ltd. (NexGen). The Project would be located in northwestern Saskatchewan, approximately 40 km east of the Saskatchewan-Alberta border, 130 km north of the town of La Loche, and 640 km northwest of the city of Saskatoon (Figure 1). The Project would reside within Treaty 8 territory and within the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, and along the upper Clearwater River system (Figure 2). Access to the Project would be from an existing road off of Highway 955. The Project would include underground and surface facilities to support the extraction and processing of uranium ore from the Arrow deposit, a land-based, basement-hosted, high-grade uranium deposit.

The hydrometric monitoring baseline report represents a component of a comprehensive baseline program that documents the natural and socio-economic environments in the anticipated area of the Project. The hydrometric monitoring baseline program was undertaken to provide context from which Project environmental hydrometric monitoring effects could be assessed in the Environmental Impact Statement (EIS).

Since exploration at the Project commenced in 2013, NexGen has engaged regularly and established relationships with local First Nation and Métis Groups (collectively referred to as Indigenous Groups) and northern communities, specifically those closest and with greatest access to the proposed Project. NexGen respects the rights of Indigenous Peoples and the unique relationship Indigenous Peoples have with the environment and recognizes the importance of full and open discussion with interested or potentially affected Indigenous communities regarding the development, operation, and decommissioning of the proposed Project. Engagement activities to date, as well as future planned engagement activities, reflect the value NexGen places on meaningful engagement with Indigenous Peoples and northern communities who could be potentially affected by the proposed Project. Engagement mechanisms have included, but are not limited to: meetings with leadership, workshops and community information sessions, Project site tours, establishing Joint Working Groups to support the gathering and incorporation of Indigenous and Local Knowledge throughout the Environmental Assessment (EA) process, and providing funding for Traditional Land Use (TLU) Studies[1] to understand how the proposed Project may interact with the Indigenous communities traditional use of the anticipated area of the Project.

Feedback received during engagement activities was documented for contribution to the EIS for the Project; examples of feedback received include discussion of concerns, interests, potential adverse effects, mitigation, and design alternatives. Many baseline studies were initiated in advance of formal engagement on the EA for the Project; however, engagement during the execution of baseline studies has helped inform the understanding of baseline conditions and confirmed components of the natural and socio-economic environments that required study. A summary of feedback related to the hydrometric monitoring baseline program is presented in the Hydrology Baseline Road Map (Annex IV).

[1] Traditional Land Use Studies include all land use studies developed by the Project's affected Indigenous Groups, including Traditional Land Use and Occupancy studies, Traditional Knowledge and Use studies, and Indigenous Rights and Knowledge studies, henceforth referred collectively as TLU studies.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- ATHABASCA BASIN BOUNDARY
- PROJECT LOCATION

0 100 200

1:3,500,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

LOCATION OF THE ROOK I PROJECT, SASKATCHEWAN

CONSULTANT

YYYY-MM-DD	2023-02-10
DESIGNED	SS
PREPARED	NO/AK
REVIEWED	JMC
APPROVED	MM

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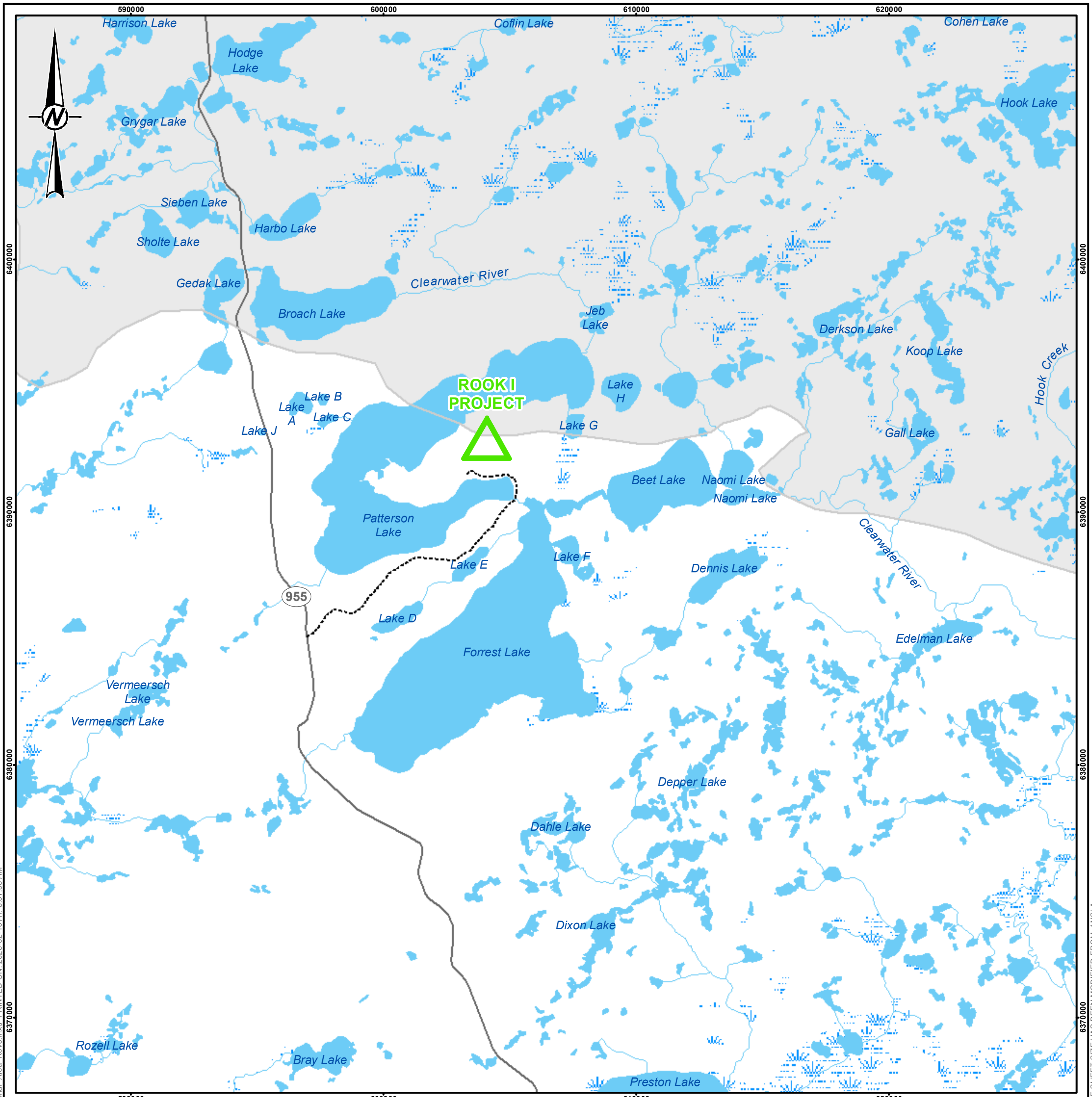

LEGEND

- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- WETLAND
- ATHABASCA BASIN
- PROJECT LOCATION
- EXISTING ACCESS ROAD

0 5,000 10,000

1:225,000 METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

REGIONAL AREA OF THE ROOK I PROJECT

CONSULTANT

wsp

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PREPARED	NO/AK
REVIEWED	JMC
APPROVED	MM

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2.0 STUDY OBJECTIVE

The overall objective of the hydrometric baseline report was to describe the existing hydrological conditions in the baseline study area to support an EA for the Project. Specifically, the objectives of the hydrology baseline study were to characterize:

- snow accumulation available for melt at the basin scale;
- spatial and seasonal variation of water surface elevation (WSE) and discharge; and
- sediment transport characteristics.

The field studies completed in support of the hydrological baseline included:

- late winter snow surveys in April 2018 and March 2019;
- hydrometric monitoring of eight watercourses and eight waterbodies within the hydrology regional study area (RSA);
- hydrometric monitoring at three stations downstream of the RSA along the Clearwater River;
- hydrometric monitoring at one watercourse and one waterbody outside of the RSA along Hodge Creek;
- geodetic (an elevation of a given point on land above a published vertical datum reference system) GPS (global positioning system) RTK (real-time kinematic) surveys of key hydrometric station benchmarks; and
- suspended and bed load sediment sampling at three locations along the Clearwater River mainstem (i.e., main channel) downstream of Patterson Lake.

3.0 STUDY AREAS

The study areas for the hydrology baseline program include the following (Figure 3):

- local study area (LSA): the Clearwater River watershed to Naomi Lake outlet; and
- RSA: the Clearwater River watershed above the Mirror River confluence.

The Project would be located adjacent to Patterson Lake near the headwaters of the Clearwater River system at Broach Lake. The Clearwater River Upper Reach flows from the area near Broach Lake through a series of lakes including Patterson, Forrest, Beet, and Naomi lakes in order from upstream to downstream. The upper Clearwater River flows over a distance of 41.5 km from Broach to Naomi lakes; this area is dominated by glaciolacustrine terrain (Annex IV.3). From Naomi Lake, the Clearwater River flows another 20 km southeast before reaching the Mirror River confluence. Below the Mirror River confluence, the Clearwater River deepens with higher flow volumes from the Mirror River, and the channel form becomes meandering within a well-defined river valley. Farther downstream, the Clearwater River flows through Lloyd Lake, which is just upstream of the Clearwater River Provincial Park; the downstream end of the park is at the Saskatchewan–Alberta border.

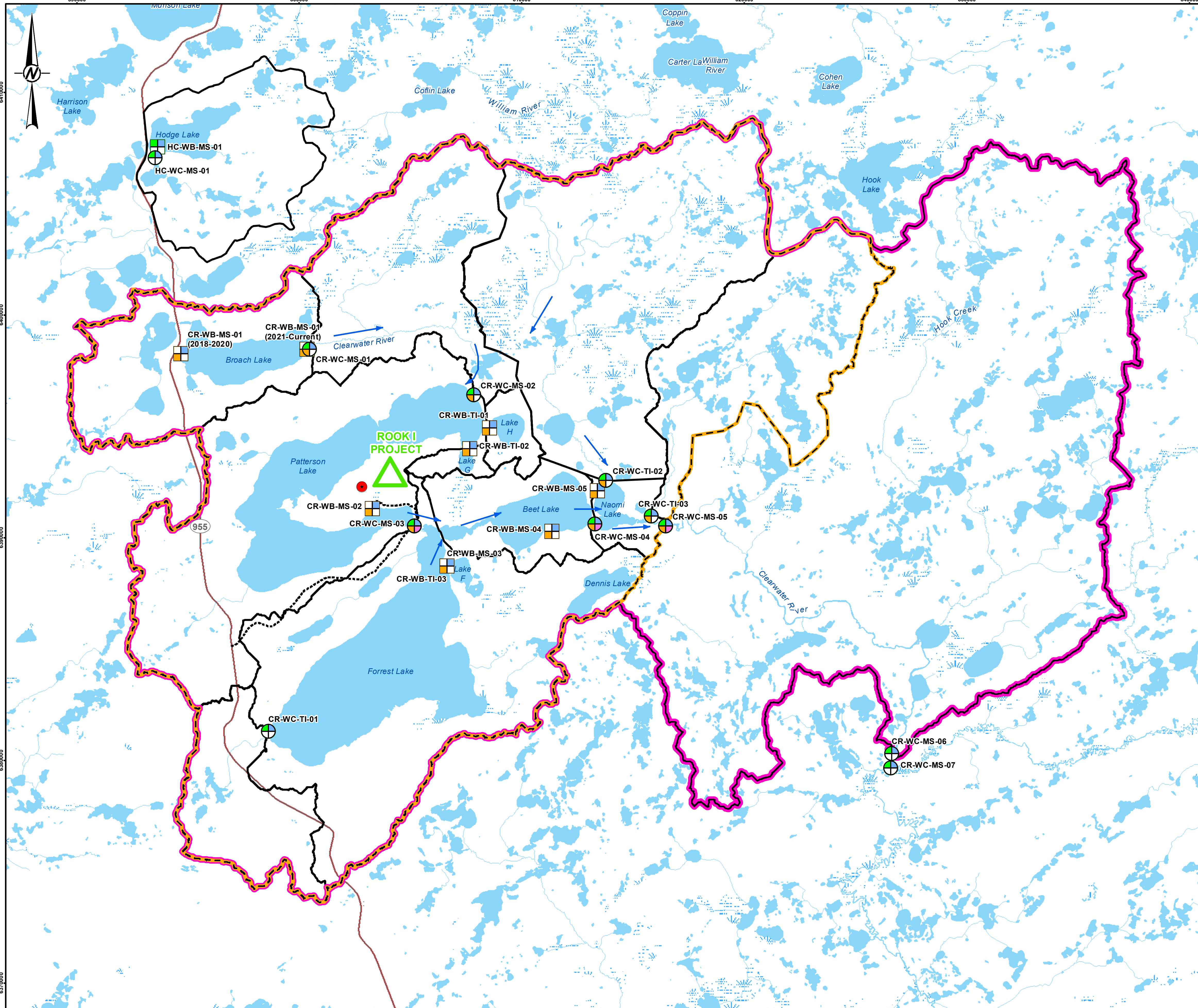
Based on hydrological characteristics of the region and a screening-level assessment of the potential direct effects of the Project, the LSA is defined as the Clearwater River watershed up to the Naomi Lake outlet

(Figure 3). The Clearwater River watershed above the Naomi Lake outlet drains an area of 685 km^2. Direct effects on hydrology may include changes to flows and water levels.

The RSA for hydrology includes waterbodies and watercourses within the Clearwater River watershed above the Mirror River confluence, which includes the LSA (Figure 3). The Clearwater River watershed above the Mirror River confluence drains an area of 1,070 km^2. The spatial extent of the Clearwater River watershed above the Mirror River confluence is expected to provide an ecologically relevant RSA for the EA. The RSA spans an area that provides habitat requirements for a discernible population unit of large-bodied fish species where cumulative effects may occur. The hydrometric stations in the RSA are shown in Figure 3.

The hydrological baseline studies collected sufficient data over approximately three years at numerous locations within the LSA and RSA and a wide range of hydrological conditions was observed. Hydrological baseline studies focused on the Clearwater River watershed to the Patterson Lake outlet and along the main lake chain downstream, including Forrest Lake, Beet Lake, Naomi Lake, and the reaches of the Clearwater River separating these lakes. Additional data were collected in small waterbodies adjacent to Patterson Lake (i.e., Lakes G and H), and upstream of Patterson Lake (i.e., Broach Lake, Broach Lake outflow, and the Clearwater River above Patterson Lake).

There are three hydrometric stations at locations of interest downstream of the RSA boundary, referred to as far-field stations. These locations contribute valuable information about hydrological variation in the upper Clearwater River and include the Clearwater River downstream of the Mirror River confluence, at the Lloyd Lake outlet, and above Warner Rapids. Hodge Lake and its outlet were added as reference monitoring locations in 2020; these stations are north of the Clearwater River watershed. Locations and watershed boundaries for the three far-field hydrometric stations and Hodge Lake reference stations relevant to the hydrology baseline are shown in Figure 4.



LEGEND

- FLOW DIRECTION
- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- WETLAND

PROJECT FEATURES

- EXISTING ACCESS ROAD
- PROJECT LOCATION
- METEOROLOGICAL STATION

WATERBODY HYDROMETRIC STATIONS

- DISCHARGE
- SURVEYED BENCHMARK (GEODETIC DATUM)
- TOTAL SUSPENDED SOLIDS AND BEDLOAD
- WATER SURFACE ELEVATION

WATERCOURSE HYDROMETRIC STATIONS

- DISCHARGE
- SURVEYED BENCHMARK (GEODETIC DATUM)
- TOTAL SUSPENDED SOLIDS AND BEDLOAD
- WATER SURFACE ELEVATION
- HYDROLOGY LOCAL STUDY AREA
- HYDROLOGY REGIONAL STUDY AREA
- WATERSHED

0 3,500 7,000

1:175,000 METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. WATERSHEDS DELINEATED BY GOLDER USING GREENKENUE SOFTWARE BASED ON CANADIAN DIGITAL ELEVATION DATA AND NATIONAL HYDROGRAPHIC NETWORK WATERCOURSES.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

HYDROLOGY BASELINE STUDY AREAS

CONSULTANT

wsp

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DESIGNED	JH
PREPARED	NO
REVIEWED	JD
APPROVED	RWP

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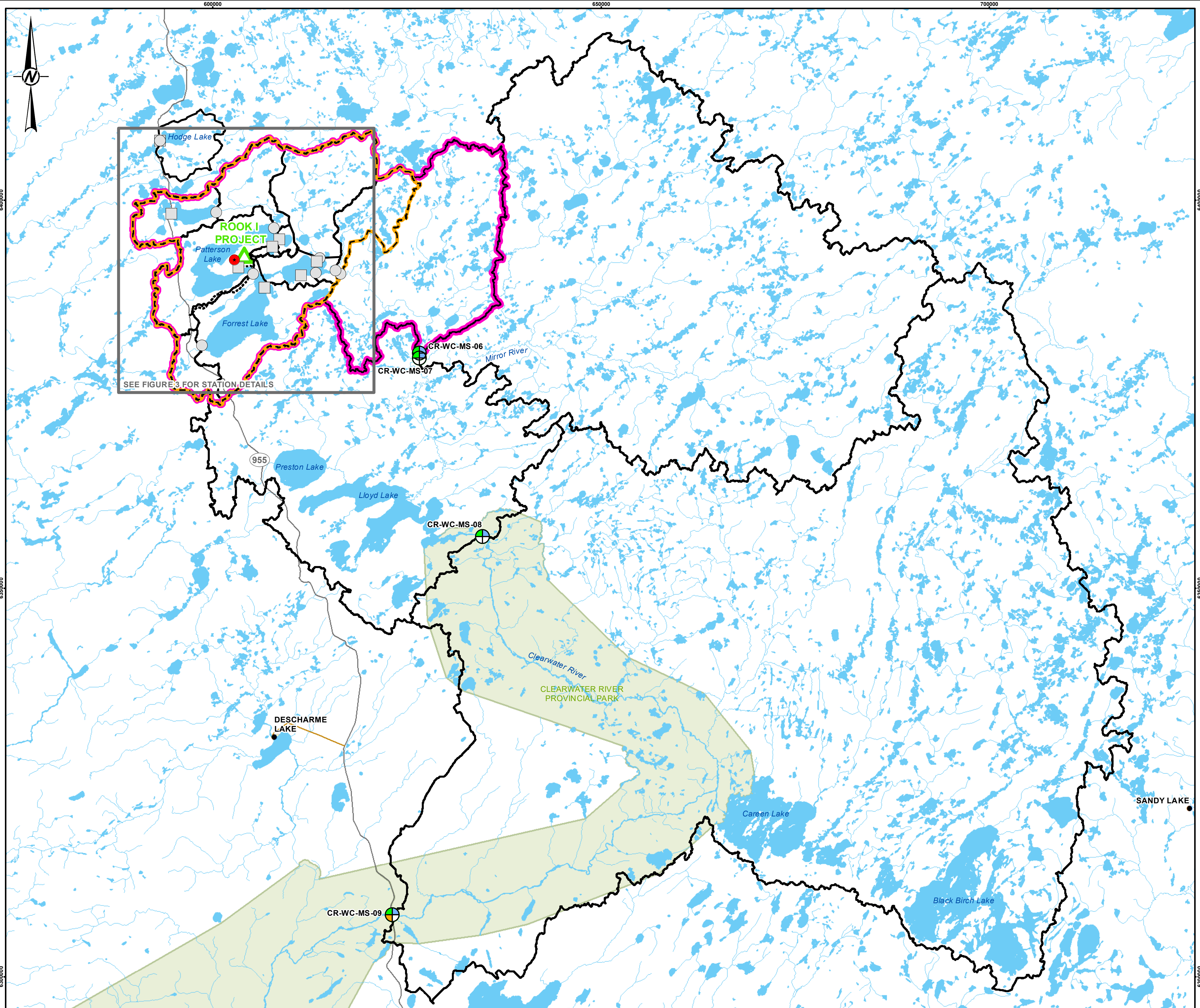

LEGEND

- POPULATED PLACE
- SECONDARY HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- PARK
- WATERBODY

PROJECT FEATURES

- EXISTING ACCESS ROAD
- PROJECT LOCATION

- METEOROLOGICAL STATION

WATERBODY HYDROMETRIC STATIONS

- DISCHARGE
- SURVEYED BENCHMARK (GEODETIC DATUM)
- TOTAL SUSPENDED SOLIDS AND BEDLOAD
- WATER SURFACE ELEVATION

WATERCOURSE HYDROMETRIC STATIONS

- DISCHARGE
- SURVEYED BENCHMARK (GEODETIC DATUM)
- TOTAL SUSPENDED SOLIDS AND BEDLOAD
- WATER SURFACE ELEVATION
- HYDROLOGY LOCAL STUDY AREA
- HYDROLOGY REGIONAL STUDY AREA
- WATERSHED

0 10 20

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, OCTOBER 28, 2019.
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3. WATERSHEDS DELINEATED BY GOLDER USING GREENKENUE SOFTWARE BASED ON CANADIAN DIGITAL ELEVATION DATA AND NATIONAL HYDROGRAPHIC NETWORK WATERCOURSES.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT
NexGen Energy Ltd.

PROJECT
ROOK I PROJECT

TITLE
FAR-FIELD HYDROMETRIC STATIONS

CONSULTANT
wsp

YYYY-MM-DD	2023-10-25
DESIGNED	JH
PREPARED	NO
REVIEWED	JD
APPROVED	RWP

PROJECT NO.	PHASE	REV.	FIGURE
20138965		0	4

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4.0 METHODS

4.1 Review of Existing Information

No publicly available hydrometric data collected within the RSA were available for use in the baseline study. The Rook I Meteorological Station (Figure 3) was in place before the commencement of the hydrometric baseline program; its data were used in the current study, and details are provided in Section 4.3.

4.2 Approach

The hydrological baseline data collection from 2018 to 2020 included the following main components:

- Local meteorological conditions were monitored from 2018 to 2020.
- Snow surveys were completed in the Patterson Lake watershed in April 2018 and March 2019.
- Hydrometric monitoring was conducted from 2018 to 2020:
  - Hydrometric stations were established in August 2018 at eight waterbodies (i.e., lakes or ponds) and 12 watercourses (i.e., flowing channels such as rivers, creeks, streams, brooks), and monitored until September 2020. Additional hydrometric stations were established at Hodge Lake and its outflow in June 2020 and monitored until September 2020.
  - Three local benchmarks were installed at each hydrometric station and surveyed during each field visit using an optical level.
  - Geodetic elevations for benchmarks at the 15 hydrometric stations were obtained in October 2018 using both real-time kinematic (RTK) and station occupation (static) global positioning service (GPS) survey methods. Four Global Navigation Satellite System (GNSS) receivers were used: two receivers were used as an RTK base and rover system, while the other two receivers were used to perform static surveys at various survey control points. Static surveys allowed for post-processing of the GNSS data using the Canadian Spatial Reference System Precise Point Positioning (CSRS-PPP). Horizontal positions were established in Universal Transverse Mercator North American Datum of 1983 (UTM NAD83 Zone 12).
  - Discharge and WSE were measured during the field visits completed between August 2018 and September 2020. Continuous records of WSE were developed for the waterbodies and watercourses with installed Solinst Levelogger pressure transducers, which compensated for barometric pressure and corrected to geodetic or local benchmark elevations using the field WSE surveys. Discharge records were derived for watercourses using stage-discharge rating curves for the same period that Levelogger pressure transducers were installed.
- Sediment sampling was conducted from 2018 to 2020:
  - total suspended solids (TSS) was sampled on numerous dates at the same time that discharge was measured;
  - sediment discharge was measured; and
  - bed material samples were collected at three hydrometric stations along the Clearwater River mainstem.

The following sections describe the field data collection and data analysis methods used for each of the main study components, followed by quality assurance / quality control (QA/QC) used to confirm the integrity of the data.

4.3 Local Meteorological Data

Local meteorological data, in particular precipitation and air temperature, provided valuable baseline information about seasonal and annual variations in hydrological conditions near the proposed Project. Precipitation data were used to interpret the rainfall-response and recession of waterbody and watercourse hydrographs. Air temperature data were used to interpret mid-winter cold snaps that can influence water level hydrographs, as well as help to define the spring thaw and fall freeze-up hydrographs.

4.3.1 Data Collection

Local meteorological conditions were monitored at the Rook I Meteorological Station, located near the exploration camp (UTM NAD83 12V 602795 E 6392291 N, 550 m). The Rook I Meteorological Station has operated since installation on 13 September 2018 (Figure 3).

The meteorological variables measured included air temperature, total precipitation, humidity, solar radiation, rainfall, and wind speed. Total precipitation, which is of principal interest for providing context for the hydrometric monitoring, was measured using a Geonor T-200B total precipitation gauge, which reported cumulative precipitation in millimetres on an hourly interval. The Geonor gauge was equipped with an Alter-style wind shield to improve rainfall and snowfall catch efficiency. A Campbell-scientific CR1000 data logger was installed in an enclosure and the power supply consisted of a 20-watt solar panel and 26 Amp-hour battery. The station has a 10 m anemometer tower (used to measure wind speed and direction), where the air temperature sensor was installed at a height of 2 m, and the Geonor and Alter shield were installed at a height of 2.5 m.

Prior to 15 September 2018, local precipitation was measured using a TE525M tipping bucket rain gauge (TBRG) (UTM NAD83 12V 604501 E 6393442 N) installed at a height of 1.5 m above ground. The TBRG measured rainfall rates, but not total precipitation as it is measured by the Geonor gauge. As a result, total precipitation during months where snowfall would have occurred was under-estimated before 15 September 2018. As such, only the Geonor gauge data were relied upon for this report.

More detail on the Rook I Meteorological Station is provided in the atmospheric studies characterization report (Annex I, Atmospheric Baseline Report). The calculation methods and the data completeness requirements followed the guidance provided by ECCC (ECCC 2020a) and the World Meteorology Organization (WMO 2017).

4.3.2 Data Analysis

Raw hourly cumulative precipitation values observed at the Geonor gauge were rounded to the nearest 0.01 mm and corrected for gauge catch efficiency hourly. At certain times during the period of record, the Geonor gauge would have caught more than 100% (i.e., over-catch) or less than 100% of the actual total precipitation that fell, depending mainly on the wind speed. Catch efficiency correction was necessary to properly account for the influence of wind on precipitation measurements. Therefore, catch efficiency correction at the meteorological station was based on wind speed measured at 10 m height, corrected to the wind speed at the height of the Geonor gauge, and assumed a roughness value for the surrounding area. Rainfall corrections used a method outlined in Devine and Mekis 2008, and snowfall corrections used a method outlined in MacDonald and Pomeroy 2007.

The precipitation data presented in this report are daily total precipitation values. The TBRG rainfall rates for each day were added together to obtain total daily rainfall values. The Geonor gauge accumulated precipitation over time, and raw hourly data were converted to total precipitation measured each day.

Local data collected by the Rook I Meteorological Station were compared to regional historical meteorological data and climate normal obtained from Environment and Climate Change Canada (ECCC 2019).

4.4 Snow Surveys

The annual end of winter snowpack surveys provided valuable baseline information about seasonal and inter-annual variation of hydrological conditions near the proposed Project. The snowpack surveys provided information needed to validate measured snowfall, calibrate estimated atmospheric losses of snow to sublimation, and establish the end of winter water volume available to melt during the spring freshet, which occurs for approximately two to three weeks every mid- to late April. The snowpack survey data was also important to validate remote sensing data with ground-based measurements to characterize uncertainties or bias in the remote sensing data. In a similar approach to the overall hydrological modelling, the few years with field-based snow surveys were used to check the validity of a much longer remote sensing data record that spans a 40-year period.

Spring snowmelt often provides the largest volume of runoff into a watershed each year, and the highest water levels and peak flows often occur during spring freshet. A snow survey program was completed late in the winters of 2017-2018 and 2018-2019, with the objective of establishing the pre-freshet snowpack conditions in the Patterson Lake watershed. A stratified snow survey design was used, which involved selecting numerous snow survey plots in a wide range of terrain types (e.g., terrestrial, lake, or lake edge) and landscape features (e.g., slope and aspect) that were representative of the watershed. The snow survey results were weighted according to the proportional areal coverage of each terrain type in the watershed. Results are expressed as a snow water equivalent (SWE), which can be visualized as the depth of water on the ground surface if the entire snowpack were to melt at once. The SWE is reported in units of millimetres depth of melted SWE.

Two years of end-of-year SWE data collection provides a sufficient baseline for the Patterson Lake watershed; however additional data collection was planned. In 2020, a snow survey was planned for late March to early April but was not completed. A stop-work order was implemented 26 March 2020 (at the early stage of the COVID-19 outbreak in Canada), and the window to complete the snow survey had passed once discussions about the program had restarted (Golder 2020). Instead, local SWE was estimated with remote sensing and regional SWE data. The two years of comparison of field and remote sensing data provide confidence that available remote sensing data provided adequate estimates of end-of-winter SWE for the proposed Project, while a third end-of-winter snow survey was completed March 2021 to provide further validation (Golder 2020).

4.4.1 Data Collection

Stratified snow surveys were completed at the end of winter in 2018 and 2019. The 2018 survey was completed from 15 April 2018 to 16 April 2018, and the 2019 survey was completed from 21 March 2019 to 23 March 2019. The 2018 field survey was conducted during the onset of the spring freshet, and as a result, timing of the field survey presented challenges for access and sample collection. Temperatures were above the freezing point during this survey and some snowmelt was noted on south-facing slopes. In some cases, access to planned sampling points was restricted as a result of a low number of cut lines, a large number of regenerating burn areas populated by dense jack pine, or rapidly changing spring conditions in low-lying waterbodies and watercourses. In particular, the planned snow survey plots on lakes could not all be completed safely, and the single lake plot completed in 2018 was assumed to be representative of the snow conditions on lakes.

The 2019 survey was conducted from 21 March 2019 to 23 March 2019. Although the 2019 field survey was conducted earlier in the year than in 2018, air temperatures were well above normal, and snowmelt had started by the beginning of the snow survey. Average daily temperatures were at or above 0°C on 11 March 2019, 17 March 2019 to 22 March 2019, 25 March 2019, and 26 March 2019. As a result, the maximum surface SWE may not have been captured by the 2019 survey; however, the timing and magnitude of the peak SWE was estimated through the use of remote sensing methods.

For all surveys, photos were taken at each plot, and the plot location was documented with a handheld GPS. Results were entered into standard snow survey data entry sheets. The type and density of terrestrial vegetation was noted, as were the slope and aspect. Slope was estimated with an inclinometer and classified as flat if less than 1° from the horizon, low slope if less than 10°, and high slope of between 10° and 33°. Aspect (i.e., the direction the slope faces) was noted to the nearest of cardinal directions (i.e., north, east, south, west) or flat for instances with no slope.

At each snow survey plot, snow depth was measured to the nearest centimetre at three locations using a snow probe or metal measuring stick. The average snow depth at each plot was obtained as the average of the three measurements. Plots were located a minimum of 50 m from any disturbed area such as a road or trail.

Snow density was measured once at each plot using a snow corer with a cutting blade at its base. A cradle hanging digital scale was used for snow sampling, which was tared (i.e., unladen weight set to zero) at the beginning of each day and periodically throughout the day (or before each measurement if there was a build-up of ice or snow inside). The snow corer sampling tube was pushed slowly through the snowpack until it reached the ground surface, and a snow depth reading was made. The tube was then twisted into the soil to get a “plug” of soil and prevent granular snow at the bottom of the sample from falling out. If a plug could not be obtained, the field staff dug around the corer with a shovel, slid the blade of the shovel under the corer, and lifted out the corer with the blade against it to prevent the snow from falling out. The sampler tube was held horizontally, and its weight was measured using the digital scale. The “loaded” weight (i.e., sampler, cradle, and snow) were recorded on the data sheet.

4.4.2 Data Analysis

The average snow depth at each plot was obtained as the average of three measurements made with a metal ruler. Snow density was calculated as follows:

$$\rho_s = \frac{w_s}{d_s \pi R^2} \quad \text{Equation 1}$$

Where, ρ_s is snow density in units of grams per cubic centimetre [g/cm^3], w_s is weight of snow [g] calculated as loaded weight minus tare of the scale, d_s is snow depth [cm], π = 3.14159 [dimensionless], and R is snow corer sampling tube radius [cm].

Using the snow density and average snow depth for each survey plot, the SWE [mm] was then calculated as follows:

$$SWE = \rho_s * d_s * 10 \quad \text{Equation 2}$$

The mean SWE in the Patterson Lake watershed was estimated by weighting the SWE results for the various terrain types by total area of that terrain type in the watershed. Snow depth and snow density were measured at 34 plots in 2018 and 50 plots in 2019, distributed over 11 terrain types in 2019 and nine in 2018. For the purposes of the snow survey, the Patterson Lake watershed was divided into Lake, Lake Edge, and Terrestrial categories. Terrestrial areas were further sub-divided into terrain types by slope and aspect, which accounts for primary drivers of snow accumulation, redistribution by wind, and losses to sublimation and evaporation (Table 1). The Lake area was taken to be the area classified as “Lake” in the Southern Digital Landcover set (Saskatchewan Research Council 2000). The Lake Edge area was established as a 30 m buffer around the perimeter of Patterson Lake. Based on observations during the field snow surveys, the terrestrial landscape consists primarily of open canopy jack pine stands and regenerating jack pine burns. As a result, the Terrestrial landcovers were grouped together as one aggregate landcover class, which was further subdivided by aspect (i.e., flat, facing north, east, south, or west) and slope (i.e., flat is classified as a slope of less than 1°, low slope less than 10°; and slope of 10° to 33°).

Table 1: Patterson Lake Terrain Type Classification for 2018 and 2019 Sample Points

Terrain Classification	Area (km^2)	Percentage of Cover (%)	Number of Snow Survey Plots	
			2018	2019
Lake	59.5	22.5	1	10
Lake Edge	6.5	2.5	3	1
Terrestrial: flat, low slope	39.5	15.0	n/d	7
Terrestrial: north, low slope	33.9	12.8	4	6
Terrestrial: north, 10° to 33°	1.21	0.5	5	1
Terrestrial: west, low slope	34.5	13.1	3	6
Terrestrial: west, 10° to 33°	0.59	0.2	5	1
Terrestrial: south, low slope	38.0	14.4	3	7
Terrestrial: south, 10° to 33°	1.4	0.5	8	1
Terrestrial: east, low slope	48.2	18.2	n/d	9
Terrestrial: east, 10° to 33°	0.88	0.3	2	1
Total	**264.2**	**100.0**	**34**	**50**

n/d = no data.

For regional context, local SWE data obtained from the snow surveys in Patterson Lake watershed were compared to publicly available regional SWE data, including a regional SWE snow pillow monitoring station and remotely sensed maps of SWE for the Canadian Prairie provinces (i.e., Alberta, Saskatchewan, and Manitoba). Alberta Environment provides hourly SWE data at Gordon Lake Lookout (Station 07CE801) (Government of Alberta 2020). This station is located 137 km southwest of the proposed Project and is within the Clearwater River watershed in Alberta. Gordon Lake Lookout is at an elevation of 500 masl, which is approximately 40 m lower than the elevation of Patterson Lake.

The SWE results obtained during the snow surveys were also compared with passive microwave remote sensing data published by ECCC (2020b) and available on the Canadian Cryospheric Information Network (CCIN) website (CCIN 2020). These data cover the Canadian Prairie provinces and provide a snapshot of SWE for all locations, weekly throughout the winter. Data are provided on maps with increments of SWE over a 10 mm range (e.g., 80 mm to 90 mm SWE). These data provided a comparison for approximately the same location as the anticipated area of the Project.

4.5 Hydrometric Monitoring

Twenty-two hydrometric monitoring stations were included in the baseline hydrology program to provide field data for a wide range of sub-watershed sizes, waterbody sizes, and other physical factors. Monitoring covered both open-water and ice-covered conditions, and wide ranges of water levels and discharge conditions were captured between August 2018 and September 2020. Monitoring was also conducted through the winter of 2020-2021. Watercourse station locations were chosen along straight reaches with uniform flow characteristics (e.g., not highly turbulent flow, near-uniform depth, and near-uniform velocities across the channel at the measurement locations); however, the gradient is relatively low between some of the waterbodies included in the program, and backwater[2] from the downstream waterbodies was observed at several watercourse stations which was an expected occurrence, especially when water levels were high. Waterbody station locations were chosen to facilitate easy access by boat, and at relatively sheltered locations to reduce fluctuations in water levels influenced by wind and waves.

Hydrometric station numbers and names, the period of operation, and watershed areas contributing to each station are provided in Table 2 for watercourses and Table 3 for waterbodies. The locations of the stations are shown in Figure 3 and Figure 4. The naming convention adopted for the hydrometric stations used the following naming convention: the first pair of letters indicates the watershed, with CR indicating the Clearwater River and HC indicating Hodge Creek. The second pair of letters identifies whether the hydrometric station is a waterbody, WB (i.e., lake or pond), or watercourse, WC (i.e., flowing channels referred to colloquially as rivers, creeks, streams, and brooks). The third pair of letters indicates whether the waterbody or watercourse is on the mainstem (MS) of the drainage system or if it is a tributary (TI). The two-digit numbers at the end of the Station ID are sequential, starting upstream and increasing in the downstream direction.

[2] Backwater is measured at a hydrometric station where stage was observed to be above the base stage-discharge rating curve when the stage is on the y-axis.

Table 2: Watercourse Hydrometric Station Details

Station ID	Station Name	Period of Operation	Watershed Area (km^2)
CR-WC-MS-01	Clearwater River below Broach Lake	7 August 2018 to 24 September 2020	56.4
CR-WC-MS-02	Clearwater River above Patterson Lake	6 August 2018 to 23 September 2020	121
CR-WC-MS-03	Clearwater River below Patterson Lake	4 August 2018 to 26 September 2020	264
CR-WC-MS-04	Clearwater River below Beet Lake	5 August 2018 to 25 September 2020	473
CR-WC-MS-05	Clearwater River below Naomi Lake	5 August 2018 to 25 September 2020	685
CR-WC-MS-06	Clearwater River above Mirror River confluence	3 August 2018 to 24 September 2020	1,070
CR-WC-MS-07	Clearwater River below Mirror River confluence	3 August 2018 to 24 September 2020[(a)]	3,300
CR-WC-MS-08	Clearwater River at the Lloyd Lake outlet	4 August 2018 to 24 September 2020	4,370
CR-WC-MS-09	Clearwater River at Warner Rapids	8 August 2018 to 29 September 2020	9,590
CR-WC-TI-01	Tributary inflow above Forrest Lake	6 August 2018 to 3 October 2019[(b)]	34.8
CR-WC-TI-02	Tributary inflow to Naomi Lake	5 August 2018 to 27 September 2020	134
CR-WC-TI-03	Tributary inflow Downstream of Naomi Lake	5 August 2018 to 26 September 2020	67.5
HC-WC-MS-01	Hodge Creek below Hodge Lake	8 June 2020 to 28 September 2020	52.6

a) Only instantaneous measurements of discharge (2018 and 2019) and water surface elevation (2019 only) were monitored at Station CR-WC-MS-07 to measure the inflows from the Mirror River for comparison with flows upstream of the Clearwater River-Mirror River confluence.

b) Station monitoring was discontinued after 2019 due to beaver dam activity at the station.

Table 3: Hydrometric Monitoring Program Waterbody Stations

Station ID	Description	Period of Operation	Cumulative Watershed Area (km^2)
CR-WB-MS-01	Broach Lake	7 August 2018 to 28 September 2020	56.4
CR-WB-TI-01	Lake H	6 August 2018 to 23 September 2020	7.36
CR-WB-TI-02	Lake G	6 August 2018 to 23 September 2020	3.75
CR-WB-MS-02	Patterson Lake	4 August 2018 to 26 September 2020	264
CR-WB-MS-03	Forrest Lake	2 August 2018 to 25 September 2020	445
CR-WB-TI-03	Lake F	2 August 2018 to 25 September 2020	9.73
CR-WB-MS-04	Beet Lake	5 August 2018 to 25 September 2020	473
CR-WB-MS-05	Naomi Lake	5 August 2018 to 27 September 2020	685
HC-WB-MS-01	Hodge Lake	8 June 2020 to 28 September 2020	52.6

4.5.1 Data Collection

4.5.1.1 Benchmark Installation and Geodetic Benchmark Survey

Water surface elevations of waterbodies and watercourses were measured at hydrometric stations using periodic optical level surveys relative to local benchmarks. The benchmark coordinates and elevations for the watercourse stations are presented in Table 4. The benchmark coordinates and elevations for the waterbody stations are presented in Table 5. A detailed summary of the geodetic benchmark surveys is provided in Appendix A, Geodetic Survey Summary.

For the stations that were easily accessible, RTK GPS surveying equipment and static surveys were used to establish the geodetic elevation of local benchmarks between 29 September 2018 and 2 October 2018. Surveys were conducted at 15 watercourse and waterbody hydrometric stations considered important locations for the baseline program within the LSA, and also at CR-WC-MS-09 where a published Natural Resources Canada (NRCan) control point was located. Unless otherwise stated, the WSE referenced is geodetic based on the 2018 survey throughout this report. The accuracy of the RTK survey benchmark elevations was expected to be approximately plus or minus 0.03 m in consideration of the density of trees around each benchmark. Where a geodetic survey was not possible, an assumed elevation of 100 m was assigned to the primary benchmark, and elevations for the other benchmarks were determined relative to that elevation based on an optical level survey. The use of repeated surveys of WSE relative to non-geodetic benchmarks is a standard method to maintain the vertical datum at hydrometric stations over time.

Three benchmarks were installed or adopted (if in place already) at each of the 22 hydrometric stations. The primary benchmark was named BM1 and was usually rebar driven into the ground, and the second and third benchmarks (BM2 and BM3) were usually 3/8-inch diameter lag bolts installed at the base of large tree trunks and marked with yellow survey tags (Figure 5). Other suitable benchmarks installed or adopted included large boulders or a galvanized steel pipe driven into the ground. The purpose of the second and third benchmarks was to check if the primary benchmark heaved or shifted vertically between field visits.

Two complete levelling surveys were conducted for each station during each field visit using an optical level. The accuracy of each survey was verified by opening and closing on the primary benchmark, and was deemed acceptable if the survey closed at equal to or less than 0.005 m. The results of the two surveys at each site were also compared and were deemed acceptable if they agreed within 0.01 m and if they did not the survey was repeated. Elevations of each benchmark were also compared with previous field visits. Movement of the primary benchmark relative to the secondary benchmark was checked.

Table 4: Geodetic and Local Benchmark Survey Results at Watercourse Hydrometric Monitoring Stations

Station Name and Number	October 2018 Benchmark Coordinates and Elevation (m)	Benchmark Elevations (m) as of September 2020 and Details
Clearwater River below Broach Lake (CR-WC-MS-01)	BM1: 6398465.1 N 600437.4 E and 527.604 BM2: 6398466.1 N 600439.3 E and 527.766 BM3: 6398467 N 600433 E and 528[(a)]	BM1: No Change BM2: 527.787 BM3: 527.801
Clearwater River above Patterson Lake (CR-WC-MS-02)	BM1: 6396407.6 N 607825.0 E and 499.344 BM2: 6396409.9 N 607824.8 E and 499.186 BM3: 6396407.7 N 607826.4 E and 499.290	BM1: 499.413 BM2: 499.200 BM3: 499.293
Clearwater River below Patterson Lake (CR-WC-MS-03)	BM1: 6390535.7 N 605166.6 E and 499.699 BM2: 6390536.8 N 605168.0 E and 499.975 BM3: 6390535.8 N 605161.7 E and 499.569	BM1: No Change BM2: 499.991 BM3: No Change

Table 4: Geodetic and Local Benchmark Survey Results at Watercourse Hydrometric Monitoring Stations

Station Name and Number	October 2018 Benchmark Coordinates and Elevation (m)	Benchmark Elevations (m) as of September 2020 and Details
Clearwater River below Beet Lake (CR-WC-MS-04)	BM1: 6390617.6 N 613269.7 E and 498.788 BM2: 6390616.0 N 613267.1 E and 498.750 BM3: 6390618.8 N 613268.1 E and 498.741	BM1: No Change BM2: 498.769 BM3: 498.719
Clearwater River below Naomi Lake (CR-WC-MS-05)	BM1: 6390518.0 N 616451.7 E and 498.867 BM2: 6390515.7 N 616453.8 E and 498.711 BM3: 6390516.7 N 616452.0 E and 498.855	BM1: 498.879 BM2:498.897 BM3: 498.733
Clearwater River above Mirror River Confluence (CR-WC-MS-06)	BM1: 6380305.0 N 626600.0 E and 100.000 BM2: 6380300.0 N 626599.0 E and 100.098 BM3: 6380299.0 N 626595.0 E and 100.197 (Non-Geodetic)	BM1 to BM3: No Change
Clearwater River below Mirror River Confluence (CR-WC-MS-07)[b]	BM1: 6379687.0 N 626541.0 E and 100.000 BM2: 6379688.0 N 626543.0 E and 100.074 BM3: 6379688.0 N 626537.0 E and 99.181 (Non-Geodetic)	BM1 to BM3: No Change
Clearwater River at the Lloyd Lake outlet (CR-WC-MS-08)	BM1: 6356667.0 N 634720.0 E and 100.000 BM2: 6356660.0 N 634730.0 E and 98.635 (Non-Geodetic)	Downstream of Rapids: BM1: No Change BM2: No Change At WSC Station 07CD006: S73-76: 100.000; (WSP) 5.493 m (WSC) S73-75: 97.553 (WSP 3.048 m (WSC)
Clearwater River at Warner Rapids (CR-WC-MS-09)	BM1: 6307938.7 N 623078.0 E and 400.339 BM2: 6307933.0 N 623076.0 E and 400.454 BM3: 6307937.0 N 623077.0 E and 400.975 BM4: 6307936.0 N 623087.0 E and 399.207	BM1 to BM2: No Change BM3: 400.990 BM4: Not surveyed in 2020
Tributary inflow above Forrest Lake (CR-WC-TI-01)[c]	BM1: 6381301 N 598609 E and 499.969 BM2: 6381297 N 598613 E and 501.119 BM3: 6381299 N 598602 E and 500.369 BM4: 6381302 N 598609 E and 500.229	BM1 to BM4: No Change
Tributary inflow to Naomi Lake (CR-WC-TI-02)	BM1: 6392567.9 N 613764.2 E and 499.139 BM2: 6392557.9 N 613770.5 E and 499.175 BM3: 6392573.7 N 613765.0 E and 498.982	BM1 and BM3: No Change BM2: 499.147
Tributary inflow Downstream of Naomi Lake (CR-WC-TI-03)	BM1: 6390961.2 N 615808.2 E and 498.912 BM2: 6390967.7 N 615802.6 E and 499.505 BM3: 6,390951.3 N 615802.2 E and 499.062	BM1: 498.897 [d] BM2: 499.569 BM3: 499.046

Table 4: Geodetic and Local Benchmark Survey Results at Watercourse Hydrometric Monitoring Stations

Station Name and Number	October 2018 Benchmark Coordinates and Elevation (m)	Benchmark Elevations (m) as of September 2020 and Details
Hodge Creek below Hodge Lake (HC-WC-MS-01)	BM1: 6407639.2 N 593181.9 E and 100.000[e] BM2: 6407639.6 N 593182.4 E and 100.353[e] BM3: 6407639.0 N 593182.0 E and 99.785[e] (Non-Geodetic)	BM1 to BM3: No Change

Note: All coordinates referenced are in UTM Zone 12 and North American Datum 1983 (NAD83). "No Change" in benchmark elevation is defined as a surveyed difference of less than 0.010 m for optical level surveys but allows for additional error in the RTK survey vertical elevations. Benchmark coordinates and elevations measured in October 2018 by RTK GPS survey and elevations updated using optical levelling survey in October 2019.

a) BM3 at CR-WC-MS-01 was not surveyed by RTK GPS in fall 2018. The coordinates are based on handheld GPS coordinates reported here to the nearest metre and vertical elevation surveyed relative to BM1 using an optical level.

b) All benchmarks for the Station CR-WC-MS-07 were installed in May 2019.

c) Benchmarks for CR-WC-TI-01 are based on handheld GPS coordinates reported to the nearest metre and vertical elevation relative to lake level for Forrest Lake are reported to the nearest 0.001 m but may be accurate to the nearest 0.1 m.

d) This benchmark was not stable between August 2018 and October 2019 as BM2, BM3, and the top of the staff gauge all moved upward by approximately 0.015 m relative to BM1; therefore, BM1 likely moved downward by 0.015 m.

e) Benchmarks established June 2020.

Table 5: Geodetic Benchmark Survey Results at Waterbody Hydrometric Monitoring Stations

Station Name and Number	October 2018 Benchmark Coordinates and Elevations (m)	Benchmark Elevations (m) as of September 2020 and Details
Broach Lake (CR-WB-MS-01)	BM1: 6398271.6 N 594670.3 E and 528.068 BM2: 6398271.1 N 594672.3 E and 527.725 BM3: 6398269.3 N 594670.6 E and 528.250	BM1 to BM3: No Change
Lake H (CR-WB-TI-01)	BM1: 6394930.9 N 608522.5 E and 500.675 BM2: 6394933.0 N 608527.5 E and 501.642 BM3: 6394925.4 N 608526.7 E and 501.358	BM1: No Change BM2: 6394917.0 N 608506.0 E and 501.098[a] BM3: 6394917.0 N 608509.0 E and 501.009[b]
Lake G (CR-WB-TI-02)	BM1: 6393993.9 N 607640.9 E and 500.171 BM2: 6393996.2 N 607643.5 E and 499.860 BM3: 6393993.0 N 607648.5 E and 500.250	BM1: 500.141 BM2: 499.979[c] BM3: 500.223
Patterson Lake (CR-WB-MS-02)	BM1: 6391309.7 N 603271.0 E and 500.139 BM2: 6391312.3 N 603278.8 E and 500.424 BM3: 6391308.1 N 603277.1 E and 500.624	BM1: 500.080 BM2: 500.361 BM3: 500.560
Forrest Lake (CR-WB-MS-03)	BM1: 6388736.0 N 606636.8 E and 500.175 BM2: 6388731.9 N 606644.8 E and 500.278 BM3: 6388745.3 N 606641.5 E and 499.638	BM1 to BM3: No Change
Lake F (CR-WB-TI-03)	BM1: 6388736.0 N 606636.8 E and 500.175 BM2: 6388731.9 N 606644.8 E and 500.278 BM3: 6388745.3 N 606641.5 E and 499.638	BM1 to BM3: No Change
Beet Lake (CR-WB-MS-04)	BM1: 6390290.8 N 611334.2 E and 500.067 BM2: 6390289.7 N 611334.3 E and 500.133 BM3: 6390294.5 N 611337.1 E and 499.238	BM1 to BM3: No Change
Naomi Lake (CR-WB-MS-05)	BM1: 6392109.9 N 613375.5 E and 500.296 BM2: 6392109.4 N 613383.6 E and 498.847 BM3: 6392122.5 N 613379.0 E and 499.497	BM1: No Change BM2: 498.914 BM3: No Change

Station Name and Number	October 2018 Benchmark Coordinates and Elevations (m)	Benchmark Elevations (m) as of September 2020 and Details
Hodge Lake (HC-WB-MS-01)	BM1: 6407639.2 N 593181.9 E and 100.000(d) BM2: 6407639.6 N 593182.4 E and 100.353(d) BM3: 6407639.0 N 593182.0 E and 99.785(d) (Non-Geodetic)	BM1 to BM3: No Change

Note: All coordinates referenced are in UTM Zone 12 and North American Datum 1983 (NAD83). “No Change” in benchmark elevation is defined as a surveyed difference of less than 0.010 m.

a) Benchmark replaced in August 2020. Benchmark supporting tree had fallen.

b) Benchmark replaced in June 2020. Benchmark supporting tree had fallen.

c) Benchmark replaced in June 2019.

d) Benchmark established June 2020.

Figure 5: Typical Benchmarks Installed during the Hydrometric Program in 2018

a) Lag Bolt

b) Rebar

4.5.1.2 Water Surface Elevation Monitoring

Non-vented Solinst Levelogger pressure transducers (Leveloggers), which monitor combined air and water pressure, were installed at the hydrometric stations during the initial site visit. Pressure and water temperature were recorded every 30 or 60 minutes at each station during its period of operation, and field visits were required to retrieve the locally stored data. At most stations, the Levelogger was deployed inside a tubular aluminum housing threaded onto an aluminum plate that rested on the stream bottom. At Hodge Lake and Hodge Creek below Hodge Lake, the Leveloggers were secured to an aluminum clamp with a stake driven into the stream bottom by hand. For watercourses, Leveloggers were deployed as close to the discharge measurement cross-section as possible, on firm substrate, and at a depth of 0.3 m to 1.0 m. For waterbodies, Leveloggers were deployed near shore, in a sheltered location, if possible, on firm substrate, and at a depth of 0.3 m to 0.5 m.

Since atmospheric pressure varies with time, pressure measured with the Leveloggers was converted to water depth by subtracting the barometric pressure measured with Solinst Baraloggers (Barologgers). Barologgers were installed at three locations: Clearwater River below Broach Lake, within Patterson Lake, and Clearwater River above Warner Rapids. The recommended maximum distance between a Barologger and corresponding Levelogger is 30 km horizontal distance and 300 m elevation change (Solinst 2018). The closest Barologger was used to correct Levelogger data. Water depth records at each hydrometric station were then converted to WSE values using an offset correction based on the difference between the primary benchmark elevation and the WSE of the watercourse or waterbody surveyed during each field visit.

During each monitoring station visit, a levelling survey was conducted with an optical level to measure the WSE at each hydrometric station relative to local benchmarks. A description of the benchmarks for each station are provided in Section 4.5.1.1 and Appendix A. Section 4.7 provides further discussion on data QA and checking effort, and Section 5.5 discusses data confidence and uncertainties for these measurements.

Staff gauges were installed at all hydrometric stations within the LSA, as they provide a means of verifying the WSE survey results. Each staff gauge was attached to a length of 19 mm diameter rebar or T-post driven into the stream bed at the discharge measurement cross-section. The staff gauges were installed so that approximately 1 m of rebar extended above the stream bed. For stability purposes, the length of rebar used was approximately 2 m. If a staff gauge was installed at a hydrometric station, a staff gauge reading was made concurrent with the optical level survey, and the top of the staff gauge was surveyed relative to the primary benchmark. Staff gauge readings were estimated to the nearest millimetre if conditions allowed. The elevation of the top of the staff gauge was surveyed at its highest point during levelling surveys.

4.5.1.3 Discharge Measurements

In watercourses that could not be waded, a Sontek M9 acoustic doppler current profiler (ADCP) was used to measure discharge. RiverSurveyor Live software was used to collect measurements and complete data review in the field, and the field results were reviewed a second time in the office. A compass calibration was completed daily prior to the first ADCP measurement. Magnetic declination from true north for the field location and date was entered in the software based on NRCan (2020) website values. Typically, more than three discharge measurements were collected at each site during a single field visit. An average discharge was estimated from a minimum of three discharge measurements having results within 5%. Although moving beds were not observed at most sites, the GPS-Generalized Gradient Approximation (GGA) track reference (i.e., boat velocity calculated from GPS data) was usually preferred over the bottom track reference method (i.e., boat velocity calculated from river bottom data), as the channel widths were more realistic using the GPS-GGA track reference compared to measured widths.

A Sontek FlowTracker acoustic Doppler velocimeter (ADV) was used to measure discharge in watercourses that were wadable. Manual discharge measurements were conducted according to the Water Survey of Canada (WSC) standard described by Terzi et al. (1994). Velocity and depth measurements used for discharge calculation were collected using the ADV and a top-setting wading rod. The mid-section method (i.e., in which both depth and velocity are measured at numerous points across the channel transect and area is calculated based on the depth at each point multiplied by the interval between points) was used to measure discharge, and the sampling time for velocity was 40 seconds.

4.5.2 Data Analysis

4.5.2.1 Data Management and Correction

The Aquarius Time Series Software (Aquarius) was used to store and make corrections to hydrology data, perform and document QA/QC, and develop rating curves for the watercourses. Discharge time series were derived from these rating curve relationships. Data uploaded to Aquarius included WSE and discharge, as well as the continuous WSE records from the barometrically compensated Levelogger data. Total precipitation data and water temperature records were also uploaded and used to interpret hydrographs.

For the hydrometric stations that had Leveloggers in place over the winters of 2018-2019 and 2019-2020, water levels were corrected for the overwinter backwater as these data were used for calibration of the regional hydrology model (EIS Appendix 9A). There is higher uncertainty in the corrected under-ice water level data, but it was reasonably assumed that water levels receded gradually over the winter under the ice until the beginning of the spring freshet, which was in mid-March in 2019 and mid-April in 2020. Water surface elevation surveys were conducted in late March 2019 at selected hydrometric stations, which allowed for accurate backwater corrections at those stations. The winter discharge records were further corrected using discharge measurements (or unit-area discharge estimates for the stations not visited in late March 2019), if required.

The WSC (2012) reference was used as a guide for all hydrometric data corrections. The following are the most common basic data corrections made for waterbody and watercourse stations:

- Stage (for watercourses) or water level (for waterbody) offset corrections to the vertical gauge datum established relative to local benchmarks. Offset corrections were made to the field stage or water level survey results.
- Drift corrections to stage or water level logger readings were made between two field survey results if required (i.e., if the logger readings differed from the corresponding field survey result by more than 0.003 m).
- Data were deleted from the record for any time period that the logger was removed from the water.
- Stage-discharge rating curves were initially fit to the stage-discharge paired data using a power equation, and the base equation or curves were adjusted over time as more data became available.
- Temporary stage-shifts were applied to the base rating curves when stage-discharge points did not fit within about 0.01 m or 5% of the base rating curve. Shifts were usually above the base rating curve when backwater conditions occurred.

As described in WSC (2012): “many factors can affect the stage discharge relationship and require its adjustment. Examples are backwater due to beaver dams, weed growth or ice and scour or deposition in the channel. In those situations, shifts are then applied to the stage-discharge relationship. Shifts are temporary adjustments to base rating that apply until the cause for the change has receded or been confirmed as permanent and a new rating is developed.”.

4.5.2.2 Rating Curve Development

Water surface elevation values were converted to stage values by subtracting a consistent offset (i.e., stage datum) at each hydrometric station; the stage datum was generally a value slightly below the minimum bed elevation at the watercourse, so that stage values were always positive and representative of the maximum water depth across the watercourse. Stage was related to discharge using an empirical equation referred to as the open water rating curve (OWRC), developed based on sets of manual stage and discharge measurements at each station.

The rating curve relating Patterson Lake WSE and lake outflow was developed based on simulations from a 1-D Hydrologic Engineering Center – River Analysis System (HEC-RAS) hydraulic model developed for the reach of the Clearwater River that separates Patterson Lake and Forrest Lake (EIS Appendix 9B). As more data were collected in 2019 and 2020, rating curves for watercourse stations were developed from the paired stage and discharge measurements.

Rating curves were developed in Aquarius and following guidance in WSC (2012). At several stations, stage-shifts were applied to correct the base rating curve to the value of stage-discharge points that were at least 0.003 m above (or less frequently, below) the curve. At CR-WC-MS-09, no stage-shifts were used, and at two stations, only small shifts were required (i.e., CR-WC-MS-01, CR-WC-MS-08), while larger stage-shifts of over 0.1 m were required at all remaining stations for at least one field visit (Appendix B). Several stations experienced seasonal backwater due to aquatic vegetation growth in the channel in the summer months or due to ice in the channel or downstream, and a few stations were occasionally backwatered by downstream waterbodies, particularly when lake water levels increased. Negative shift values indicate backwater conditions when the stage is higher for a given discharge. Stage-shifts were applied for most field visits, although not for the stage-discharge points that defined the base rating curve which had no shift applied. Stage-shifts were also occasionally applied in between field visits at transitions such as before and after spring thaw, or when backwater conditions were increasing (e.g., prior to documentation of beaver dams downstream of a station or aquatic vegetation growth, or as water levels rose in downstream waterbodies). Stage-shift reports were exported from Aquarius for most hydrometric stations for QA/QC documentation purposes (Appendix B). Anomalous stage-discharge measurements that fell below the base rating curve occurred at CR-WC-MS-03 and CR-WC-MS-04 and were corrected using positive stage shifts; more extensive effort was made in these cases to identify and resolve potential errors in WSE levelling surveys and discharge manual measurements, and that station’s time series was compared to results from other stations.

The OWRCs are based on a relatively wide range of WSE and discharge conditions that occurred, with the lowest water levels and discharges measured in 2018 and the highest water levels and discharges measured in 2020. At most stations in the LSA, field visits were conducted monthly or every two months during the open water period, with one late-winter field visit conducted in March 2019. A higher number of field visits increases confidence in the

WSE and derived discharge time series records. Hydrometric stations closest to Patterson Lake were considered the highest priority and were visited most frequently.

The OWRCs with six or fewer paired discharge-stage data points are currently classed as preliminary. These stations were not visited as often during the monitoring program, as they were considered lower priority due to their location being farther from Patterson Lake, being outside the LSA, or because they were not easy to access when ice cover was in place in early spring. Monitoring at hydrometric Station CR-WC-TI-01 was discontinued due to the station being continuously affected by beaver dams and/or Forrest Lake water levels, as well as having low flows.

4.6 Sediment

Watercourses transport solid material as suspended particles that are held in suspension by the turbulence of the flowing water, and as bed load where solid particles bounce, roll, or slide along the stream bed (Henderson 1966). Suspended and bed load sediment transport were measured periodically at key watercourse locations in the RSA downstream of Patterson Lake: hydrometric stations CR-WC-MS-03, CR-WC-MS-04, and CR-WC-MS-05. These locations had relatively uniform depths across the channel and were characterized by fine to medium sand substrate with relatively uniform ripple bed form.

4.6.1 Data Collection

Sediment data collection included repeated sampling for suspended sediment and monitoring bed load at three watercourse locations, and one-time sampling of bed material to obtain a particle size distribution for the stream beds.

Suspended sediment measurements involved collecting surface water samples from the watercourses using grab samples from the middle of the water column. The samples were submitted to the Saskatchewan Research Council in Saskatoon for laboratory analysis of TSS. Duplicate TSS samples were taken during the 2018 field visits and were within acceptable margin of error, and duplicate samples were not taken in 2019 or 2020 field visits.

Bed load sampling was initially attempted at each of the three hydrometric stations in August 2018 using a Helley-Smith handheld wading bed load sampler with a large nylon mesh sediment collection bag. Instantaneous bed load sampling was initially conducted in a uniform cross-section at several equally spaced points across each station cross-section for a period of 10 minutes at each point. However, this method did not collect a measurable amount of sediment at any of the three stations. The Helley-Smith sampler is known to be unsuitable for characterizing bed load of some streams and bed forms based on the median diameter of bed material measured < 1.0 mm at these locations (Section 5.4.1) (Pickering 1979; Boning 1990). Once these results were obtained in 2018, no further attempts were made to use the Helley-Smith sampler.

For subsequent field visits, a test sample was completed at a higher velocity location at each station to determine if there was enough bed load transport occurring over a period of 60 minutes to warrant further sampling at lower velocity locations. If a measurable amount of bed load was not collected over a 60-minute period, a measurement of “Not Detected” was assigned and no further sampling was completed at lower velocity locations. During the field visits in 2019 (all three stations) and June 2020 (CR-WC-MS-03 only), an alternative bed load transport monitoring method was used whereby a square aluminum plate, with 0.25 m sides and thickness of about 0.007 m, was installed flush with the stream bed with a sampling bag at the downstream end. This plate and sample bag were left in place for a longer period of time (i.e., 1 hour to 38 hours depending on the site visit), and the sediment that migrated onto the plate or into the bag during that time was collected and rinsed into a plastic sampling bag, labelled, and double bagged.

The width of the plate perpendicular to the flow direction was used to estimate the total load over the sampling period. The total bed load material sampled was then submitted to the WSP soils laboratory in Saskatoon as a single composite sample to determine the sample dry weight. Only sampling periods exceeding 24 hours yielded sufficient sediment mass to submit for laboratory analysis; a mass of 300 g is normally required to conduct a sieve test.

For all visits following June 2020, a similar method of extended duration was used with the Helley-Smith handheld wading bed load sampler instead of the square aluminum plate. The width of the Helley-Smith sampler perpendicular to the flow was used to estimate the total load over the sampling period. The sampler was left in place for similar durations (i.e., 1 hour to 38 hours depending on the site visit) with the exception of July 2020 at CR-WC-MS-04, when it was deployed for approximately 67 hours due to thunderstorms and monitoring prioritizing.

Representative bed substrate samples were also collected at hydrometric stations CR-MS-WC-03, CR-MS-WC-04, and CR-MS-WC-05 in 2018 to characterize bed material grain size distribution. Bed material samples were collected with a shovel and sediment bag, double bagged, labelled, and submitted to the WSP soils laboratory in Saskatoon for particle size analysis. A combination of sieve method and the hydrometer method was used to test a subset of each sample to determine the particle size distribution.

4.6.2 Data Analysis

When sufficient sample was collected during bed load sampling as described in Section 4.6.1, the sediment samples were submitted to the WSP soils laboratory in Saskatoon to obtain the particle size distribution results. Channel bed substrate particle size was determined using standard laboratory methods and was based on combined mechanical sieve and hydrometer methods.

The TSS concentrations were analyzed by an accredited laboratory using a standard gravimetric TSS analytical method for the examination of water and wastewater (APHA-AWWA-WEF 2018). The detection limit used in the analyses was 1 mg/L.

Bed load sediment data were collected, reviewed, and related to stream parameters including channel width, velocity, and discharge. Bed load sediment concentrations (C_{SED}) were calculated as follows:

$$C_{SED}=\frac{M_{Dry}}{Q\times t\times 1000}$$

Where, C_{SED} = bed load sediment concentration (mg/L), M_{Dry} = sample mass dry weight (mg), Q = discharge (m^3/s), and t = sample collection time (s). Daily total sediment loads were also calculated based on the dry mass of the samples collected relative to sampler width and multiplied by the total channel width.

$$SL=\left(\frac{M_{Dry}}{W\ \times t}\right)W_b$$

Where, SL = bed load (tonnes/day), M_{Dry} = oven dried sample mass (tonnes), W = sampler width (m), t = sample collection time (days), W_b = total channel width (m).

Suspended sediment, bed load, and channel substrate results obtained are provided in Section 5.4.

4.7 Quality Assurance and Quality Control

Quality assurance (QA) and quality control (QC) practices determine data integrity and are relevant to all aspects of the study, from sample collection to data analysis and reporting. The QA encompasses management and technical practices designed to confirm that the data generated are of consistent high quality. The QC is an aspect of QA and includes the procedures used to measure and evaluate data quality, and the corrective actions to be taken when data quality objectives are not met.

The QA/QC information for the main components of this study is outlined in this section.

4.7.1 Meteorological Data

The meteorological station instrumentation, including the Geonor gauge, was installed according to manual specifications by experienced technical staff. This instrumentation was installed at standard heights above ground and considering fetch distances (i.e., un-obstructed distance over which the wind blows) relative to forested areas and occupied buildings. Meteorological data were reviewed by qualified staff. Details on the meteorological instrumentation and data collection are provided in Section 4.3.

4.7.2 Snow Surveys

Standard techniques were used for the snow surveys completed in late winter of 2018 and 2019 (Section 4.4). Detailed work instructions including proposed snow survey locations, and maps were provided to the field crew prior to the surveys. Care was taken to avoid placement of snow survey plots within 50 m of a disturbed area such as a road.

Soil plugs were obtained at the base of the snow cores wherever possible to reduce underestimation of snow density through verification of reaching the soil layers below. If snow was observed to be lost from a core when it was removed from the snowpack, a second replacement snow core was taken. The scales used for measuring weight of the snow cores were calibrated with standard weights prior to the surveys, and the scale was zeroed regularly in the field.

4.7.3 Hydrometric Monitoring

Field equipment was calibrated throughout the field programs, following manufacturer specifications, and all samples were collected by experienced personnel. Specific work instructions outlining each field task in detail were provided to, and followed by, field personnel. Field notes were recorded in waterproof field books and on pre-printed waterproof field data sheets in either pencil or indelible ink. Data sheets were checked at the end of each field day for completeness and accuracy and were scanned into electronic copies at the completion of the field program.

To provide QA on levelling surveys of water surface elevations, two levelling surveys were completed at each station during each field visit so that WSE results could be compared; for most field visits, the surveys were started and finished on the primary benchmark to provide additional confidence in the WSE results. If the results of the two levelling surveys differed by 0.005 m or less, then that was considered a good result; differences of up to 0.010 m were considered adequate. If lake conditions were windy and wavy, the WSE levelling survey and staff gauge readings were not always within the 0.010 m accuracy, and these weather conditions and reading instances were documented when they occurred. Section 4.5.1 provides further discussion on data QA and checking effort, and Section 5.5 discusses data confidence and uncertainties for these measurements.

Discharge during the field visits was measured with a Sontek Flowtracker ADV, Flowtracker2 ADV, and RiverSurveyor M9 Acoustic Doppler current profiler (ADCP). These devices do not require recalibration; however, QA tests were completed prior to starting measurements and a compass calibration was completed for the ADCP before use. Quality control measures were applied to the ADCP and ADV results following the field programs to check the following:

- the correct offsets and magnetic declination were used for the ADCP;
- there was minimal missing data;
- depth and velocity measuring spacing for the measurements were logical;
- the ADCP speed did not greatly exceed stream velocity;
- the ADCP tilt, pitch, and roll were minimal;
- each ADCP discharge measurement accepted was within 5% of the averaged discharge measurements; and
- the ADV percent uncertainty, number of measurement verticals, and measurement flags were reviewed.

All field data were transcribed into an online database. Data entry, summary tables, and statistical analyses were reviewed by a second qualified scientist or engineer.

Hydrometric program data collection methods are provided in detail in Section 4.5.

4.7.4 Sediment Sampling and Measurements

Suspended sediment sampling and bed load measurements were obtained during the baseline program period along the Clearwater River downstream of Patterson Lake (Section 4.6).

As mentioned in Section 4.6, an external laboratory was used to obtain water sample results for TSS, and a detection limit of 1 mg/L was used for all the tests. Chain-of-custody forms were used to track shipment and receipt of samples submitted to laboratories. Standard test methods were used. Results from duplicate samples for TSS from fall 2018 were identical and usually not detectable or very low. Due to this, duplicate TSS samples were not taken in 2019 or 2020 field visits.

The particle size analysis and dry weight of bed load samples were submitted to a qualified soils laboratory and standard methods were used. Additional QA/QC methods included using specific work instructions for every field visit to provide detailed instructions to the field crew, and field data were reviewed following each field trip.

5.0 RESULTS

5.1 Meteorological Data

Monthly total precipitation in the anticipated area of the Project in 2018 to 2020 are presented in Figure 6 alongside long-term European Re-analysis Interim (ERAI) data to provide historical context. In Figure 6, the schematic plot describes the variability of monthly precipitation over a 42-year period from 1979 to 2020. In Figure 7, 2018 to 2020 monthly average air temperature is presented with historical variability in the anticipated area of the Project over a 42-year period from 1979 to 2020. The length of the box in the plots represents the inter-quartile range (i.e., 25th and 75th inter-quartiles), with the median denoted by the horizontal line within the box. The whiskers represent the minimum and maximum values of the central 50% of the dataset. Any outliers are represented by "+" sign.

In 2018, observed precipitation at Rook I Meteorological Station was below normal in every month except June, November, and December. In 2019, observed precipitation was also below normal in every month except May, August, November, and December. In August 2019, total precipitation at Rook I Meteorological Station was 206.4 mm, which exceeded the maximum August precipitation in the ERAI records in the anticipated area of the Project and was about three times higher than the mean August precipitation of 73.1 mm. The largest rainfall events at Rook I Meteorological Station occurred over multiple days: 56 mm of rainfall between 1 August 2019 and 3 August 2019, and 92 mm between 17 August 2019 and 18 August 2019.

Total annual precipitation in the anticipated area of the Project was 361.6 mm in 2018, 495.3 mm in 2019 measured up to 26 October 2019, and 603.4 mm in 2020 measured from 29 April 2020 to 3 November 2020. Precipitation data from 26 October 2019 to 28 April 2020 appeared erroneous and were well above other regional meteorological station data; therefore, the data have been intentionally omitted. Mean annual precipitation was 531 mm for the years 1979 to 2019 based on ERAI data. Hence 2018, and possibly also 2019, was below the long-term average value, and 2020 was above the long-term average value.

Monthly average air temperatures in 2018 to 2020 are presented in Figure 7, alongside historical temperatures for the anticipated area of the Project from 1979 to 2019 based on ERAI data. In general, observed air temperatures in 2018 and 2019 followed long-term average conditions with occasional exceptions.

Figure 6: Monthly Precipitation Records for 2018 to 2020 at Rook I Meteorological Station Compared to Long-Term ERAI Records (1979 to 2019)

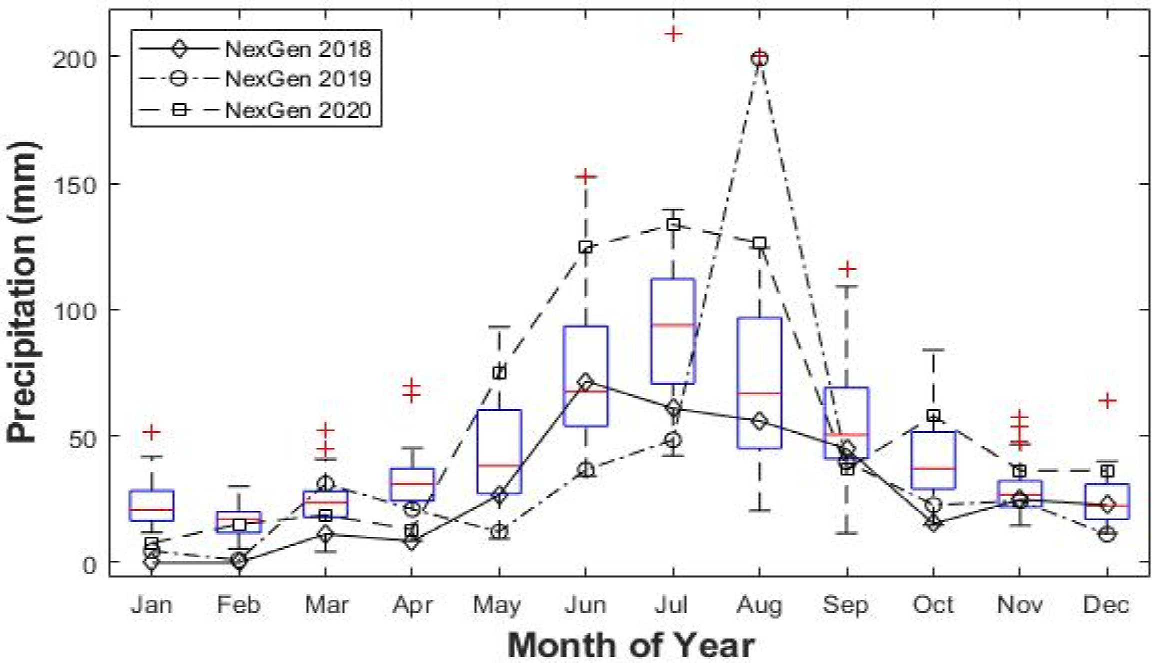
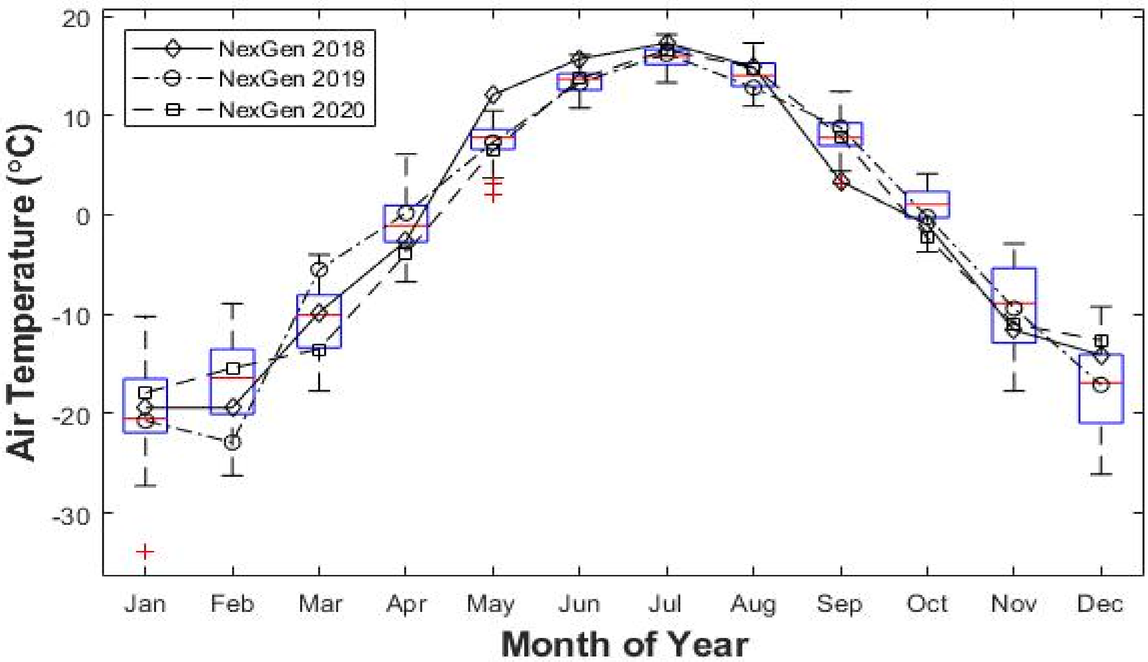


Figure 7: Monthly Air Temperature Records for 2018 to 2020 Relative to Long-Term (1979 to 2019) Records



5.2 Snow Surveys

Snow survey results for the Patterson Lake watershed, collected between 15 April 2018 and 17 April 2018 and between 21 March 2019 and 23 March 2019, are presented in Table 6. Detailed snow survey results are included in Appendix C, Snow Survey Data.

The average SWE on the ground on 17 April 2018 (i.e., at the end of the 2018 snow survey) for all terrain types, not weighted by area, was 78.5 mm and ranged from 31.3 mm to 104.5 mm. The average SWE on the ground on 23 March 2019 (i.e., at the end of the 2019 snow survey) for all terrain types, not weighted by area, was 75.5 mm and ranged from 62.8 mm to 91.5 mm. The area-weighted SWE for the Patterson Lake watershed was estimated to be 74.0 mm in 2018 and 70.0 mm in 2019. This corresponds to an estimated snowpack available for melt of 19.6 million cubic metres (Mm^3) in 2018 and 18.4 Mm^3 in 2019 in the Patterson Lake watershed. The total volume of snow available for melt was expected to have peaked in advance of the field surveys in both 2018 and 2019.

Based on the weather and observations made during both years' snow surveys, some melt likely occurred prior to the surveys; therefore, these results likely underestimate the volume available for melt in Patterson Lake watershed. Additionally, no adjustment was made to account for sublimation losses between the time of the surveys and when the snowpack had fully melted, although blowing snow-sublimation losses would have been minimal as snowmelt had started and losses to wind-blown sublimation are typically minimal once melting of the snowpack begins. In spring 2018, snowmelt occurred relatively soon after the survey; therefore, this loss may have been small. In spring 2019, the spring freshet extended from the initial melt in March to early or mid-May; therefore, additional sublimation losses would be expected. No survey was conducted in 2020.

Table 6: Snow Survey Summary Results, April 2018 and March 2019

Terrain Type	2018			2019		
	Sample Mean Depth (cm)	Sample Mean Density (g/cm^3)	Sample SWE (mm)	Sample Mean Depth (cm)	Sample Mean Density (g/cm^3)	Sample SWE (mm)
Lake	22.0	0.14	31.3	22.9	0.33	75.1
Lake Edge	47.9	0.16	78.8	26.3	0.29	75.7
Terrestrial: flat, low slope[(a)]	65.3	0.14	87.6	29.5	0.24	69.8
Terrestrial: north, low slope	61.3	0.14	88.4	32.9	0.19	64.1
Terrestrial: north, 10° to 33°	60.3	0.15	88.5	37.7	0.24	91.5
Terrestrial: west, low slope	84.0	0.14	104.5	31.6	0.26	78.0
Terrestrial: west, 10° to 33°	58.4	0.11	68.4	35.3	0.24	86.5
Terrestrial: south, low slope	51.6	0.13	70.0	31.0	0.22	65.2
Terrestrial: south, 10° to 33°	43.7	0.16	70.7	24.0	0.30	70.9
Terrestrial: east, low slope[(b)]	70.8	0.12	87.5	31.7	0.21	62.8
Terrestrial: east, 10° to 33°	70.8	0.12	87.5	43.0	0.21	91.1
All Types	**57.8**	**0.14**	**78.5**	**31.4**	**0.25**	**75.5**

a) No sample points were collected for Terrestrial: Flat, Low Slope terrain type and was assumed to be the average of low slope observations in all directions.

b) In 2018, Terrestrial: East, Low Slope was assumed to be the same as Terrestrial: East, High Slope as the results are similar to observations for north facing slopes in 2019.

SWE = snow water equivalent.

For late winter 2020, SWE values for the Patterson Lake watershed were estimated using data collected from regional remote sensing data and ground-based methods. Ground-based methods are important in validating the remote sensing data.

Comparison of local snow survey results to regional SWE conditions was possible based on publicly available regional measurements, as well as remotely sensed maps of SWE. Publicly available measurements of SWE are available at Gordon Lake Lookout snow pillow station. At the time of snow surveys from 15 April 2018 to 17 April 2018, SWE at Station 07CE801 was relatively stable at around 128 mm, and from 6 March 2018 to 19 April 2018, SWE at Station 07CE801 generally exceeded 120 mm. These values are much higher than the 74 mm of weighted SWE average measured at the anticipated area of the Project on the same dates. This is likely due to differences in snow pack at the two locations.

In 2019, peak SWE of 93 mm occurred at Station 07CE801 on 20 March 2019. At the time of snow surveys from 21 March 2019 to 23 March 2019, SWE was slightly lower than the peak and steadily melting such that it decreased from 86 mm to 67 mm over the three-day period. These values are similar to the 70 mm of weighted SWE average measured at the anticipated area of the Project on the same dates.

In 2020, peak SWE of 127 mm occurred at Station 07CE801 on 12 April 2020. From 1 April to 2020 to 17 April 2020, SWE of 120 mm or greater was sustained, followed by steady snowmelt beginning 21 April 2020 and ending 27 April 2020. No local snow surveys were completed in 2020 that could be compared with regional values.

Additional regional context was gained by reviewing weekly estimates of SWE for the Canadian Prairie provinces published by ECCC, accessed through CCIN (CCIN 2020; ECCC 2020b). Weekly snapshots from the expected peak annual condition between 22 March 2018 and 1 April 2018 up to the time of the snow survey show that snow ablation (i.e., reduction) and snow melt likely began before the snow survey (Figure 8a to Figure 8d). In Figure 8, the anticipated area of the Project is indicated in the weekly snapshots by a black star in northwest Saskatchewan. The estimated SWE in place on 15 April 2018 validates the SWE shown in Figure 8c for the anticipated area of the Project, which is approximately 70 mm. The peak SWE of between 100 mm and 110 mm occurred the week of 1 April 2018. This value is close to the peak SWE in 2018 of 124 mm estimated using Global Snow Monitoring for Climate Research (GlobSnow) data (ESA 2020) for the anticipated area of the Project and is close to the long-term average peak SWE of 115 mm using the GlobSnow data for 1980 to 2019 (ESA 2020).

In winter 2019, weekly snapshots were obtained for dates between 22 February 2019 and 1 April 2019 that include the peak annual SWE and the timing of the snow survey (CCIN 2020; ECCC 2020b).

Figure 9 includes six snapshots that show snow ablation and melt had likely started before the snow survey was completed. The estimated SWE on 21 March 2019 validates the SWE shown in Figure 9 for the anticipated area of the Project, which appears to be roughly between 80 mm and 90 mm. The peak SWE of between 100 mm and 110 mm appears to have occurred during the week of 1 March 2019. This is close to the peak SWE in 2018 of 119 mm estimated using GlobSnow data (ESA 2020) for the anticipated area of the Project, and is close to the long-term average peak SWE of 115 mm.

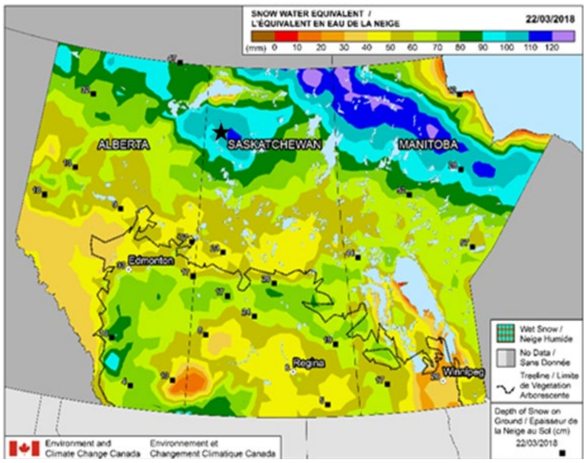
In winter 2020, weekly snapshots in late-winter 2020 were obtained for dates between 22 February 2020 and 22 April 2020 that include the peak annual SWE (CCIN 2020; ECCC 2020b).

Figure 10 includes nine snapshots that show that snow ablation and melt likely began in mid-April 2020, which is similar to GlobSnow and Station 07CE801. Peak snowpack between 100 mm and 110 mm is validated by GlobSnow data, which has a maximum value of 115 mm. GlobSnow and ECCC values are slightly lower than those for Station 07CE801.

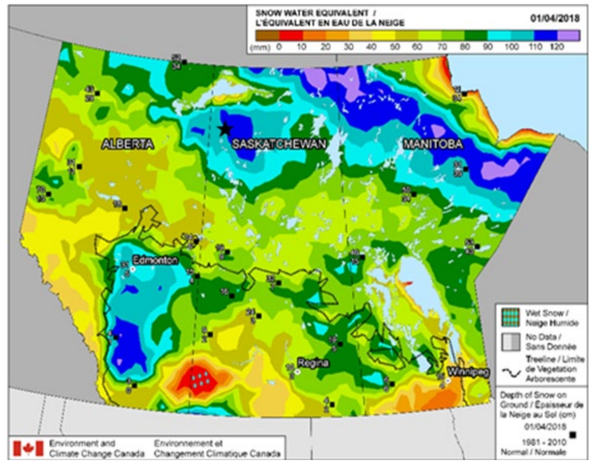
Based on the comparison of results in previous years, SWE at the anticipated area of the Project can be adequately approximated using the remote sensing data for 2020.

Figure 8: Weekly Snow Water Equivalent Estimates, March and April 2018

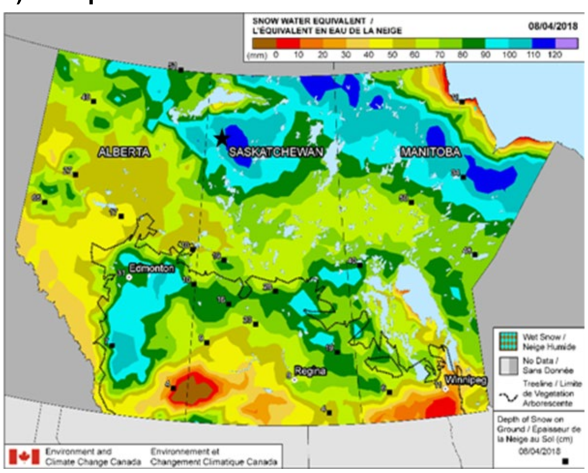
a) 22 March 2018



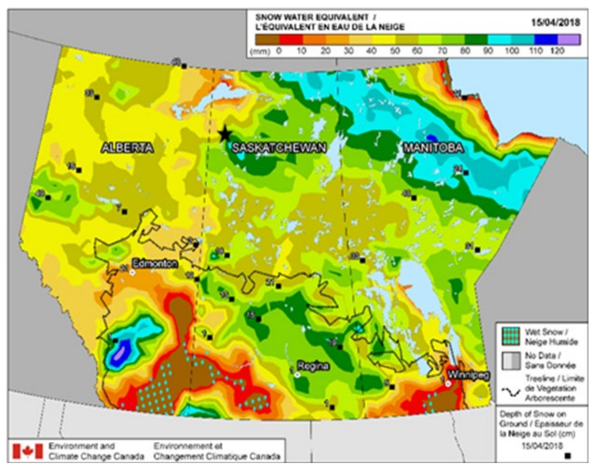
b) 1 April 2018



c) 8 April 2018



d) 15 April 2018

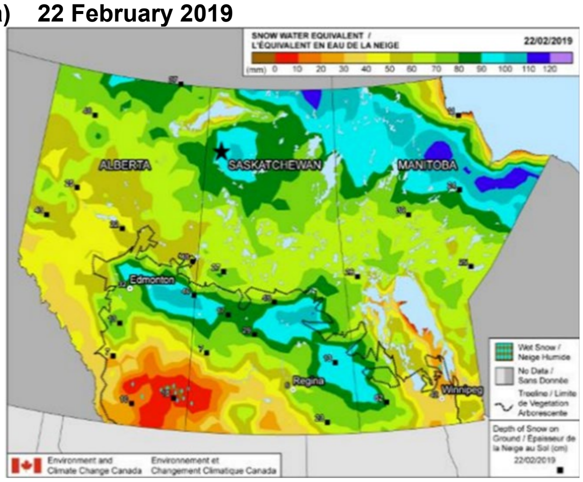


Source: ECCC 2020b.

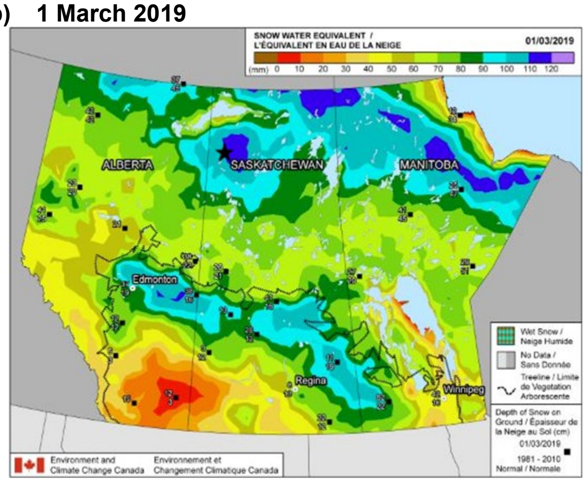
Note: Project location is indicated in the snapshots by a black star immediately northwest of the label for Saskatchewan.

Figure 9: Weekly Snow Water Equivalent Estimates, February to April 2019

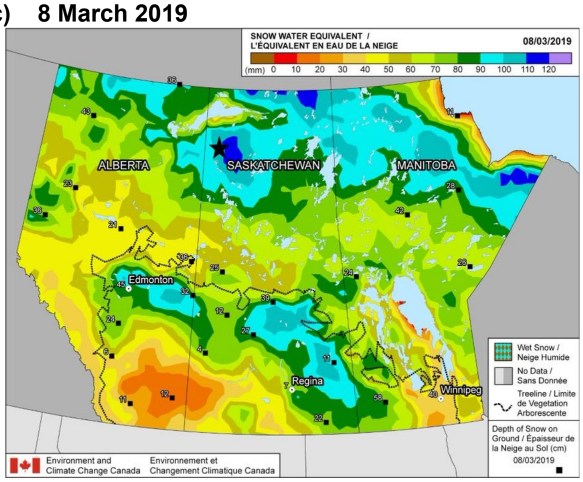
a) **22 February 2019**



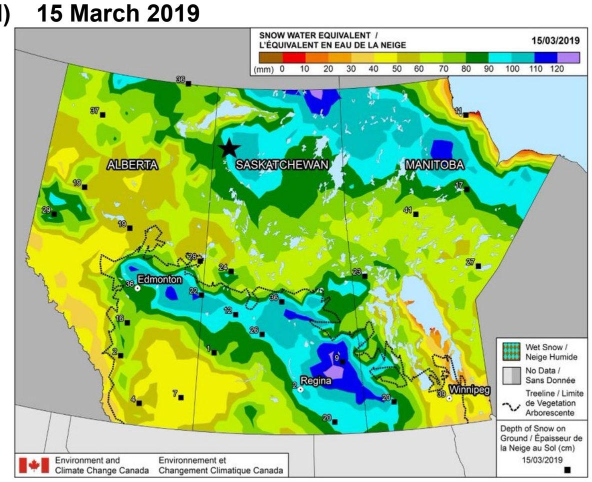
b) **1 March 2019**



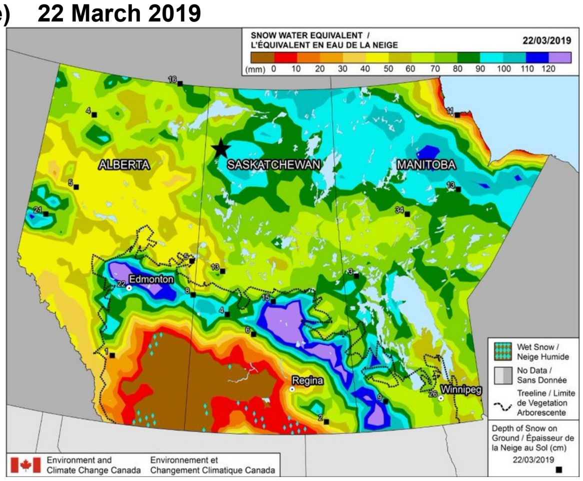
c) **8 March 2019**



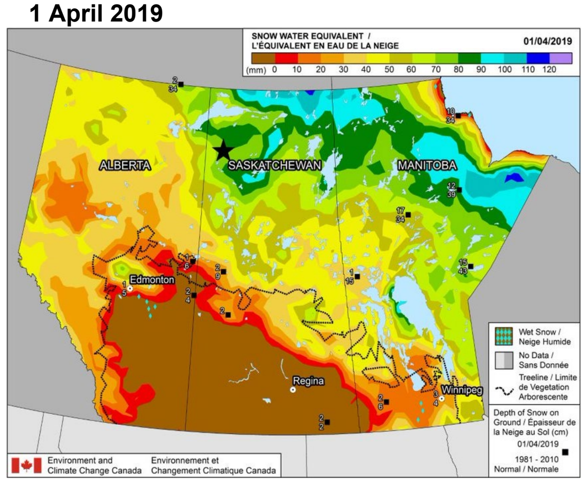
d) **15 March 2019**



e) **22 March 2019**



f) **1 April 2019**

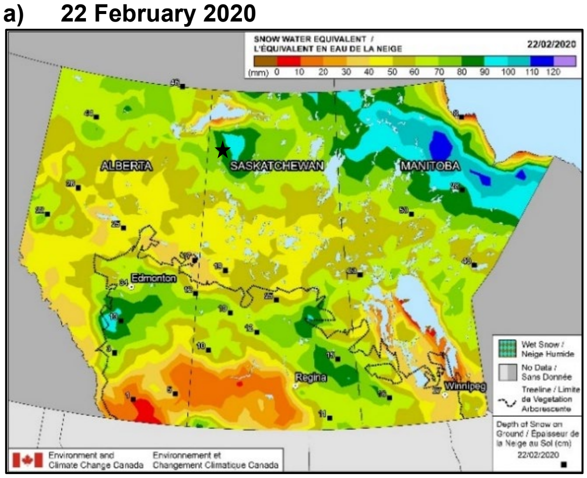


Source: ECCC 2020b.

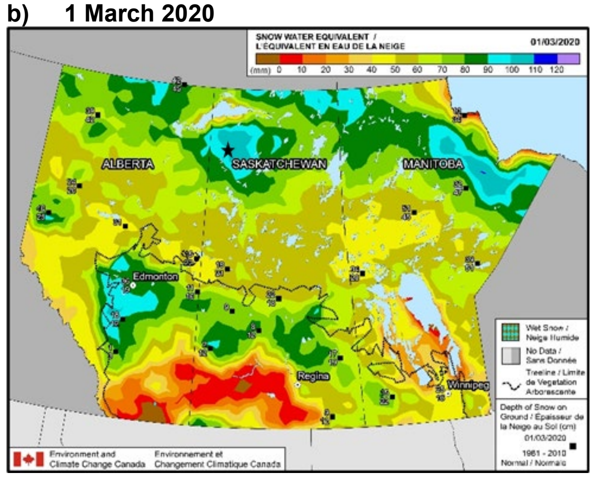
Note: Project location is indicated in the snapshots by a black star immediately northwest of the label for Saskatchewan.

Figure 10: Weekly Snow Water Equivalent Estimates, February to April 2020

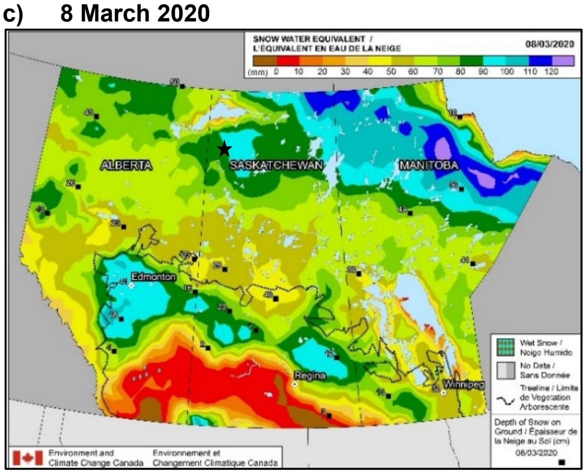
a) 22 February 2020



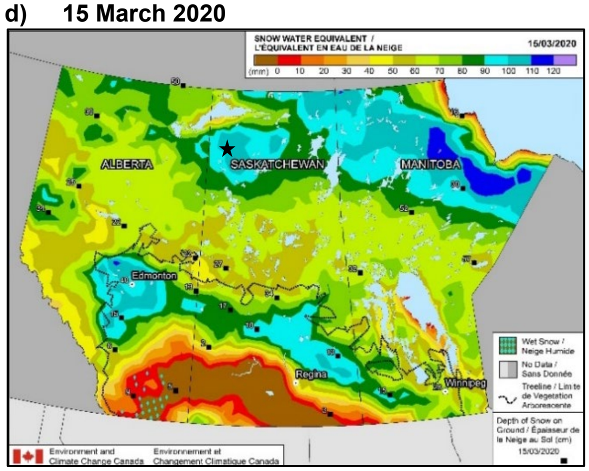
b) 1 March 2020



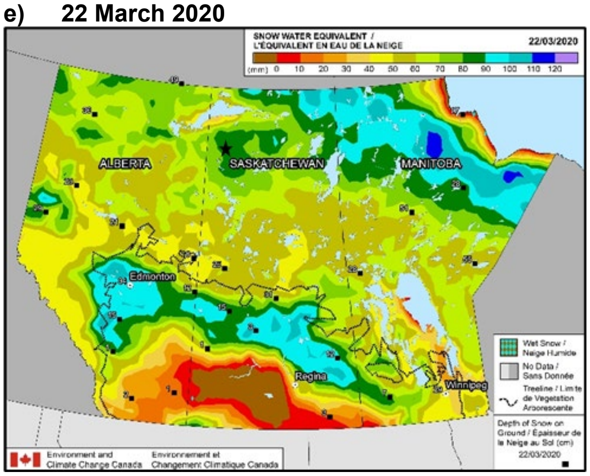
c) 8 March 2020



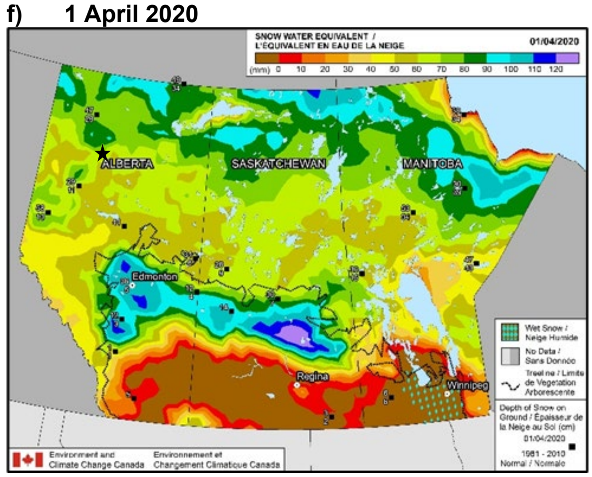
d) 15 March 2020



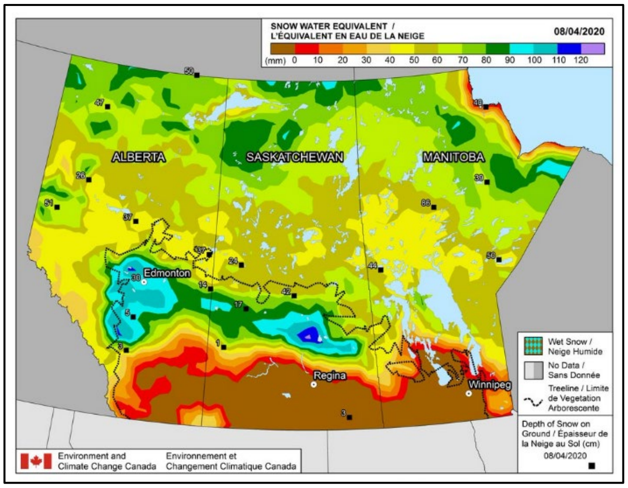
e) 22 March 2020



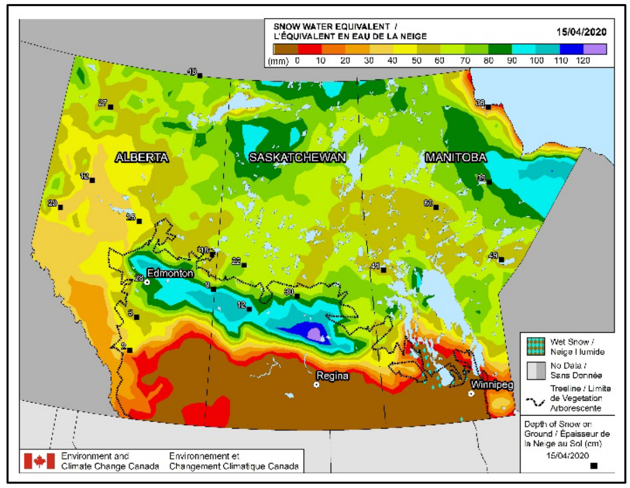
f) 1 April 2020



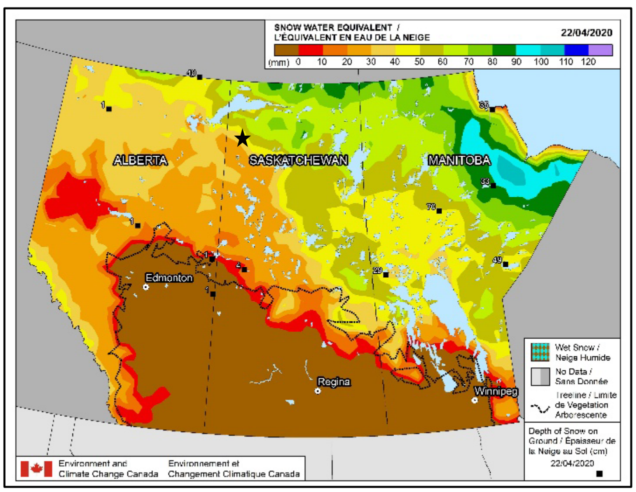
g) 8 April 2020



h) 15 April 2020



i) 22 April 2020



Source: ECCC 2020b.
Note: Project location is indicated in the snapshots by a black star immediately northwest of the label for Saskatchewan.

5.3 Hydrometric Monitoring

5.3.1 Watercourse Hydrometric Monitoring

Discharge and WSE data collected for each hydrometric station during the 2018 to 2020 hydrology field programs are provided in the following subsections. Daily mean WSE and discharge data are included in Appendix D, Hydrometric Monitoring Daily Data.

Only paired WSE and discharge measurements that were considered to be unaffected by backwater were used to develop the OWRC base curve equation. Stage-shifts were applied to the stage-discharge points that were affected by backwater. Small stage-shifts were applied to the OWRC to improve the derived discharge time series; the rating curve stage-shift report is included in Appendix B.

5.3.1.1 Station CR-WC-MS-01: Clearwater River below Broach Lake

Hydrometric monitoring work at the Clearwater River below Broach Lake (i.e., CR-WC-MS-01) began in 2018 in support of the hydrological baseline. The station is located approximately 20 m downstream of the Broach Lake outlet (Figure 3) and is shown in Figure 11. The field results for CR-WC-MS-01 are summarized in Table 7.

The OWRC, calibrated using available field measurements, is shown in Figure 12. A wide range of WSE (i.e., 0.296 m) and discharge (i.e., 0.140 m^3/s to 0.631 m^3/s) were measured during the monitoring period from August 2018 to September 2020, as shown in Table 7. This hydrometric station is located in the Clearwater River Upper Reach, which has a relatively higher slope than reaches farther downstream and may only experience minor backwater from terrestrial vegetation such as sweet gale (*Myrica gale*) hanging over the channel banks, as shown in Figure 11, or due to ice cover in winter. Based on the quality of discharge measurements and good fit of the stage-discharge rating curve over a wide range of conditions, the derived discharge records provide a good representation of baseline conditions at this location.

The daily mean WSE and discharge series derived from the Levelogger and OWRC, along with observed precipitation and air temperature, are presented in Figure 13.

Table 7: Summary of Hydrometric Monitoring Results, CR-WC-MS-01

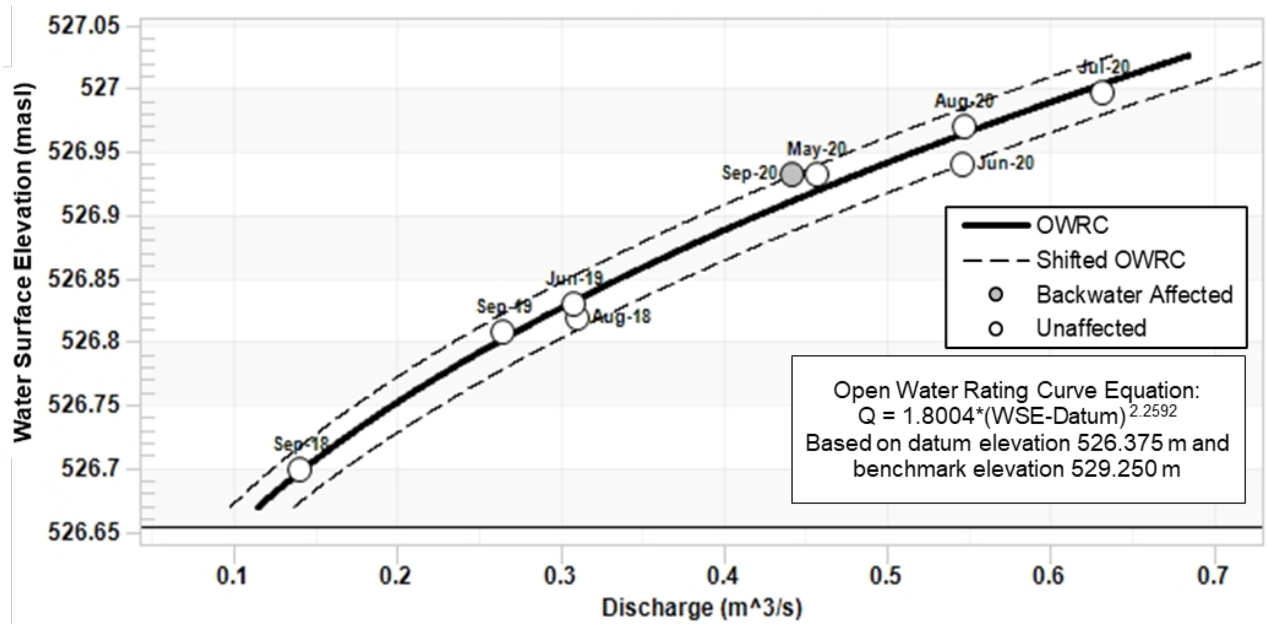
Date and Time	WSE[(a)] (masl)	Staff Gauge Reading (m)	Discharge (m^3/s)
7 August 2018 14:30	526.819	0.288	0.310
30 September 2018 17:50	526.701	0.170	0.140
4 June 2019 12:15	526.831	0.295	0.307
29 September 2019 14:00	526.808	0.265	0.264
3 May 2020 08:00	526.933	0.382	0.465
6 June 2020 14:27	526.940	0.394	0.546
11 July 2020 14:45	526.997	0.453	0.631
22 August 2020 10:16	526.970	0.423	0.547
24 September 2020 15:15	526.932	0.395	0.441

a) Water surface elevation (WSE) measured by levelling survey relative to rebar benchmark, CR-WC-MS-01_BM1.
masl = metres above sea level.

Figure 11: Clearwater River at CR-WC-MS-01

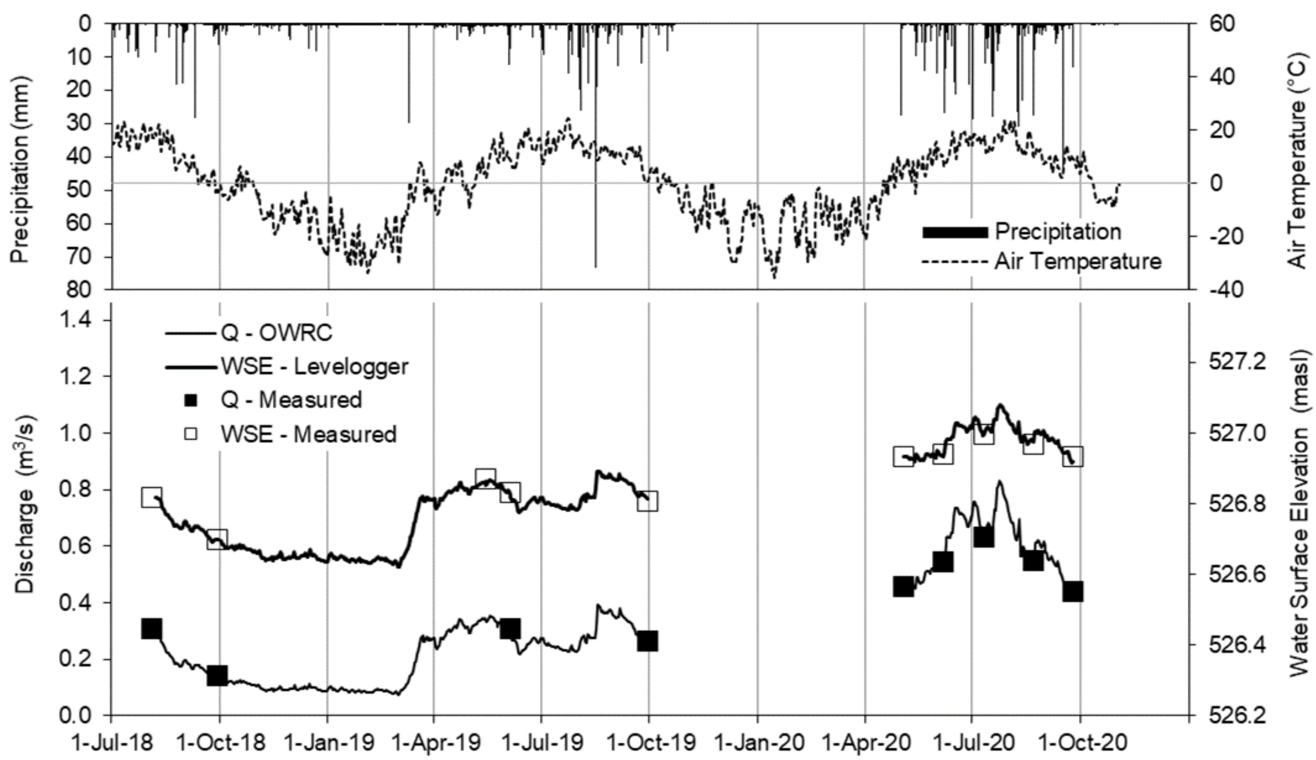
Note: View of CR-WC-MS-01 from the discharge transect on 24 September 2020; view is facing upstream (west).

Figure 12: Open Water Rating Curve for CR-WC-MS-01



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

Figure 13: CR-WC-MS-01 Water Surface Elevation and Discharge, 2018 to 2020



OWRC = open water rating curve; Q = discharge (m^3/s) WSE = water surface elevation.

5.3.1.2 Station CR-WC-MS-02: Clearwater River above Patterson Lake

Hydrometric monitoring at the Clearwater River above Patterson Lake (i.e., CR-WC-MS-02) began in August 2018. The station is located about 60 m upstream of Patterson Lake (Figure 3) and is shown in Figure 14. The field results for CR-WC-MS-02 are summarized in Table 8. The OWRC base curve equation was fit to the spring 2019 and spring 2020 field measurements that were unaffected by backwatering from Patterson Lake as shown in Figure 15. There was extensive backwater at this station once Patterson Lake levels increased following spring freshet, particularly in 2020 as the lake levels remained relatively high.

As this station has uniform water depth and velocities at its gauge location, the nine discharge measurements made with an ADV between August 2018 and September 2020 had good accuracy. A wide range of WSE (i.e., 0.315 m) and discharge (i.e., from 0.400 m^3/s to 2.54 m^3/s) were measured during the monitoring period, which provides confidence in the derived discharge time series as shown in Table 8.

The daily mean WSE and derived discharge time series, along with observed precipitation and air temperature, are presented in Figure 16.

Table 8: Summary of Hydrometric Monitoring Results, Station CR-WC-MS-02

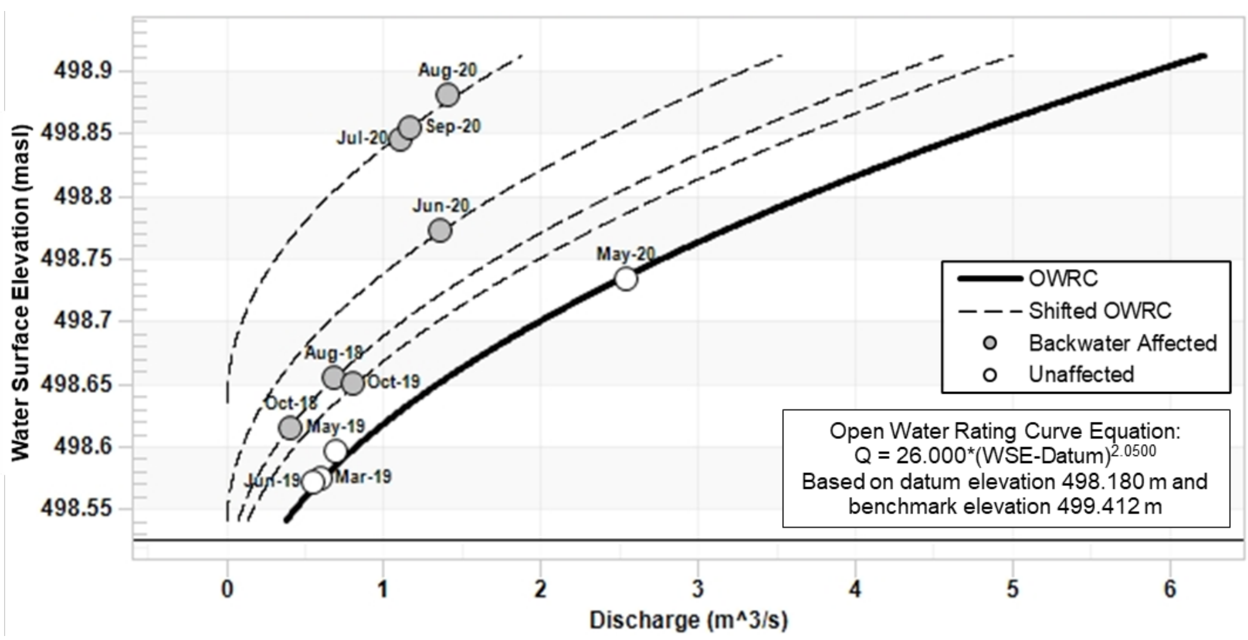
Date and Time	WSE[a] (masl)	Staff Gauge Reading (m)	Discharge (m^3/s)
6 August 2018 11:00	498.656	n/d	0.680
2 October 2018 11:42	498.615	n/d	0.400
25 March 2019 11:00	498.575	0.465	0.600
6 May 2019 17:15	498.597	0.487	0.693
3 June 2019 16:50	498.573	0.478	0.553
1 October 2019 13:00	498.651	0.555	0.806
4 May 2020 07:45	498.734	0.674	2.54
4 June 2020 17:10	498.773	0.723	1.36
9 July 2020 14:40	498.845	0.762	1.11
19 August 2020 15:09	498.882	0.808	1.40
24 August 2020 09:20	498.888	0.805	n/d
23 September 2020 13:59	498.856	0.785	1.16

a) Water surface elevation (WSE) measured by levelling survey using rebar benchmark, CR-WC-MS-02_BM1.
n/d = no measurement.

Figure 14: Clearwater River at Station CR-WC-MS-02

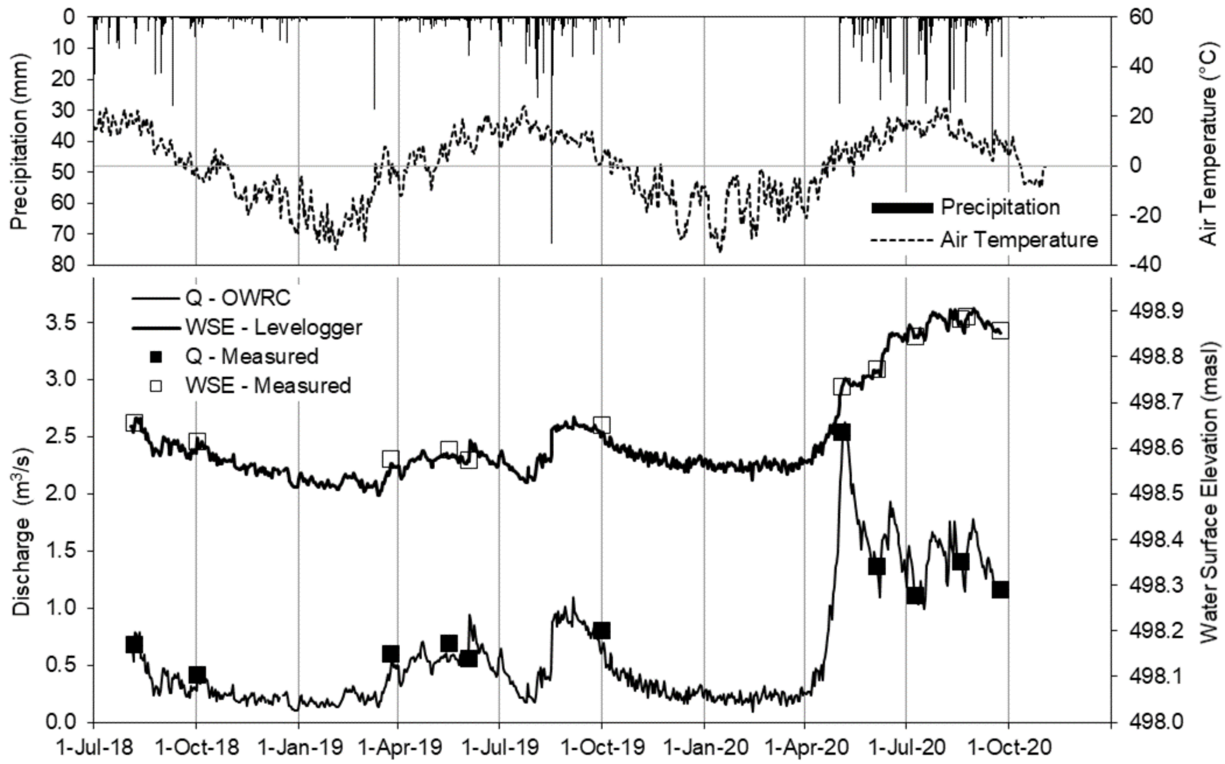
Note: View of CR-WC-MS-02 on 23 September 2020; view is facing upstream (northeast).

Figure 15: Open Water Rating Curve for Station CR-WC-MS-02



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

Figure 16: Station CR-WC-MS-02 Water Surface Elevation and Discharge, 2018 to 2020



OWRC = open water rating curve; Q = discharge; WSE = water surface elevation.

5.3.1.3 Station CR-WC-MS-03: Clearwater River below Patterson Lake

Hydrometric monitoring at the Clearwater River below Patterson Lake (i.e., CR-WC-MS-03) began in August 2018. The hydrometric monitoring station is located approximately 100 m downstream of the Patterson Lake outlet and 10 m upstream of the access road bridge (Figure 3), and is shown in Figure 17. The field results for CR-WC-MS-03 are summarized in Table 9.

Table 9: Summary of Hydrometric Monitoring Results, Station CR-WC-MS-03

Date and Time	WSE(a) (masl)	Staff Gauge Reading (m)	Discharge (m^3/s)	TSS (mg/L)	Bed Load (mg/L)
4 August 2018 14:30	498.584	0.320	1.16	<1	0
29 September 2018 17:50	498.496	0.180	0.983	<1	0
26 March 2019 14:27	498.536	0.288	0.984	n/d	n/d
15 May 2019 17:15	498.534	0.290	1.46	n/d	n/d
18 May 2019 16:45	498.531	0.290	1.42	<1	0
4 June 2019 17:15	498.533	0.291	1.33	<1	0
30 September 2019 16:00	n/d	n/d	n/d	<1	0
30 September 2019 16:30	498.564	0.322	1.17	n/d	n/d
2 May 2020 20:03	498.661	0.430	1.59	n/d	n/d
3 May 2020 10:30	498.669	0.445	1.56	n/d	n/d
4 May 2020 15:00	498.688	0.465	1.62	n/d	n/d
6 June 2020 17:00	498.758	0.517	2.22	n/d	n/d
8 June 2020 08:32	n/d	n/d	n/d	<1	0
10 July 2020 16:18	498.794	0.550	2.35	n/d	n/d
14 July 2020 07:33	n/d	n/d	n/d	1	0
23 August 2020 15:24	498.842	0.602	2.32	n/d	n/d
24 August 2020 11:15	498.845	0.600	n/d	n/d	n/d
25 August 2020 07:48	n/d	n/d	n/d	<1	0
26 September 2020 14:57	498.831	0.590	2.16	<1	n/d
28 September 2020 10:15	n/d	n/d	n/d	<1	0

a) Water surface elevation (WSE) measured by levelling survey using rebar benchmark, CR-WC-MS-03_BM1.

TSS = total suspended solids; n/d = no data; masl = metres above sea level; < = less than.

Figure 17: Clearwater River below Patterson Lake, Station CR-WC-MS-03

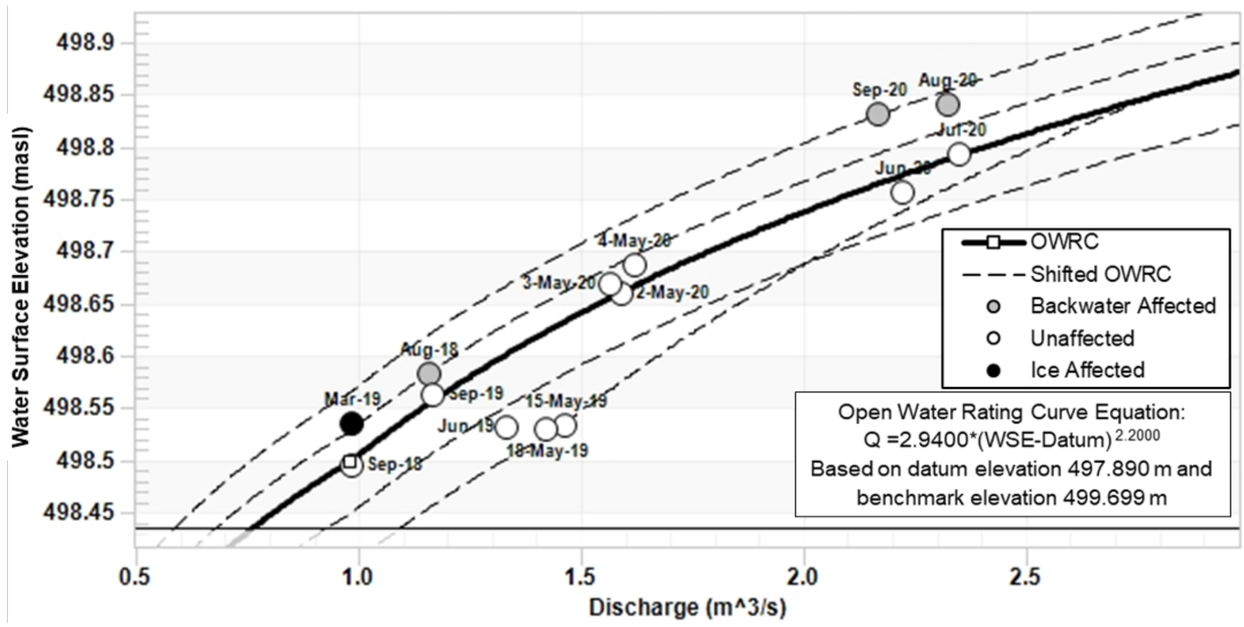
Note: View of CR-WC-MS-03 measurement cross-section and bed load sample location 26 September 2020 facing upstream (west).

The OWRC for CR-WC-MS-03 was developed using a calibrated 1-D HEC-RAS hydraulic model for the Clearwater River reach between Patterson and Forrest lakes. The rating curve relates the WSE of Patterson Lake to discharge at the outlet with the WSE elevations from the station location. The OWRC and field measurements are shown in Figure 18. The rating curve is supported by 14 coincident stage-discharge measurement points, as this was the most frequently visited station due to its importance as the outflow of Patterson Lake. There were 15 levelling surveys completed between August 2018 and September 2020. Three stage-discharge points measured in May 2019 and June 2019 were below the base rating curve and no levelling or discharge error or physical cause was identified; therefore, this issue was resolved for the derived discharge time series by using a stage-shift over this period that relies on the high accuracy of the discharge measurements made during these field visits (Appendix A).

As this station has uniform water depth and velocities at its gauge location, the numerous discharge measurements made with an ADV between August 2018 and September 2020 were sufficiently accurate. A wide range of WSE (i.e., 0.350 m) and discharge (i.e., from 0.980 m^3/s to 2.30 m^3/s) were measured during this period as shown in Table 9. Based on these factors, there is high confidence in the derived discharge time series during the open water monitoring period.

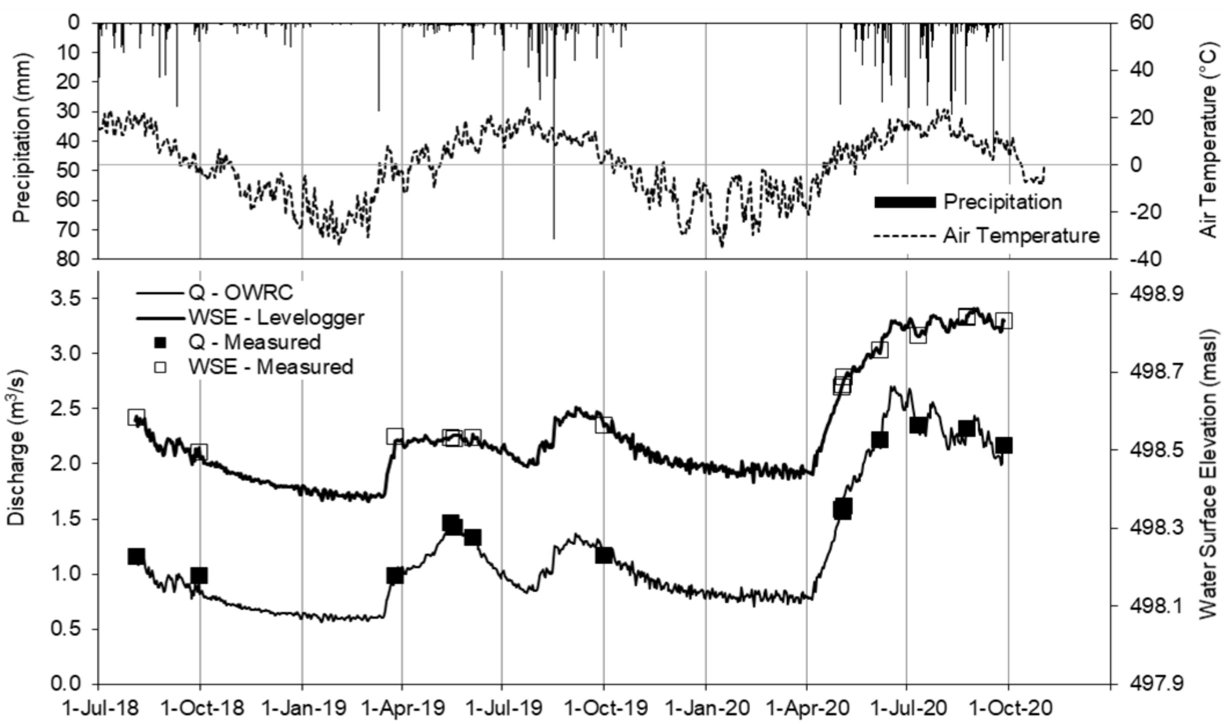
The rating curve shift report is included in Appendix B. The daily mean WSE and discharge series derived from the Levelogger and OWRC, along with observed precipitation and air temperature, are presented in Figure 19.

Figure 18: Open Water Rating Curve for Station CR-WC-MS-03



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

Figure 19: Station CR-WC-MS-03 Water Surface Elevation and Discharge, 2018 to 2020



OWRC = open water rating curve; masl = metres above sea level; Q = discharge (m^3/s); WSE = water surface elevation.

5.3.1.4 Station CR-WC-MS-04: Clearwater River below Beet Lake

Hydrometric monitoring work at the Clearwater River below Beet Lake (i.e., CR-WC-MS-04) began in 2018 in support of the hydrological baseline. The station is located approximately 300 m downstream of the Beet Lake outlet (Figure 3) and is shown in Figure 20. The field results for CR-WC-MS-04 are summarized in Table 10.

The OWRC was developed based on nine coincident stage and discharge measurements (Figure 21). A WSE survey was not completed in June 2019 due to bear activity at the station. The daily mean WSE and discharge time series derived from the Levelogger and OWRC is presented in Figure 22 along with observed precipitation and air temperature. Due to a programming error, the Levelogger records for CR-MS-WC-04 stopped on 4 July 2019 for the remainder of 2019. To infill the gap in the discharge time series for the remainder of the year, the Levelogger records for Beet Lake (i.e., Station CR-WB-MS-04) were used along with the rating curve for CR-WC-MS-04.

Table 10: Summary of Hydrometric Monitoring Results, CR-WC-MS-04

Date and Time	WSE[(a)] (masl)	Staff Gauge Reading (m)	Discharge (m^3/s)	TSS (mg/L)	Bed Load (mg/L)
5 August 2018 13:00	498.253	0.475	1.92	0	0
1 October 2018 15:42	498.185	n/d	1.70	0	0
28 March 2019 10:36	498.358	0.580	2.14	n/d	n/d
1 June 2019 16:45	n/d	0.380	2.54	2	n/d
2 October 2019 15:45	498.284	0.498	1.83	<1	n/d
3 May 2020 15:30	498.427	0.715	4.85	n/d	n/d
5 June 2020 13:20	498.439	0.676	5.50	n/d	n/d
6 June 2020 10:00	n/d	n/d	n/d	3	0
10 July 2020 13:30	498.468	0.698	4.80	n/d	n/d
13 July 2020 10:57	n/d	n/d	n/d	2	0
20 August 2020 12:30	498.507	0.738	3.87	n/d	n/d
21 August 2020 10:36	n/d	n/d	n/d	<1	0
25 September 2020 11:45	498.508	0.750	4.65	<1	n/d
26 September 2020 8:41	n/d	n/d	n/d	<1	0

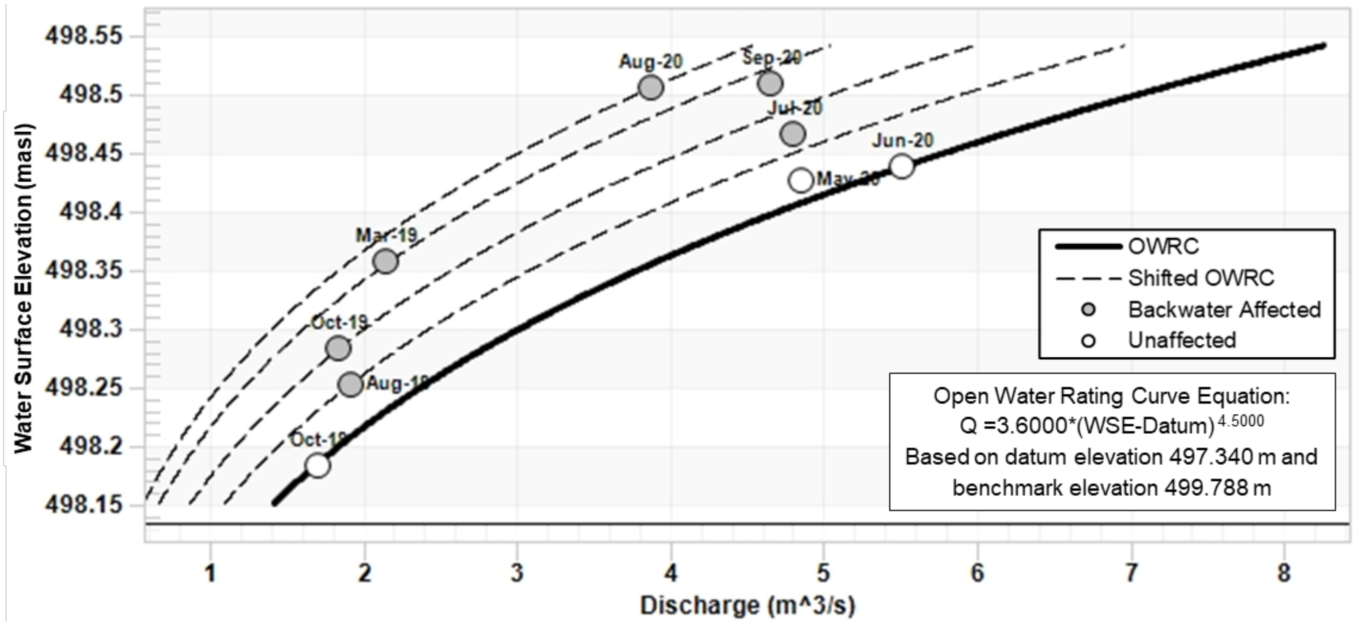
a) Water surface elevation (WSE) measured by levelling survey using rebar benchmark, CR-WC-MS-04_BM1.

TSS = total suspended solids; n/d = no data; masl = metres above sea level; < = less than.

Figure 20: Clearwater River below Beet Lake, Station CR-WC-MS-04

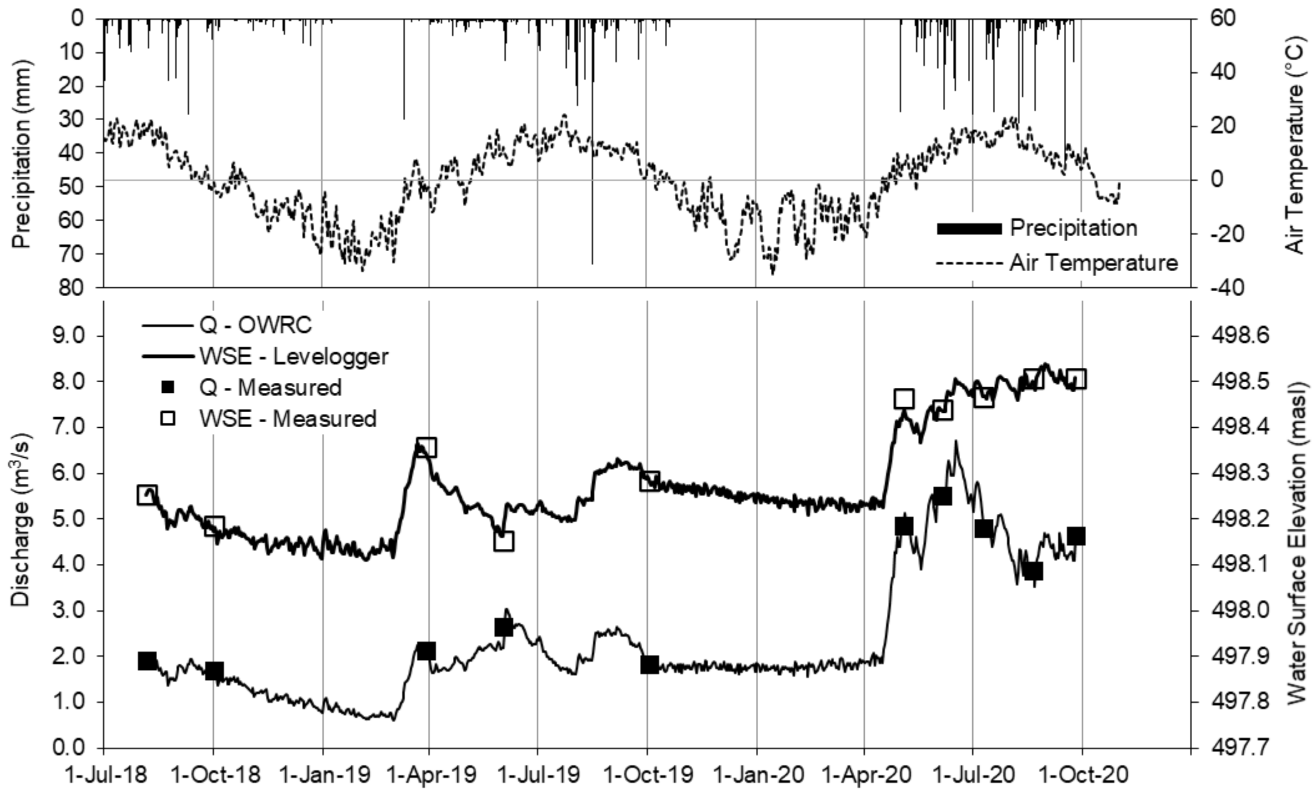
Note: View of CR-WC-MS-04 on 25 September 2020; view is from the right bank (when facing downstream) facing upstream (northeast).

Figure 21: Open Water Rating Curve for Station CR-WC-MS-04



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

Figure 22: Station CR-WC-MS-04 Water Surface Elevation and Discharge, 2018 to 2020



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

5.3.1.5 Station CR-WC-MS-05: Clearwater River below Naomi Lake

Hydrometric monitoring at the Clearwater River below Naomi Lake (i.e., CR-WC-MS-05) began in 2018. The station is located approximately 1 km downstream of the Naomi Lake outlet (Figure 3) and is shown in Figure 23. The field results for CR-WC-MS-05 are summarized in Table 11.

The OWRC equation was fit to the field measurements not apparently affected by backwater and was supported by eight coincident stage and discharge measurements (Figure 24). The OWRC was manually adjusted to the points unaffected by backwatering, and stage-shifts were applied to the affected points. The rating curve shift report is included in Appendix B. The daily mean WSE and discharge time series derived from the Levelogger and OWRC, along with observed precipitation and air temperature, are presented in Figure 25.

Due to operator error, the Levelogger records for CR-WC-MS-05 stopped on 4 July 2019, and for the remainder of the year (i.e., through 2 October 2019), the Levelogger records for Naomi Lake Station CR-WB-MS-05 were used to derive discharge. Discharge measurements for CR-WC-MS-05 were used along with WSE measurements from CR-WB-MS-05 to develop an additional preliminary OWRC equation for the period of 4 July 2019 to 2 October 2019. Station CR-WB-MS-05 Levelogger records are not as accurate a representation of CR-WC-MS-05 WSE, due to the distance between the two stations and the increased variation in WSE in the waterbody due to waves during windy periods. Based on the wide range of WSE (i.e., 0.406 m) Table 11, and accurate discharge measurements made for CR-WC-MS-05 (i.e., ranging from 2.90 m^3/s to 8.23 m^3/s), derived discharge was considered adequate for the purposes of characterizing hydrology at this location for the open water period. Although there were no under-ice field measurements taken at this station, the derived discharge was checked against unit-discharge records for other stations, and time series data fall within the expected range.

Table 11: Summary of Hydrometric Monitoring Results, CR-WC-MS-05

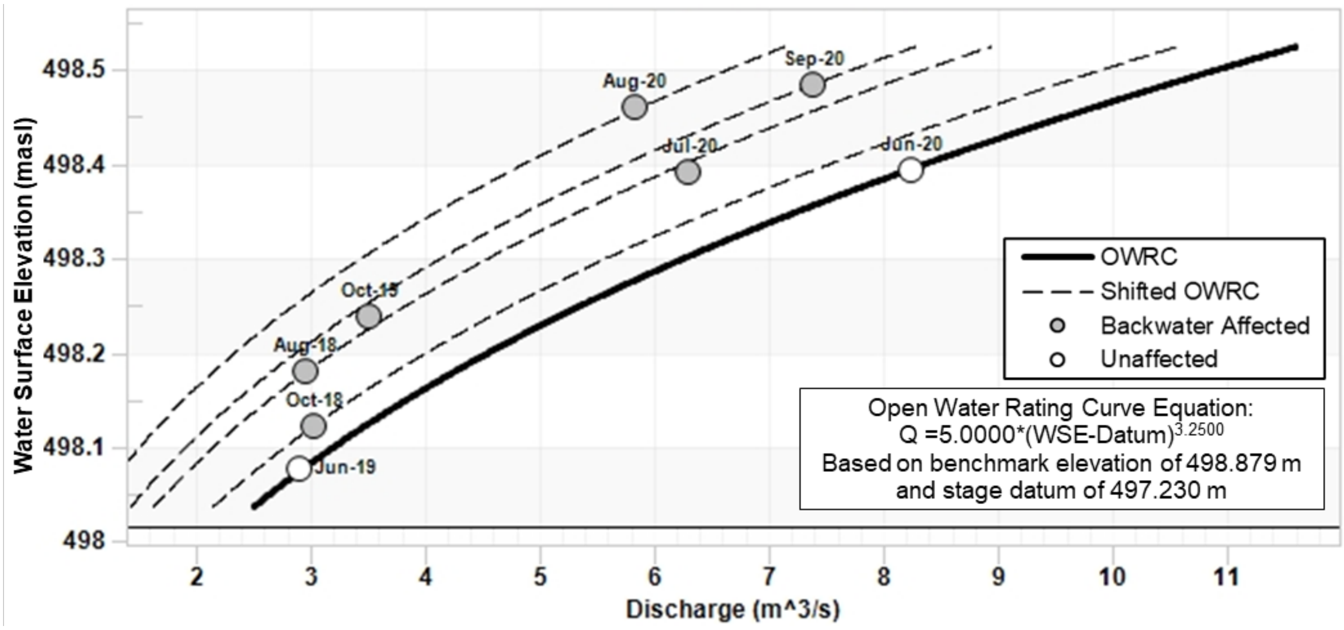
Date and Time	WSE[(a)] (masl)	Staff Gauge Reading (m)	Discharge (m^3/s)	TSS (mg/L)	Bed Load (mg/L)
5 August 2018 13:00	498.182	0.773	2.95	0	0
1 October 2018 14:38	498.123	n/d	3.01	0	0
1 June 2019 13:00	498.079	0.670	2.90	<1	n/d
2 October 2019 11:00	498.240	0.837	3.51	<1	n/d
5 June 2020 10:40	498.396	n/d	8.23	n/d	n/d
5 June 2020 17:18	n/d	n/d	n/d	3	0
10 July 2020 09:30	498.392	0.965	6.30	n/d	n/d
10 July 2020 15:00	n/d	n/d	n/d	2	0
20 August 2020 10:30	498.462	n/d [(b)]	5.83	n/d	n/d
20 August 2020 15:50	n/d	n/d [(b)]	n/d	<1	0
25 September 2020 9:44	498.485	n/d [(b)]	7.38	2	n/d
27 September 2020 9:40	n/d	n/d [(b)]	n/d	2	0

a) Water surface elevation (WSE) measured by levelling survey using rebar benchmark, CR-WC-MS-05_BM1.
b) Staff gauge completely submerged.
TSS = total suspended solids; n/d = no data; < = less than.

Figure 23: Clearwater River below Naomi Lake, CR-WC-MS-05

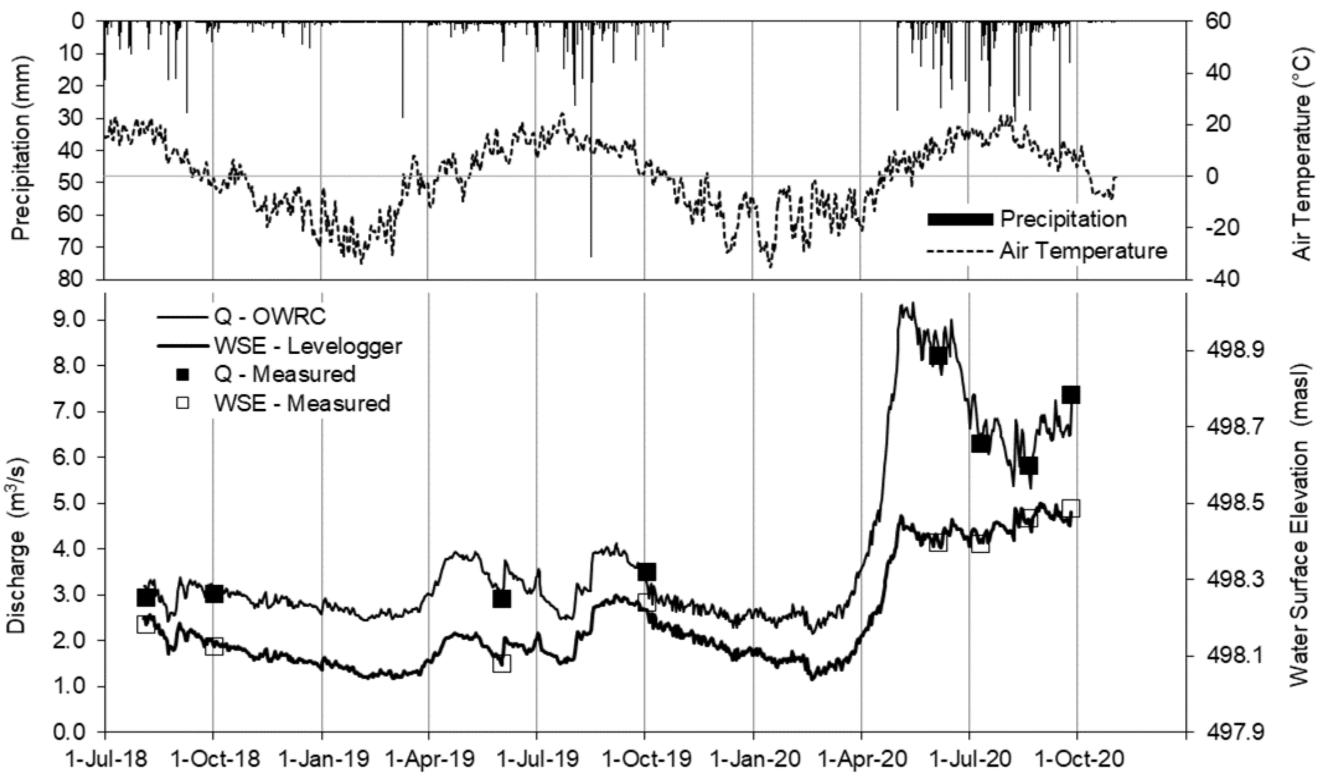
Note: View of CR-WC-MS-05 measurement cross-section on 20 August 2020; view is from the right bank (when facing downstream) facing upstream (northeast).

Figure 24: Open Water Rating Curve for CR-WC-MS-05



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

Figure 25: CR-WC-MS-05 Water Surface Elevation and Discharge, 2018 to 2020



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

5.3.1.6 Station CR-WC-MS-06: Clearwater River above Mirror River Confluence

Hydrometric monitoring at the Clearwater River above Mirror River confluence station (i.e., CR-WC-MS-06) began in 2018. The station is located approximately 600 m upstream of the confluence (Figure 4). This station marks the farthest downstream point of the RSA. The field results for CR-WC-MS-06 are summarized in Table 12. The Clearwater River at CR-WC-MS-06 is shown in Figure 26.

The OWRC was based on eight coincident stage and discharge field measurements, as shown in Figure 27. The curve is fit through the May 2019, June 2020, and July 2020 points only, as backwater was observed during the late summer and fall visits in 2018 to 2020 and was attributed to observed dense vegetation in the channel at this location. The OWRC was manually adjusted to the points unaffected by backwater and stage-shifts were applied to the affected points. The rating curve shift report is included in Appendix B.

The daily mean WSE and discharge series derived from the Levelogger and OWRC, along with observed precipitation and air temperature, are presented in Figure 28. A data gap occurred from 1 July 2020 to 11 July 2020 when the Levelogger was found to be physically removed from the water. A wide range of WSE (i.e., 0.801 m) and discharge (i.e., 3.80 m^3/s to 12.7 m^3/s) were measured at this hydrometric station (Table 12).

Table 12: Summary of Hydrometric Monitoring Results, CR-WC-MS-06

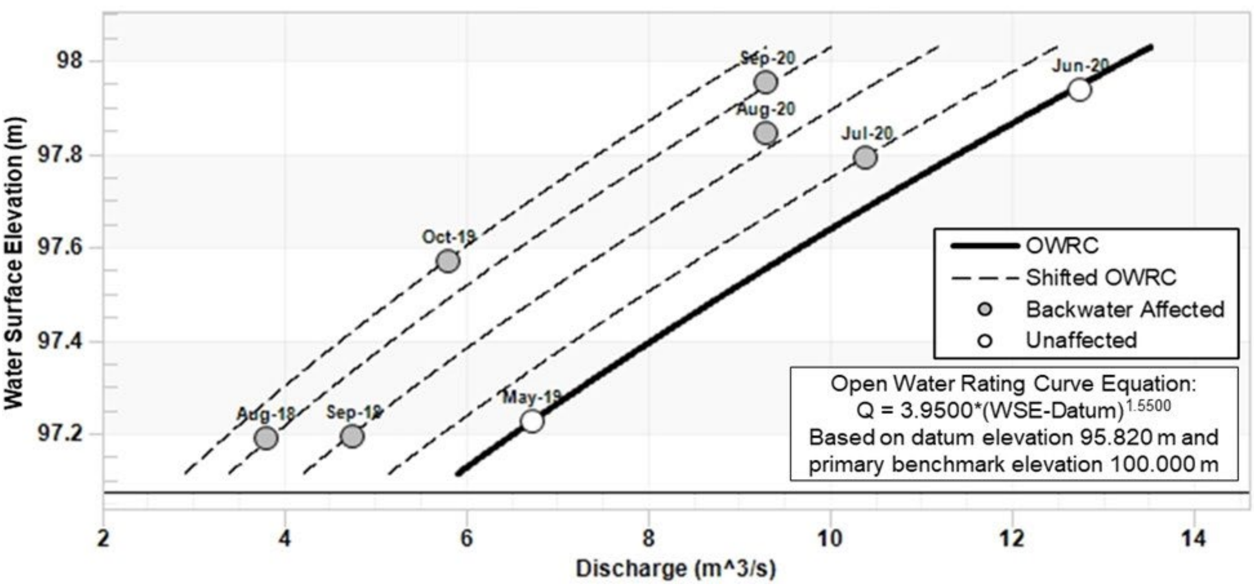
Date and Time	WSE[(a)] (m; non-geodetic)	Staff Gauge Reading (m)	Discharge (m^3/s)
4 August 2018 11:30	97.193	n/a	3.80
2 October 2018 13:00	97.198	n/a	4.75
17 May 2019 15:00	97.223	n/a	6.72
4 October 2019 12:00	97.571	n/a	5.80
4 May 2020 10:32	97.994	n/a	n/d
7 June 2020 12:15	97.938	n/a	12.7
11 July 2020 11:15	97.795	n/a	10.4
21 August 2020 13:30	97.848	n/a	9.30
24 September 2020 11:55	97.955	n/a	9.28

a) Water surface elevation (WSE) measured by levelling survey using anchor bolt in tree benchmark, CR-WC-MS-06_BM1.
TSS = total suspended solids; n/a = not applicable as no staff gauge installed; n/d = no data.

Figure 26: Clearwater River above Mirror River Confluence, CR-WC-MS-06

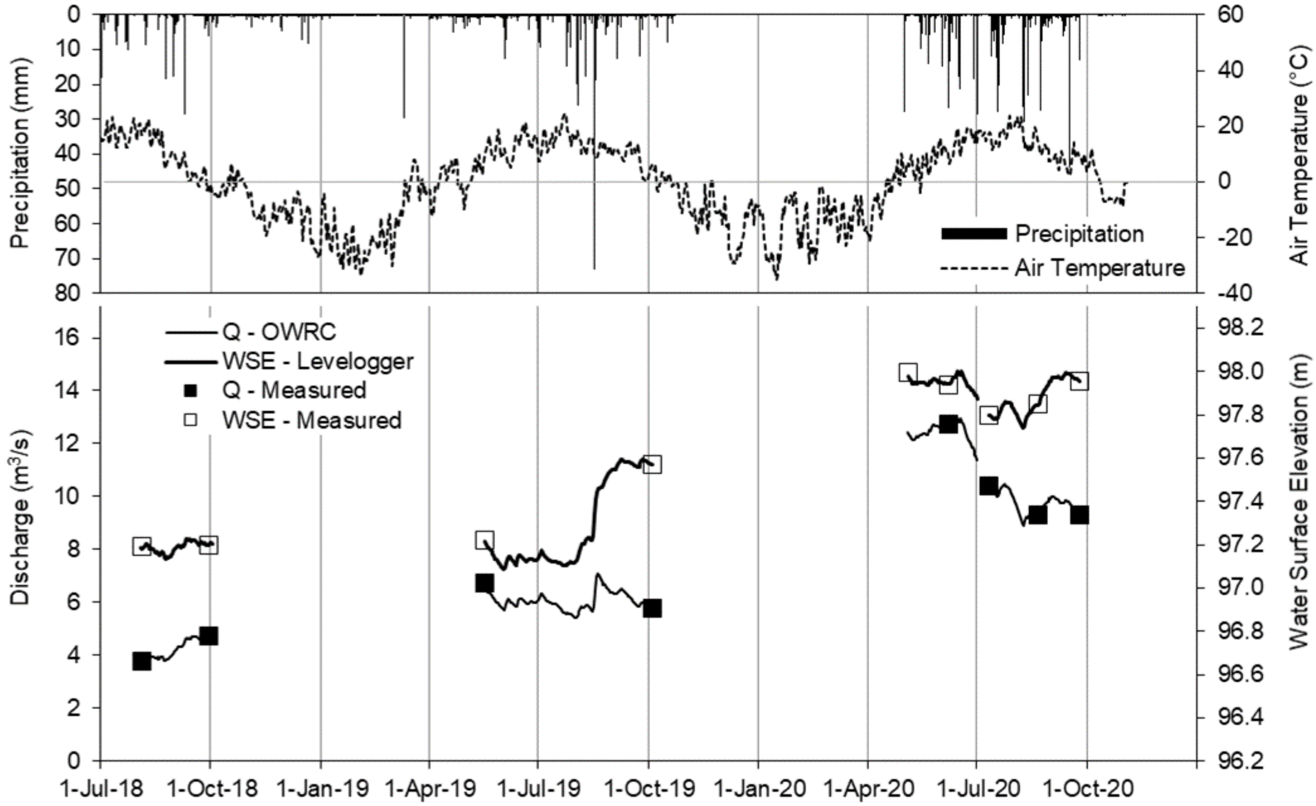
Note: View of CR-WC-MS-06 facing downstream (south) on 24 September 2020 from right bank (when facing downstream).

Figure 27: Open Water Rating Curve for CR-WC-MS-06



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

Figure 28: CR-WC-MS-06 Water Surface Elevation and Discharge, 2018 to 2020



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

5.3.1.7 Station CR-WC-MS-07: Clearwater River below Mirror River Confluence

Hydrometric monitoring work at the Clearwater River below Mirror River confluence station (i.e., CR-WC-MS-07) began in 2018. The station is located just downstream of the confluence (Figure 4). The field results for CR-WC-MS-07 are summarized in Table 13. The Clearwater River at CR-WC-MS-07 is shown in Figure 29. Discharge was monitored at CR-WC-MS-07 to measure the inflows from the Mirror River by comparison with flows in the Clearwater River upstream of the Mirror River confluence. An OWRC was developed beginning in 2019, as benchmarks were first installed in May 2019; the stage-discharge points fit the base curve well (Figure 30). A wide range of WSE (i.e., 0.758 m) and discharge (i.e., 15.7 m^3/s to 34.5 m^3/s) was measured at this station between August 2018 and September 2020 (Table 13).

The measured WSE and discharge data for this station, along with observed precipitation and air temperature, are presented in Figure 31. No Levelogger was installed at this station. Discharge measured upstream of the Mirror River confluence (i.e., CR-WC-MS-06) was approximately 30% of discharge measured at CR-WC-MS-07 on the same dates which is an expected results as the watershed area of CR-WC-MS-06 is about one-third that of the Clearwater River downstream of the confluence.

Table 13: Summary of Hydrometric Monitoring Results, CR-WC-MS-07

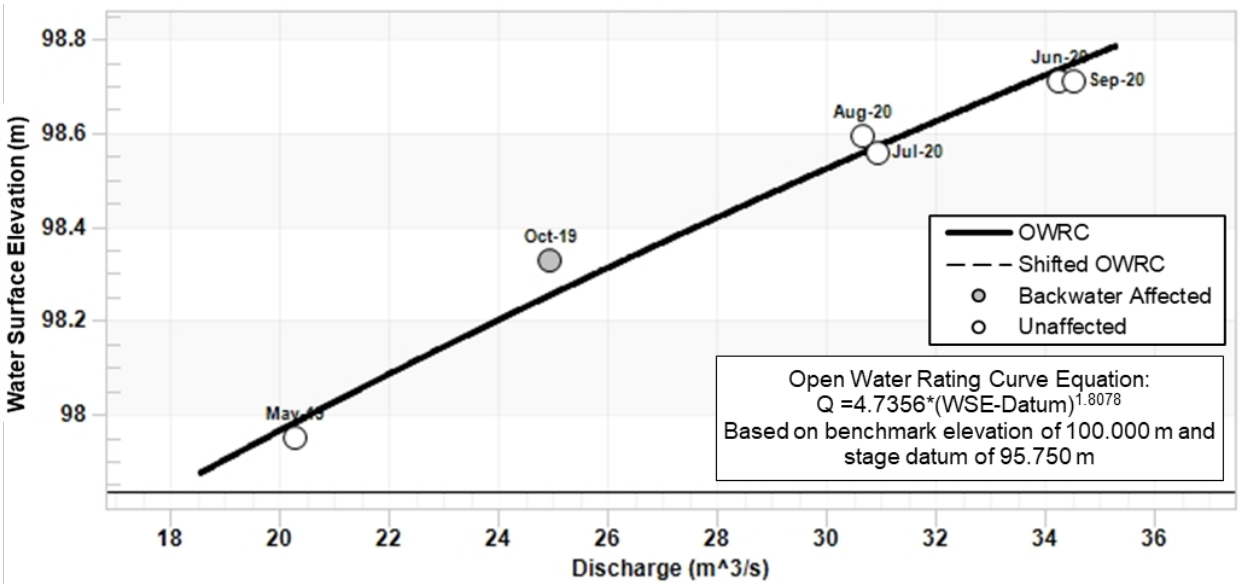
Date and Time	WSE[(a)] (m; non-geodetic)	Staff Gauge Reading (m)	Discharge (m^3/s)
4 August 2018 12:30	n/a	n/a	15.7
2 October 2018 14:00	n/a	n/a	18.0
17 May 2019 17:00	97.953	n/a	20.3
4 October 2019 14:15	98.328	n/a	24.9
7 June 2020 15:50	98.711	n/a	34.2
11 July 2020 13:06	98.558	n/a	30.9
21 August 2020 15:13	98.596	n/a	30.6
24 September 2020 13:36	98.711	n/a	34.5

a) Water surface elevation (WSE) measured by levelling survey using anchor bolt in tree benchmark, CR-WC-MS-07_BM1.
n/a = not applicable as no staff gauge and/or benchmarks installed.

Figure 29: Clearwater River below Mirror River Confluence, CR-WC-MS-07

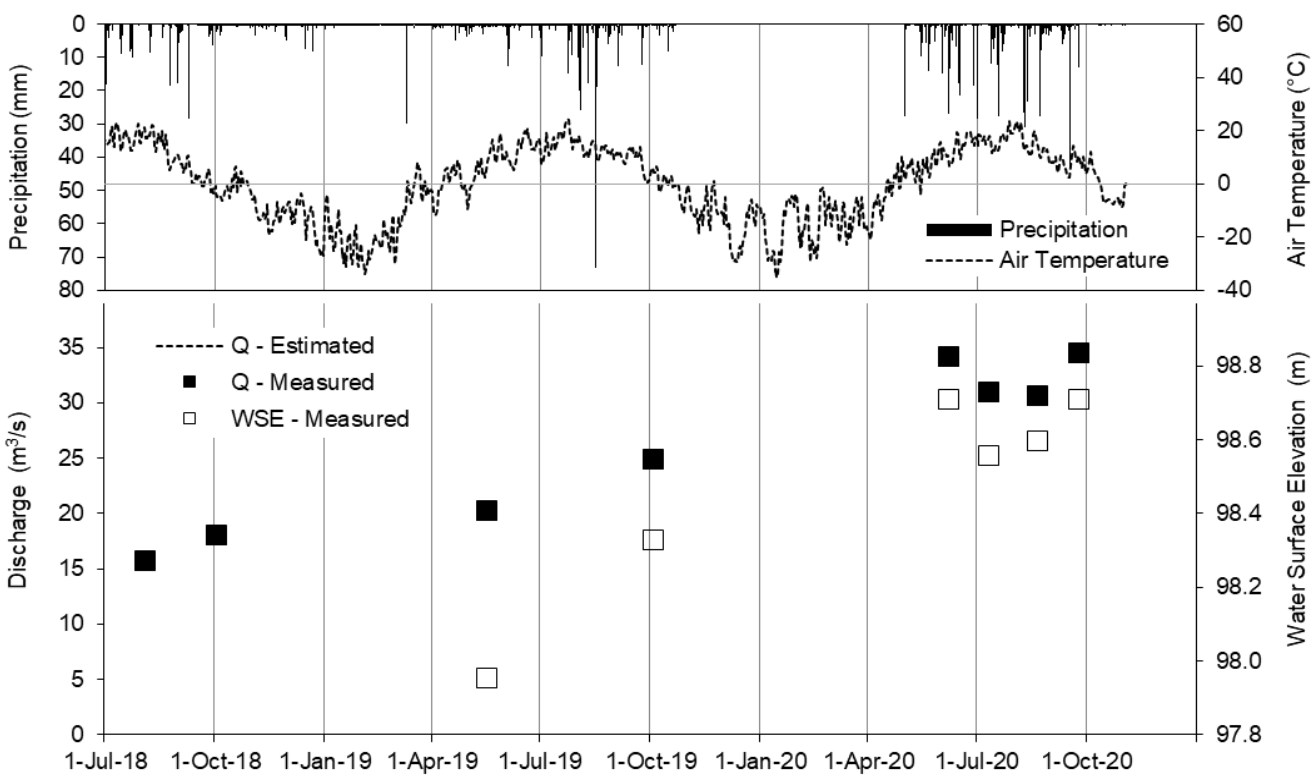
Note: View of CR-WC-MS-07 on 24 September 2020; view is from the right bank (when facing downstream) facing downstream (west).

Figure 30: Open Water Rating Curve for CR-WC-MS-07



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

Figure 31: CR-WC-MS-07 Water Surface Elevation and Discharge, 2018 to 2020



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

5.3.1.8 Station CR-WC-MS-08: Clearwater River at the Lloyd Lake Outlet

Hydrometric monitoring at the Clearwater River at the Lloyd Lake outlet (i.e., CR-WC-MS-08) began in 2018. The station is located near the historical WSC Station 07CD006. The WSC operated the hydrometric station on the Clearwater River at the Lloyd Lake outlet (WSC Station 07CD006) between 1973 and 1995 (ECCC 2016); this station was located approximately 45 km southeast and downstream of the anticipated area of the Project (Figure 4). CR-WC-MS-08 is within the boundaries of Clearwater River Provincial Park (Figure 4).

Prior to June 2020, measurements at CR-WC-MS-08 were collected at a location approximately 500 m downstream of the discontinued WSC Station 07CD006. This previous river cross section located just downstream of CR-WC-MS-08, rather than at WSC Station 07CD006, had been selected to improve safety associated with increased distance from downstream rapids and preferred helicopter landing locations. However, during the 7 June 2020 visit, a helicopter landing location deemed more safe than previous landing locations during high water levels was observed upstream of the rapids at the WSC Station 07CD006; from that date onward, this location upstream of the WSC station became the preferred hydrometric monitoring location. WSE was also periodically measured at the original downstream station to develop a WSE relationship between the two stations. The river cross-section at WSC Station 07CD006 is shown on Figure 32.

The field results for CR-WC-MS-08 are summarized in Table 14. The OWRC for data collected at the original downstream hydrometric station is presented in Figure 33. The daily mean WSE and discharge series derived from the Levelogger and OWRC, along with observed precipitation and air temperature, are presented in Figure 34. This station was not visited in June 2019, October 2019, or May 2020 due to logistical challenges, because it is downstream of the hydrology RSA and sufficient data had already been collected during the historical record.

Table 14: Summary of Hydrometric Monitoring Results, CR-WC-MS-08

Date and Time	WSE[(a,b)] (m; non-geodetic)	WSE (m; non-geodetic)	Staff Gauge Reading (m)	Discharge (m^3/s)
04 August 2018 11:30	97.995	n/d	n/a	25.2
02 October 2018 14:38	97.986	n/d	n/a	23.7
17 May 2019 17:00	98.040	n/d	n/a	26.1
7 June 2020 08:15	98.473	96.765	n/a	50.0
11 July 2020 08:50	n/d	96.718	n/a	43.9
23 August 2020 11:05	98.346	96.664	n/a	39.9
24 September 2020 07:53	98.374	96.673	n/a	43.8

Note: Water surface elevation (WSE) measured at Historical WSC Station 07CD006 using WSC benchmarks S7375 and S7376.

a) WSE measured by levelling survey using anchor bolt in tree benchmark, CR-WC-MS-08_BM1.

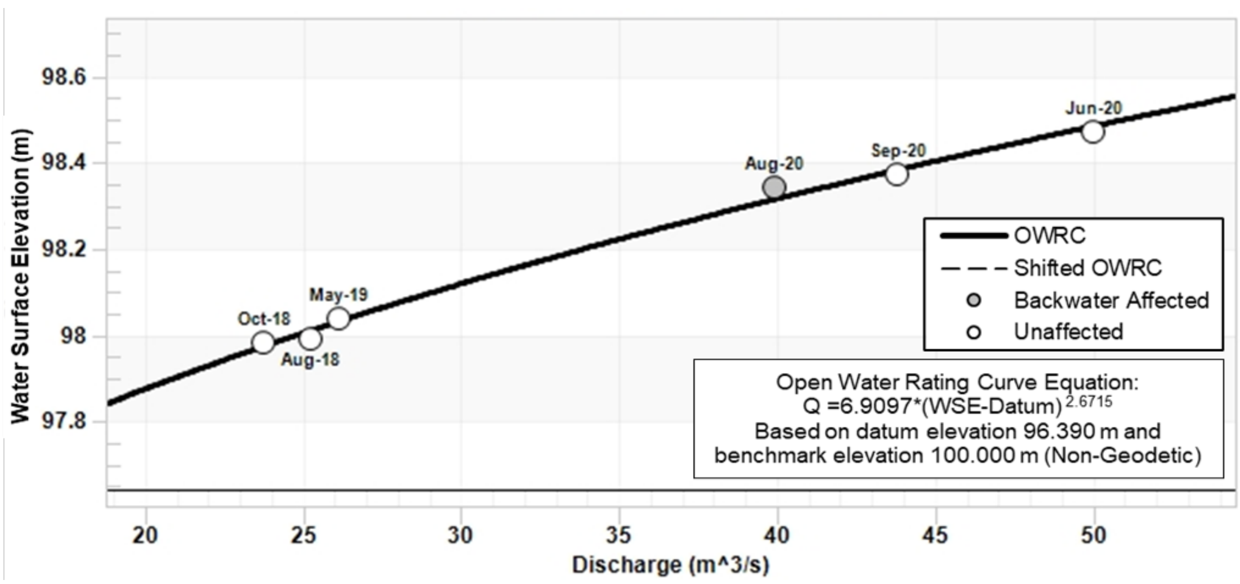
b) WSE measured at WSP hydrometric station.

n/a = not applicable as no staff gauge and/or benchmarks installed; n/d = no data.

Figure 32: Clearwater River at Lloyd Lake, CR-WC-MS-08

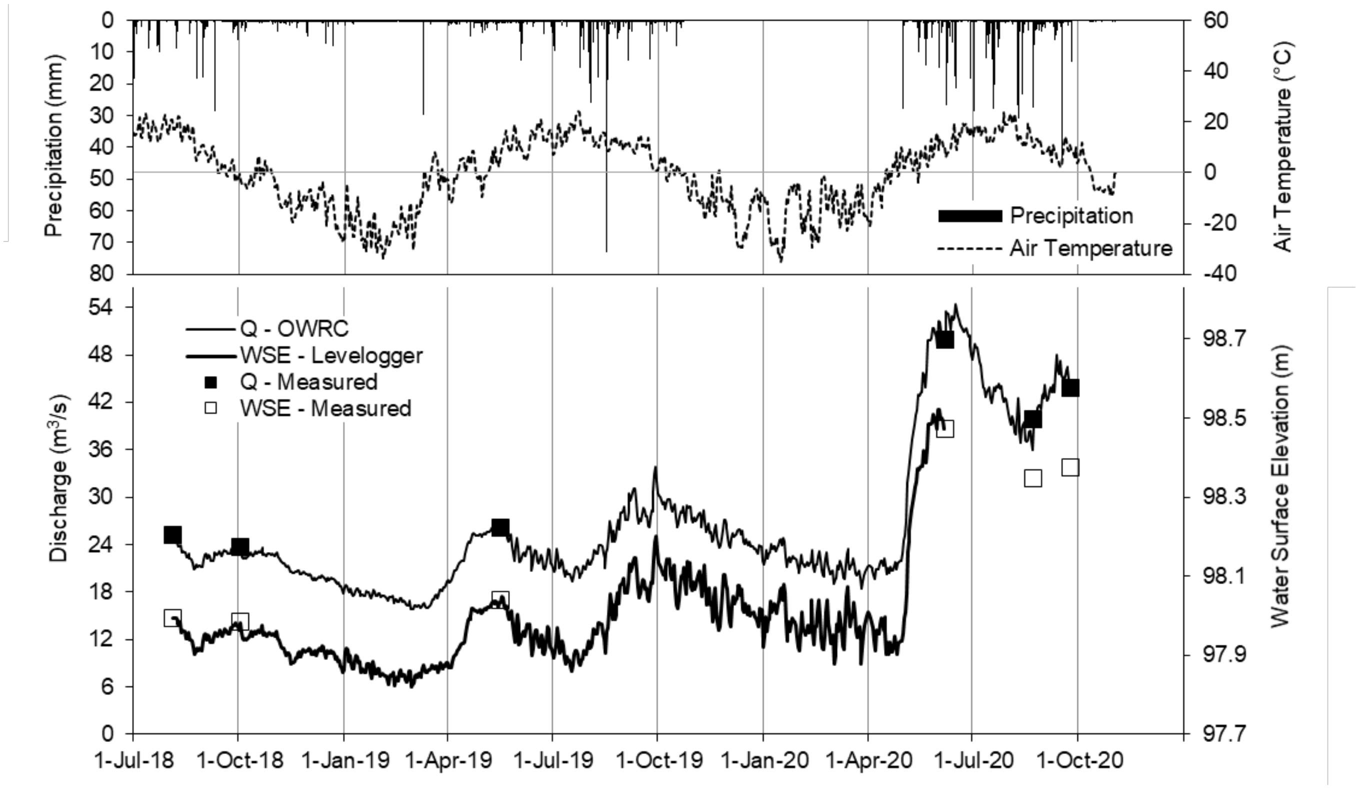
Note: View CR-WC-MS-08 near historical WSC station on 24 September 2020; view is from the right bank (when facing downstream) facing upstream (west).

Figure 33: Open Water Rating Curve for CR-WC-MS-08 at the WSP Hydrometric Station



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

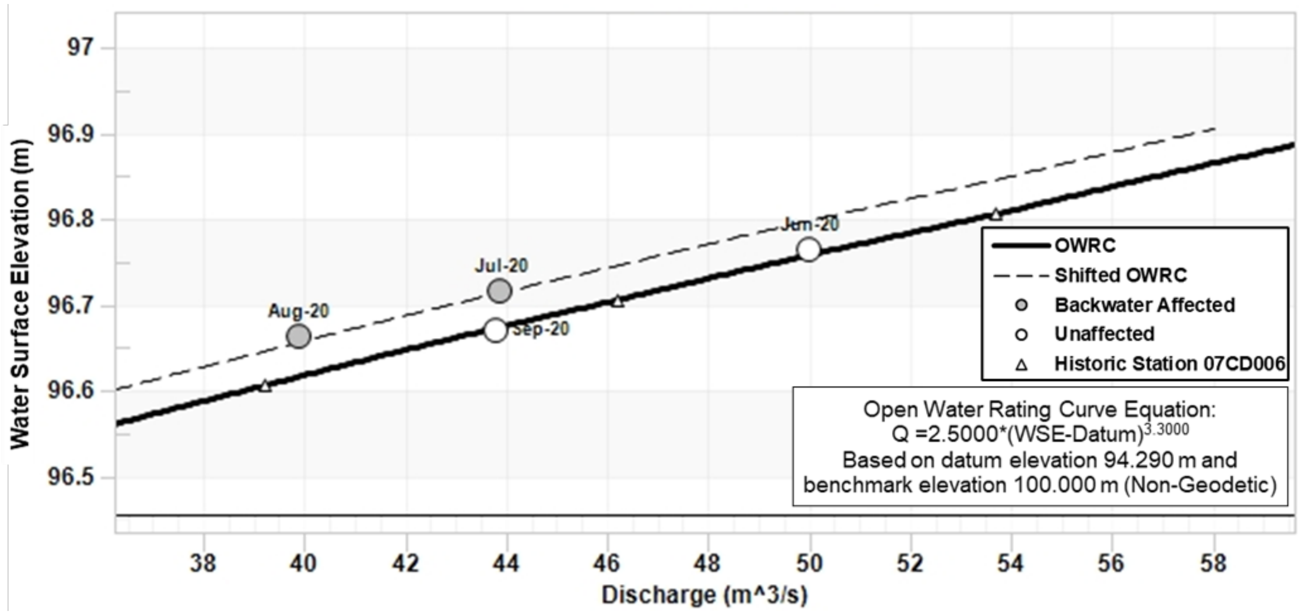
Figure 34: CR-WC-MS-08 Water Surface Elevation and Discharge at the WSP Hydrometric Station, 2018 to 2020



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

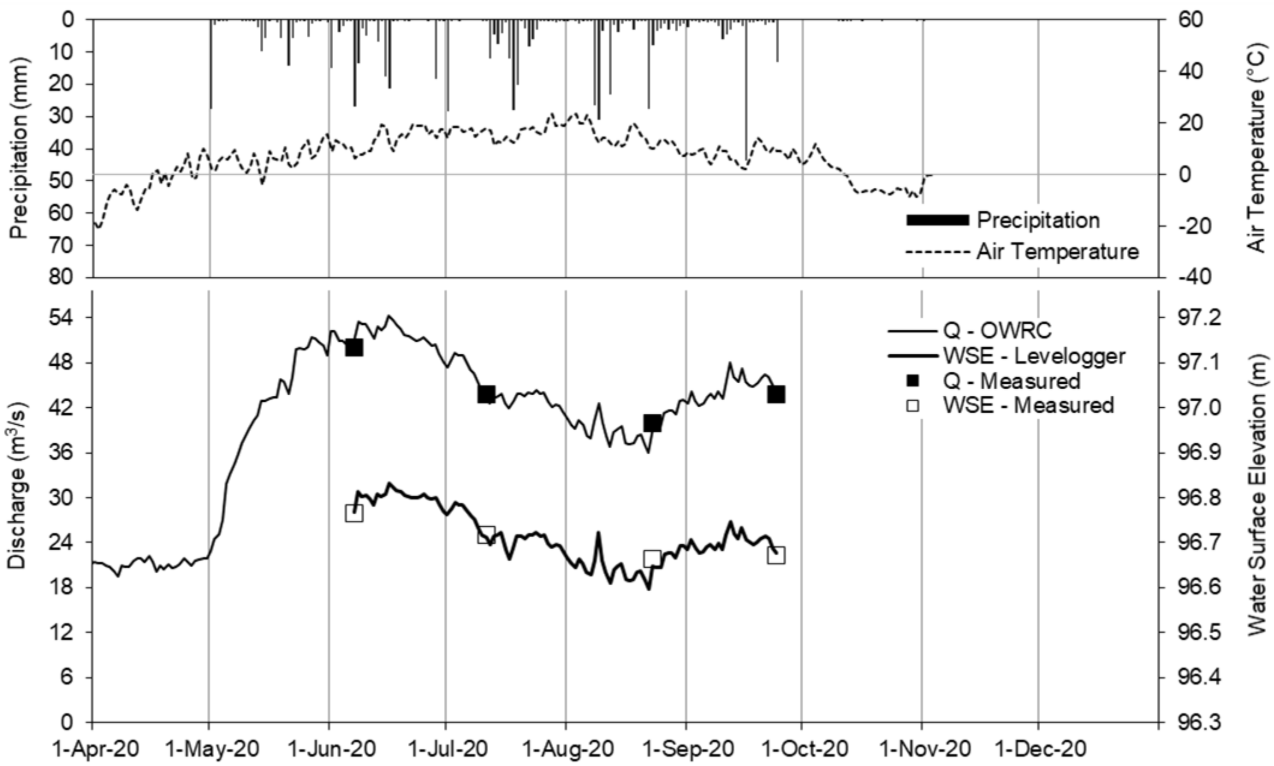
The OWRC for data collected at the WSC Station 07CD006 are presented in Figure 35. The most recent WSC stage-discharge rating table from 1995, for Station 07CD006 was verified in summer 2020. Of the four total measurements, two measurements perfectly fit the OWRC and two more were only 6% to 7% above the curve during the summer months (July and August 2020). The high flows measured 7 June 2020 exceeded all historically measured flows at the station. The daily mean WSE and discharge series derived from the Levelogger and OWRC, along with observed precipitation and air temperature, are presented in Figure 36.

Figure 35: Open Water Rating Curve for CR-WC-MS-08 at the Historical WSC Station 07CD006



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

Figure 36: CR-WC-MS-08 Water Surface Elevation and Discharge at the Historical WSC Station 07CD006, 2020



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

5.3.1.9 Station CR-WC-MS-09: Clearwater River at Warner Rapids

Hydrometric monitoring at the Clearwater River at Warner Rapids (i.e., CR-WC-MS-09) began in 2018. The station is located approximately 100 m upstream of Warner Rapids (Figure 4). The field activities completed at CR-WC-MS-09 are summarized in Table 15. The Clearwater River at CR-WC-MS-09 is shown in Figure 37. The rating curve calibrated using available field measurements is shown in Figure 38. No rating curve shifts were required for this station as no backwatering was observed. The daily mean WSE and discharge series derived from the Levelogger and OWRC, along with observed precipitation and air temperature, are presented in Figure 39.

Table 15: Summary of Hydrometric Monitoring Results, CR-WC-MS-09

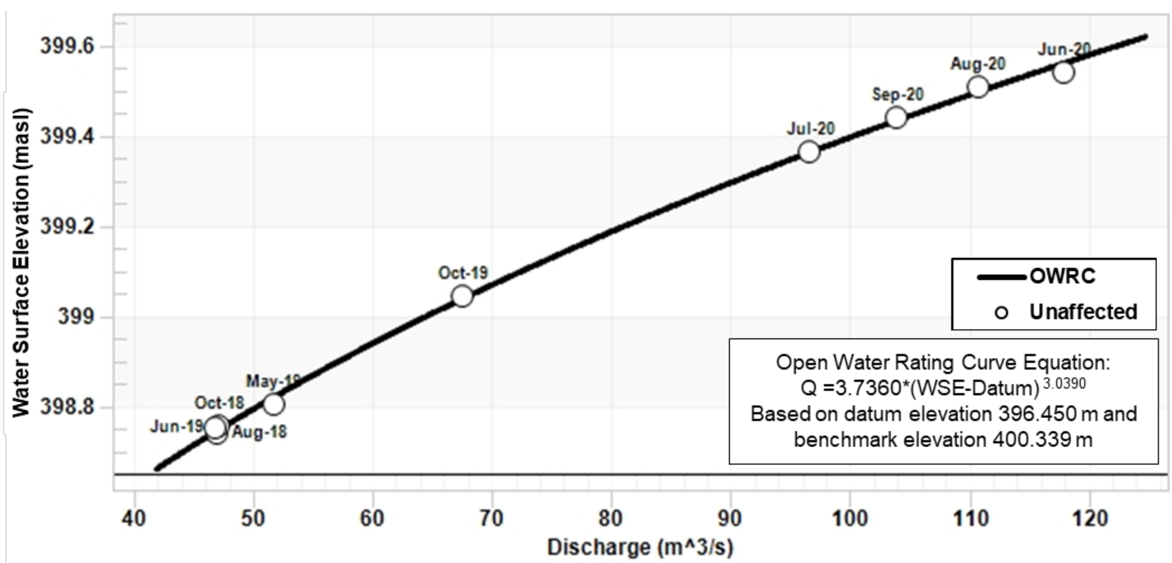
Date and Time	WSE[(a)] (masl)	Staff Gauge Reading (m)	Discharge (m^3/s)
8 August 2018 10:30	398.744	n/a	46.9
4 October 2018 11:00	398.759	n/a	47.1
29 March 2019 12:23	398.967	n/a	33.1
14 May 2019 16:45	398.807	n/a	51.6
30 May 2019 16:50	398.721	n/a	n/d
5 June 2019 09:40	398.757	n/a	46.7
5 October 2019 09:30	399.047	n/a	67.4
5 May 2020 07:10	399.607	n/a	n/d
8 June 2020 15:10	399.542	n/a	118
14 July 2020 09:35	399.369	n/a	96.4
25 August 2020 09:11	399.513	n/a	111
29 September 2020 09:43	399.441	n/a	104

a) Water surface elevation (WSE) measured by levelling survey using anchor bolt in tree benchmark, CR-WC-MS-09_BM1.
n/a = not applicable as a staff gauge was not installed; n/d = no data; masl = metres above sea level.

Figure 37: Clearwater River at Warner Rapids, CR-WC-MS-09

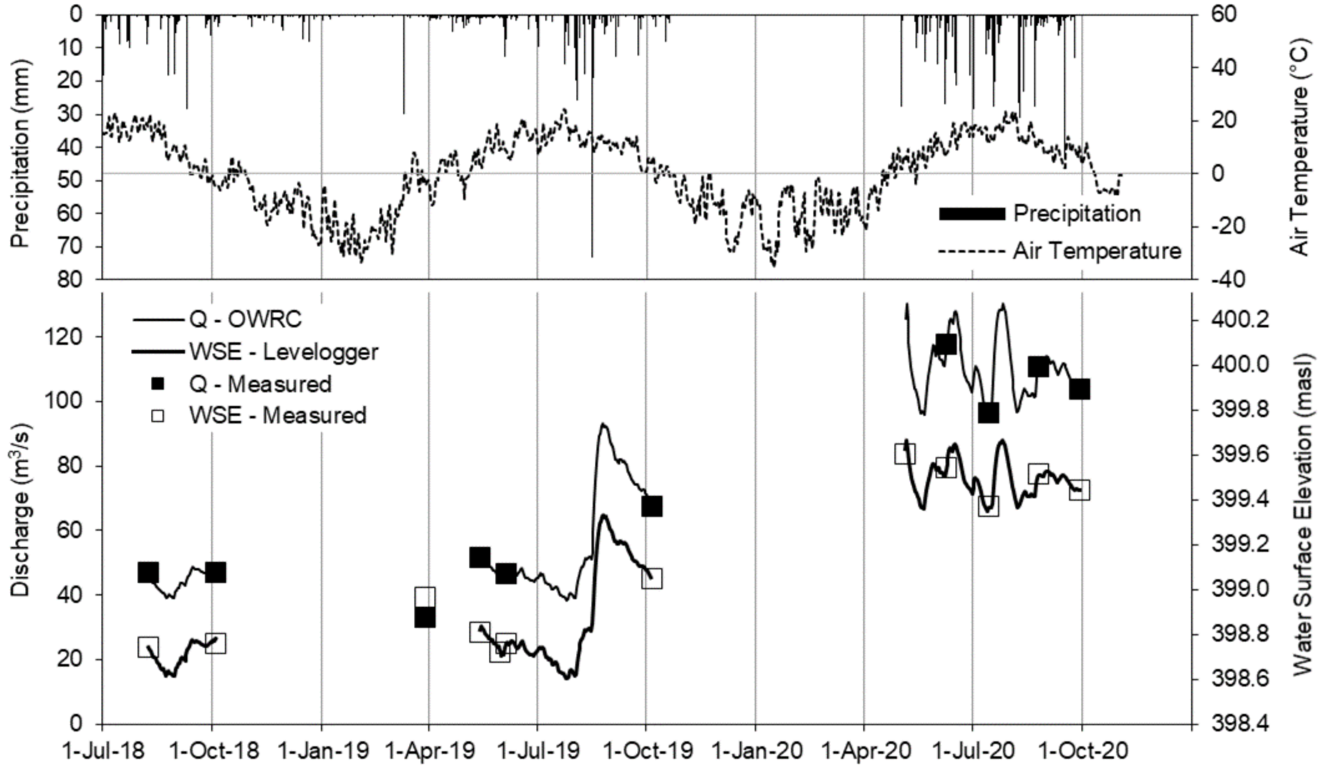
Note: View of CR-WC-MS-09 on 29 September 2020; view is from the right bank (when facing downstream) facing downstream (west).

Figure 38: Open Water Rating Curve for CR-WC-MS-09



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

Figure 39: CR-WC-MS-09 Water Surface Elevation and Discharge, 2018 to 2020



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

5.3.1.10 Station CR-WC-TI-01: Tributary Inflow above Forrest Lake

Hydrometric monitoring at the Clearwater River Tributary Inflow above Forrest Lake (i.e., CR-WC-TI-01) began in 2018. The station is sited on an unnamed tributary located at the southwest corner of Forrest Lake (Figure 3). The field results for CR-WC-TI-01 are summarized in Table 16. The tributary inflow to Forrest Lake at CR-WC-TI-01 is shown in Figure 40.

The rating curve was based on available field measurements as shown in Figure 41. The daily mean WSE and discharge series derived from the Levelogger and OWRC, along with observed precipitation and air temperature, are presented in Figure 42. During every field visit in 2019, a beaver dam was found downstream of the station and dismantled. Backwater corrections (i.e., stage-shifts) were made to the discharge record that coincided with the beaver activity over time; therefore, the uncertainty in the discharge record at this station is high. The Levelogger and its base could not be located during the fall 2019 field visit; therefore, the water level and discharge time series end on 31 May 2019. A beaver may have relocated the Levelogger.

Monitoring at CR-WC-TI-01 was discontinued following the September 2019 field visit as persistent beaver activity resulted in relatively poor-quality data. This tributary is a minor inflow to the Clearwater River system, and discontinuing the station was not consequential for the hydrology baseline.

Table 16: Summary of Hydrometric Monitoring Results, CR-WC-TI-01

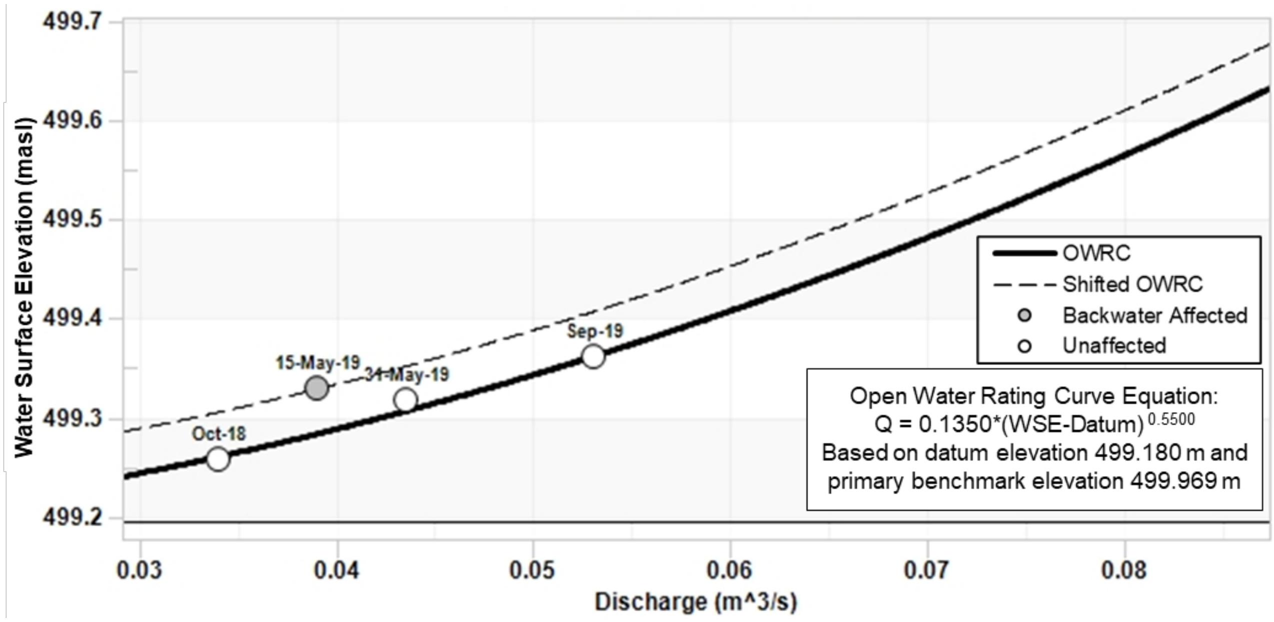
Date and Time	WSE[a] (masl)	Staff Gauge Reading (m)	Discharge (m^3/s)
2 August 2018 14:00	499.379	0.303	0.028
3 October 2018 16:30	499.259	0.260	0.034
15 May 2019 10:30	499.331	0.300	0.039
31 May 2019 13:10	499.883[b]	0.980[b]	n/d
31 May 2019 14:30	499.318[c]	0.270[c]	0.044
29 September 2019 12:00	499.363	0.322	0.053

a) Water surface elevation (WSE) measured by levelling survey using rebar benchmark, CR-WC-TI-01_BM1.
b) Measured before the beaver dam was dismantled.
c) Measured after the beaver dam was dismantled.
n/d = no measurement; masl = metres above sea level.

Figure 40: Beaver Dam at Clearwater River Tributary Inflow above Forrest Lake, CR-WC-TI-01

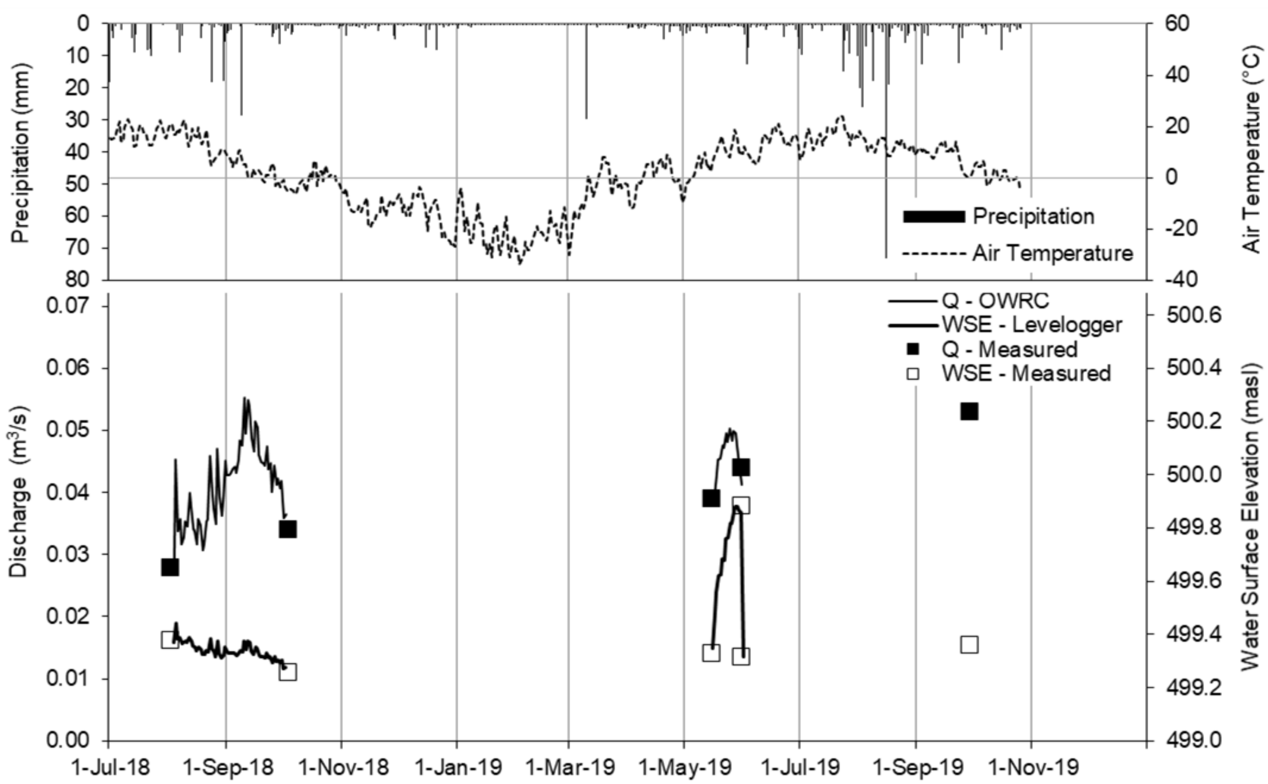
Note: View is facing upstream, 31 May 2019; view of inflow facing upstream.

Figure 41: Preliminary Open Water Rating Curve for CR-WC-TI-01



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

Figure 42: CR-WC-TI-01 Water Surface Elevation and Discharge, 2018 and 2019



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

5.3.1.11 Station CR-WC-TI-02: Clearwater River Tributary Inflow to Naomi Lake

Hydrometric monitoring at the Clearwater River tributary inflow to Naomi Lake (i.e., CR-WC-TI-02) began in 2018. The station is located approximately 50 m upstream of the mouth of Naomi Lake and may be subject to backwater from the Clearwater River at Naomi Lake (Figure 3). The field results for CR-WC-TI-02 are summarized in Table 17. The watercourse at CR-WC-TI-02 is shown in Figure 43.

The OWRC was developed using eight field measurements, as shown in Figure 44. A wide range of WSE (i.e., 0.358 m) and discharge (i.e., 0.454 m^3/s to 1.71 m^3/s) were measured during the open water monitoring period from August 2018 to September 2020 (Table 17). This station was observed to experience backwater that may be attributed to Naomi Lake being located downstream of the station, and/or to aquatic emergent vegetation growth during the summer that required stage-shift corrections for specific periods.

The daily mean WSE and discharge series derived from the Levelogger and OWRC, along with observed precipitation and air temperature, are presented in Figure 45.

Table 17: Summary of Hydrometric Monitoring Results CR-WC-TI-02

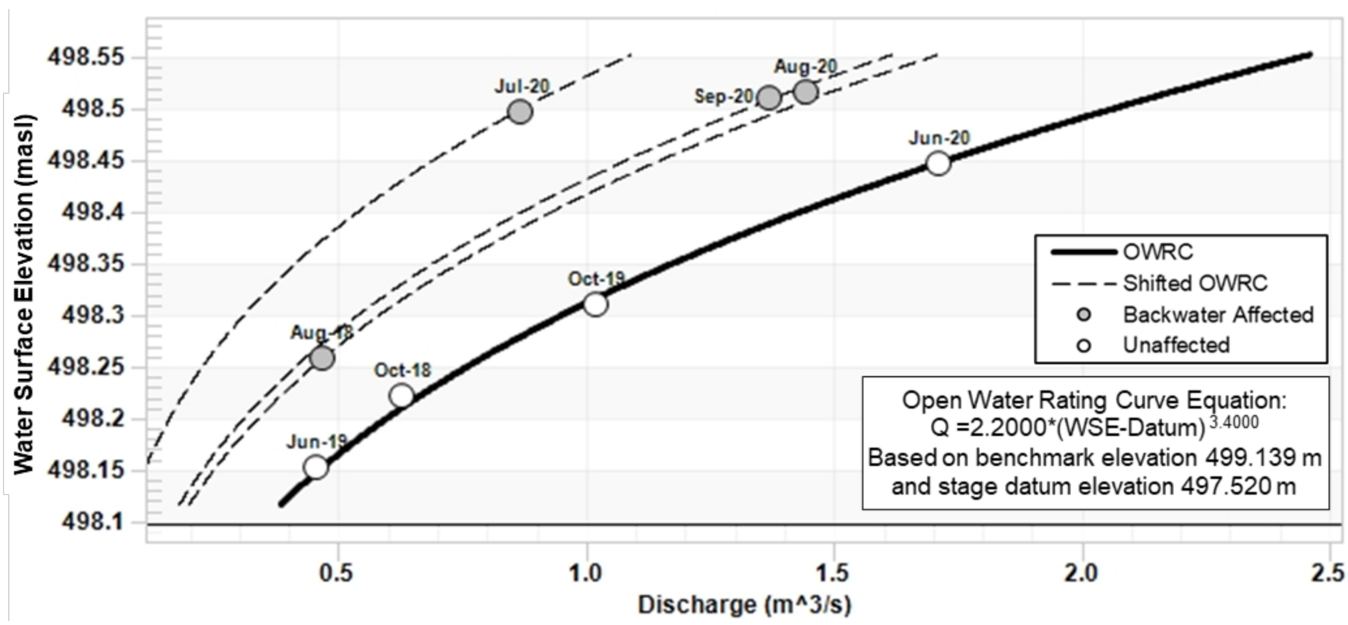
Date and Time	WSE[a] (masl)	Staff Gauge Reading (m)	Discharge (m^3/s)
5 August 2018 13:00	498.259	0.190	0.464
1 October 2018 15:30	498.223	0.140	0.628
28 March 2019 12:00	n/d	n/d	0.561
2 June 2019 11:45	498.159	0.053	0.454
2 October 2019 14:15	498.311	0.211	1.02
6 June 2020 10:50	498.449	0.375	1.71
13 July 2020 08:30	498.499	0.435	0.866
21 August 2020 08:33	498.517	0.468	1.44
27 September 2020 10:00	498.511	0.471	1.37

a) Water surface elevation (WSE) measured by levelling survey using rebar benchmark, CR-WC-TI-02_BM1.
n/d = no data; masl = metres above sea level.

Figure 43: Clearwater River Tributary Inflow to Naomi Lake, CR-WC-TI-02

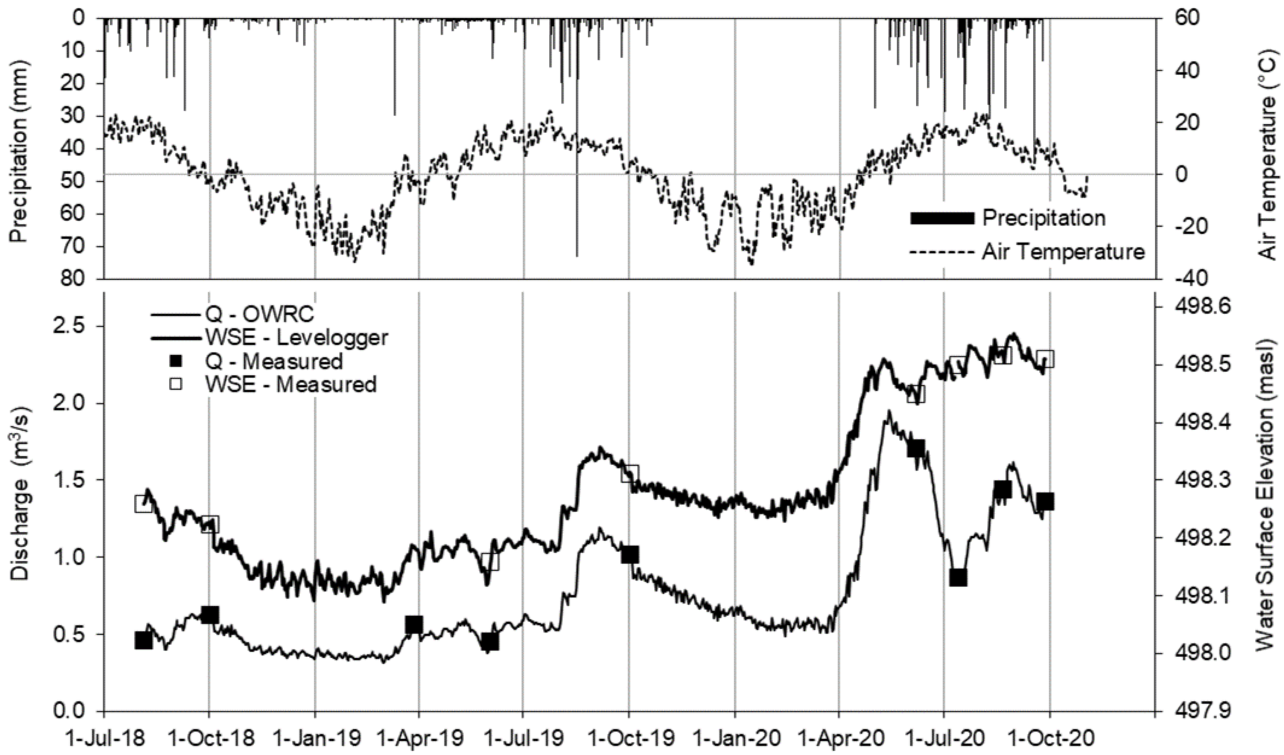
Note: View of CR-WC-TI-02 on 21 August 2020; view is from the right bank (when facing downstream) facing upstream (north).

Figure 44: Open Water Rating Curve for CR-WC-TI-02



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

Figure 45: CR-WC-TI-02 Water Surface Elevation and Discharge, 2018 to 2020



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

5.3.1.12 Station CR-WC-TI-03: Clearwater River Tributary Inflow Downstream of Naomi Lake

Hydrometric monitoring at the Clearwater River tributary inflow downstream of Naomi Lake (i.e., CR-WC-TI-03) began in 2018. The station is located approximately 100 m upstream of the Clearwater River tributary inflow (Figure 3). The field results for CR-WC-TI-03 are summarized in Table 18. The unnamed tributary at CR-WC-TI-03 is shown in Figure 46.

The OWRC was based on nine field measurements, as shown in Figure 47. A wide range of WSE (i.e., 0.356 m) and discharge (i.e., 0.255 m^3/s to 0.848 m^3/s) were measured during the open water monitoring periods from August 2018 to September 2020. This station was observed to experience backwater that may be attributed to aquatic and terrestrial vegetation growth during the summer, and/or sandy bed mobility that required stage-shift corrections for specific periods.

The daily mean WSE and discharge series derived from the Levelogger and OWRC, along with observed precipitation and air temperature, are presented in Figure 48.

Table 18: Summary of Hydrometric Monitoring Results, CR-WC-TI-03

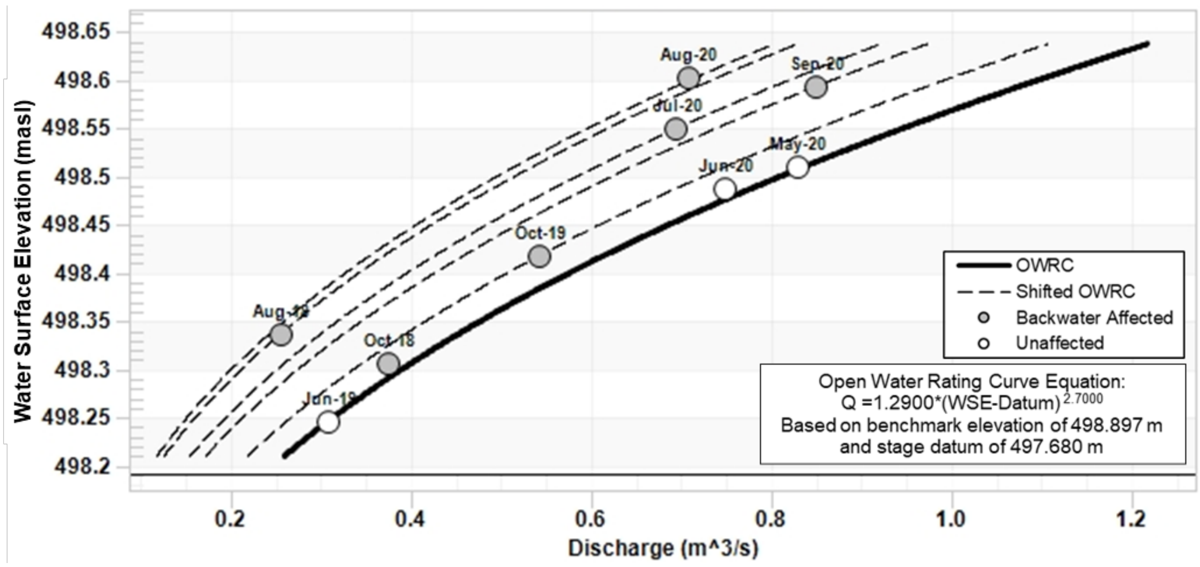
Date and Time	WSE[(a)] (masl)	Staff Gauge Reading (m)	Discharge (m^3/s)
5 August 2018 13:30	498.337	0.460	0.255
1 October 2018 16:00	498.307	0.435	0.375
1 June 2019 14:40	498.247	0.329	0.307
2 October 2019 12:00	498.404[(b)]	0.496	0.542
4 May 2020 12:28	498.510	0.718	0.829
5 June 2020 15:43	498.489	0.688	0.748
10 July 2020 11:25	498.551	0.730	0.693
20 August 2020 13:58	498.603	0.792	0.707
26 September 2020 09:15	498.593	0.795	0.848

a) Water surface elevation (WSE) measured by levelling survey using anchor bolt in tree benchmark, CR-TI-WC-03_BM1.
b) This is based on BM1 assumed elevation of 498.897 masl as of 2 October 2019 field visit.
masl = metres above sea level.

Figure 46: Clearwater River Tributary Inflow downstream of Naomi Lake, CR-WC-TI-03

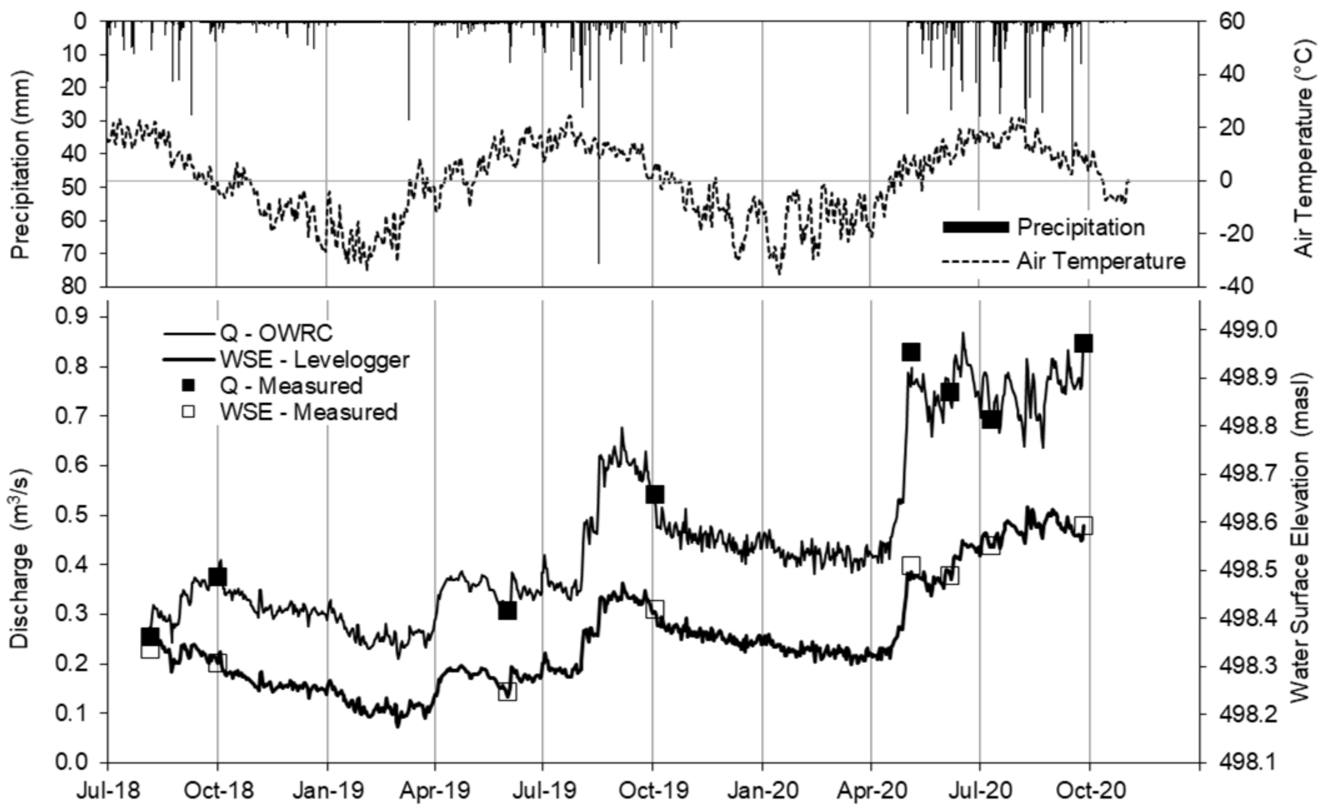
Note: View of CR-WC-TI-03 downstream of discharge transect 26 September 2020; view is from the right bank when facing upstream (northeast).

Figure 47: Open Water Rating Curve for CR-WC-TI-03



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

Figure 48: CR-WC-TI-03 Water Surface Elevation and Discharge, 2018 to 2020



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

5.3.1.13 Station HC-WC-MS-01: Hodge Creek below Hodge Lake

Hydrometric monitoring at Hodge Creek below Hodge Lake (i.e., HC-WC-MS-01) began in 2020. The station is located approximately 10 m downstream of the Hodge Lake outlet (Figure 3). The field results for Station HC-WC-MS-01 are summarized in Table 19. Hodge Creek at HC-WC-MS-01 is shown in Figure 49.

The preliminary rating curve was based on four field measurements in 2020, as shown in Figure 50. Derived discharge results are considered adequate for the open water period in 2020 and provide spatially variable results outside the LSA.

The daily mean WSE and discharge series derived from the Levelogger and OWRC, along with observed precipitation and air temperature, are presented in Figure 51.

Table 19: Summary of Hydrometric Monitoring Results, HC-WC-MS-01

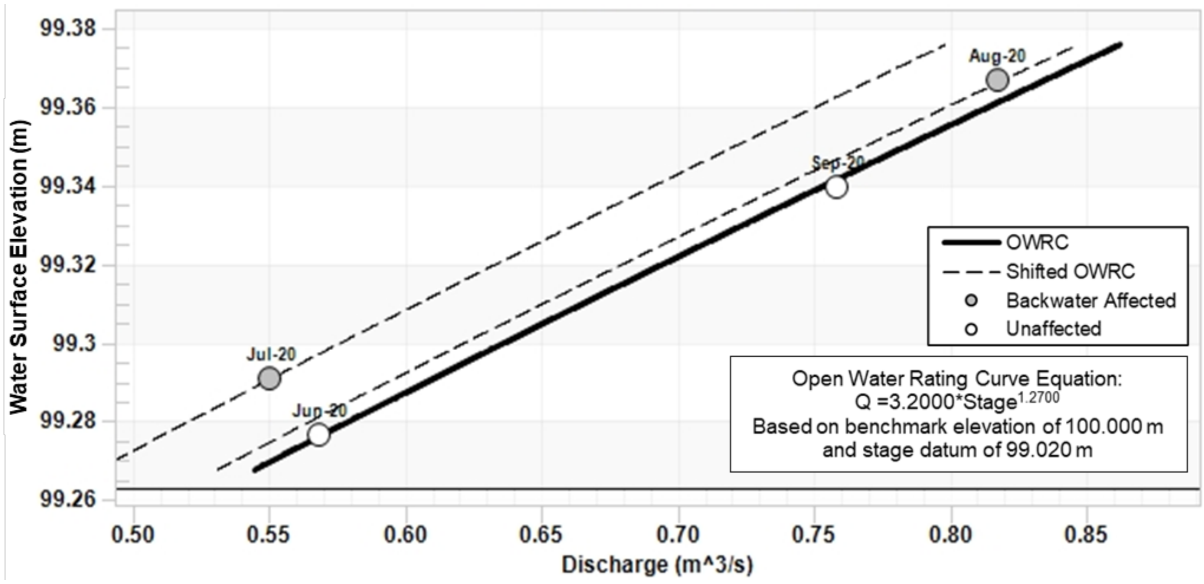
Date and Time	WSE[(a)] (m; non-geodetic)	Staff Gauge Reading (m)	Discharge (m^3/s)
8 June 2020 10:10	99.277	0.445	0.568
12 July 2020 11:30	99.291	0.460	0.550
22 August 2020 14:45	99.367	0.540	0.817
28 September 2020 11:05	99.339	0.520	0.758

a) Water surface elevation (WSE) measured by levelling survey using rebar benchmark, HC-WC-MS-01_BM1.

Figure 49: Hodge Creek below Hodge Lake, HC-WC-MS-01

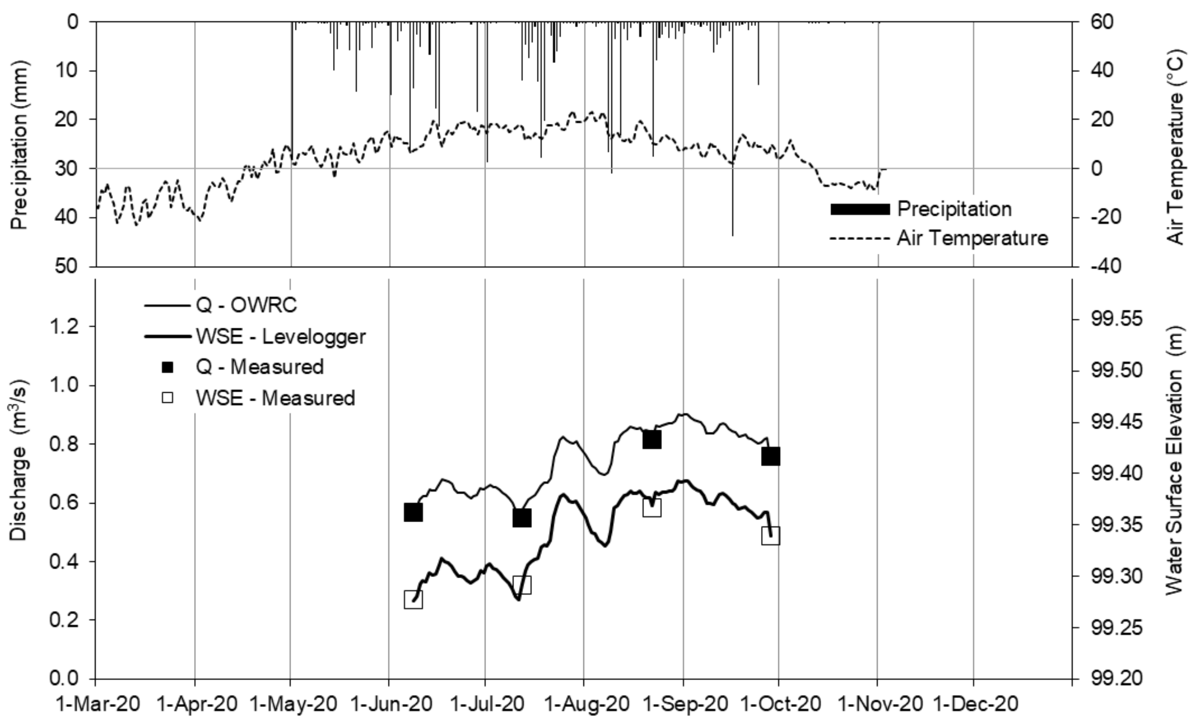
Note: View of HC-WC-MS-01 from the discharge measurement cross-section on 28 September 2020; view is facing downstream (west).

Figure 50: Preliminary Open Water Rating Curve for HC-WC-MS-01



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

Figure 51: HC-WC-MS-01 Water Surface Elevation and Discharge, 2020



OWRC = open water rating curve; Q = discharge (m^3/s); WSE = water surface elevation.

5.3.2 Waterbody Hydrometric Monitoring

The WSE data collected for each hydrometric station during the 2018 to 2020 hydrology field programs are provided in the following subsections. Daily mean WSE and discharge data are included in Appendix D.

5.3.2.1 Station CR-WB-MS-01: Broach Lake

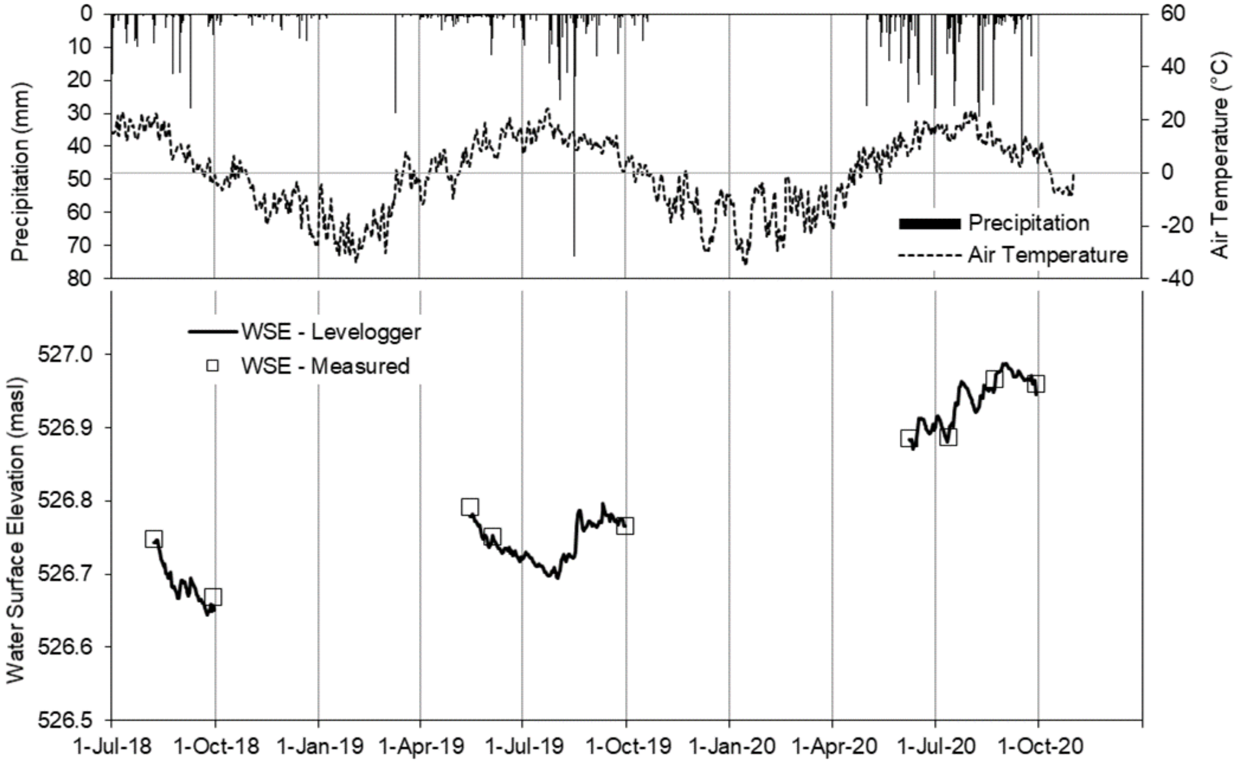
Broach Lake has a surface area of approximately 9.2 km^2 and is located at the headwaters of the Clearwater River (Figure 3). Hydrometric monitoring at Broach Lake (i.e., CR-WB-MS-01) began in August 2018. The station is located on the west shore of the lake. The field activities completed at CR-WB-MS-01 are summarized in Table 20. The daily mean WSE record derived from the Levelogger, along with observed precipitation and air temperature, are presented in Figure 52.

Table 20: Summary of Hydrometric Monitoring Results, CR-WB-MS-01

Date and Time	WSE[(a)] (masl)	Staff Gauge Reading (m)
7 August 2018 15:30	526.748	0.275
29 September 2018 16:11	526.668	0.185
15 May 2019 13:45	526.792	0.150
4 June 2019 14:00	526.751	0.152
29 September 2019 16:15	526.766	0.162
8 June 2020 09:10	526.885	n/d[(b)]
12 July 2020 13:00	526.887	n/d[(b)]
22 August 2020 16:50	526.966	0.430
28 September 2020 13:05	526.960	0.430

a) Water surface elevation (WSE) measured by levelling survey using rebar benchmark, CR-WB-MS-01_BM1.
b) Staff gauge lying on lake bed, re-established 22 August 2020.
n/d = no measurement; masl = metres above sea level.

Figure 52: CR-WB-MS-01 Water Surface Elevation, 2018 to 2020



WSE = water surface elevation.

5.3.2.2 Station CR-WB-MS-02: Patterson Lake

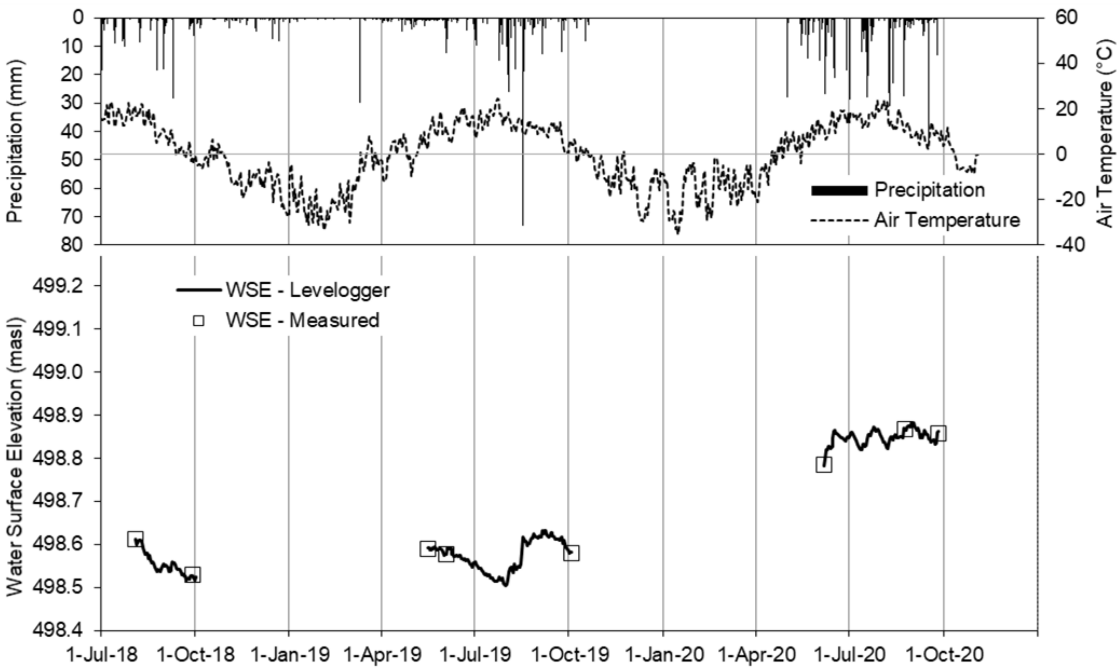
Patterson Lake has a surface area of approximately 38.2 km^2 and is located downstream of Broach Lake and upstream of Forrest Lake (Figure 3). Hydrometric monitoring work at Patterson Lake (i.e., Station CR-WB-MS-02) began in 2018. The station is located on the southeast side of the lake. The field activities completed at CR-WB-MS-02 are summarized in Table 21. The daily mean WSE record derived from the Levelogger, along with observed precipitation and air temperature, are presented in Figure 53.

Table 21: Summary of Hydrometric Monitoring Results, CR-WB-MS-02

Date and Time	WSE[(a)] (masl)	Staff Gauge Reading (m)
4 August 2018 08:30	498.612	0.415
29 September 2018 12:00	498.530	0.330
18 May 2019 16:10	498.585	0.830
3 June 2019 19:00	498.578	0.820
3 October 2019 15:15	498.581	0.845
6 June 2020 18:55	498.786	n/d[(b)]
10 July 2020 18:00	n/d[(c)]	n/d[(b)]
24 August 2020 12:45	498.868	n/d[(b)]
26 September 2020 17:21	498.857	n/d[(b)]

a) Water surface elevation (WSE) measured by levelling survey using rebar benchmark, CR-WB-MS-02_BM1.
b) Staff gauge completely submerged.
c) Survey error was identified, and this result was likely an overestimate and has been omitted.
n/d = no data; masl = metres above sea level.

Figure 53: CR-WB-MS-02 Water Surface Elevation, 2018 to 2020



WSE = water surface elevation.

5.3.2.3 Station CR-WB-MS-03: Forrest Lake

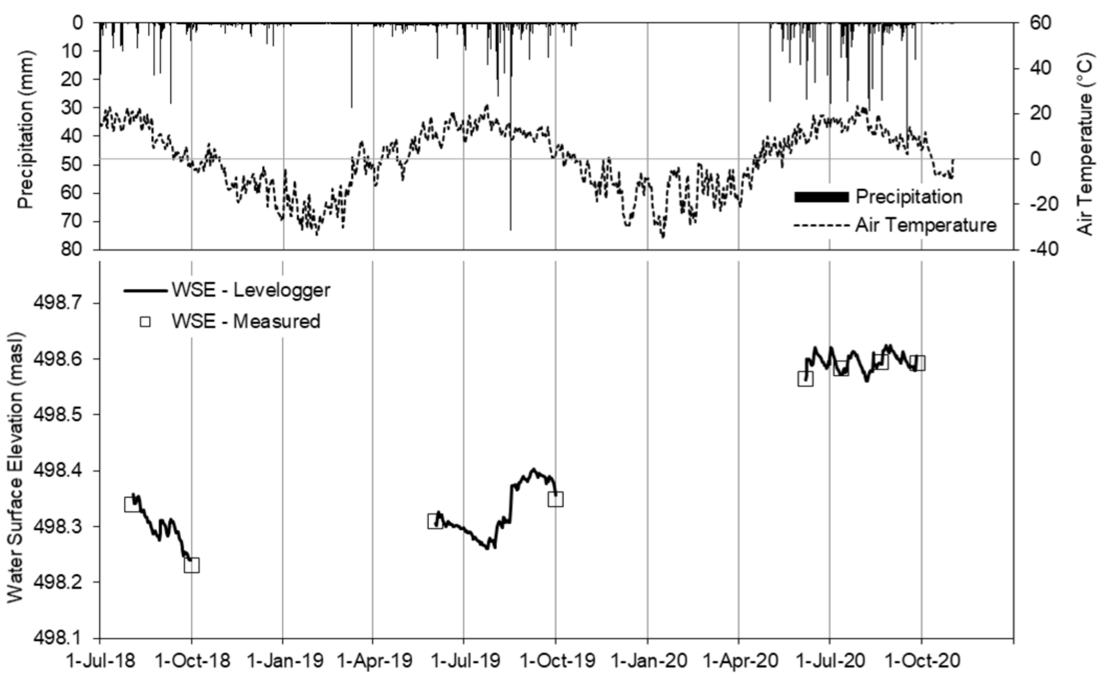
Forrest Lake has a surface area of approximately 40.1 km^2 and is located at the downstream end of Patterson Lake and upstream of Beet Lake (Figure 3). Hydrometric monitoring work at Forrest Lake (i.e., Station CR-WB-MS-03) began in 2018. The station is located on the northeast shore of the lake. The field activities completed at CR-WB-MS-03 are summarized in Table 22. The daily mean WSE record derived from the Levelogger, along with observed precipitation and air temperature, are presented in Figure 54.

Table 22: Summary of Hydrometric Monitoring Results, CR-WB-MS-03

Date and Time	WSE[(a)] (masl)	Staff Gauge Reading (m)
2 August 2018 16:15	498.340	0.395
1 October 2018 15:52	498.230	0.275
2 June 2019 17:30	498.310	0.475
30 September 2019 14:00	498.349	0.515
6 June 2020 08:05	498.565	n/d[(b)]
12 July 2020 08:40	498.584	n/d[(b)]
21 August 2020 11:07	498.594	0.380
25 September 2020 15:37	498.592	0.370

a) Water surface elevation (WSE) measured by levelling survey using rebar benchmark, CR-WB-MS-03_BM1.
b) Staff gauge lying on lake bed. Re-established 21 August 2020.
n/d = no data; masl = metres above sea level.

Figure 54: Station CR-WB-MS-03 Water Surface Elevation, 2018 to 2020



WSE = water surface elevation.

5.3.2.4 Station CR-WB-MS-04: Beet Lake

Beet Lake has a surface area of approximately 8.66 km^2 and is located downstream of Forrest Lake and upstream of Naomi Lake (Figure 3). Hydrometric monitoring at Beet Lake (i.e., CR-WB-MS-04) began in 2018. The station is located on the south shore of the lake. The field activities completed at CR-WB-MS-04 are summarized in Table 23. The daily mean WSE record derived from the Levelogger, along with observed precipitation and air temperature, are presented in Figure 55.

Table 23: Summary of Hydrometric Monitoring Results, CR-WB-MS-04

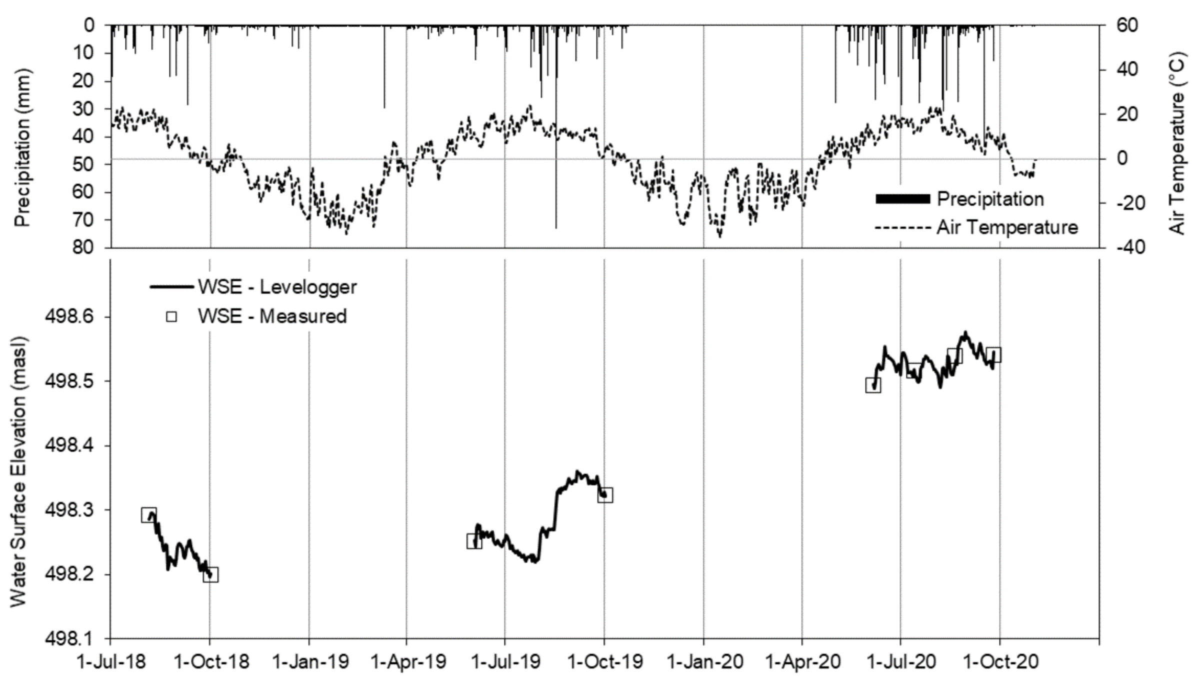
Date and Time	WSE[(a)] (masl)	Staff Gauge Reading (m)
5 August 2018 14:30	498.291	0.330
1 October 2018 14:27	498.200	n/d
2 June 2019 16:30	498.252	0.265
2 October 2019 17:00	498.323	0.342
6 June 2020 09:00	498.494	n/d[(b)]
13 July 2020 11:20	498.517	n/d[(b)]
20 August 2020 16:30	498.539	0.710
25 September 2020 14:20	498.541	0.725

a) Water surface elevation (WSE) measured by levelling survey using rebar benchmark, CR-WB-MS-04_BM1.

b) Staff gauge sheared, likely due to ice. Re-established 20 August 2020.

n/d = no data; masl = metres above sea level.

Figure 55: CR-WB-MS-04 Water Surface Elevation, 2018 to 2020



WSE = water surface elevation.

5.3.2.5 Station CR-WB-MS-05: Naomi Lake

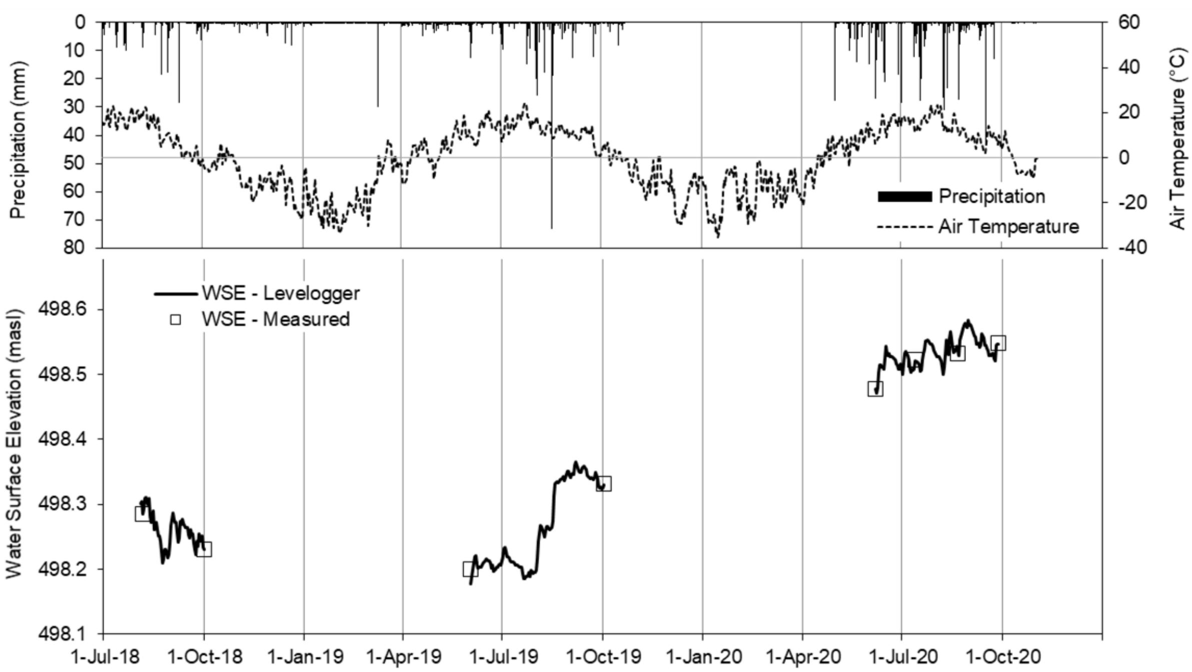
Naomi Lake has a surface area of approximately 2.4 km^2, is located downstream of Beet Lake and meets the Clearwater River downstream at the southeast end of the lake (Figure 3). Hydrometric monitoring work at Naomi Lake (i.e., CR-WB-MS-05) began in 2018. The station is located on the northwest shore of Naomi Lake. The field activities completed at CR-WB-MS-05 are summarized in Table 24. The daily mean WSE record derived from the Levelogger, along with observed precipitation and air temperature, are presented in Figure 56.

Table 24: Summary of Hydrometric Monitoring Results, CR-WB-MS-05

Date and Time	WSE[(a)] (masl)	Staff Gauge Reading (m)
5 August 2018 16:00	498.285	0.235
1 October 2018 13:00	498.230	0.180
2 June 2019 14:00	498.200	0.028
2 October 2019 11:00	498.331	0.175
6 June 2020 10:15	498.487	0.300
13 July 2020 10:20	498.524	0.368
21 August 2020 10:07	498.532	0.385
27 September 2020 12:08	498.548	0.390

a) Water surface elevation (WSE) measured by levelling survey using rebar benchmark, CR-WB-MS-05_BM1.
masl = metres above sea level.

Figure 56: CR-WB-MS-05 Water Surface Elevation, 2018 to 2020



WSE = water surface elevation.

5.3.2.6 Station CR-WB-TI-01: Lake H

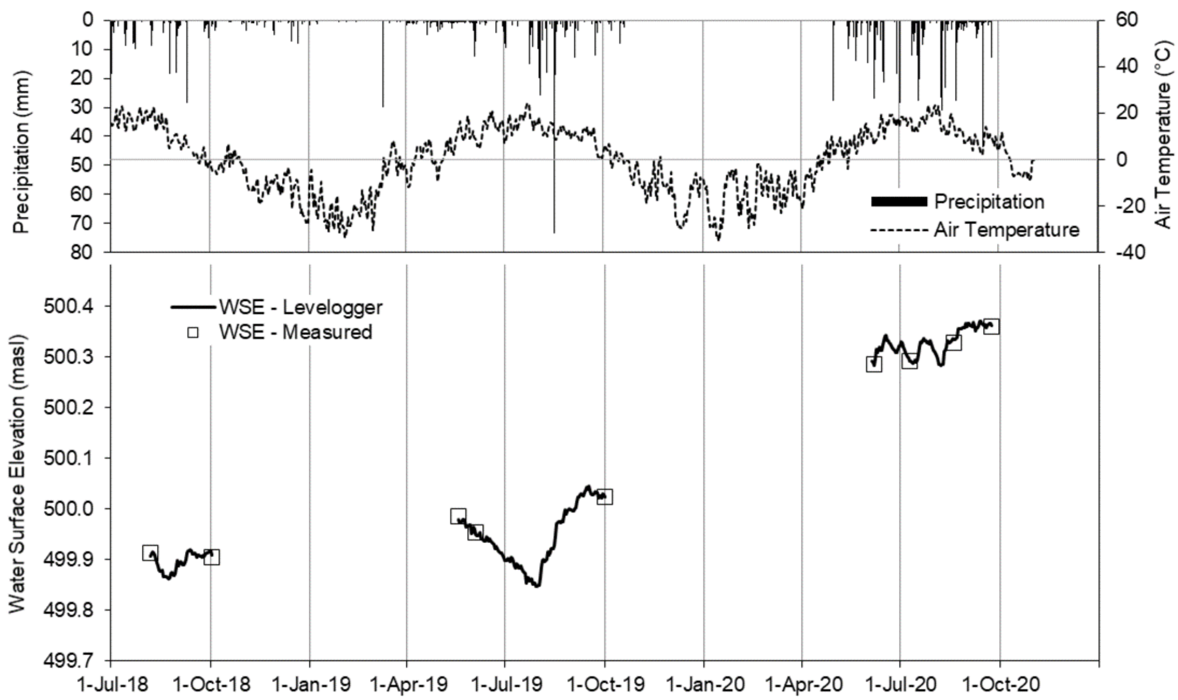
Lake H has a surface area of approximately 1.7 km^2 and is located near the upstream portion of Patterson Lake (Figure 3). Hydrometric monitoring at Lake H (i.e., CR-WB-TI-01) began in 2018. The station is located on the southwest shore of Lake H. The field activities completed at CR-WB-TI-01 are summarized in Table 25. The daily mean WSE record derived from the Levelogger, along with observed precipitation and air temperature, are presented in Figure 57.

Table 25: Summary of Hydrometric Monitoring Results, CR-WB-TI-01

Date and Time	WSE[(a)] (masl)	Staff Gauge Reading (m)
6 August 2018 11:00	499.900	0.264
2 October 2018 15:00	499.900	0.245
18 May 2019 11:45	499.985	0.230
3 June 2019 15:05	499.954	0.195
1 October 2019 11:00	500.024	0.260
4 June 2020 16:10	500.285	0.525
9 July 2020 13:50	500.291	0.525
19 August 2020 14:00	500.329	0.570
23 September 2020 13:09	500.360	0.600

a) Water surface elevation (WSE) measured by levelling survey using rebar benchmark, CR-WB-TI-01_BM1.
masl = metres above sea level.

Figure 57: CR-WB-TI-01 Water Surface Elevation, 2018 to 2020



WSE = water surface elevation.

5.3.2.7 Station CR-WB-TI-02: Lake G

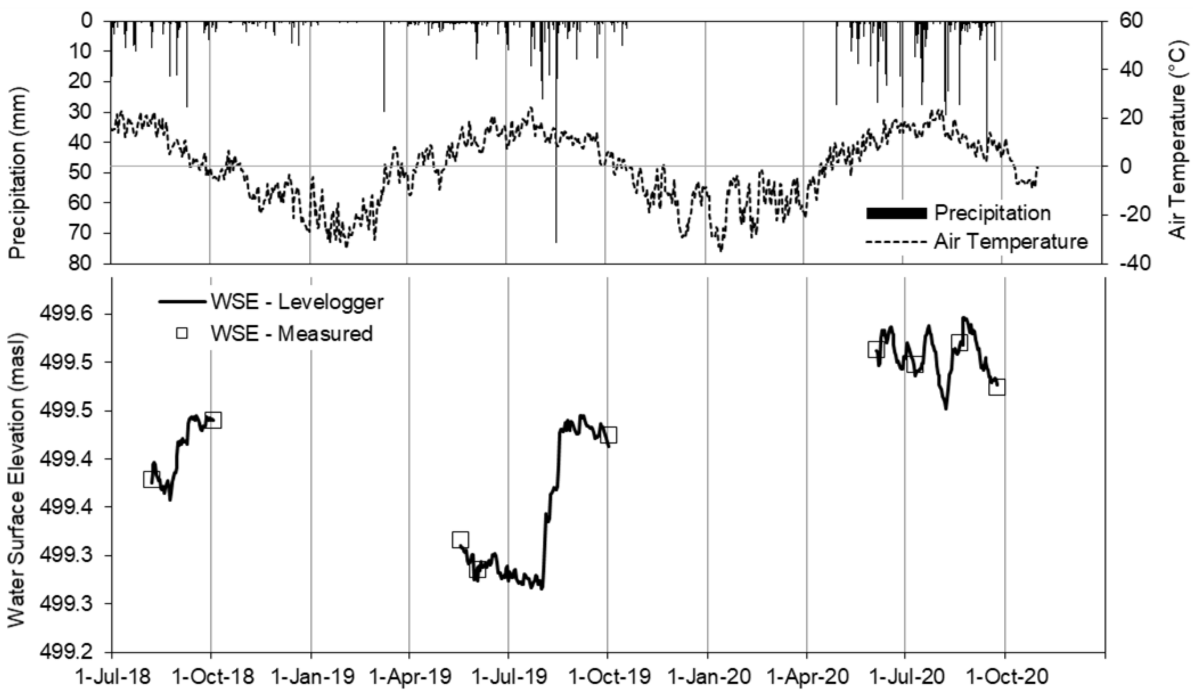
Lake G has a surface area of approximately 0.57 km^2 and is located near the upstream portion of Patterson Lake (Figure 3). Hydrometric monitoring at Lake G (i.e., CR-WB-TI-02) began in 2018 in support of the hydrological baseline. The CR-WB-TI-02 station is located on the north shore of Lake G. The field activities completed at CR-WB-TI-02 are summarized in Table 26. The daily mean WSE record derived from the Levelogger, along with observed precipitation and air temperature, are presented in Figure 58.

Table 26: Summary of Hydrometric Monitoring Results, CR-WB-TI-02

Date and Time	WSE[(a)] (masl)	Staff Gauge Reading (m)
6 August 2018 13:00	499.379	0.306
2 October 2018 16:00	499.440	0.375
18 May 2019 10:45	499.316	0.575
3 June 2019 10:25	499.286	0.548
1 October 2019 10:15	499.425	0.675
4 June 2020 15:15	499.513	0.773
9 July 2020 12:46	499.498	0.748
19 August 2020 13:05	499.521	0.778
23 September 2020 12:05	499.474	0.738

a) Water surface elevation (WSE) measured by levelling survey using anchor bolt in tree benchmark, CR-WB-TI-02_BM1.
masl = metres above sea level.

Figure 58: CR-WB-TI-02 Water Surface Elevation, 2018 to 2020



WSE = water surface elevation.

5.3.2.8 Station CR-WB-TI-03: Lake F

Lake F has a surface area of approximately 1.19 km^2 and is located near adjacent to the north basin of Forrest Lake (Figure 3 and Figure 4). Hydrometric monitoring at Lake F (i.e., CR-WB-TI-03) began in 2018. The field activities completed at CR-WB-TI-03 are summarized in Table 27. Lake F was monitored opportunistically as it is near CR-WB-MS-03. Monitoring activities included instantaneous measurements of WSE during field visits. A Levelogger was not installed at this station as it is considered a lower priority due to its location on a small waterbody far from the proposed Project.

Table 27: Summary of Hydrometric Monitoring Results, CR-WB-TI-03

Date and Time	WSE[(a)] (masl)	Staff Gauge Reading (m)
2 August 2018 13:00	498.795	0.410
1 October 2018 16:00	498.797	0.400
30 September 2019 14:15	499.022	0.543
6 June 2020 08:05	499.345	0.915
12 July 2020 08:40	499.405	0.962
21 August 2020 11:07	499.425	0.990
25 September 2020 15:37	499.500	n/d[(b)]

a) Water surface elevation (WSE) measured by levelling survey using rebar benchmark, CR-WB-TI-03_BM1.

b) Staff gauge submerged.

n/d = no measurement; masl = metres above sea level.

5.3.2.9 Station HC-WB-MS-01: Hodge Lake

Hodge Lake has a surface area of approximately 13.02 km^2 and is located approximately 16 km north of Broach Lake (Figure 3). Hydrometric monitoring at the Hodge Lake (i.e., HC-WB-MS-01) began in June 2020 in support of the hydrological baseline. The station is located on the west shore of Hodge Lake near the outlet. The field activities completed at HC-WB-MS-02 are summarized in Table 28. The daily mean WSE record derived from the Levelogger, along with observed precipitation and air temperature, are presented in Figure 59.

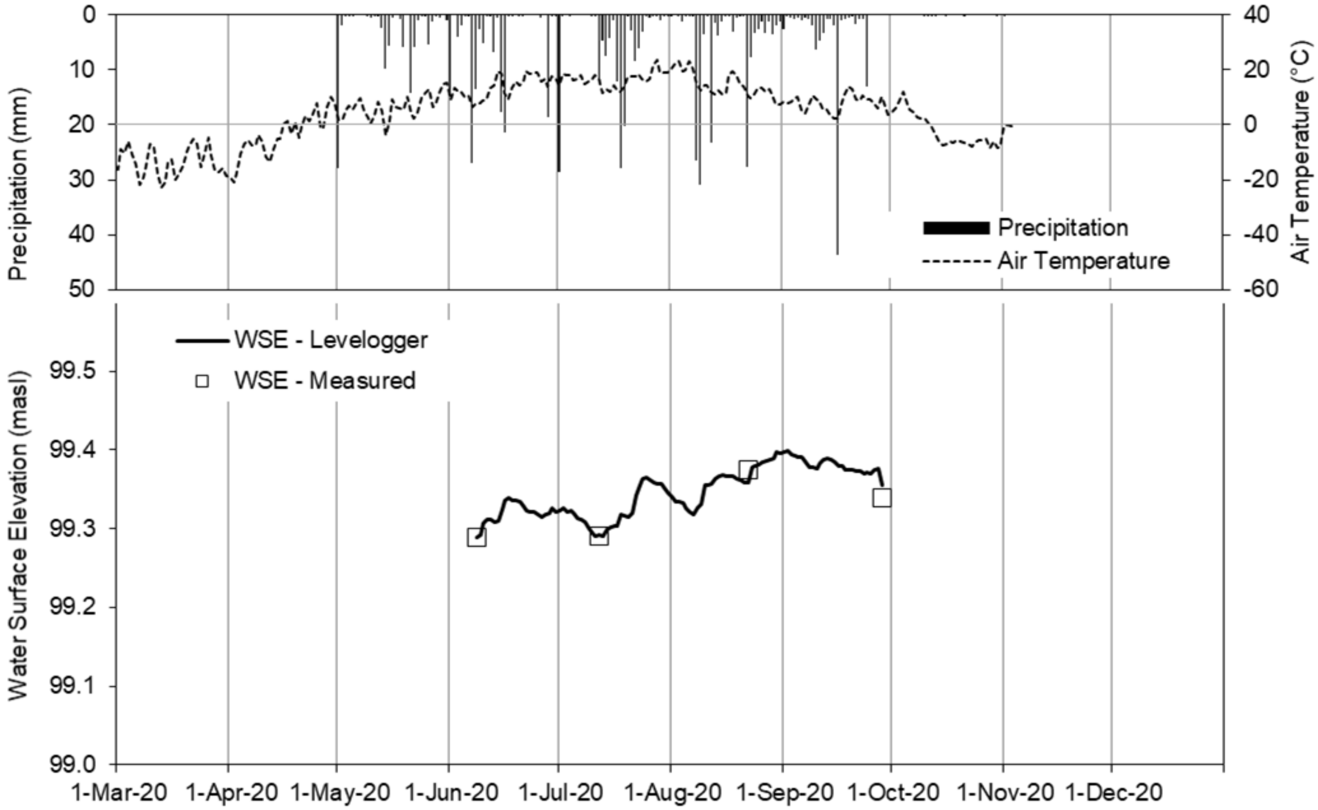
Table 28: Summary of Hydrometric Monitoring Results, HC-WB-MS-01

Date and Time	WSE[(a)] (masl)	Staff Gauge Reading (m)
8 June 2020 10:10	99.289	0.450
12 July 2020 11:30	99.290	0.460
22 August 2020 14:45	99.375	0.555
28 September 2020 11:05	99.339	0.520

a) Water surface elevation (WSE) measured by levelling survey using rebar benchmark, HC-WB-MS-01_BM1.

masl = metres above sea level.

Figure 59: HC-WB-MS-01 Water Surface Elevation, 2020



WSE = water surface elevation.

5.3.3 Comparison to Historical Regional Records

The 2018, 2019, and 2020 hydrometric baseline study provisional discharge records for the Douglas River (i.e., WSC Station 07MA003) were compared with long-term values for the years 1975 to 2020 (Figure 60; WSC 2020). Most of 2018 and 2019 had near or below normal discharge including spring 2018. The August 2019 peak flow that occurred on the Douglas River was well above normal conditions for that time of year and would be close to a 1-in-2-year flood event for that station. Discharge measured in 2020 was above normal beginning in early May until the end of the year. The August 2020 peak flow was approximately timed with the 2019 peak and a secondary peak in 2018. The August 2020 peak flow would be greater than the 1-in-100-year flood event for that station.

A comparison of 2018, 2019, and 2020 hydrometric baseline study discharge records for the Clearwater River at Outlet of Lloyd Lake (CR-WC-MS-08) with historical observations for the Clearwater River (i.e., WSC Station 07CD006) is shown in Figure 61 (WSC 2020). Discharge records at CR-WC-MS-08 were near normal in 2018. Discharge observed in May to August 2019 was well below normal, and in September 2019 through April 2020 was above normal. During 2020 freshet, the observed discharge was well above normal, and this trend continued through October 2020.

Figure 60: Comparison of 2018 to 2020 Hydrographs for the Douglas River near Cluff Lake (Station 07MA003) with Long-Term Discharge Records

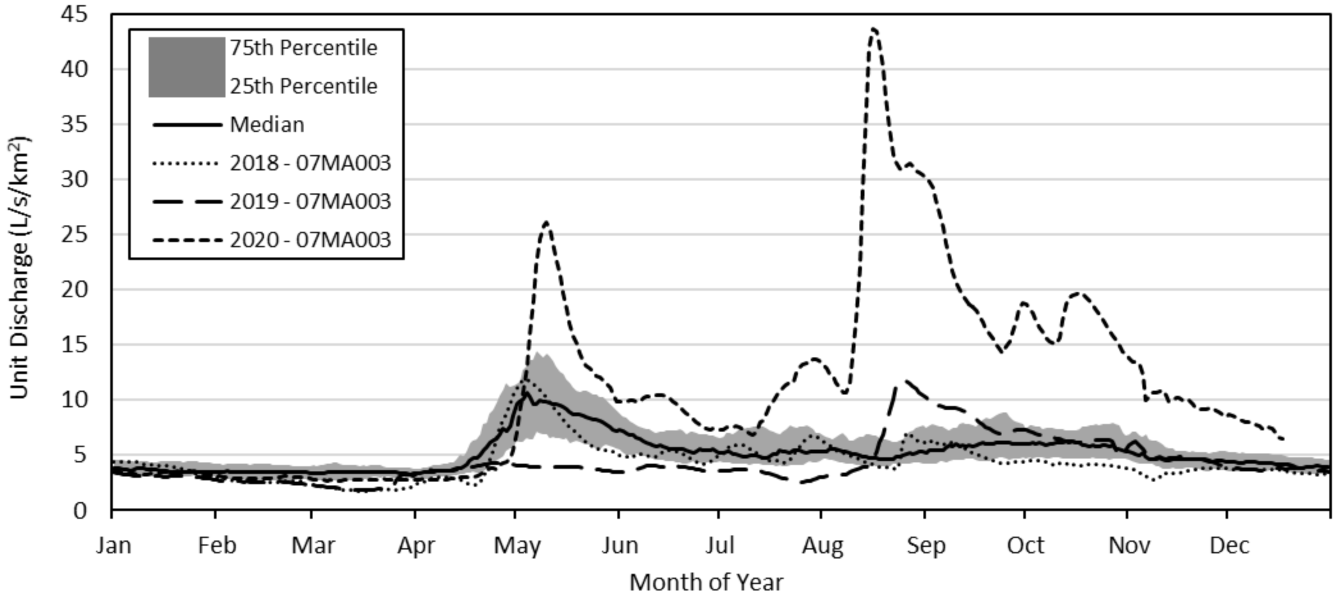
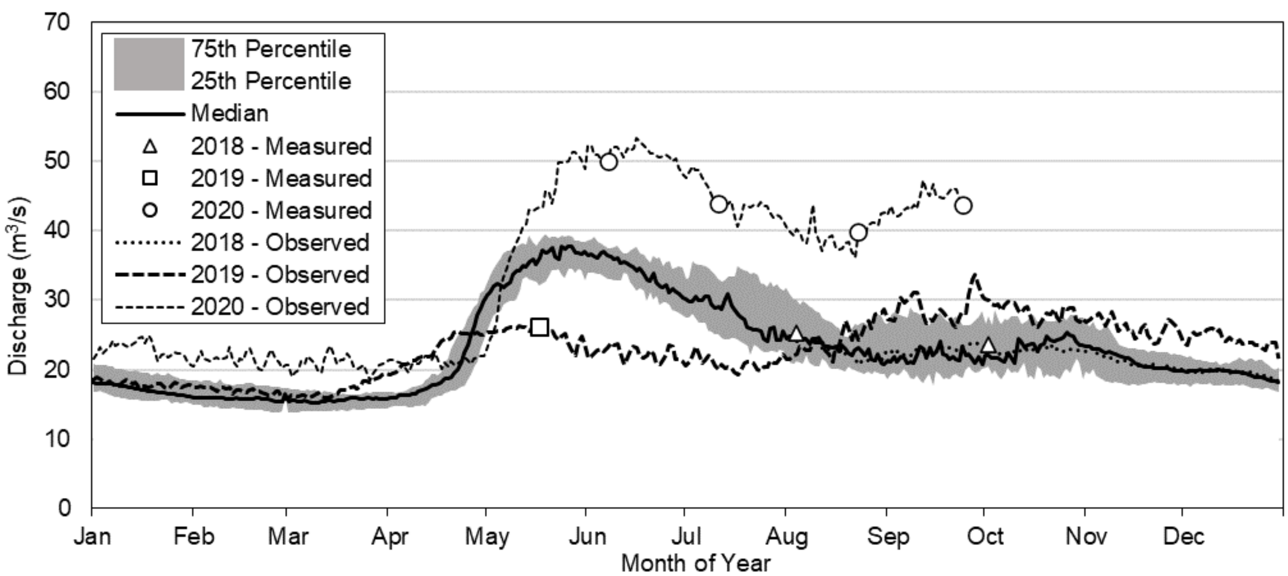


Figure 61: Comparison of 2018 to 2020 Observations at the Clearwater River at Outlet of Lloyd Lake to Historical Observations at Station 07CD006 Clearwater River at Outlet of Lloyd Lake, 1974 to 1995



5.4 Sediment

5.4.1 Bed Substrate Particle Size

River bed substrate samples were collected in October 2018 at three hydrometric stations on the Clearwater River downstream of Patterson Lake to characterize particle size. At all three hydrometric stations, the bed was observed to be uniform and composed of fine to medium sand. Characteristic particle sizes are summarized in Table 29. The full grain size distributions analyzed for each of the samples are included in Appendix E, Total Suspended Solids and Bed Load Laboratory Results.

Table 29: Bed Substrate Characteristics at Selected Stations on the Clearwater River

Watercourse	Hydrometric Station	Sample Number	D_{15} (mm)	D_{50} (mm)	D_{85} (mm)
Clearwater River below Patterson Lake	CR-WC-MS-03	SL6312	0.177	0.282	0.393
Clearwater River below Beet Lake	CR-WC-MS-04	SL6313	0.189	0.306	0.422
Clearwater River below Naomi Lake	CR-WC-MS-05	SL6314	0.271	0.381	0.673

Note: Samples collected October 2018.

D = particle size diameter, with the subscript number referring to the percentage of particles that are finer than this size.

5.4.2 Suspended and Bed Load

Suspended load and bed load observations were made during each field visit in 2018, 2019, and 2020 at three hydrometric stations on the Clearwater River downstream of Patterson Lake. The measured TSS concentration in the water column and bed load concentration are summarized in Table 30. The highest TSS measured was 3 mg/L at CR-WC-MS-04 on 6 June 2020 and at CR-WC-MS-05 on 5 June 2020 which coincided with the highest discharge measured during the monitoring program. Measurements of 2 mg/L TSS were obtained at CR-WC-MS-04 on 1 June 2019 and 13 July 2020 and at CR-WC-MS-05 on 13 July 2020. All the remaining TSS samples were at or below the detection limit of 1 mg/L.

For bed load, if insufficient mass or no mass could be collected within the sampling duration, these samples were not submitted to the laboratory for further analysis and are indicated as “not detected” in Table 30. Even the highest bed load concentrations were low concentrations compared to many natural streams when measured over a period of hours at CR-WC-MS-03 of 0.0029 mg/L on 4 Jun 2019 and 0.0028 mg/L on 4 June 2019, which correspond to slightly higher mean velocities than the other results shown in Table 30. No regional sediment monitoring data are available for the Clearwater River in Saskatchewan (including the RSA) or surrounding watersheds for comparison with the local sampling results.

Table 30: Suspended and Bed Load Sampling Results, 2018 to 2020

Hydrometric Station and Watercourse	Date	TSS (mg/L)	Bed Load (mg/L)	Bed Load Sampling Duration (s)	Daily Load (t/d)	Discharge (m³/s)	Mean Velocity (m/s)
Clearwater River below Patterson Lake CR-WC-MS-03	4 August 2018	<1	Not Detected	3,600	Not Detected	1.16	0.250
	1 October 2018	<1	Not Detected	3,600	Not Detected	0.98	0.253
	18 May 2019	<1	0.0021	60,480	0.0083	1.46	0.318
	4 June 2019	<1	0.0028	49,800	0.0102	1.33	0.282
	30 September 2019	<1	0.0010	86,400	0.0031	1.17	0.234
	3 May 2020	n/d	Not Detected	88,500	Not Detected	1.56	0.241
	8 June 2020	<1	0.0000	138,420	0.0002	2.22	0.311
	14 July 2020	1	0.0002	69,120	0.0049	2.35	0.307
	25 August 2020	<1	0.0003	69,900	0.0090	2.32	0.294
	28 September 2020	<1	0.0001	75,000	0.0041	2.16	0.232
Clearwater River below Beet Lake CR-WC-MS-04	5 August 2018	<1	Not Detected	3,600	Not Detected	1.92	0.133
	1 October 2018	<1	Not Detected	3,600	Not Detected	1.70	0.242
	1 June 2019	2	Not Detected	6,060	Not Detected	2.54	0.242
	2 October 2019	<1	Washload only	1,500	0.0043	1.83	0.108
	6 June 2020	3	0.0001	57,900	0.0108	5.50	0.261
	13 July 2020	2	0.0001	243,540	0.0074	4.80	0.266
	21 August 2020	<1	0.0000	66,420	0.0013	3.87	0.184
	26 September 2020	<1	0.0001	67,560	0.0087	4.65	0.248
Clearwater River below Naomi Lake CR-WC-MS-05	5 August 2018	<1	Not Detected	3,600	Not Detected	2.95	0.208
	1 October 2018	<1	Not Detected	3,600	Not Detected	3.01	0.250
	1 June 2019	<1	Not Detected	6,060	Not Detected	2.90	0.157
	2 October 2019	<1	Washload only	90,660	0.0000	3.51	0.219
	5 June 2020	3	0.0000	18,180	0.0062	8.23	0.402
	10 July 2020	2	0.0001	16,200	0.0098	6.30	0.377
	20 August 2020	<1	0.0000	14,100	0.0010	5.82	0.307
	27 September 2020	2	0.0000	88,320	0.0037	7.38	0.358

TSS = total suspended solids; < = less than.

5.5 Uncertainty and Limitations

The purpose of this section is to identify the key sources of uncertainty and discuss how uncertainty has been addressed to increase the level of confidence in results. The confidence in hydrology results are related to:

- natural variability in meteorological and hydrological conditions over time;
- period of baseline data collection and timing of field visits in relation to natural variability; and
- accuracy of baseline data collected, methods used, and application of QA/QC measures.

5.5.1 Natural Variability over Time

The baseline hydrology program and field visits documented in this report occurred over a limited period of two calendar years with data collected in three open-water seasons. Short-term records such as this do not usually adequately characterize the entire range of natural variability of hydrology that long-term records would. However, the hydrology records collected capture both relatively dry and wet periods, which is a better result than expected in a short-term record. The range of water level and discharge conditions measured during the 2018 and 2019 field visits at the hydrometric stations was relatively low; however, as additional data were collected in 2020, the upper ranges of many rating curves became more reliable, and these uncertainties were reduced.

As described in Section 5.0, baseline hydrology data including total precipitation, peak SWE for the winters of 2017-2018 and 2018-2019, and water levels and discharge records were all collected during relatively dry to near-average precipitation conditions. Exceptional events were also recorded. For instance, the total monthly recorded precipitation in August 2019 exceeded historical precipitation for this month based on long-term European Re-analysis Interim (ERAI) data from 1979 to 2019.

Based on a comparison of 2018 and 2019 discharge at the Douglas River (i.e., WSC Station 07MA003), most of this baseline period had near normal or below normal discharge, including spring 2018 and 2019. The peak flow that occurred in August 2019 and early September 2019 on the Douglas River was well above normal conditions for that time of year but would be just below a 1-in-2-year flood event for that station. With the exception of the winter 2019 to 2020 discharge, nearly all of 2020 was well above normal conditions, including one portion above the 1-in-100-year flood.

No snow survey was completed in 2020. The limited baseline data collection period may not characterize the full range of hydrological conditions that could occur. End-of-winter snow surveys are important in characterizing the interannual variation of snowfall, sublimation, and water available during spring freshet. Ground-based measurements are valuable for validating the publicly available remote sensing data. Comparing the 2018 and 2019 snow surveys to the remote sensing data provided some confidence that the 2020 remote sensing data provided an adequate representation of the conditions at the Project site; the ground-based data further increased this confidence and reduce the uncertainty.

5.5.2 Period of Baseline Data Collection

The hydrology assessment relies on a combination of available climate and hydrometric data and short-term monitoring of flows and water levels in the RSA and farther downstream. Hydrology data were collected at numerous stations over a period of just over two years, which is a relatively short period of time. However, most stations were visited several times or more frequently which increased the validity of the data set, and a wide range of conditions were observed between August 2018 and September 2020, which lends additional confidence to the results.

5.5.3 Data Collection Methods and Quality Assurance and Quality Control

A high level of prediction confidence was maintained during data collection and analysis by managing uncertainty as follows:

- Carefully selecting sites.
- Using standard methods and QA/QC in the field program.

- Correcting data.
- Using corrected datasets (e.g., precipitation data were adjusted).
- Comparing short-term data from the baseline study with long-term data observed at regional stations that would be most representative of the anticipated area of the Project, as well as with long-term results from the calibrated hydrological model.

The delineation of watershed boundaries and the stream network was determined for the 22 hydrology stations using digital elevation model and mapped stream network data and compared with visible streams, wetlands, and upland features shown on recent satellite imagery for the region. Canadian Digital Elevation Data for the surrounding region were used as the digital elevation model base data (NRCan 2019a). The mapped stream network was represented by the National Hydrologic Network dataset for the region (NRCan 2019b). These data were imported to the ECCC software ENSIM (GreenKenue 2010) and used to delineate watershed boundaries for hydrometric station locations. These initial watershed boundaries and stream network results were plotted on satellite imagery using Google Earth Pro to compare them with features on the ground. Although the topography in general in this region is sufficient to be confident in the boundaries, there is less certainty in watershed boundary locations and flow directions in flatter areas such as peatlands. For example, some peatlands flow out in multiple directions and have varying water levels and connections to downstream areas. The focus of QC effort was on these more difficult areas, and more effort was placed on QC in the RSA. These uncertainties affect the synthesized flow and flood frequency results, which are based on watershed areas.

Uncertainties in the results of the hydrometric monitoring study were reduced using the QA and QC methods identified in Section 4.7. However, there are still limits in accuracy and precision of measurements, in understanding/interpretation of the physical processes affecting the hydrology data analysis, and limits in the physical range of water level and flow conditions that occurred during the monitoring period that leads to uncertainty in extrapolation of flows beyond the measured values.

Uncertainties in discharge measurements can be attributed to precision in channel width, depth, and velocity measurements, and particularly the number of verticals and number of points in each vertical (WMO 2010). Increasing the duration of velocity measurements decreases the influence from natural variations or pulsations over time due to turbulence; this influence was reduced by measuring for a standard 40-second period for each vertical. An increased number of verticals and increased number of points in each vertical also increases confidence in discharge results with the ADV. The standard number of measurement verticals proposed for a cross-section for this program was 20, with more verticals located near the thalweg, which is deepest point of the cross-section and therefore is the line of lowest elevation along the watercourse. Increased points in each vertical were required whenever the water depth exceeded 0.75 m. This standard was not universally carried out as some stream channels were too narrow to obtain 20 measurement verticals with the proper spacing for the current meter used.

Discharge during the field visits was measured with a Sontek Flowtracker ADV, Flowtracker2 ADV, and RiverSurveyor M9 ADCP. These devices do not require recalibration; however, the QA tests were completed prior to starting measurements and the ADCP received an additional compass calibration before use. The range of discharge measured at most hydrometric stations was well within the acceptable range for the equipment used. The range of uncertainty measured with the ADVs varied with each site; most measurements had low uncertainty

(5%), but one station (CR-WC-TI-01) had low flows and a narrow channel such that uncertainty was usually high (>10%).

The objective was to have at least three, preferably four, ADCP measurements that were within 5% of the averaged discharge measurements, and the average discharge was used. Although most sites did not have visibly moving beds, the GPS-Generalized Gradient Approximation (GGA) track reference usually provided a more accurate channel width than the bottom tracking track reference mode.

Water level surveys were typically completed using an optical level, and the accuracy of these surveys is up to 1 cm (0.01 m) but was usually less. Two complete water level surveys (including survey of all local benchmarks) were conducted for each hydrometric station during each field visit. The results of the two complete water level surveys were compared to each other: A measurement was considered good quality if the difference was within 5 mm, and acceptable if within 1 cm. In windy and wavy exposed locations, particularly on the waterbodies with large fetch, the water level survey results were expected to have larger variance, and a difference greater than 1 cm was sometimes deemed acceptable based on professional opinion. The benchmark elevations and top of staff gauge elevations were compared to previous elevation results and potential for movement or heaving of the primary benchmark was identified in some cases.

Two stations were located in predominantly organic terrain including CR-TI-WC-02 and Lake G CR-TI-WB-02 and had benchmarks that were not likely to be as stable over time as at other stations. Over the course of the monitoring period, benchmarks were occasionally lost due to beavers cutting down the trees that the survey spikes had been embedded in, or due to these trees falling down from extreme wind events or other natural causes. However, three benchmarks were always maintained at each hydrometric station and any lost benchmarks were replaced during the next field visit with no consequence to data quality or continued data collection.

Staff gauge readings were compared with previous field visit results at each site that had a staff gauge, and the survey to the top of the staff gauge was used to estimate alternate WSE, which were then compared with the direct WSE readings. Staff gauges were used to provide a QC on the WSE surveys to local benchmarks which provide more reliable data. Staff gauges often shifted position or were lost during the winter, however. In all of these cases, staff gauges were re-established and re-surveyed during the next field visit with no consequence to data quality or continued data collection.

Aquarius software was used to store and correct the hydrometric data and check or generate stage-discharge rating curves. Continuous water level records were corrected using the water level survey measurements and compared with local precipitation and air temperature records to assist with QC and corrections. For the hydrometric stations that had Leveloggers in place over the winter of 2018-2019, water levels were corrected over the winter for backwater using WSE survey data from late March 2019. There is uncertainty in the corrected data prior to that field visit; however, it was assumed that water levels receded gradually over the winter under the ice until mid-March when air temperatures increased, and snowmelt started. Using discharge measurements or unit-area discharge estimates for the stations not visited in late March 2019, the winter discharge records were further corrected, if required. For the hydrometric stations that had Leveloggers in place over the winter of 2019-2020, water levels were corrected similarly using WSE survey data from early May 2020 or early June 2020. Similar procedures were followed to complete the winter discharge records.

As part of standard field practice, rating curves were extrapolated above and below the measured water level and discharge records in 2018 to 2020; in most cases, the rating curve extrapolation function in Aquarius was used to extrapolate discharge from higher water levels. Higher confidence was placed on periods when water levels were within the range of measured stage-discharge values. To understand and address uncertainty in extrapolating higher discharge from the rating curves, unit-area runoff hydrographs for all the watercourse stations were plotted together for comparison. This QC step was completed for all streamflow stations and provided an indication of when the upper end of the rating curves needed to be modified. The upper extrapolated regions of the rating curves were adjusted if required to avoid overestimating peak discharge.

Backwater can cause discharge to be overestimated for a given stage value. There is more uncertainty in the results at certain streamflow stations that experienced, or were inferred to have had, backwater conditions during the open-water periods. All streamflow stations experience backwater during ice-covered conditions. Stations with noted potential for backwater conditions included:

- Observations of dense aquatic vegetation in the channel at CR-WC-MS-06 and CR-WC-TI-02.
- Beaver dams and beaver activity at the inflow to Forrest Lake at CR-WC-TI-01.
- Observed or inferred conditions during ice-covered periods at all the streamflow stations.
- Due to the low gradients in this area – the location of tributary inflow stations near the confluence with the Clearwater River and/or upstream of its waterbodies causes increased uncertainty for the monitoring periods in between field measurements (e.g., CR-WC-MS-02 is located upstream of Patterson Lake and was backwatered as lake levels increased in 2020, as well as CR-WC-TI-01, CR-WC-TI-02, and CR-WC-TI-03).

Backwater effects are alleviated using frequent (e.g., monthly) field measurements of coincident stage and discharge, which allow the base stage-discharge curves (unaffected by backwater) to be shifted upward to provide a more correct derived discharge. Hydrometric monitoring for this program included frequent measurements at key locations such as along the Clearwater River main stem in the LSA which greatly improves confidence in the results and reduces uncertainty. Stage-shifts are a method used to improve the discharge data derived from the stage-discharge rating curves. They were used for the stage-discharge pairs in which stage was 5% above or below the rating curves (WSC 2012). The magnitudes and dates of stage shifts for each rating curve were summarized in Appendix B.

6.0 SUMMARY

Extensive baseline hydrology field data were collected at 22 hydrometric monitoring stations with most located in the hydrology RSA in the Clearwater River watershed. This included eight waterbody and 12 watercourse locations in the Clearwater River watershed, and one watercourse and one waterbody in the adjacent Hodge Creek watershed. The monitoring period included in this report started in August 2018 and continued to September 2020; 11 field visits were conducted during this time. The hydrology field program also included snow surveys in late winter, which provided results for snow accumulation available for snowmelt in Patterson Lake watershed, suspended sediment sampling and bed load monitoring at three locations in the LSA downstream of Patterson Lake. Local meteorological data from the Rook I Meteorological Station were also collected and used to support interpretation of hydrology monitoring data.

A wide range of hydrological conditions were observed during the monitoring period with lower water levels and flows in 2018 and spring 2019 and higher water levels and flows observed throughout the 2020 open water season. Water level and discharge observations during the 2020 open-water period were well above long-term average values at the Douglas and Clearwater rivers at regional Water Survey of Canada gauging stations. At most local hydrometric stations, the highest water level and discharge were recorded following heavy rainfalls in August and mid-September 2020.

The high number of field visits made at key locations in the LSA, and the wide range of conditions observed, increases confidence in the hydrology results. Therefore, the main objective of this study has been met in that the hydrology baseline provides sufficient and detailed information to support an EA for the Project.

Results from the hydrology monitoring program met the overall objective of describing the existing hydrological conditions in the baseline study area to support an EA for the Project.

7.0 CLOSING

WSP is pleased to submit this report to NexGen in support of the Environmental Assessment for the Rook I Project. For details on the limitations and use of information presented in this report, please refer to the Study Limitations section following this page. If you have any questions or require additional details related to this study, please contact the undersigned.

WSP Canada Inc.

Jacoby Donnelly, BSc, EIT
Engineer-in-Training

Nathan Schmidt, PhD
Principal, Senior Water Resources Specialist

PROFESSIONAL ENGINEERS
R.W. PHILLIPS
MEMBER 22672
24 05 16
YR. MN. DAY
SASKATCHEWAN

Ross Phillips, MSc, PEng
Water Resources Engineer

Jaime Hogan, MSc, PGeo
Hydrologist

JD/NS/RP/JH/ir/jr

Association of Professional Engineers & Geoscientists of Saskatchewan
CERTIFICATE OF AUTHORIZATION
WSP Canada Inc.
Number C0868
Permission to Consult held by:

Discipline	Sk. Reg. No.	Signature
Water Resources	22672	

8.0 STUDY LIMITATIONS

This report has been prepared by WSP Canada Inc. (WSP) for NexGen Energy Ltd. (Client) and for the express purpose of supporting the Environmental Assessment (EA) of the proposed Rook I Project. This report is provided for the exclusive use by the Client. WSP authorizes use of this report by other parties involved in, and for the specific and identified purpose of, the EA review process. Any other use of this report by others is prohibited and is without responsibility to WSP.

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The scope and the period of WSP's services are as described in WSP's proposal, and are subject to restrictions and limitations. WSP did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the report. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by WSP in regard to it. Any assessments, designs and advice made in this report are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this report. Where data supplied by the Client or other external sources (including without limitation, other consultants, laboratories, public databases), including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by WSP for incomplete or inaccurate data supplied by others.

The passage of time affects the information and assessment provided in this report. WSP's opinions are based upon information that existed at the time of the production of the report. The Services provided allowed WSP to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to WSP by the Client, communications between WSP and the Client, and to any other reports prepared by WSP for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be to the foregoing and to the entirety of the report. WSP cannot be responsible for use of portions of the report without reference to the entire report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client and were prepared for the specific purpose set out herein. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, is the responsibility of such third parties. WSP accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

9.0 REFERENCES

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APPENDIX A

Geodetic Survey Summary

GOLDER

TECHNICAL MEMORANDUM

DATE April 7, 2021 **Reference No.** 19114981

TO Susan Mathieu
NexGen Energy Ltd.

CC Ross Phillips, Marci Mehl

FROM Kyle Nontell **EMAIL kyle_nontell@golder.com**

TOPOGRAPHIC SURVEYS COMPLETED FOR HYDROLOGICAL BASELINE 2018

1.0 INTRODUCTION

The Rook I Project (Project) is a proposed new uranium mining and milling operation that is 100% owned by NexGen Energy Ltd. (NexGen). The Project is located in northwestern Saskatchewan, approximately 40 km east of the Alberta-Saskatchewan border, 130 km north of the town of La Loche, and 640 km northwest of the city of Saskatoon. The Project resides within Treaty 8 territory and within the Homeland of the Metis. At a regional scale, the Project is situated within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system. Access to the Project will be from an existing road off Highway 955.

The Project would include underground and surface facilities to support the extraction and processing of uranium ore from the Arrow deposit, a land-based, basement hosted, high grade uranium deposit. The terrain and soils baseline report is a component of a comprehensive baseline program that documents the natural and socio-economic environments in the anticipated area of the Project. The terrain and soils baseline program was undertaken to provide context from which effects to terrain and soils from the Project can be assessed in the Rook I Environmental Impact Statement.

2.0 SURVEY METHODS

2.1 Survey Setup

The 2018 survey program required both Real-Time Kinematic (RTK) and Static Occupation (Static) surveys be performed. Golder utilized four GNSS receivers – two receivers were used as an RTK base and rover system, while the remaining receivers were available to perform Static surveys at various survey control points.

The GNSS receivers used during the program were Sokkia GRX2 units which have 226 satellite tracking channels and one (1) watt UHF2 internal radios.

All Static surveys were performed using tripods and tri-brachs to ensure stable positioning during the occupations, with the exception of the occupation at the geodetic monument 94V063 where the tribrach was placed directly on top of the plate on the concrete pier.

All RTK surveys were performed using a base station receiver affixed to a tripod and tribrach and a rover receiver attached to a two-piece carbon fibre pole. During the RTK survey at the hydrometric station on the Clearwater

Golder Associates Ltd.
1721 8th Street East, Saskatoon, Saskatchewan, S7H 0T4, Canada T: +1 306 665 7989 F: +1 306 665 3342

River directly upstream of the Highway 955 bridge crossing, the base station receiver's tribrach was placed directly on top of the plate of geodetic monument 94V063.

2.2 Control Points

The survey data collection relied on eight control points; four of these control points were intended for use only during the field program which they were installed. Details of the four long-term control points are summarized in Table 1. A photograph of 94V063 at the time of the survey is shown on Figure 1.

Table 1: NexGen Rook I Survey Control Information

ID	Northing (m)	Easting (m)	Elevation (m)	Location	Type	Date (yyyy-mm-dd)	Method	Length of Occupation (hh:mm:ss)	Sigma Y (m)	Sigma X (m)	Sigma Z (m)
94V063	6307623.834	623044.631	415.419	Approximately 250 m south of the HWY 955 bridge crossing the Clearwater River	Concrete pier monument	2018-09-29	Static Occupation	18:04:45	0.005	0.008	0.014
Golder CP1	6391350.689	603199.134	506.962	At the south west edge of the Rook 1 camp. South of the parking area on the crest of the slope towards Patterson Lake.	600 mm x 15 mm rebar	2018-10-02	Static Occupation	24:00:15	0.003	0.004	0.009
Golder CP2	6390524.359	605154.616	500.168	Approximately 20 m southwest of the south abutment of the bridge crossing the Clearwater River on the Rook 1 camp access road.	600 mm x 15 mm rebar	2018-10-02	RTK Averaging	20 seconds (performed twice)	0.002	0.001	0.002
Golder CP11	6398241.468	594649.090	528.652	Approximately 20 m north of the Broach Lake boat launch at the northern edge of the vehicle turnaround area.	600 mm x 15 mm rebar	2018-09-30	Static Occupation	7:26:00	0.005	0.010	0.020

Notes: All coordinates are in UTM Zone 12, NAD83

1. 94V063 exhibits signs of damage to the concrete pier which are not expected to affect the stability of the monument. The centering bolt at the top of the pier was missing and the plate appeared slightly damaged at the time of the field program. The damage found on the plate is not expected to have significant impact on the accuracy of the Static occupation. Photographs are provided below.
2. CP11 has been retained to maintain consistency with communications from NRCan.

Figure 1: Geodetic Monument 94V063 at the Time of Golder's Static Survey

3.0 GEODETIC SURVEY OF HYDROMETRIC STATION BENCHMARKS

Local benchmarks established at each watercourse and waterbody hydrometric station were surveyed using RTK survey equipment in reference to geodetic control established through Static surveys. The results of the survey are summarized in Table 2. This will allow all water surface elevation surveys completed throughout the monitoring program to be related to a consistent, geodetic datum. This task is considered essential to improve the quality and future value of the data collected during the baseline monitoring program, and will tie the bathymetry and water level data into the site's topographic surfaces, support ESIA modeling activities, and allow data comparison between sites.

4.0 STREAM CHANNEL SURVEY

A stream channel survey of a reach of the Clearwater River was completed on 2 October and 3 October 2018 downstream of Patterson Lake extending to the inlet of Forrest Lake. The survey data collected will be used to characterize channel geomorphology and inform estimates of potential bank erosion and bed scour associated with changes in flows associated with Project activities. A plan showing the cross sections surveyed as part of the stream channel survey is presented in Figure 2.

Table 2: Hydrometric Station Geodetic BM Data

Sr. No.	Name	Station	Field Site ID	Northing (m)	Easting (m)	Elevation (m)	Field BM ID
1	Clearwater River below Broach Lake	CR-WC-MS-01	Broach Lake east	6398465.111	600437.410	527.604	BROACH LK WEST BM3 REBAR
				6398466.136	600439.333	527.766	BROACH LK WEST BM2
				6398624.904	600436.801	528.356	BROACH LK WEST CP101
2	Broach Lake	CR-WB-MS-01	Broach Lake west	6398269.315	594670.637	528.250	CAN NORTH BM1
				6398271.122	594672.261	527.725	CAN NORTH BM2
				6398271.571	594670.321	528.068	CAN NORTH REBAR BM3
3	Clearwater River above Patterson Lake	CR-WC-MS-02	North Patterson Lake Tributary	6396407.687	607826.372	499.290	NORTH PATTERSON TRIB SOUTH BM
				6396409.975	607824.797	499.186	NORTH PATTERSON TRIB NORTH BM
				6396407.655	607825.052	499.344	NORTH PATTERSON TRIB REBAR BM
4	Lake H	CR-WB-MS-02	Lake H	6394933.031	608527.545	501.642	LK H BM1
				6394925.401	608526.724	501.358	LK H BM3
				6394930.916	608522.481	500.675	LK H BM2 REBAR
5	Lake G	CR-WB-MS-03	Lake G	6393993.920	607640.945	500.171	LK G BM1
				6393993.003	607648.552	500.250	LK G BM3
6	Patterson Lake	CR-WB-MS-04	Patterson Lake at camp	6391308.068	603277.066	500.351	BM1
				6391312.349	603278.840	500.585	BM2
				6391309.701	603270.978	500.139	BM3
			Patterson Lake West	6389233.534	597607.292	500.840	PATTERSON WEST NORTH BM
				6389229.266	597606.521	500.694	PATTERSON WEST SOUTH BM
				6389231.895	597605.668	501.165	PATTERSON WEST REBAR

Table 2: Hydrometric Station Geodetic BM Data

Sr. No.	Name	Station	Field Site ID	Northing (m)	Easting (m)	Elevation (m)	Field BM ID
7	Clearwater River below Patterson Lake	CR-WC-MS-03	Clearwater at access road bridge	6390535.777	605161.710	499.975	RIVER BM WEST
				6390536.771	605167.781	499.569	RIVER BM EAST
				6390535.707	605166.562	499.699	RIVER BM REBAR
9	Forrest Lake	CR-WB-MS-05	Forrest Lake / Lake F	6388735.981	606636.803	500.175	FOREST LK REBAR BM
				6388731.958	606644.797	500.278	FOREST LK SOUTH BM
				6388745.306	606641.476	499.621	FOREST LK NORTH BM
11	Beet Lake	CR-WB-MS-07	Beet Lake	6390290.831	611334.239	500.067	REBAR BM
				6390289.754	611334.316	500.133	SOUTH BM
				6390294.489	611337.066	499.238	NORTH BM
12	Clearwater River below Beet Lake	CR-WC-MS-04	Clearwater River DS of Beet Lake	6390618.789	613268.095	498.741	NORTH BM
				6390616.048	613267.102	498.750	SOUTH BM
				6390617.622	613269.728	498.788	REBAR BM
13	Tributary Inflow to Naomi Lake	CR-WC-TI-02	North end of Naomi Lake	6392557.918	613770.515	498.982	NAOMI NORTH BM1
				6392573.689	613765.014	499.175	NAOMI NORTH GOLDER BM1
				6392567.894	613764.181	499.139	NAOMI NORTH REBAR BM
14	Naomi Lake	CR-WB-MS-08	Northwest end of Naomi Lake	6392109.920	613375.547	500.296	NAOMI NW REBAR BM
				6392109.416	613383.590	498.847	NAOMI NW SOUTH BM
15	Tributary Inflow Downstream of Naomi Lake	CR-WC-TI-03	Clearwater Tributary DS of Naomi Lake	6390951.279	615802.259	499.062	NAOMI TRIB BM3
				6390961.232	615808.257	498.912	NAOMI TRIB BM1
				6390967.717	615802.627	499.505	NAOMI TRIB BM2

Table 2: Hydrometric Station Geodetic BM Data

Sr. No.	Name	Station	Field Site ID	Northing (m)	Easting (m)	Elevation (m)	Field BM ID
16	Clearwater River below Naomi Lake	CR-WC-MS-05	Clearwater River DS of Naomi Lake	6390515.704	616453.763	498.855	BM SOUTH
				6390516.746	616451.983	498.711	BM NORTH
				6390517.983	616451.735	498.867	BM REBAR
19	Clearwater River at Warner Rapids	CR-WC-MS-08	Clearwater at 955	6307938.673	623078.305	400.339	YELLOW TAG BM1

Notes: All coordinates are in UTM Zone 12, NAD83.

LEGEND

- STREAM SURVEY POINT
- EXISTING ACCESS ROAD (APPROXIMATE)

0 50 100
1:3,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM THE CLIENT, SEPT. 2018. IMAGERY DATE: 2015.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK 1 PROJECT

TITLE

STREAM SURVEY LOCATIONS

CONSULTANT

GOLDER

YYYY-MM-DD	2019-01-31
DESIGNED	RP
PREPARED	LMS
REVIEWED	NPS
APPROVED	NPS

PROJECT NO.	PHASE	REV.	FIGURE
1899581	2003	0	2

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

PATH: G:_Clients\NexGen\Rook1Project_SASK\99_PROJECTS\1899581_Rook1\StreamChannelSurveys\02_PRODUCTION\MXD\GeodeticSurveyTechMemo\Fig2_1899581_StreamSurveys.mxd

5.0 CLOSURE

We trust that this memo sufficiently documents the survey work completed in 2018 at the NexGen Rook I site.

Prepared By:

Reviewed by:

Ross Phillips, M.Sc., P.Eng.
Water Resources Engineer

Nathan Schmidt, Ph.D.
Principal, Senior Water Resources Specialist

KN/RWP/NPS/pls/jlb

https://golderassociates.sharepoint.com/sites/122721/project files/5 technical work/02_hydrology/03 - reporting/07 - 2020 hydrometric report/appendices/appendix a - geodetic survey summary/appendixb.docx

APPENDIX B

Rating Curve Shift Reports

Table B-1: 2018-20 Rating Shift Report for CR-WC-MS-01

SHIFT REPORT

STATION NUMBER CR-WC-MS-01 Clearwater River below Broach Lake
Date Processed: 2020-12-15 09:49:07 By JHogan

Rating QR # 001

SHIFT CURVES
2018-08-01 - 2020-09-30
DD 1, Discharge (m^3/s)

	STARTS		ENDS	INPUT	SHIFT	INPUT	SHIFT	INPUT	SHIFT
PRV:	2018-05-01	7:09:24 [UTC-06:00]		526.820	0.015				
1	2018-09-15	7:09:24 [UTC-06:00]		526.800	0.000				
2	2020-05-03	7:09:24 [UTC-06:00]		526.930	-0.015				
3	2020-06-06	14:09:24 [UTC-06:00]		526.940	0.024				
4	2020-09-24	14:09:24 [UTC-06:00]		526.930	-0.020				

Table B-2: 2018-20 Rating Shift Report for CR-WC-MS-02

SHIFT REPORT

STATION NUMBER CR-WC-MS-02 Clearwater river above Patterson lake
Date Processed: 2020-12-17 12:51:41 By JHogan

Rating QR # 001

SHIFT CURVES
2018-08-01 - 2020-09-30
DD 1, Discharge (m^3/s)

	STARTS			ENDS	INPUT	SHIFT	INPUT	SHIFT	INPUT	SHIFT
PRV:	2018-08-01	12:00:00	[UTC-06:00]		498.655	-0.070				
1	2018-08-01	12:00:00	[UTC-06:00]		498.655	-0.070				
2	2018-10-02	12:00:00	[UTC-06:00]		498.610	-0.065				
3	2019-03-25	12:00:00	[UTC-06:00]		498.550	0.000				
4	2019-05-16	13:50:00	[UTC-06:00]		498.590	-0.015				
5	2019-06-03	13:50:00	[UTC-06:00]		498.650	-0.004				
6	2019-10-01	13:00:00	[UTC-06:00]		498.650	-0.050				
7	2020-04-15	12:00:00	[UTC-06:00]		498.600	-0.050				
8	2020-05-04	12:00:00	[UTC-06:00]		498.730	0.000				
9	2020-06-04	12:00:00	[UTC-06:00]		498.880	-0.120				
10	2020-07-09	12:00:00	[UTC-06:00]		498.850	-0.220				
11	2020-08-19	12:00:00	[UTC-06:00]		498.940	-0.220				
12	2020-09-23	12:00:00	[UTC-06:00]		498.870	-0.220				

Table B-3: 2018-20 Rating Shift Report for CR-WC-MS-03

SHIFT REPORT

STATION NUMBER CR-WC-MS-03 Clearwater River below Patterson Lake
Date Processed: 2020-12-13 14:52:20 By JHogan

Rating # 002

SHIFT CURVES
2018-08-01 - 2020-09-30
DD 1, Discharge (m^3/s)

	STARTS		ENDS	INPUT	SHIFT	INPUT	SHIFT	INPUT	SHIFT
PRV:	2018-08-04	0:00:00 [UTC-06:00]		498.580	-0.029				
1	2018-08-04	0:00:00 [UTC-06:00]		498.580	-0.029				
2	2019-04-15	0:00:00 [UTC-06:00]		498.500	0.000				
3	2019-05-01	0:00:00 [UTC-06:00]		498.550	0.050				
4	2019-05-15	0:00:00 [UTC-06:00]		498.530	0.100	498.850	0.000		
5	2019-06-04	0:00:00 [UTC-06:00]		498.530	0.070	498.850	0.000		
6	2019-06-30	0:00:00 [UTC-06:00]		498.560	0.000				
7	2020-05-01	0:00:00 [UTC-06:00]		498.660	0.000				
8	2020-06-02	0:00:00 [UTC-06:00]		498.760	0.016				
9	2020-07-03	0:00:00 [UTC-06:00]		498.790	0.000				
10	2020-08-15	0:00:00 [UTC-06:00]		498.840	-0.052				
11	2020-09-16	0:00:00 [UTC-06:00]		498.830	-0.066				

Table B-4: 2018-20 Rating Shift Report for CR-WC-MS-04

SHIFT REPORT

STATION NUMBER CR-WC-MS-04 Clearwater River below Beet Lake
Date Processed: 2020-12-14 20:51:04 By JHogan

Rating QR # 001

SHIFT CURVES
2018-08-01 - 2020-09-30
DD 1, Discharge (m^3/s)

	STARTS		ENDS	INPUT	SHIFT	INPUT	SHIFT	INPUT	SHIFT
PRV:	2018-08-05	13:00:00 [UTC-06:00]		498.250	-0.045				
1	2018-08-05	13:00:00 [UTC-06:00]		498.250	-0.045				
2	2018-10-01	15:00:00 [UTC-06:00]		498.190	0.000				
3	2019-03-28	10:36:00 [UTC-06:00]		498.355	-0.125				
4	2019-05-10	16:45:00 [UTC-06:00]		0.100	0.000				
5	2019-06-01	16:45:00 [UTC-06:00]		498.150	0.075				
6	2019-07-10	16:45:00 [UTC-06:00]		498.300	0.000				
7	2019-10-02	16:45:00 [UTC-06:00]		498.285	-0.083				
8	2020-05-03	15:00:00 [UTC-06:00]		498.425	-0.016				
9	2020-06-05	13:00:00 [UTC-06:00]		498.400	0.000				
10	2020-07-10	14:00:00 [UTC-06:00]		498.460	-0.060				
11	2020-08-20	14:00:00 [UTC-06:00]		498.500	-0.150				
12	2020-09-25	14:00:00 [UTC-06:00]		498.510	-0.110				

Table B-5: 2018-20 Rating Shift Report for CR-WC-MS-05

SHIFT REPORT

STATION NUMBER CR-WC-MS-05 Clearwater River Below Naomi Lake
Date Processed: 2020-12-15 12:42:32 By JHogan

Rating QR # 001

SHIFT CURVES
2018-08-01 - 2020-09-30
DD 1, Discharge (m^3/s)

	STARTS			ENDS	INPUT	SHIFT	INPUT	SHIFT	INPUT	SHIFT
PRV:	2018-08-03	0:00:00	[UTC-06:00]		498.180	-0.100				
1	2018-08-03	0:00:00	[UTC-06:00]		498.180	-0.100				
2	2018-10-01	0:00:00	[UTC-06:00]		498.120	-0.037				
3	2019-03-28	0:00:00	[UTC-06:00]		0.100	0.000				
4	2019-05-16	0:00:00	[UTC-06:00]		498.100	0.000				
5	2019-06-01	13:00:00	[UTC-06:00]		498.075	0.000				
6	2019-10-02	11:00:00	[UTC-06:00]		498.240	-0.110				
7	2020-05-03	11:00:00	[UTC-06:00]		498.200	0.000				
8	2020-06-05	11:00:00	[UTC-06:00]		498.200	0.000				
9	2020-07-10	11:00:00	[UTC-06:00]		498.390	-0.088				
10	2020-08-20	11:00:00	[UTC-06:00]		498.460	-0.180				
11	2020-09-25	11:00:00	[UTC-06:00]		498.480	-0.128				

Table B-6: 2018-20 Rating Shift Report for CR-WC-MS-06

SHIFT REPORT

STATION NUMBER CR-WC-MS-06 Clearwater River above Mirror River Confluence
Date Processed: 2020-12-14 12:21:54 By JHogan

Rating QR # 001

SHIFT CURVES
2018-08-01 - 2020-09-30
DD 1, Discharge (m^3/s)

	STARTS		ENDS	INPUT	SHIFT	INPUT	SHIFT	INPUT	SHIFT
PRV:	2018-08-01	14:23:55 [UTC-06:00]		97.220	-0.390				
1	2018-08-01	14:23:55 [UTC-06:00]		97.220	-0.390				
2	2018-09-29	12:54:00 [UTC-06:00]		97.800	-0.255				
3	2019-05-17	14:23:55 [UTC-06:00]		97.200	0.000				
4	2019-07-16	14:23:55 [UTC-06:00]		97.300	0.000				
5	2019-08-18	14:23:55 [UTC-06:00]		97.380	-0.150				
6	2019-08-30	14:23:55 [UTC-06:00]		97.570	-0.360				
7	2019-09-29	14:23:55 [UTC-06:00]		97.570	-0.475				
8	2020-06-07	14:23:55 [UTC-06:00]		97.900	0.000				
9	2020-07-11	14:23:55 [UTC-06:00]		97.800	-0.110				
10	2020-08-21	14:23:55 [UTC-06:00]		97.800	-0.290				
11	2020-09-22	14:23:55 [UTC-06:00]		97.960	-0.400				

Table B-7: 2018-20 Rating Shift Report for CR-WC-MS-08

SHIFT REPORT

STATION NUMBER CR-WC-MS-08 Clearwater River at Lloyd Lake
Date Processed: 2020-12-22 09:58:30 By JHogan

Rating # HQ4

SHIFT CURVES
2020-06-07 - 2020-09-30
DD 1, Discharge (m^3/s)

	STARTS		ENDS	INPUT	SHIFT	INPUT	SHIFT	INPUT	SHIFT
PRV:	2020-06-07	8:54:37 [UTC-06:00]		96.765	0.000				
1	2020-06-07	8:54:37 [UTC-06:00]		96.765	0.000				
2	2020-07-01	8:54:37 [UTC-06:00]		96.700	-0.040				
3	2020-08-23	8:54:37 [UTC-06:00]		96.664	-0.040				
4	2020-09-24	8:54:37 [UTC-06:00]		96.700	0.000				

Table B-8: 2018-19 Rating Shift Report for CR-WC-TI-01

SHIFT REPORT

STATION NUMBER CR-WC-TI-01 Tributary Inflow above Forrest Lake
Date Processed: 2020-12-22 14:02:08 By jdonnelly

Rating QR # 001

SHIFT CURVES
2018-08-01 - 2020-09-30
DD 1, Discharge (m^3/s)

	STARTS			ENDS	INPUT	SHIFT	INPUT	SHIFT	INPUT	SHIFT
PRV:	2018-08-01	0:00:00	[UTC-06:00]		499.380	-0.140				
1	2018-08-01	0:00:00	[UTC-06:00]		499.380	-0.140				
2	2018-09-10	0:00:00	[UTC-06:00]		499.360	0.000				
3	2019-05-10	0:00:00	[UTC-06:00]		499.330	-0.045				
4	2019-05-15	23:00:00	[UTC-06:00]		499.330	-0.045				
5	2019-05-16	3:00:00	[UTC-06:00]		499.400	-0.200				
6	2019-05-31	0:00:00	[UTC-06:00]		499.600	-0.570				

Table B-9: 2018-20 Rating Shift Report for CR-WC-TI-02

SHIFT REPORT

STATION NUMBER CR-WC-TI-02 Tributary Inflow to Naomi Lake
Date Processed: 2020-12-15 12:32:32 By JHogan

Rating QR # 001

SHIFT CURVES
2018-08-01 - 2020-09-30
DD 1, Discharge (m^3/s)

	STARTS		ENDS	INPUT	SHIFT	INPUT	SHIFT	INPUT	SHIFT
PRV:	2018-08-01	14:46:21 [UTC-07:00]		498.250	-0.105				
1	2018-08-01	14:46:21 [UTC-07:00]		498.250	-0.105				
2	2018-10-01	4:00:00 [UTC-07:00]		498.220	-0.010				
3	2019-10-02	4:00:00 [UTC-07:00]		498.300	0.000				
4	2020-04-20	4:00:00 [UTC-07:00]		498.400	-0.100				
5	2020-05-20	4:00:00 [UTC-07:00]		498.500	0.000				
6	2020-06-06	4:00:00 [UTC-07:00]		498.400	0.000				
7	2020-07-13	8:00:00 [UTC-07:00]		498.500	-0.220				
8	2020-08-21	8:00:00 [UTC-07:00]		498.500	-0.120				

Table B-10: 2018-20 Rating Shift Report for CR-WC-TI-03

SHIFT REPORT

STATION NUMBER CR-WC-TI-03 Tributary Inflow D/S of Naomi Lake
Date Processed: 2020-12-16 09:21:14 By JHogan

Rating # 002B

SHIFT CURVES
2018-08-01 - 2020-09-30
DD 1, Discharge (m^3/s)

	STARTS			ENDS	INPUT	SHIFT	INPUT	SHIFT	INPUT	SHIFT
PRV:	2018-08-02	13:00:00	[UTC-07:00]		498.335	-0.130				
1	2018-08-02	13:00:00	[UTC-07:00]		498.335	-0.130				
2	2018-10-02	12:00:00	[UTC-07:00]		498.310	-0.014				
3	2019-06-01	14:40:00	[UTC-07:00]		498.250	0.000				
4	2019-10-02	12:00:00	[UTC-07:00]		498.419	-0.034				
5	2020-05-04	11:00:00	[UTC-07:00]		498.510	0.000				
6	2020-06-05	15:00:00	[UTC-07:00]		498.490	-0.013				
7	2020-07-10	11:00:00	[UTC-07:00]		498.550	-0.096				
8	2020-08-20	11:00:00	[UTC-07:00]		498.600	-0.140				
9	2020-09-26	9:31:00	[UTC-07:00]		498.590	-0.078				

APPENDIX C

Snow Survey Data

Year	Point (Object ID)	Easting	Northing	Summarized Landcover	Slope Classification	Aspect Classification	Mean Depth (cm)	Depth in Snow Tube (cm)	Snow Sample Mass (kg)	Snow Sample Volume (cm^3)	Density (g/cm^3)	SWE (mm)
15 to 16 April 2018	022	605195	6396914	Jack Pine, Tall Shrub	Low Slope	W	68.3	74	0.56	4,299	0.13	89.0
	023	605210	6396733	Open Canopy, Jack Pine, Ecosite C	Low Slope	W	70.0	70	0.54	4,066	0.13	93.0
	024	605063	6396756	Open Canopy, Mature Jack Pine, Ecosite C	10-33	S	41.0	40	0.42	2,324	0.18	74.1
	025	605041	6396727	Black Spruce, Dominant Treed Bog	Low Slope	S	64.0	58	0.49	3,369	0.15	93.1
	026	605271	6396897	Shrub, Jack Pine	10-33	E	74.0	66	0.45	3,834	0.12	86.9
	027	605307	6396956	Shrub, Jack Pine	10-33	W	63.3	68	0.30	3,950	0.08	48.1
	028	603021	6396557	Shrub, Jack Pine	Low Slope	N	76.7	72	0.43	4,182	0.10	78.8
	029	602970	6396510	Open Canopy, Jack Pine	10-33	N	63.0	63	0.52	3,660	0.14	89.5
	030	603075	6396531	Open Canopy, Jack Pine	10-33	W	30.7	26	0.14	1,510	0.09	28.4
	031	602759	6396451	Open Canopy, Jack Pine	Low Slope	N	54.3	60	0.57	3,485	0.16	88.9
	032	602627	6396347	Open Canopy, Jack Pine	10-33	E	67.7	70	0.53	4,066	0.13	88.2
	033	602118	6396202	Open Canopy, Jack Pine	10-33	S	46.3	42	0.52	2,440	0.21	98.8
	034	602073	6396165	Tall Shrub, Jack Pine	10-33	N	70.7	76	0.60	4,415	0.14	96.0
	035	601848	6396064	Tall Shrub, Jack Pine	10-33	N	61.3	62	0.56	3,601	0.16	95.4
	036	601560	6396027	Tall Shrub, Jack Pine	10-33	S	66.7	64	0.52	3,718	0.14	93.2
	037	600399	6395883	Tall Shrub, Jack Pine	10-33	W	73.0	80	0.78	4,647	0.17	122.5
	038	594337	6398222	Open Canopy, Jack Pine	10-33	N	53.0	60	0.52	3,485	0.15	79.1
	039	594324	6398205	Open Canopy, Jack Pine	Low Slope	N	52.3	52	0.55	3,021	0.18	95.3
	041	596123	6390222	Tall Shrub, Jack Pine	10-33	W	59.0	60	0.39	3,485	0.11	66.0
	043	596064	6390076	Tall Shrub, Jack Pine	10-33	S	34.7	42	0.34	2,440	0.14	48.3
	044	605261	6390814	Black Spruce Bog	Low Slope	N	57.7	72	0.66	4,182	0.16	91.0
	045	604013	6391415	Black Spruce, Jack Pine	10-33	S	56.7	58	0.59	3,369	0.18	99.2
	046	603237	6391297	Lake	Lake	E	22.0	23	0.19	1,336	0.14	31.3
	047	603293	6391367	Black Spruce	Low Slope	S	51.3	61	0.45	3,543	0.13	65.2
	048	603373	6391488	Black Spruce	Low Slope	S	39.3	42	0.32	2,440	0.13	51.6
	049	603384	6391332	Lake Edge	Lake	S	60.7	64	0.65	3,718	0.17	106.1
	050	603284	6391310	Lake Edge	Lake	S	51.0	44	0.39	2,556	0.15	77.8
	051	604523	6393494	Tall Shrub, Jack Pine	Low Slope	W	84.0	88	0.80	5,112	0.16	131.5
	052	603057	6391181	Black Spruce	10-33	S	23.7	30	0.29	1,743	0.17	39.4
	053	603028	6391181	Black Spruce	10-33	S	39.7	42	0.34	2,440	0.14	55.3
	054	603038	6391157	Lake Shore	Lake	W	32.0	42	0.40	2,440	0.16	52.5
	055	599785	6387109	Tall Shrub, Jack Pine (See Comments)	10-33	W	66.0	62	0.42	3,601	0.12	77.0
	056	596371	6387008	Black Spruce	10-33	N	58.7	64	0.52	3,718	0.14	82.1
	057	596158	6387264	Open Canopy, Jack Pine	10-33	S	40.7	55	0.45	3,195	0.14	57.3
21 to 23 March, 2019	1	604825	6391544	Jack pine	10-33	S	24.0	23	0.30	1,016	0.30	70.9
	2	601287	6390389	Jack pine -partially closed	Low slope	S	24.3	27	0.34	1,193	0.29	69.4
	3	601346	6390391	Jack pine	Low slope	S	33.0	34	0.45	1,502	0.30	98.9
	4	603634	6391521	Mature jack pine	Low slope	S	32.3	34	0.24	1,502	0.16	51.7
	5	603493	6396640	Mature jack pine - open	Low slope	E	27.7	28	0.25	1,237	0.20	55.9
	6	603258	6396584	Mature jack pine - open	Low slope	E	23.3	25	0.23	1,104	0.21	48.6
	7	603838	6396818	Mature jack pine - open	Low slope	E	46.7	49	0.33	2,165	0.15	71.1
	8	601034	6395746	Jack pine -open	Low slope	S	35.0	36	0.23	1,590	0.14	50.6
	9	597761	6395978	Jack pine	Low slope	S	27.7	35	0.38	1,546	0.25	68.0
	10	604999	6391440	Jack pine	Low slope	S	37.3	42	0.29	1,856	0.16	58.3
	11	604945	6391483	Jack pine	Low slope	S	27.3	28	0.27	1,237	0.22	59.7
	12	605144	6391396	Jack pine	Low slope	W	28.7	30	0.45	1,325	0.34	97.3
	13	605126	6391350	Jack pine	Low slope	W	40.7	45	0.16	1,988	0.08	32.7
	14	605024	6390434	Mature black spruce -open	Low slope	N	33.0	34	0.29	1,502	0.19	63.7
	15	604997	6390417	Mature black spruce -open	Low slope	N	49.3	49	0.40	2,165	0.18	91.2
	16	601367	6388182	Mature jack pine- semi open	Low slope	N	29.3	31	0.24	1,370	0.18	51.4
	17	601327	6388186	Mature jack pine- open	Low slope	N	26.0	29	0.19	1,281	0.15	38.6
	18	607968	6396339	Old burn jack pine -very open	Flat	N/A	14.7	16	0.27	707	0.38	56.0
	19	608008	6396292	Old burn jack pine -very open	Flat	N/A	34.3	35	0.46	1,546	0.30	102.1
	20	597270	6385290	Jack pine	Flat	N/A	35.7	35	0.31	1,546	0.20	71.5
	21	597296	6385327	Jack pine	Flat	N/A	41.3	42	0.40	1,856	0.22	89.1
	22	594282	6397398	Mature jack pine -open	Flat	N/A	21.7	22	0.13	972	0.13	29.0
	23	594302	6397357	Mature jack pine -open	Flat	N/A	28.7	30	0.24	1,325	0.18	51.9
	24	595705	6388752	Mature jack pine -open	Flat	N/A	30.0	36	0.47	1,590	0.30	88.7
	25	595718	6396248	Jack pine -open	10-33	W	35.3	37	0.40	1,635	0.24	86.5
	26	594900	6395568	Mature jack pine - open	Low slope	N	23.3	25	0.24	1,104	0.22	50.7
	27	595731	6396302	Jack pine -partially closed	10-33	N	37.7	41	0.44	1,811	0.24	91.5
	28	598041	6396035	Mature jack pine - open	Low slope	E	45.0	49	0.28	2,165	0.13	58.2
	29	598309	6396014	Mature jack pine - open	Low slope	E	29.0	30	0.25	1,325	0.19	54.7
	30	597839	6392158	Mature mixed -open	Low slope	E	17.3	18	0.29	795	0.36	63.2
	31	597955	6392569	Mature mixed -open	Low slope	E	29.7	30	0.38	1,325	0.29	85.1
	32	599282	6395948	Jack pine -open	Low slope	W	27.3	30	0.34	1,325	0.26	70.1
	33	599325	6395942	Jack pine -open	Low slope	W	28.7	30	0.37	1,325	0.28	80.0
	34	600552	6395865	Jack pine -open	Low slope	W	34.0	36	0.32	1,590	0.20	68.4
	35	600607	6395859	Jack pine -open	Low slope	W	30.0	29	0.51	1,281	0.40	119.4
	36	601435	6396005	Mature jack pine - open	Low slope	E	37.0	37	0.32	1,635	0.20	72.4
	37	601439	6396045	Mature jack pine - open	Low slope	E	29.7	31	0.26	1,370	0.19	56.3
	38	602229	6396027	Mature jack pine - open	Low slope	E	43.0	47	0.44	2,076	0.21	91.1
	39	602116	6396080	Jack pine - open	Low slope	N	36.3	37	0.40	1,635	0.24	88.9
	40	603283	6391304	Lake edge	Flat	N/A	26.3	26	0.33	1,149	0.29	75.7
	41	598382	6391073	Lake	Flat	N/A	31.3	32	0.77	1,414	0.54	170.7
	42	602998	6390366	Lake	Flat	N/A	14.7	16	0.07	707	0.10	14.5
	43	599727	6389685	Lake	Flat	N/A	15.0	16	0.21	707	0.30	44.6
	44	607396	6395868	Lake	Flat	N/A	31.3	32	0.27	1,414	0.19	59.8
	45	599569	6392809	Lake	Flat	N/A	24.7	26	0.37	1,149	0.32	79.5
	46	601448	6393624	Lake	Flat	N/A	23.3	24	0.11	1,060	0.10	24.2
	47	608751	6395117	Lake	Flat	N/A	13.3	15	0.33	663	0.50	66.4
	48	594989	6398179	Lake	Flat	N/A	23.7	24	0.39	1,060	0.37	87.1
	49	595857	6398163	Lake	Flat	N/A	34.7	35	0.55	1,546	0.36	123.3
	50	596694	6398016	Lake	Flat	N/A	17.0	18	0.38	795	0.48	81.2

Note: All coordinates are in UTM Zone 12 NAD 83. cm = centimetres; kg=kilograms; cm^3 = cubic centimetres; g/cm^3 = grams per cubic centimetre.

APPENDIX D

Hydrometric Monitoring Daily Data

Table D-1a: 2018 Daily Precipitation at NexGen Rook I Site

Date	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.0	0.0	0.0	0.0	6.4	1.3	18.3	0.0	2.9	0.3	0.9	0.0
2	0.0	0.0	0.0	0.0	0.3	6.1	2.1	0.0	2.2	2.2	0.1	0.0
3	0.0	0.0	0.0	0.0	0.5	0.7	4.3	0.0	1.9	1.6	3.6	0.0
4	0.0	0.0	0.0	0.0	0.3	5.2	0.6	0.0	0.0	0.5	0.3	0.0
5	0.0	0.0	0.0	0.0	0.0	5.3	0.0	0.0	0.0	3.5	0.7	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	2.5	0.8	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	2.1	8.8	0.0	0.2	0.4	0.0
8	0.0	0.0	0.0	0.0	1.6	0.0	0.0	3.7	0.6	0.2	0.9	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.5	0.2	0.9	0.0
10	0.0	0.0	1.7	0.0	0.0	11.9	0.0	0.0	0.0	0.3	1.1	0.0
11	0.0	0.0	6.8	0.0	0.0	2.6	0.0	0.0	0.0	0.1	0.4	0.0
12	0.0	0.0	4.4	0.0	0.0	3.2	0.0	0.0	0.0	0.3	0.1	0.0
13	0.0	0.0	0.0	0.0	2.7	2.4	4.6	0.0	0.0	0.4	1.7	0.0
14	0.0	0.0	0.0	0.1	0.0	1.6	8.8	0.0	0.0	0.1	0.2	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.2	0.8	0.0
16	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.2	0.4	0.2	0.0
17	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0
18	0.0	0.0	0.0	1.0	0.0	0.0	0.0	4.4	0.2	0.8	0.0	0.0
19	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.9	0.1	0.6	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.8	0.0	0.0
21	0.0	0.0	0.0	2.5	0.0	0.0	8.2	0.0	0.3	0.2	0.0	0.0
22	0.0	0.0	0.0	5.3	0.0	0.0	7.6	0.0	0.2	0.3	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	10.1	0.6	0.3	0.2	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.4	0.1	0.3	0.0	0.0
25	0.0	0.0	0.0	0.0	11.0	0.0	0.0	1.2	4.0	0.1	0.0	0.0
26	0.0	0.0	0.0	0.0	6.8	14.6	0.0	0.0	3.0	0.2	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	2.0	0.3	0.0	0.0
28	0.0	0.0	0.0	0.2	0.3	7.7	0.0	0.2	1.6	0.4	0.0	0.0
29	0.0	-	0.0	0.0	0.0	15.8	0.6	0.8	6.3	0.1	0.0	0.0
30	0.0	-	0.0	0.0	0.0	0.1	0.0	17.9	0.1	1.4	0.0	0.0
31	0.0	-	0.0	-	0.0	-	0.0	5.6	-	0.6	-	0.0

Note: Precipitation data in table is in millimetres. Prior to September 15, 2018 precipitation was rainfall monitored by a tipping bucket. As a result solid precipitaiton before that time would be under reported. Following September 15, 2018 a Geonor total precipitation gauge was installed.

ND= No data.

Table D-1b: 2019 Daily Precipitation at NexGen Rook I Site

Date	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	1.6	0.2	0.5	1.7	0.4	1.1	8.0	10.1	0.2	0.0	ND	ND
2	0.1	0.1	0.1	1.0	3.2	3.5	9.6	19.9	0.9	0.0	ND	ND
3	0.2	0.3	0.1	1.1	1.2	12.6	0.2	26.0	0.3	0.0	ND	ND
4	0.3	0.5	0.1	1.0	2.4	7.5	0.0	0.4	12.8	0.0	ND	ND
5	0.4	0.4	0.1	0.2	0.8	1.0	0.1	7.1	2.9	0.6	ND	ND
6	0.1	0.4	0.1	0.9	0.8	0.4	0.2	0.0	0.2	1.5	ND	ND
7	0.7	0.3	0.2	1.4	0.7	0.1	0.1	0.0	3.6	0.6	ND	ND
8	1.3	0.2	0.2	1.1	0.7	1.2	1.6	2.7	0.2	3.5	ND	ND
9	0.2	0.2	0.1	0.1	0.6	0.3	0.2	18.0	0.2	0.4	ND	ND
10	0.0	0.2	29.9	1.3	1.0	0.6	0.0	0.1	0.2	0.3	ND	ND
11	0.1	0.2	0.1	0.6	0.5	0.2	0.1	0.2	0.1	0.8	ND	ND
12	0.0	0.1	0.3	0.3	1.2	0.7	0.1	1.5	0.2	0.5	ND	ND
13	0.2	0.5	0.3	0.2	3.0	1.9	2.1	0.1	0.6	0.3	ND	ND
14	0.2	0.4	0.5	0.1	0.9	0.9	0.2	2.7	0.2	0.1	ND	ND
15	0.5	0.3	0.2	0.3	0.9	0.1	0.1	0.1	0.1	0.1	ND	ND
16	0.3	0.0	1.1	0.3	0.5	0.2	0.1	73.2	0.0	8.2	ND	ND
17	0.3	0.4	0.2	0.9	0.8	0.2	0.1	18.9	0.1	1.0	ND	ND
18	0.3	0.3	0.2	0.4	0.9	0.1	0.3	4.1	0.1	0.3	ND	ND
19	0.2	0.1	0.2	0.6	0.8	0.1	0.1	1.3	0.1	1.3	ND	ND
20	0.0	0.3	0.3	5.0	0.7	0.1	0.2	0.1	1.6	2.5	ND	ND
21	0.0	0.2	0.4	0.5	0.6	0.3	0.1	0.0	0.1	0.3	ND	ND
22	0.2	0.1	0.3	0.2	0.8	0.2	0.1	1.2	0.1	0.2	ND	ND
23	0.3	0.2	0.5	2.6	0.7	4.2	0.1	0.2	12.2	ND	ND	ND
24	0.3	0.2	0.3	0.9	0.8	0.7	15.0	2.4	1.1	ND	ND	ND
25	0.1	0.2	0.1	0.8	1.1	0.1	5.0	0.5	4.3	ND	ND	ND
26	0.0	0.0	0.5	0.8	0.6	0.1	2.3	6.0	0.2	ND	ND	ND
27	0.3	0.1	0.5	0.8	0.5	0.1	9.3	3.8	0.8	ND	ND	ND
28	0.5	0.3	0.1	0.8	0.3	0.1	0.0	3.2	0.9	ND	ND	ND
29	0.2	-	0.3	2.2	0.6	2.0	0.1	0.1	0.2	ND	ND	ND
30	0.0	-	0.5	3.9	0.9	4.1	0.1	0.2	0.2	ND	ND	ND
31	0.1	-	0.3	-	0.6	-	0.1	2.2	-	ND	-	ND

Note: Precipitation data in table is in millimetres. Prior to September 15, 2018 precipitation was rainfall monitored by a tipping bucket. As a result solid precipitaiton before that time would be under reported. Following September 15, 2018 a Geonor total precipitation gauge was installed.

ND= No data.

Table D-1c: 2020 Daily Precipitation at NexGen Rook I Site

Date	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	27.9	14.7	28.9	0.1	2.5	0.0	0.2	ND
2	ND	ND	ND	ND	1.8	0.1	0.5	0.3	0.3	0.0	0.0	ND
3	ND	ND	ND	ND	0.1	3.9	0.1	0.4	0.5	0.0	0.0	ND
4	ND	ND	ND	ND	0.1	1.9	0.1	1.2	0.7	0.0	ND	ND
5	ND	ND	ND	ND	0.1	0.2	0.1	0.1	0.6	0.0	ND	ND
6	ND	ND	ND	ND	0.1	0.3	0.2	0.1	1.0	0.0	ND	ND
7	ND	ND	ND	ND	0.1	27.1	0.1	0.3	0.5	0.0	ND	ND
8	ND	ND	ND	ND	0.1	13.3	0.1	26.7	0.7	0.0	ND	ND
9	ND	ND	ND	ND	0.3	2.6	0.1	31.2	2.0	0.0	ND	ND
10	ND	ND	ND	ND	0.4	5.1	0.2	4.2	6.2	0.1	ND	ND
11	ND	ND	ND	ND	0.2	0.2	0.1	0.4	4.7	0.1	ND	ND
12	ND	ND	ND	ND	0.1	0.2	12.1	23.4	3.2	0.1	ND	ND
13	ND	ND	ND	ND	2.5	6.8	4.9	2.2	0.7	0.1	ND	ND
14	ND	ND	ND	ND	9.9	0.8	7.6	4.2	0.8	0.0	ND	ND
15	ND	ND	ND	ND	5.6	17.8	4.6	1.7	1.9	0.0	ND	ND
16	ND	ND	ND	ND	0.5	21.3	1.1	0.3	43.7	0.1	ND	ND
17	ND	ND	ND	ND	0.0	0.3	12.2	0.3	0.9	0.0	ND	ND
18	ND	ND	ND	ND	0.8	0.1	28.2	3.1	0.7	0.0	ND	ND
19	ND	ND	ND	ND	5.8	0.0	20.0	0.6	0.5	0.0	ND	ND
20	ND	ND	ND	ND	0.0	0.1	0.2	0.3	0.2	0.0	ND	ND
21	ND	ND	ND	ND	14.3	0.1	2.9	0.2	1.7	0.1	ND	ND
22	ND	ND	ND	ND	6.0	0.0	8.4	27.9	0.7	0.0	ND	ND
23	ND	ND	ND	ND	0.9	0.1	6.0	7.6	0.7	0.0	ND	ND
24	ND	ND	ND	ND	0.1	0.0	3.1	4.8	13.0	0.0	ND	ND
25	ND	ND	ND	ND	0.1	0.0	0.2	5.5	0.0	0.0	ND	ND
26	ND	ND	ND	ND	5.4	0.5	0.6	1.4	0.0	0.0	ND	ND
27	ND	ND	ND	ND	1.5	0.0	0.2	3.8	0.0	0.0	ND	ND
28	ND	ND	ND	ND	0.3	18.5	0.2	1.8	0.0	0.0	ND	ND
29	ND	ND	ND	0.0	0.4	0.1	1.0	3.7	0.0	0.0	ND	ND
30	ND	-	ND	0.0	0.1	0.2	0.2	1.5	0.0	0.1	ND	ND
31	ND	-	ND	-	1.1	-	0.1	0.0	-	0.0	-	ND

Note: Precipitation data in table is in millimetres. Prior to September 15, 2018 precipitation was rainfall monitored by a tipping bucket. As a result solid precipitaiton before that time would be under reported. Following September 15, 2018 a Geonor total precipitation gauge was installed.

ND= No data.

Table D-2a: 2018 Daily Precipitation at ECCC Fort McMurry Station (ID: 3062697)

Date	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.0	ND	ND	0.0	0.5	1.4	0.0	1.2	2.3	0.0	0.0	0.0
2	0.0	ND	0.0	0.0	0.0	4.3	11.4	0.0	ND	ND	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.5	ND	0.0	0.0	ND	1.1	0.0
4	0.0	0.0	0.0	0.0	0.0	ND	ND	0.0	0.0	ND	0.0	0.0
5	0.0	0.0	1.6	0.0	0.0	ND	0.0	0.0	0.0	ND	0.0	0.0
6	ND	0.0	ND	0.0	0.0	ND	ND	0.5	0.0	ND	0.0	0.0
7	ND	0.0	0.0	0.0	0.0	ND	6.5	0.0	0.8	0.0	0.0	0.0
8	0.5	0.0	0.0	0.0	0.0	ND	ND	0.0	16.8	0.0	0.0	ND
9	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	0.0	0.0	ND
10	ND	0.0	0.0	0.0	0.0	1.5	0.0	0.0	ND	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	ND	0.0	0.0	ND	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	14.0	ND	0.0	ND	0.0	0.0	0.0
13	0.0	ND	0.0	0.0	0.0	3.3	1.4	0.0	ND	0.0	0.2	0.0
14	0.0	ND	0.0	0.0	0.0	ND	6.5	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	ND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	ND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	ND	0.0	0.0	0.0	0.0	0.0	7.0	0.8	0.0	0.0	0.0	0.0
19	ND	ND	ND	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	ND	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	54.9	0.0	0.0	0.0	0.0	0.0
22	1.0	0.0	0.0	0.0	0.0	ND	6.0	0.0	0.0	0.0	ND	0.0
23	0.0	0.0	0.0	0.0	0.0	ND	14.3	1.9	0.0	0.0	0.0	0.2
24	0.0	0.0	2.7	0.0	0.0	0.0	12.5	ND	0.0	0.0	0.2	0.0
25	0.0	0.0	0.0	0.0	0.8	12.5	0.0	ND	0.0	0.0	0.0	0.0
26	ND	0.0	ND	0.0	3.2	ND	0.0	ND	ND	0.0	0.0	0.0
27	ND	0.0	ND	0.0	0.0	22.5	0.0	0.0	ND	0.0	0.0	0.0
28	ND	0.0	0.0	0.0	0.0	12.4	0.0	0.5	ND	0.0	0.0	1.5
29	0.0	-	0.0	0.0	0.0	3.5	0.0	7.9	ND	0.8	0.0	0.0
30	ND	-	0.0	0.0	0.0	4.2	4.3	3.4	ND	0.0	0.0	0.0
31	0.0	-	0.0	-	0.0	-	0.0	5.5	-	0.0	-	0.0

Note: Precipitation data in table is in millimetres.
ND= No data.

Table D-2b: 2019 Daily Precipitation at ECCC Fort McMurry Station (ID: 3062697)

Date	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.2	0.0	0.0	ND	0.2	7.0	12.7	1.0	0.0	0.0	0.0	0.0
2	0.0	2.2	0.0	ND	0.0	3.5	5.1	11.5	0.8	0.0	0.0	0.0
3	0.0	0.1	0.0	1.1	5.1	6.3	0.4	0.4	0.0	12.2	0.6	0.0
4	0.0	0.0	0.0	0.0	0.0	1.6	0.4	0.8	2.9	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.6	0.7	4.8	0.0	0.0
6	0.0	0.0	0.0	3.6	0.4	0.0	0.0	0.5	0.0	0.0	0.0	0.0
7	0.7	0.0	0.0	2.6	0.0	0.0	0.0	0.0	11.4	2.4	0.0	0.0
8	0.3	0.0	0.0	0.0	0.0	0.0	5.5	6.4	0.8	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	1.0	0.4	2.3	0.0	0.0	0.0	0.0
10	0.0	0.0	5.3	1.2	0.2	0.0	1.5	0.0	0.0	0.0	0.0	0.0
11	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.6	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	1.2	0.7	2.0	0.0	0.0	0.4	0.0
14	0.0	0.0	0.0	0.0	0.0	16.6	5.8	1.0	0.0	0.0	0.2	0.1
15	0.0	0.0	0.0	0.0	0.0	1.8	0.0	5.5	0.0	3.7	1.3	0.0
16	0.4	0.0	0.0	0.0	0.0	0.0	0.0	41.6	0.0	2.2	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	3.9	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	23.3	0.0	0.2	0.0	2.0	1.2
19	0.0	0.0	0.0	0.8	0.0	2.0	0.0	0.0	0.0	0.4	0.0	0.0
20	0.3	0.0	0.0	0.8	0.0	1.6	0.0	0.0	2.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	7.5	0.0	2.7	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	8.4	0.0	0.0	2.2	1.2	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	9.0	15.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	ND	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.7	0.0	0.0	0.0	0.0
27	3.0	0.0	0.0	0.0	0.0	3.3	7.9	0.6	0.0	1.7	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	18.1	0.0	3.4	0.0	0.2	0.0	0.0
29	0.1	-	0.0	0.5	0.0	21.2	0.0	ND	0.0	0.0	0.0	0.0
30	0.0	-	0.0	0.2	0.0	1.2	2.2	0.0	0.0	1.6	0.0	0.0
31	0.0	-	0.0	-	0.0	-	0.0	0.8	-	0.2	-	1.2

Note: Precipitation data in table is in millimetres.
ND= No data.

Table D-2c: 2020 Daily Precipitation at ECCC Fort McMurry Station (ID: 3062697)

Date	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.0	0.0	0.0	0.0	0.0	29.2	16.1	0.0	2.4	0.4	7.3	0.0
2	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	5.9	0.0	0.0	4.8	0.0	0.0	0.0
4	0.0	0.0	0.0	2.9	0.0	3.7	0.5	0.0	1.2	0.5	0.0	0.4
5	0.0	0.0	0.0	2.1	0.0	0.2	2.3	0.0	2.1	0.4	0.0	0.0
6	0.0	0.0	0.0	1.7	0.0	4.9	0.0	0.0	0.0	0.0	0.0	0.0
7	0.9	0.0	0.0	0.2	0.0	34.9	0.0	4.5	1.7	1.0	0.0	0.7
8	0.5	0.0	0.0	0.0	2.5	6.2	0.0	4.4	0.0	8.7	0.0	0.0
9	0.0	0.0	0.8	0.4	0.0	1.7	0.0	0.6	1.8	0.0	0.0	0.0
10	1.0	0.2	0.0	ND	0.0	1.6	3.4	1.6	1.2	5.0	0.0	0.0
11	2.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	7.2	33.0	0.0	0.0
12	2.6	0.0	0.0	0.0	0.0	0.0	15.0	8.2	0.0	0.0	0.0	0.0
13	0.6	0.0	0.0	0.0	0.0	1.2	23.1	0.0	0.0	0.0	0.2	0.0
14	1.5	0.0	0.0	0.0	2.3	1.8	5.9	3.6	0.0	0.0	0.0	0.0
15	0.4	0.0	0.0	0.0	0.0	9.3	0.0	0.0	0.0	0.0	0.0	0.0
16	0.5	0.3	0.0	0.0	5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.1
17	3.4	0.0	0.0	0.0	0.0	0.0	22.8	0.0	0.0	0.0	0.0	5.5
18	0.2	0.0	0.0	0.0	0.7	0.0	7.9	0.0	ND	0.0	0.0	9.3
19	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.2	0.0	0.0	0.0	0.2
20	0.0	10.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0
21	0.0	1.2	0.0	0.0	9.9	0.0	3.7	ND	0.6	0.0	0.0	0.0
22	0.0	0.0	ND	1.4	9.8	0.0	3.2	43.6	0.0	0.0	0.0	ND
23	0.0	0.0	0.0	1.7	0.4	0.0	0.2	0.5	0.0	0.0	0.0	ND
24	0.0	0.0	0.0	0.8	0.4	0.0	1.4	2.8	20.5	0.0	0.0	ND
25	0.2	0.0	0.0	0.0	0.2	0.2	1.0	2.3	0.2	0.0	0.0	ND
26	0.0	0.0	0.6	0.0	0.0	0.0	0.0	2.8	1.7	0.0	0.0	ND
27	2.1	0.0	0.0	0.0	0.0	6.0	0.0	8.2	0.2	1.4	0.6	ND
28	0.0	0.2	0.0	0.0	0.0	8.7	0.0	0.0	0.2	0.2	0.0	ND
29	0.0	0	0.0	0.0	0.0	10.1	4.0	20.7	ND	0.0	0.0	ND
30	1.0	0.04667	0.0	0.0	0.0	2.0	0.0	7.2	0.2	0.0	0.0	ND
31	3.9	-	0.0	-	2.2	-	0.0	2.5	-	0.0	-	ND

Note: Precipitation data in table is in millimetres.
ND= No data.

Table D-3a: 2018 Daily Precipitation at ECCC Key lake Station (ID: 4063755 & 4063753)

Date	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.0	0.0	0.0	0.0	1.2	9.4	0.8	0.0	4.4	0.0	0.0	0.2
2	0.0	0.0	0.2	0.0	2.0	6.4	0.0	0.0	0.4	2.2	0.0	0.0
3	0.0	1.0	0.0	0.0	0.4	1.4	0.4	17.4	13.4	0.5	3.1	0.0
4	0.0	0.2	0.0	0.4	0.4	3.6	5.8	0.0	0.2	0.0	0.7	0.4
5	0.0	0.0	5.2	0.0	0.0	1.9	0.0	1.8	0.0	3.8	0.2	0.4
6	4.2	0.2	0.6	0.0	0.0	0.2	2.0	4.0	0.0	0.2	0.6	0.0
7	0.8	0.0	0.0	0.0	0.0	0.0	6.2	0.0	1.2	0.2	0.8	0.0
8	3.0	0.0	0.0	0.0	7.2	0.0	0.0	0.0	1.2	0.2	0.0	0.0
9	3.4	1.8	1.6	0.0	0.0	0.0	0.0	0.0	11.2	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	12.6	0.0	0.0	0.4	0.0	0.5	0.0
11	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	1.6	0.0	0.2	0.0
12	0.0	1.4	ND	0.0	0.4	1.4	0.0	0.0	6.4	0.0	0.2	0.2
13	0.0	1.2	ND	0.0	0.0	0.0	1.0	0.0	1.2	0.0	0.0	0.0
14	0.0	0.0	0.0	3.4	0.2	0.0	36.6	0.0	0.0	0.2	0.7	0.0
15	0.0	0.0	0.0	2.0	0.0	0.0	1.2	0.0	0.0	0.8	0.6	0.9
16	0.0	0.8	0.0	0.0	0.0	0.0	3.4	0.0	0.0	0.7	0.2	0.2
17	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.4	0.2	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.2	0.0
19	2.0	0.6	0.0	0.0	0.0	0.0	0.0	6.6	0.0	0.3	0.0	0.0
20	2.6	0.0	2.6	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.2	0.0
21	0.0	0.0	1.8	0.6	0.0	3.6	22.9	0.0	0.0	0.3	1.2	4.8
22	1.4	0.0	0.2	8.6	0.0	0.0	3.4	0.0	0.0	0.0	0.0	2.7
23	0.0	1.6	2.4	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0
24	0.0	1.0	0.0	0.0	0.0	0.0	0.0	13.2	0.0	0.2	0.2	0.0
25	0.0	0.0	0.4	0.0	11.6	0.0	0.0	1.8	11.8	0.0	0.2	0.9
26	0.0	0.0	0.8	0.0	0.2	27.7	0.0	0.0	2.0	0.0	0.0	1.3
27	0.0	2.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.8	0.0	1.0
28	0.0	0.0	0.4	0.0	5.6	2.5	0.0	3.4	ND	0.2	0.0	0.8
29	12.4	-	0.0	0.0	0.0	7.4	2.0	3.4	0.0	0.0	1.5	0.2
30	8.8	-	0.0	0.2	0.0	11.6	2.4	4.1	0.2	0.4	0.2	0.0
31	0.0	-	0.0	-	0.0	-	2.6	7.7	-	0.2	-	0.0

Note: Precipitation data in table is in millimetres. Station ID: 4063755 Jan 1, 2018 - Sep 29, 2018. Station ID: 4063753 Sep 30, 2018 - Nov
ND= No data.

Table D-3b: 2019 Daily Precipitation at ECCC Key lake Station (ID: 4063755 & 4063753)

Date	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	2.0	0.2	0.4	3.8	0.2	0.0	5.4	0.0	0.0	0.0	0.3	0.0
2	1.2	0.7	0.0	0.5	0.0	7.9	4.7	0.0	0.0	0.0	0.1	0.0
3	0.2	0.7	0.0	0.2	3.5	4.1	0.6	44.6	3.2	0.0	1.6	1.0
4	0.2	0.0	0.0	0.7	1.6	6.0	0.9	1.4	1.2	0.1	0.0	0.0
5	0.4	0.0	0.0	0.0	0.2	0.8	0.0	0.0	10.5	0.7	0.0	0.1
6	1.6	0.0	0.2	0.0	0.2	0.2	0.0	2.4	0.2	3.7	0.1	2.6
7	4.6	0.0	0.0	1.6	1.2	25.6	0.0	0.0	2.8	0.7	0.1	0.0
8	2.9	0.0	0.2	2.0	0.2	6.1	0.7	0.0	0.0	2.7	0.8	0.2
9	0.0	0.0	0.0	0.2	0.0	0.2	5.2	2.9	0.0	0.3	0.0	0.0
10	0.0	0.0	0.0	0.0	8.2	2.1	0.0	0.0	0.0	0.0	0.6	0.0
11	0.0	0.0	0.0	0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	1.3	1.5	0.2	0.4	0.0	0.0	0.6	0.9	0.0	0.1	0.0
13	0.0	0.6	0.2	0.0	0.6	0.0	2.5	6.9	0.1	0.5	0.9	0.0
14	9.2	0.0	0.2	0.3	0.2	9.8	13.0	5.4	0.1	0.2	0.0	1.3
15	0.2	0.0	0.2	0.2	0.0	1.4	0.0	0.0	0.0	0.2	4.3	0.0
16	0.2	0.0	0.2	0.0	0.0	0.2	0.0	20.8	0.0	0.5	0.0	0.0
17	0.0	0.0	0.4	0.0	0.0	0.0	0.0	25.4	0.7	3.0	1.0	1.6
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	1.6	3.2	1.7
19	0.2	0.7	0.0	1.7	0.0	0.0	0.0	1.8	0.0	0.1	0.0	0.3
20	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	3.7	0.1	0.3
21	0.2	0.2	0.0	0.2	0.0	4.3	0.0	0.0	0.0	0.3	0.0	0.0
22	0.2	0.6	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.1	0.0
23	0.3	0.2	0.0	0.0	0.0	2.5	0.0	0.0	14.3	0.1	0.0	0.0
24	0.2	0.2	0.0	0.4	0.0	0.4	5.4	1.7	1.7	0.7	0.0	0.0
25	0.0	0.0	0.0	0.2	0.3	5.0	1.4	0.0	0.3	0.0	0.9	1.2
26	0.0	0.7	0.0	1.4	0.2	ND	0.0	4.7	1.7	0.5	0.6	1.0
27	0.2	1.1	0.2	0.2	0.2	ND	0.0	0.0	0.0	1.1	0.0	0.4
28	0.2	1.0	2.6	0.0	0.0	0.0	0.2	1.1	4.5	0.0	0.1	0.4
29	0.2	-	0.2	0.2	0.0	22.0	0.0	0.0	0.1	0.0	0.0	0.0
30	0.7	-	0.2	6.1	0.0	3.4	2.1	1.3	0.0	0.0	0.0	0.1
31	1.9	-	0.7	-	0.2	-	0.4	0.3	-	0.4	-	0.0

Note: Precipitation data in table is in millimetres. Station ID: 4063755 Jan 1, 2018 - Sep 29, 2018. Station ID: 4063753 Sep 30, 2018 - Nov
ND= No data.

Table D-3c: 2020 Daily Precipitation at ECCC Key lake Station (ID: 4063755 & 4063753)

Date	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.2	1.1	0.1	0.2	3.0	5.9	11.0	0.0	0.7	0.0	0.0	0.5
2	0.1	1.8	2.0	5.8	0.1	0.0	17.6	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.4	0.0	0.0	5.4	6.7	0.0	0.0	1.1	0.0	0.0
4	5.3	0.0	0.5	0.0	0.0	1.8	0.5	0.0	0.0	1.4	ND	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	14.3	0.0	4.7	0.5	1.7	ND
6	1.5	0.3	1.4	1.8	0.0	0.0	0.0	0.0	0.5	3.2	1.0	0.1
7	0.0	0.0	0.0	3.1	0.0	8.8	0.0	0.0	0.0	1.0	0.0	2.6
8	0.0	0.1	0.1	0.8	0.4	0.5	0.0	45.9	0.2	7.4	0.0	0.0
9	0.5	0.5	0.1	0.0	0.0	6.0	0.0	40.0	3.9	0.4	0.0	0.0
10	0.0	0.3	0.0	0.1	0.0	1.5	0.8	16.1	9.5	4.1	3.1	0.0
11	0.4	0.0	2.4	0.0	0.0	0.1	0.0	28.4	11.5	4.8	0.0	0.0
12	1.0	0.0	0.0	0.2	0.0	0.0	22.5	ND	1.9	3.2	0.0	2.6
13	0.4	2.6	0.1	0.0	0.0	0.0	0.0	ND	2.2	3.1	0.0	0.0
14	1.5	2.3	0.0	0.0	2.2	0.0	1.9	0.3	0.0	0.1	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	5.4	4.3	1.8	0.7	0.8	0.4	1.4
16	0.0	0.0	0.4	0.0	0.0	17.3	0.0	0.1	0.0	1.7	0.0	0.6
17	2.3	0.0	0.0	1.0	0.0	0.0	1.9	0.0	0.0	1.1	0.5	5.4
18	0.0	0.0	0.0	1.1	0.0	0.0	5.7	2.0	0.0	2.0	1.3	0.2
19	0.0	0.0	0.0	3.5	1.4	0.0	0.0	7.2	0.0	0.1	0.0	2.5
20	0.0	0.0	0.0	0.0	0.0	0.0	5.2	0.0	0.0	0.0	0.0	2.1
21	0.2	0.0	0.2	1.0	13.7	0.0	0.6	0.0	0.0	0.0	0.0	0.9
22	0.0	0.0	0.2	2.3	5.1	0.0	1.2	1.1	0.0	0.6	0.0	ND
23	0.0	0.2	0.0	0.1	3.0	0.8	2.9	2.5	0.0	0.2	0.6	ND
24	0.1	0.1	0.0	0.0	0.0	0.5	8.1	0.0	1.4	0.1	0.3	ND
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	5.4	0.2	ND	ND
26	0.0	1.4	1.8	2.6	2.2	1.9	0.0	2.8	0.1	0.6	0.0	ND
27	0.0	0.0	0.6	0.0	21.9	5.8	0.0	2.4	0.0	2.7	2.3	ND
28	0.0	3.2	2.7	0.0	1.0	3.8	0.0	0.0	3.0	0.4	0.0	ND
29	0.0	0.0	1.4	0.1	0.0	0.0	7.5	4.7	0.5	0.2	0.0	ND
30	0.0	-	4.2	0.0	0.0	1.3	0.0	2.4	0.0	0.4	0.0	ND
31	1.1	-	2.4	-	7.5	-	0.0	1.2	-	1.2	-	ND

Note: Precipitation data in table is in millimetres. Station ID: 4063755 Jan 1, 2018 - Sep 29, 2018. Station ID: 4063753 Sep 30, 2018 - Nov
ND= No data.

Table D-4a: 2018 Daily Water Surface Elevation for CR-WB-

DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	526.691	ND	ND	ND
2	ND	526.688	ND	ND	ND
3	ND	526.689	ND	ND	ND
4	ND	526.682	ND	ND	ND
5	ND	526.680	ND	ND	ND
6	ND	526.675	ND	ND	ND
7	526.742	526.670	ND	ND	ND
8	526.743	526.676	ND	ND	ND
9	526.747	526.694	ND	ND	ND
10	526.747	526.689	ND	ND	ND
11	526.738	526.687	ND	ND	ND
12	526.730	526.684	ND	ND	ND
13	526.720	526.679	ND	ND	ND
14	526.717	526.673	ND	ND	ND
15	526.712	526.671	ND	ND	ND
16	526.710	526.665	ND	ND	ND
17	526.714	526.664	ND	ND	ND
18	526.701	526.665	ND	ND	ND
19	526.700	526.661	ND	ND	ND
20	526.694	526.660	ND	ND	ND
21	526.698	526.655	ND	ND	ND
22	526.703	526.649	ND	ND	ND
23	526.684	526.645	ND	ND	ND
24	526.681	526.649	ND	ND	ND
25	526.683	526.649	ND	ND	ND
26	526.679	526.659	ND	ND	ND
27	526.675	526.656	ND	ND	ND
28	526.668	526.650	ND	ND	ND
29	526.667	526.657	ND	ND	ND
30	526.681	526.651	ND	ND	ND
31	526.691	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-4b: 2019 Daily Water Surface Elevation for CR-WB-MS-01												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	526.736	526.722	526.694	526.769	ND	ND	ND
2	ND	ND	ND	ND	ND	526.739	526.725	526.700	526.767	ND	ND	ND
3	ND	ND	ND	ND	ND	526.743	526.731	526.706	526.766	ND	ND	ND
4	ND	ND	ND	ND	ND	526.753	526.726	526.720	526.764	ND	ND	ND
5	ND	ND	ND	ND	ND	526.746	526.727	526.722	526.767	ND	ND	ND
6	ND	ND	ND	ND	ND	526.744	526.724	526.728	526.772	ND	ND	ND
7	ND	ND	ND	ND	ND	526.742	526.722	526.720	526.770	ND	ND	ND
8	ND	ND	ND	ND	ND	526.738	526.721	526.717	526.771	ND	ND	ND
9	ND	ND	ND	ND	ND	526.736	526.718	526.724	526.787	ND	ND	ND
10	ND	ND	ND	ND	ND	526.735	526.716	526.728	526.796	ND	ND	ND
11	ND	ND	ND	ND	ND	526.732	526.715	526.726	526.790	ND	ND	ND
12	ND	ND	ND	ND	ND	526.729	526.712	526.724	526.784	ND	ND	ND
13	ND	ND	ND	ND	ND	526.730	526.711	526.724	526.780	ND	ND	ND
14	ND	ND	ND	ND	ND	526.735	526.711	526.722	526.781	ND	ND	ND
15	ND	ND	ND	ND	526.779	526.734	526.715	526.723	526.780	ND	ND	ND
16	ND	ND	ND	ND	526.778	526.734	526.713	526.732	526.772	ND	ND	ND
17	ND	ND	ND	ND	526.782	526.732	526.712	526.766	526.782	ND	ND	ND
18	ND	ND	ND	ND	526.779	526.736	526.710	526.782	526.780	ND	ND	ND
19	ND	ND	ND	ND	526.773	526.729	526.708	526.787	526.777	ND	ND	ND
20	ND	ND	ND	ND	526.773	526.733	526.703	526.787	526.772	ND	ND	ND
21	ND	ND	ND	ND	526.770	526.731	526.702	526.787	526.773	ND	ND	ND
22	ND	ND	ND	ND	526.765	526.726	526.699	526.776	526.770	ND	ND	ND
23	ND	ND	ND	ND	526.768	526.726	526.697	526.762	526.768	ND	ND	ND
24	ND	ND	ND	ND	526.760	526.731	526.698	526.759	526.774	ND	ND	ND
25	ND	ND	ND	ND	526.751	526.725	526.699	526.763	526.776	ND	ND	ND
26	ND	ND	ND	ND	526.748	526.724	526.705	526.764	526.776	ND	ND	ND
27	ND	ND	ND	ND	526.754	526.721	526.703	526.767	526.773	ND	ND	ND
28	ND	ND	ND	ND	526.753	526.717	526.709	526.772	526.766	ND	ND	ND
29	ND	-	ND	ND	526.750	526.723	526.703	526.772	526.766	ND	ND	ND
30	ND	-	ND	ND	526.741	526.720	526.700	526.770	ND	ND	ND	ND
31	ND	-	ND	-	526.740	-	526.696	526.767	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-4c: 2020 Daily Water Surface Elevation for CR-WB-MS-01												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	ND	526.903	526.940	526.988	ND	ND	ND
2	ND	ND	ND	ND	ND	ND	526.915	526.938	526.988	ND	ND	ND
3	ND	ND	ND	ND	ND	ND	526.916	526.934	526.984	ND	ND	ND
4	ND	ND	ND	ND	ND	ND	526.913	526.931	526.982	ND	ND	ND
5	ND	ND	ND	ND	ND	ND	526.910	526.924	526.981	ND	ND	ND
6	ND	ND	ND	ND	ND	ND	526.903	526.921	526.980	ND	ND	ND
7	ND	ND	ND	ND	ND	ND	526.899	526.923	526.976	ND	ND	ND
8	ND	ND	ND	ND	ND	526.884	526.896	526.926	526.970	ND	ND	ND
9	ND	ND	ND	ND	ND	526.883	526.889	526.930	526.969	ND	ND	ND
10	ND	ND	ND	ND	ND	526.884	526.885	526.944	526.970	ND	ND	ND
11	ND	ND	ND	ND	ND	526.871	526.880	526.942	526.972	ND	ND	ND
12	ND	ND	ND	ND	ND	526.877	526.889	526.940	526.977	ND	ND	ND
13	ND	ND	ND	ND	ND	526.876	526.900	526.959	526.977	ND	ND	ND
14	ND	ND	ND	ND	ND	526.886	526.902	526.955	526.976	ND	ND	ND
15	ND	ND	ND	ND	ND	526.899	526.904	526.954	526.973	ND	ND	ND
16	ND	ND	ND	ND	ND	526.913	526.906	526.953	526.970	ND	ND	ND
17	ND	ND	ND	ND	ND	526.911	526.902	526.951	526.969	ND	ND	ND
18	ND	ND	ND	ND	ND	526.914	526.923	526.954	526.965	ND	ND	ND
19	ND	ND	ND	ND	ND	526.912	526.934	526.954	526.966	ND	ND	ND
20	ND	ND	ND	ND	ND	526.912	526.931	526.953	526.966	ND	ND	ND
21	ND	ND	ND	ND	ND	526.905	526.932	526.949	526.966	ND	ND	ND
22	ND	ND	ND	ND	ND	526.902	526.955	526.953	526.966	ND	ND	ND
23	ND	ND	ND	ND	ND	526.899	526.957	526.974	526.965	ND	ND	ND
24	ND	ND	ND	ND	ND	526.897	526.963	526.973	526.971	ND	ND	ND
25	ND	ND	ND	ND	ND	526.894	526.962	526.975	526.960	ND	ND	ND
26	ND	ND	ND	ND	ND	526.892	526.960	526.977	526.963	ND	ND	ND
27	ND	ND	ND	ND	ND	526.894	526.957	526.976	526.964	ND	ND	ND
28	ND	ND	ND	ND	ND	526.899	526.955	526.978	526.946	ND	ND	ND
29	ND	ND	ND	ND	ND	526.905	526.953	526.981	ND	ND	ND	ND
30	ND	-	ND	ND	ND	526.898	526.949	526.988	ND	ND	ND	ND
31	ND	-	ND	-	ND	-	526.944	526.986	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-5a: 2018 Daily Water Surface Elevation for CR-WB-

DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	498.551	498.518	ND	ND
2	ND	498.552	498.526	ND	ND
3	ND	498.549	ND	ND	ND
4	498.612	498.547	ND	ND	ND
5	498.601	498.538	ND	ND	ND
6	498.605	498.538	ND	ND	ND
7	498.611	498.539	ND	ND	ND
8	498.610	498.547	ND	ND	ND
9	498.609	498.559	ND	ND	ND
10	498.605	498.558	ND	ND	ND
11	498.593	498.557	ND	ND	ND
12	498.584	498.553	ND	ND	ND
13	498.577	498.544	ND	ND	ND
14	498.581	498.543	ND	ND	ND
15	498.580	498.542	ND	ND	ND
16	498.566	498.542	ND	ND	ND
17	498.574	498.538	ND	ND	ND
18	498.562	498.529	ND	ND	ND
19	498.560	498.533	ND	ND	ND
20	498.558	498.527	ND	ND	ND
21	498.560	498.526	ND	ND	ND
22	498.554	498.517	ND	ND	ND
23	498.546	498.519	ND	ND	ND
24	498.543	498.521	ND	ND	ND
25	498.538	498.519	ND	ND	ND
26	498.542	498.527	ND	ND	ND
27	498.540	498.526	ND	ND	ND
28	498.538	498.526	ND	ND	ND
29	498.545	498.526	ND	ND	ND
30	498.551	498.522	ND	ND	ND
31	498.555	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-5b: 2019 Daily Water Surface Elevation for CR-WB-MS-02												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	498.575	498.558	498.508	498.615	498.581	ND	ND
2	ND	ND	ND	ND	ND	498.577	498.559	498.520	498.619	498.582	ND	ND
3	ND	ND	ND	ND	ND	498.577	498.553	498.538	498.618	498.582	ND	ND
4	ND	ND	ND	ND	ND	498.591	498.551	498.546	498.619	ND	ND	ND
5	ND	ND	ND	ND	ND	498.592	498.546	498.547	498.634	ND	ND	ND
6	ND	ND	ND	ND	ND	498.590	498.545	498.547	498.626	ND	ND	ND
7	ND	ND	ND	ND	ND	498.593	498.545	498.539	498.632	ND	ND	ND
8	ND	ND	ND	ND	ND	498.589	498.540	498.534	498.633	ND	ND	ND
9	ND	ND	ND	ND	ND	498.578	498.538	498.554	498.622	ND	ND	ND
10	ND	ND	ND	ND	ND	498.578	498.532	498.547	498.620	ND	ND	ND
11	ND	ND	ND	ND	ND	498.571	498.531	498.543	498.618	ND	ND	ND
12	ND	ND	ND	ND	ND	498.572	498.533	498.548	498.619	ND	ND	ND
13	ND	ND	ND	ND	ND	498.575	498.527	498.550	498.627	ND	ND	ND
14	ND	ND	ND	ND	ND	498.575	498.530	498.548	498.627	ND	ND	ND
15	ND	ND	ND	ND	ND	498.573	498.529	498.554	498.621	ND	ND	ND
16	ND	ND	ND	ND	498.593	498.575	498.522	498.584	498.621	ND	ND	ND
17	ND	ND	ND	ND	498.592	498.575	498.523	498.617	498.617	ND	ND	ND
18	ND	ND	ND	ND	498.588	498.568	498.523	498.612	498.613	ND	ND	ND
19	ND	ND	ND	ND	498.588	498.567	498.521	498.607	498.612	ND	ND	ND
20	ND	ND	ND	ND	498.593	498.566	498.517	498.607	498.613	ND	ND	ND
21	ND	ND	ND	ND	498.592	498.566	498.514	498.599	498.613	ND	ND	ND
22	ND	ND	ND	ND	498.590	498.563	498.515	498.603	498.609	ND	ND	ND
23	ND	ND	ND	ND	498.594	498.564	498.514	498.602	498.614	ND	ND	ND
24	ND	ND	ND	ND	498.592	498.564	498.517	498.610	498.617	ND	ND	ND
25	ND	ND	ND	ND	498.587	498.560	498.525	498.615	498.602	ND	ND	ND
26	ND	ND	ND	ND	498.587	498.555	498.519	498.614	498.609	ND	ND	ND
27	ND	ND	ND	ND	498.589	498.552	498.518	498.618	498.599	ND	ND	ND
28	ND	ND	ND	ND	498.590	498.551	498.523	498.626	498.591	ND	ND	ND
29	ND	-	ND	ND	498.589	498.548	498.510	498.620	498.589	ND	ND	ND
30	ND	-	ND	ND	498.588	498.558	498.506	498.618	498.588	ND	ND	ND
31	ND	-	ND	-	498.582	-	498.506	498.618	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-5c: 2020 Daily Water Surface Elevation for CR-WB-MS-02												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	ND	498.852	498.850	498.880	ND	ND	ND
2	ND	ND	ND	ND	ND	ND	498.860	498.845	498.883	ND	ND	ND
3	ND	ND	ND	ND	ND	ND	498.860	498.838	498.873	ND	ND	ND
4	ND	ND	ND	ND	ND	ND	498.856	498.839	498.869	ND	ND	ND
5	ND	ND	ND	ND	ND	ND	498.855	498.832	498.865	ND	ND	ND
6	ND	ND	ND	ND	ND	498.781	498.850	498.826	498.871	ND	ND	ND
7	ND	ND	ND	ND	ND	498.801	498.845	498.823	498.861	ND	ND	ND
8	ND	ND	ND	ND	ND	498.819	498.841	498.835	498.848	ND	ND	ND
9	ND	ND	ND	ND	ND	498.820	498.833	498.844	498.854	ND	ND	ND
10	ND	ND	ND	ND	ND	498.827	498.828	498.850	498.849	ND	ND	ND
11	ND	ND	ND	ND	ND	498.827	498.823	498.846	498.855	ND	ND	ND
12	ND	ND	ND	ND	ND	498.821	498.820	498.841	498.866	ND	ND	ND
13	ND	ND	ND	ND	ND	498.825	498.821	498.851	498.861	ND	ND	ND
14	ND	ND	ND	ND	ND	498.828	498.832	498.851	498.856	ND	ND	ND
15	ND	ND	ND	ND	ND	498.847	498.832	498.856	498.855	ND	ND	ND
16	ND	ND	ND	ND	ND	498.863	498.828	498.849	498.845	ND	ND	ND
17	ND	ND	ND	ND	ND	498.866	498.829	498.847	498.845	ND	ND	ND
18	ND	ND	ND	ND	ND	498.858	498.845	498.848	498.837	ND	ND	ND
19	ND	ND	ND	ND	ND	498.857	498.856	498.851	498.841	ND	ND	ND
20	ND	ND	ND	ND	ND	498.855	498.854	498.850	498.843	ND	ND	ND
21	ND	ND	ND	ND	ND	498.852	498.852	498.849	498.844	ND	ND	ND
22	ND	ND	ND	ND	ND	498.850	498.863	498.848	498.843	ND	ND	ND
23	ND	ND	ND	ND	ND	498.848	498.865	498.869	498.833	ND	ND	ND
24	ND	ND	ND	ND	ND	498.847	498.874	498.867	498.836	ND	ND	ND
25	ND	ND	ND	ND	ND	498.846	498.873	498.866	498.860	ND	ND	ND
26	ND	ND	ND	ND	ND	498.841	498.871	498.874	498.862	ND	ND	ND
27	ND	ND	ND	ND	ND	498.840	498.863	498.874	ND	ND	ND	ND
28	ND	ND	ND	ND	ND	498.848	498.864	498.875	ND	ND	ND	ND
29	ND	ND	ND	ND	ND	498.849	498.868	498.873	ND	ND	ND	ND
30	ND	-	ND	ND	ND	498.847	498.862	498.882	ND	ND	ND	ND
31	ND	-	ND	-	ND	-	498.856	498.875	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-6a: 2018 Daily Water Surface Elevation for CR-WB-					
DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	498.307	ND	ND	ND
2	ND	498.312	ND	ND	ND
3	498.359	498.305	ND	ND	ND
4	498.341	498.304	ND	ND	ND
5	498.341	498.299	ND	ND	ND
6	498.345	498.289	ND	ND	ND
7	498.352	498.284	ND	ND	ND
8	498.352	498.289	ND	ND	ND
9	498.354	498.308	ND	ND	ND
10	498.347	498.313	ND	ND	ND
11	498.331	498.308	ND	ND	ND
12	498.326	498.309	ND	ND	ND
13	498.329	498.304	ND	ND	ND
14	498.329	498.297	ND	ND	ND
15	498.321	498.289	ND	ND	ND
16	498.318	498.290	ND	ND	ND
17	498.316	498.291	ND	ND	ND
18	498.307	498.280	ND	ND	ND
19	498.309	498.276	ND	ND	ND
20	498.308	498.274	ND	ND	ND
21	498.300	498.263	ND	ND	ND
22	498.294	498.258	ND	ND	ND
23	498.286	498.247	ND	ND	ND
24	498.288	498.255	ND	ND	ND
25	498.292	498.251	ND	ND	ND
26	498.288	498.253	ND	ND	ND
27	498.284	498.249	ND	ND	ND
28	498.282	498.242	ND	ND	ND
29	498.276	498.240	ND	ND	ND
30	498.289	498.240	ND	ND	ND
31	498.310	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-6b: 2019 Daily Water Surface Elevation for CR-WB-MS-03												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	ND	498.294	498.269	498.384	ND	ND	ND
2	ND	ND	ND	ND	ND	498.305	498.291	498.285	498.381	ND	ND	ND
3	ND	ND	ND	ND	ND	498.302	498.292	498.300	498.386	ND	ND	ND
4	ND	ND	ND	ND	ND	498.319	498.289	498.306	498.389	ND	ND	ND
5	ND	ND	ND	ND	ND	498.326	498.289	498.309	498.396	ND	ND	ND
6	ND	ND	ND	ND	ND	498.317	498.290	498.308	498.399	ND	ND	ND
7	ND	ND	ND	ND	ND	498.318	498.288	498.302	498.400	ND	ND	ND
8	ND	ND	ND	ND	ND	498.321	498.286	498.298	498.403	ND	ND	ND
9	ND	ND	ND	ND	ND	498.311	498.282	498.316	498.400	ND	ND	ND
10	ND	ND	ND	ND	ND	498.308	498.277	498.315	498.397	ND	ND	ND
11	ND	ND	ND	ND	ND	498.303	498.280	498.308	498.393	ND	ND	ND
12	ND	ND	ND	ND	ND	498.301	498.281	498.310	498.388	ND	ND	ND
13	ND	ND	ND	ND	ND	498.303	498.278	498.311	498.392	ND	ND	ND
14	ND	ND	ND	ND	ND	498.309	498.276	498.307	498.396	ND	ND	ND
15	ND	ND	ND	ND	ND	498.308	498.275	498.308	498.394	ND	ND	ND
16	ND	ND	ND	ND	ND	498.305	498.274	498.333	498.392	ND	ND	ND
17	ND	ND	ND	ND	ND	498.303	498.269	498.372	498.392	ND	ND	ND
18	ND	ND	ND	ND	ND	498.304	498.272	498.373	498.391	ND	ND	ND
19	ND	ND	ND	ND	ND	498.303	498.268	498.374	498.391	ND	ND	ND
20	ND	ND	ND	ND	ND	498.301	498.267	498.375	498.388	ND	ND	ND
21	ND	ND	ND	ND	ND	498.301	498.266	498.369	498.377	ND	ND	ND
22	ND	ND	ND	ND	ND	498.302	498.264	498.375	498.386	ND	ND	ND
23	ND	ND	ND	ND	ND	498.302	498.261	498.366	498.380	ND	ND	ND
24	ND	ND	ND	ND	ND	498.302	498.261	498.367	498.389	ND	ND	ND
25	ND	ND	ND	ND	ND	498.300	498.273	498.379	498.386	ND	ND	ND
26	ND	ND	ND	ND	ND	498.301	498.280	498.378	498.386	ND	ND	ND
27	ND	ND	ND	ND	ND	498.297	498.274	498.382	498.382	ND	ND	ND
28	ND	ND	ND	ND	ND	498.296	498.274	498.387	498.379	ND	ND	ND
29	ND	-	ND	ND	ND	498.296	498.275	498.390	498.369	ND	ND	ND
30	ND	-	ND	ND	ND	498.298	498.269	498.386	498.355	ND	ND	ND
31	ND	-	ND	-	ND	-	498.262	498.385	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-6c: 2020 Daily Water Surface Elevation for CR-WB-MS-03												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	ND	498.601	498.587	498.616	ND	ND	ND
2	ND	ND	ND	ND	ND	ND	498.620	498.583	498.614	ND	ND	ND
3	ND	ND	ND	ND	ND	ND	498.618	498.575	498.609	ND	ND	ND
4	ND	ND	ND	ND	ND	ND	498.610	498.577	498.605	ND	ND	ND
5	ND	ND	ND	ND	ND	ND	498.604	498.567	498.603	ND	ND	ND
6	ND	ND	ND	ND	ND	498.563	498.599	498.561	498.606	ND	ND	ND
7	ND	ND	ND	ND	ND	498.573	498.591	498.561	498.599	ND	ND	ND
8	ND	ND	ND	ND	ND	498.600	498.583	498.569	498.601	ND	ND	ND
9	ND	ND	ND	ND	ND	498.599	498.582	498.575	498.596	ND	ND	ND
10	ND	ND	ND	ND	ND	498.599	498.577	498.579	498.592	ND	ND	ND
11	ND	ND	ND	ND	ND	498.598	498.573	498.578	498.602	ND	ND	ND
12	ND	ND	ND	ND	ND	498.591	498.574	498.577	498.612	ND	ND	ND
13	ND	ND	ND	ND	ND	498.588	498.572	498.610	498.607	ND	ND	ND
14	ND	ND	ND	ND	ND	498.590	498.580	498.593	498.601	ND	ND	ND
15	ND	ND	ND	ND	ND	498.610	498.583	498.591	498.597	ND	ND	ND
16	ND	ND	ND	ND	ND	498.620	498.576	498.587	498.594	ND	ND	ND
17	ND	ND	ND	ND	ND	498.615	498.577	498.585	498.589	ND	ND	ND
18	ND	ND	ND	ND	ND	498.610	498.591	498.590	498.585	ND	ND	ND
19	ND	ND	ND	ND	ND	498.607	498.605	498.592	498.587	ND	ND	ND
20	ND	ND	ND	ND	ND	498.605	498.601	498.593	498.587	ND	ND	ND
21	ND	ND	ND	ND	ND	498.604	498.601	498.591	498.585	ND	ND	ND
22	ND	ND	ND	ND	ND	498.600	498.610	498.591	498.588	ND	ND	ND
23	ND	ND	ND	ND	ND	498.593	498.609	498.615	498.580	ND	ND	ND
24	ND	ND	ND	ND	ND	498.594	498.614	498.615	498.580	ND	ND	ND
25	ND	ND	ND	ND	ND	498.589	498.613	498.618	498.606	ND	ND	ND
26	ND	ND	ND	ND	ND	498.588	498.611	498.624	ND	ND	ND	ND
27	ND	ND	ND	ND	ND	498.582	498.606	498.620	ND	ND	ND	ND
28	ND	ND	ND	ND	ND	498.587	498.607	498.614	ND	ND	ND	ND
29	ND	ND	ND	ND	ND	498.596	498.601	498.610	ND	ND	ND	ND
30	ND	-	ND	ND	ND	498.591	498.597	498.624	ND	ND	ND	ND
31	ND	-	ND	-	ND	-	498.591	498.617	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-7a: 2018 Daily Water Surface Elevation for CR-WB-

DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	498.248	498.201	ND	ND
2	ND	498.249	ND	ND	ND
3	ND	498.247	ND	ND	ND
4	ND	498.243	ND	ND	ND
5	498.285	498.240	ND	ND	ND
6	498.290	498.229	ND	ND	ND
7	498.295	498.226	ND	ND	ND
8	498.295	498.233	ND	ND	ND
9	498.295	498.244	ND	ND	ND
10	498.293	498.244	ND	ND	ND
11	498.278	498.253	ND	ND	ND
12	498.265	498.254	ND	ND	ND
13	498.268	498.243	ND	ND	ND
14	498.279	498.237	ND	ND	ND
15	498.260	498.235	ND	ND	ND
16	498.253	498.228	ND	ND	ND
17	498.259	498.225	ND	ND	ND
18	498.244	498.232	ND	ND	ND
19	498.238	498.223	ND	ND	ND
20	498.240	498.225	ND	ND	ND
21	498.247	498.211	ND	ND	ND
22	498.245	498.207	ND	ND	ND
23	498.208	498.211	ND	ND	ND
24	498.216	498.216	ND	ND	ND
25	498.227	498.207	ND	ND	ND
26	498.222	498.220	ND	ND	ND
27	498.223	498.207	ND	ND	ND
28	498.216	498.203	ND	ND	ND
29	498.214	498.206	ND	ND	ND
30	498.225	498.197	ND	ND	ND
31	498.241	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-7b: 2019 Daily Water Surface Elevation for CR-WB-MS-04												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	ND	498.252	498.224	498.341	498.327	ND	ND
2	ND	ND	ND	ND	ND	498.254	498.262	498.240	498.345	498.322	ND	ND
3	ND	ND	ND	ND	ND	498.244	498.260	498.264	498.346	ND	ND	ND
4	ND	ND	ND	ND	ND	498.273	498.251	498.273	498.345	ND	ND	ND
5	ND	ND	ND	ND	ND	498.278	498.241	498.267	498.361	ND	ND	ND
6	ND	ND	ND	ND	ND	498.271	498.244	498.268	498.357	ND	ND	ND
7	ND	ND	ND	ND	ND	498.276	498.246	498.263	498.358	ND	ND	ND
8	ND	ND	ND	ND	ND	498.256	498.237	498.258	498.355	ND	ND	ND
9	ND	ND	ND	ND	ND	498.262	498.237	498.268	498.349	ND	ND	ND
10	ND	ND	ND	ND	ND	498.266	498.234	498.271	498.350	ND	ND	ND
11	ND	ND	ND	ND	ND	498.259	498.235	498.269	498.352	ND	ND	ND
12	ND	ND	ND	ND	ND	498.263	498.238	498.270	498.355	ND	ND	ND
13	ND	ND	ND	ND	ND	498.265	498.230	498.271	498.354	ND	ND	ND
14	ND	ND	ND	ND	ND	498.266	498.234	498.270	498.354	ND	ND	ND
15	ND	ND	ND	ND	ND	498.258	498.231	498.270	498.351	ND	ND	ND
16	ND	ND	ND	ND	ND	498.261	498.227	498.288	498.342	ND	ND	ND
17	ND	ND	ND	ND	ND	498.260	498.228	498.311	498.347	ND	ND	ND
18	ND	ND	ND	ND	ND	498.265	498.231	498.329	498.344	ND	ND	ND
19	ND	ND	ND	ND	ND	498.267	498.224	498.330	498.342	ND	ND	ND
20	ND	ND	ND	ND	ND	498.254	498.221	498.333	498.345	ND	ND	ND
21	ND	ND	ND	ND	ND	498.250	498.226	498.327	498.341	ND	ND	ND
22	ND	ND	ND	ND	ND	498.247	498.227	498.335	498.341	ND	ND	ND
23	ND	ND	ND	ND	ND	498.248	498.228	498.331	498.344	ND	ND	ND
24	ND	ND	ND	ND	ND	498.253	498.227	498.334	498.352	ND	ND	ND
25	ND	ND	ND	ND	ND	498.251	498.230	498.336	498.343	ND	ND	ND
26	ND	ND	ND	ND	ND	498.246	498.221	498.333	498.338	ND	ND	ND
27	ND	ND	ND	ND	ND	498.245	498.231	498.339	498.332	ND	ND	ND
28	ND	ND	ND	ND	ND	498.244	498.228	498.343	498.324	ND	ND	ND
29	ND	-	ND	ND	ND	498.245	498.220	498.349	498.325	ND	ND	ND
30	ND	-	ND	ND	ND	498.253	498.224	498.347	498.322	ND	ND	ND
31	ND	-	ND	-	ND	-	498.223	498.342	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-7c: 2020 Daily Water Surface Elevation for CR-WB-MS-04

DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	ND	498.510	498.519	498.569	ND	ND	ND
2	ND	ND	ND	ND	ND	ND	498.536	498.519	498.567	ND	ND	ND
3	ND	ND	ND	ND	ND	ND	498.545	498.515	498.561	ND	ND	ND
4	ND	ND	ND	ND	ND	ND	498.545	498.513	498.556	ND	ND	ND
5	ND	ND	ND	ND	ND	ND	498.541	498.508	498.553	ND	ND	ND
6	ND	ND	ND	ND	ND	498.495	498.537	498.498	498.558	ND	ND	ND
7	ND	ND	ND	ND	ND	498.490	498.530	498.491	498.545	ND	ND	ND
8	ND	ND	ND	ND	ND	498.499	498.514	498.501	498.543	ND	ND	ND
9	ND	ND	ND	ND	ND	498.518	498.513	498.520	498.543	ND	ND	ND
10	ND	ND	ND	ND	ND	498.527	498.514	498.521	498.537	ND	ND	ND
11	ND	ND	ND	ND	ND	498.523	498.514	498.514	498.545	ND	ND	ND
12	ND	ND	ND	ND	ND	498.518	498.508	498.507	498.558	ND	ND	ND
13	ND	ND	ND	ND	ND	498.520	498.519	498.539	498.552	ND	ND	ND
14	ND	ND	ND	ND	ND	498.520	498.506	498.538	498.543	ND	ND	ND
15	ND	ND	ND	ND	ND	498.534	498.508	498.525	498.544	ND	ND	ND
16	ND	ND	ND	ND	ND	498.554	498.501	498.514	498.534	ND	ND	ND
17	ND	ND	ND	ND	ND	498.541	498.498	498.511	498.532	ND	ND	ND
18	ND	ND	ND	ND	ND	498.540	498.500	498.511	498.526	ND	ND	ND
19	ND	ND	ND	ND	ND	498.539	498.518	498.518	498.529	ND	ND	ND
20	ND	ND	ND	ND	ND	498.537	498.523	498.524	498.530	ND	ND	ND
21	ND	ND	ND	ND	ND	498.536	498.523	498.534	498.532	ND	ND	ND
22	ND	ND	ND	ND	ND	498.535	498.535	498.527	498.531	ND	ND	ND
23	ND	ND	ND	ND	ND	498.533	498.535	498.554	498.523	ND	ND	ND
24	ND	ND	ND	ND	ND	498.532	498.539	498.558	498.520	ND	ND	ND
25	ND	ND	ND	ND	ND	498.526	498.538	498.563	498.546	ND	ND	ND
26	ND	ND	ND	ND	ND	498.524	498.537	498.569	ND	ND	ND	ND
27	ND	ND	ND	ND	ND	498.515	498.532	498.570	ND	ND	ND	ND
28	ND	ND	ND	ND	ND	498.521	498.532	498.566	ND	ND	ND	ND
29	ND	ND	ND	ND	ND	498.527	498.532	498.564	ND	ND	ND	ND
30	ND	-	ND	ND	ND	498.524	498.528	498.577	ND	ND	ND	ND
31	ND	-	ND	-	ND	-	498.523	498.566	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-8a: 2018 Daily Water Surface Elevation for CR-WB-

DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	498.277	498.230	ND	ND
2	ND	498.287	ND	ND	ND
3	498.302	498.277	ND	ND	ND
4	498.305	498.273	ND	ND	ND
5	498.285	498.272	ND	ND	ND
6	498.294	498.256	ND	ND	ND
7	498.309	498.241	ND	ND	ND
8	498.311	498.249	ND	ND	ND
9	498.305	498.274	ND	ND	ND
10	498.300	498.268	ND	ND	ND
11	498.309	498.278	ND	ND	ND
12	498.282	498.271	ND	ND	ND
13	498.272	498.264	ND	ND	ND
14	498.280	498.264	ND	ND	ND
15	498.290	498.264	ND	ND	ND
16	498.261	498.254	ND	ND	ND
17	498.263	498.249	ND	ND	ND
18	498.273	498.262	ND	ND	ND
19	498.261	498.254	ND	ND	ND
20	498.252	498.254	ND	ND	ND
21	498.252	498.241	ND	ND	ND
22	498.244	498.231	ND	ND	ND
23	498.210	498.222	ND	ND	ND
24	498.216	498.244	ND	ND	ND
25	498.231	498.236	ND	ND	ND
26	498.230	498.255	ND	ND	ND
27	498.226	498.249	ND	ND	ND
28	498.218	498.246	ND	ND	ND
29	498.223	498.251	ND	ND	ND
30	498.240	498.234	ND	ND	ND
31	498.268	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-8b: 2019 Daily Water Surface Elevation for CR-WB-MS-05												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	ND	498.219	498.199	498.341	498.326	ND	ND
2	ND	ND	ND	ND	ND	498.178	498.232	498.216	498.346	498.330	ND	ND
3	ND	ND	ND	ND	ND	498.190	498.235	498.244	498.348	ND	ND	ND
4	ND	ND	ND	ND	ND	498.210	498.228	498.267	498.346	ND	ND	ND
5	ND	ND	ND	ND	ND	498.220	498.219	498.266	498.360	ND	ND	ND
6	ND	ND	ND	ND	ND	498.221	498.219	498.260	498.365	ND	ND	ND
7	ND	ND	ND	ND	ND	498.208	498.217	498.257	498.360	ND	ND	ND
8	ND	ND	ND	ND	ND	498.202	498.212	498.250	498.356	ND	ND	ND
9	ND	ND	ND	ND	ND	498.203	498.212	498.259	498.350	ND	ND	ND
10	ND	ND	ND	ND	ND	498.203	498.212	498.266	498.349	ND	ND	ND
11	ND	ND	ND	ND	ND	498.203	498.211	498.266	498.349	ND	ND	ND
12	ND	ND	ND	ND	ND	498.206	498.210	498.263	498.356	ND	ND	ND
13	ND	ND	ND	ND	ND	498.210	498.207	498.262	498.358	ND	ND	ND
14	ND	ND	ND	ND	ND	498.212	498.206	498.263	498.356	ND	ND	ND
15	ND	ND	ND	ND	ND	498.212	498.206	498.265	498.354	ND	ND	ND
16	ND	ND	ND	ND	ND	498.216	498.203	498.274	498.345	ND	ND	ND
17	ND	ND	ND	ND	ND	498.214	498.203	498.313	498.343	ND	ND	ND
18	ND	ND	ND	ND	ND	498.213	498.203	498.332	498.342	ND	ND	ND
19	ND	ND	ND	ND	ND	498.213	498.195	498.333	498.340	ND	ND	ND
20	ND	ND	ND	ND	ND	498.209	498.186	498.335	498.341	ND	ND	ND
21	ND	ND	ND	ND	ND	498.202	498.185	498.334	498.340	ND	ND	ND
22	ND	ND	ND	ND	ND	498.206	498.188	498.335	498.339	ND	ND	ND
23	ND	ND	ND	ND	ND	498.196	498.189	498.338	498.341	ND	ND	ND
24	ND	ND	ND	ND	ND	498.200	498.190	498.340	498.349	ND	ND	ND
25	ND	ND	ND	ND	ND	498.204	498.196	498.343	498.344	ND	ND	ND
26	ND	ND	ND	ND	ND	498.204	498.189	498.337	498.340	ND	ND	ND
27	ND	ND	ND	ND	ND	498.206	498.199	498.342	498.326	ND	ND	ND
28	ND	ND	ND	ND	ND	498.208	498.197	498.346	498.325	ND	ND	ND
29	ND	-	ND	ND	ND	498.206	498.194	498.351	498.327	ND	ND	ND
30	ND	-	ND	ND	ND	498.213	498.195	498.351	498.324	ND	ND	ND
31	ND	-	ND	-	ND	-	498.195	498.345	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-8c: 2020 Daily Water Surface Elevation for CR-WB-MS-05												
DATE	**2020**											
	JAN	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
1	ND	ND	ND	ND	ND	ND	498.500	498.530	498.578	ND	ND	ND
2	ND	ND	ND	ND	ND	ND	498.517	498.528	498.574	ND	ND	ND
3	ND	ND	ND	ND	ND	ND	498.532	498.527	498.570	ND	ND	ND
4	ND	ND	ND	ND	ND	ND	498.536	498.524	498.564	ND	ND	ND
5	ND	ND	ND	ND	ND	ND	498.532	498.520	498.559	ND	ND	ND
6	ND	ND	ND	ND	ND	498.477	498.529	498.511	498.559	ND	ND	ND
7	ND	ND	ND	ND	ND	498.471	498.523	498.501	498.547	ND	ND	ND
8	ND	ND	ND	ND	ND	498.479	498.509	498.511	498.546	ND	ND	ND
9	ND	ND	ND	ND	ND	498.504	498.503	498.530	498.548	ND	ND	ND
10	ND	ND	ND	ND	ND	498.514	498.508	498.554	498.542	ND	ND	ND
11	ND	ND	ND	ND	ND	498.515	498.507	498.539	498.544	ND	ND	ND
12	ND	ND	ND	ND	ND	498.511	498.508	498.531	498.563	ND	ND	ND
13	ND	ND	ND	ND	ND	498.511	498.522	498.557	498.557	ND	ND	ND
14	ND	ND	ND	ND	ND	498.508	498.520	498.566	498.546	ND	ND	ND
15	ND	ND	ND	ND	ND	498.524	498.518	498.555	498.545	ND	ND	ND
16	ND	ND	ND	ND	ND	498.543	498.514	498.542	498.540	ND	ND	ND
17	ND	ND	ND	ND	ND	498.533	498.505	498.534	498.537	ND	ND	ND
18	ND	ND	ND	ND	ND	498.529	498.507	498.535	498.530	ND	ND	ND
19	ND	ND	ND	ND	ND	498.532	498.522	498.539	498.531	ND	ND	ND
20	ND	ND	ND	ND	ND	498.528	498.532	498.543	498.530	ND	ND	ND
21	ND	ND	ND	ND	ND	498.528	498.538	498.537	498.533	ND	ND	ND
22	ND	ND	ND	ND	ND	498.527	498.552	498.529	498.533	ND	ND	ND
23	ND	ND	ND	ND	ND	498.525	498.551	498.554	498.525	ND	ND	ND
24	ND	ND	ND	ND	ND	498.523	498.553	498.564	498.522	ND	ND	ND
25	ND	ND	ND	ND	ND	498.516	498.551	498.570	498.545	ND	ND	ND
26	ND	ND	ND	ND	ND	498.515	498.548	498.575	498.547	ND	ND	ND
27	ND	ND	ND	ND	ND	498.509	498.546	498.579	498.546	ND	ND	ND
28	ND	ND	ND	ND	ND	498.509	498.547	498.575	ND	ND	ND	ND
29	ND	ND	ND	ND	ND	498.517	498.544	498.572	ND	ND	ND	ND
30	ND	-	ND	ND	ND	498.514	498.538	498.584	ND	ND	ND	ND
31	ND	-	ND	-	ND	-	498.534	498.576	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-9a: 2018 Daily Water Surface Elevation for CR-WB-

DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	499.888	499.917	ND	ND
2	ND	499.893	499.910	ND	ND
3	ND	499.896	ND	ND	ND
4	ND	499.894	ND	ND	ND
5	ND	499.889	ND	ND	ND
6	499.906	499.891	ND	ND	ND
7	499.912	499.894	ND	ND	ND
8	499.914	499.900	ND	ND	ND
9	499.912	499.914	ND	ND	ND
10	499.909	499.918	ND	ND	ND
11	499.900	499.918	ND	ND	ND
12	499.894	499.919	ND	ND	ND
13	499.888	499.917	ND	ND	ND
14	499.880	499.912	ND	ND	ND
15	499.877	499.912	ND	ND	ND
16	499.877	499.914	ND	ND	ND
17	499.879	499.911	ND	ND	ND
18	499.867	499.905	ND	ND	ND
19	499.866	499.910	ND	ND	ND
20	499.867	499.908	ND	ND	ND
21	499.866	499.906	ND	ND	ND
22	499.864	499.907	ND	ND	ND
23	499.862	499.905	ND	ND	ND
24	499.865	499.908	ND	ND	ND
25	499.873	499.906	ND	ND	ND
26	499.874	499.912	ND	ND	ND
27	499.871	499.913	ND	ND	ND
28	499.868	499.913	ND	ND	ND
29	499.873	499.916	ND	ND	ND
30	499.885	499.916	ND	ND	ND
31	499.898	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-9b: 2019 Daily Water Surface Elevation for CR-WB-TI-01												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	499.964	499.898	499.849	499.997	500.024	ND	ND
2	ND	ND	ND	ND	ND	499.961	499.897	499.865	499.997	ND	ND	ND
3	ND	ND	ND	ND	ND	499.949	499.903	499.886	500.000	ND	ND	ND
4	ND	ND	ND	ND	ND	499.948	499.899	499.898	500.002	ND	ND	ND
5	ND	ND	ND	ND	ND	499.948	499.896	499.900	500.015	ND	ND	ND
6	ND	ND	ND	ND	ND	499.949	499.905	499.897	500.023	ND	ND	ND
7	ND	ND	ND	ND	ND	499.953	499.902	499.898	500.025	ND	ND	ND
8	ND	ND	ND	ND	ND	499.941	499.897	499.900	500.029	ND	ND	ND
9	ND	ND	ND	ND	ND	499.942	499.888	499.915	500.030	ND	ND	ND
10	ND	ND	ND	ND	ND	499.939	499.883	499.909	500.029	ND	ND	ND
11	ND	ND	ND	ND	ND	499.937	499.892	499.913	500.026	ND	ND	ND
12	ND	ND	ND	ND	ND	499.937	499.890	499.921	500.032	ND	ND	ND
13	ND	ND	ND	ND	ND	499.944	499.883	499.921	500.037	ND	ND	ND
14	ND	ND	ND	ND	ND	499.942	499.884	499.921	500.043	ND	ND	ND
15	ND	ND	ND	ND	ND	499.937	499.889	499.927	500.039	ND	ND	ND
16	ND	ND	ND	ND	ND	499.942	499.882	499.948	500.044	ND	ND	ND
17	ND	ND	ND	ND	ND	499.938	499.878	499.971	500.037	ND	ND	ND
18	ND	ND	ND	ND	499.980	499.935	499.875	499.972	500.031	ND	ND	ND
19	ND	ND	ND	ND	499.973	499.932	499.874	499.976	500.029	ND	ND	ND
20	ND	ND	ND	ND	499.973	499.930	499.854	499.976	500.029	ND	ND	ND
21	ND	ND	ND	ND	499.975	499.921	499.865	499.974	500.031	ND	ND	ND
22	ND	ND	ND	ND	499.979	499.926	499.864	499.977	500.034	ND	ND	ND
23	ND	ND	ND	ND	499.979	499.922	499.857	499.975	500.032	ND	ND	ND
24	ND	ND	ND	ND	499.974	499.917	499.859	499.989	500.033	ND	ND	ND
25	ND	ND	ND	ND	499.964	499.915	499.862	499.999	500.022	ND	ND	ND
26	ND	ND	ND	ND	499.966	499.913	499.853	499.990	500.026	ND	ND	ND
27	ND	ND	ND	ND	499.967	499.912	499.853	499.996	500.027	ND	ND	ND
28	ND	ND	ND	ND	499.968	499.908	499.853	499.999	500.022	ND	ND	ND
29	ND	-	ND	ND	499.969	499.904	499.847	500.000	500.029	ND	ND	ND
30	ND	-	ND	ND	499.951	499.898	499.848	499.999	500.027	ND	ND	ND
31	ND	-	ND	-	499.953	-	499.850	499.998	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-9c: 2020 Daily Water Surface Elevation for CR-WB-TI-01												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	ND	500.329	500.311	500.367	ND	ND	ND
2	ND	ND	ND	ND	ND	ND	500.328	500.308	500.367	ND	ND	ND
3	ND	ND	ND	ND	ND	ND	500.320	500.303	500.363	ND	ND	ND
4	ND	ND	ND	ND	ND	500.292	500.314	500.296	500.363	ND	ND	ND
5	ND	ND	ND	ND	ND	500.289	500.310	500.285	500.361	ND	ND	ND
6	ND	ND	ND	ND	ND	500.284	500.304	500.286	500.369	ND	ND	ND
7	ND	ND	ND	ND	ND	500.295	500.302	500.285	500.362	ND	ND	ND
8	ND	ND	ND	ND	ND	500.316	500.299	500.286	500.353	ND	ND	ND
9	ND	ND	ND	ND	ND	500.308	500.292	500.285	500.358	ND	ND	ND
10	ND	ND	ND	ND	ND	500.316	500.292	500.311	500.357	ND	ND	ND
11	ND	ND	ND	ND	ND	500.319	500.289	500.314	500.363	ND	ND	ND
12	ND	ND	ND	ND	ND	500.313	500.289	500.320	500.371	ND	ND	ND
13	ND	ND	ND	ND	ND	500.314	500.291	500.333	500.371	ND	ND	ND
14	ND	ND	ND	ND	ND	500.324	500.294	500.331	500.367	ND	ND	ND
15	ND	ND	ND	ND	ND	500.333	500.290	500.327	500.365	ND	ND	ND
16	ND	ND	ND	ND	ND	500.341	500.294	500.330	500.362	ND	ND	ND
17	ND	ND	ND	ND	ND	500.344	500.306	500.332	500.364	ND	ND	ND
18	ND	ND	ND	ND	ND	500.333	500.321	500.337	500.359	ND	ND	ND
19	ND	ND	ND	ND	ND	500.332	500.329	500.335	500.362	ND	ND	ND
20	ND	ND	ND	ND	ND	500.329	500.329	500.334	500.364	ND	ND	ND
21	ND	ND	ND	ND	ND	500.326	500.331	500.337	500.366	ND	ND	ND
22	ND	ND	ND	ND	ND	500.321	500.337	500.339	500.367	ND	ND	ND
23	ND	ND	ND	ND	ND	500.317	500.332	500.355	500.363	ND	ND	ND
24	ND	ND	ND	ND	ND	500.316	500.333	500.355	ND	ND	ND	ND
25	ND	ND	ND	ND	ND	500.314	500.328	500.356	ND	ND	ND	ND
26	ND	ND	ND	ND	ND	500.310	500.330	500.356	ND	ND	ND	ND
27	ND	ND	ND	ND	ND	500.310	500.327	500.357	ND	ND	ND	ND
28	ND	ND	ND	ND	ND	500.316	500.332	500.358	ND	ND	ND	ND
29	ND	ND	ND	ND	ND	500.321	500.326	500.358	ND	ND	ND	ND
30	ND	-	ND	ND	ND	500.322	500.319	500.366	ND	ND	ND	ND
31	ND	-	ND	-	ND	-	500.314	500.359	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-10a: 2018 Daily Water Surface Elevation for CR-WB

DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	499.414	499.441	ND	ND
2	ND	499.419	499.440	ND	ND
3	ND	499.415	ND	ND	ND
4	ND	499.421	ND	ND	ND
5	ND	499.418	ND	ND	ND
6	499.376	499.418	ND	ND	ND
7	499.387	499.419	ND	ND	ND
8	499.394	499.415	ND	ND	ND
9	499.397	499.436	ND	ND	ND
10	499.394	499.441	ND	ND	ND
11	499.384	499.442	ND	ND	ND
12	499.381	499.443	ND	ND	ND
13	499.378	499.441	ND	ND	ND
14	499.378	499.444	ND	ND	ND
15	499.369	499.440	ND	ND	ND
16	499.369	499.445	ND	ND	ND
17	499.372	499.443	ND	ND	ND
18	499.365	499.441	ND	ND	ND
19	499.371	499.437	ND	ND	ND
20	499.374	499.436	ND	ND	ND
21	499.377	499.431	ND	ND	ND
22	499.372	499.430	ND	ND	ND
23	499.358	499.434	ND	ND	ND
24	499.366	499.433	ND	ND	ND
25	499.377	499.435	ND	ND	ND
26	499.381	499.444	ND	ND	ND
27	499.386	499.442	ND	ND	ND
28	499.386	499.441	ND	ND	ND
29	499.392	499.443	ND	ND	ND
30	499.404	499.440	ND	ND	ND
31	499.417	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).
- = day not present in month; ND = no data.

Table D-10b: 2019 Daily Water Surface Elevation for CR-WB-TI-02												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	499.281	499.274	499.267	499.428	499.413	ND	ND
2	ND	ND	ND	ND	ND	499.288	499.283	499.288	499.426	ND	ND	ND
3	ND	ND	ND	ND	ND	499.273	499.281	499.315	499.426	ND	ND	ND
4	ND	ND	ND	ND	ND	499.289	499.278	499.343	499.427	ND	ND	ND
5	ND	ND	ND	ND	ND	499.284	499.277	499.339	499.444	ND	ND	ND
6	ND	ND	ND	ND	ND	499.294	499.284	499.340	499.444	ND	ND	ND
7	ND	ND	ND	ND	ND	499.288	499.286	499.336	499.443	ND	ND	ND
8	ND	ND	ND	ND	ND	499.288	499.276	499.339	499.445	ND	ND	ND
9	ND	ND	ND	ND	ND	499.290	499.274	499.363	499.440	ND	ND	ND
10	ND	ND	ND	ND	ND	499.292	499.271	499.365	499.437	ND	ND	ND
11	ND	ND	ND	ND	ND	499.287	499.273	499.367	499.434	ND	ND	ND
12	ND	ND	ND	ND	ND	499.293	499.273	499.371	499.435	ND	ND	ND
13	ND	ND	ND	ND	ND	499.296	499.270	499.369	499.433	ND	ND	ND
14	ND	ND	ND	ND	ND	499.290	499.270	499.368	499.432	ND	ND	ND
15	ND	ND	ND	ND	ND	499.293	499.273	499.372	499.433	ND	ND	ND
16	ND	ND	ND	ND	ND	499.300	499.281	499.395	499.431	ND	ND	ND
17	ND	ND	ND	ND	ND	499.300	499.280	499.427	499.430	ND	ND	ND
18	ND	ND	ND	ND	499.311	499.302	499.277	499.431	499.428	ND	ND	ND
19	ND	ND	ND	ND	499.308	499.300	499.277	499.431	499.422	ND	ND	ND
20	ND	ND	ND	ND	499.307	499.293	499.277	499.429	499.424	ND	ND	ND
21	ND	ND	ND	ND	499.305	499.283	499.271	499.431	499.423	ND	ND	ND
22	ND	ND	ND	ND	499.303	499.282	499.267	499.438	499.424	ND	ND	ND
23	ND	ND	ND	ND	499.306	499.282	499.270	499.430	499.428	ND	ND	ND
24	ND	ND	ND	ND	499.295	499.280	499.273	499.440	499.436	ND	ND	ND
25	ND	ND	ND	ND	499.292	499.277	499.274	499.438	499.433	ND	ND	ND
26	ND	ND	ND	ND	499.293	499.277	499.280	499.429	499.433	ND	ND	ND
27	ND	ND	ND	ND	499.297	499.280	499.278	499.437	499.428	ND	ND	ND
28	ND	ND	ND	ND	499.301	499.277	499.270	499.439	499.425	ND	ND	ND
29	ND	-	ND	ND	499.301	499.287	499.273	499.438	499.421	ND	ND	ND
30	ND	-	ND	ND	499.275	499.290	499.274	499.435	499.417	ND	ND	ND
31	ND	-	ND	-	499.282	-	499.266	499.431	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-10c: 2020 Daily Water Surface Elevation for CR-WB-TI-02												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	ND	499.506	499.476	499.534	ND	ND	ND
2	ND	ND	ND	ND	ND	ND	499.520	499.475	499.532	ND	ND	ND
3	ND	ND	ND	ND	ND	ND	499.517	499.472	499.524	ND	ND	ND
4	ND	ND	ND	ND	ND	499.512	499.513	499.465	499.519	ND	ND	ND
5	ND	ND	ND	ND	ND	499.511	499.509	499.462	499.513	ND	ND	ND
6	ND	ND	ND	ND	ND	499.497	499.505	499.459	499.514	ND	ND	ND
7	ND	ND	ND	ND	ND	499.499	499.503	499.453	499.504	ND	ND	ND
8	ND	ND	ND	ND	ND	499.525	499.497	499.463	499.494	ND	ND	ND
9	ND	ND	ND	ND	ND	499.533	499.487	499.473	499.497	ND	ND	ND
10	ND	ND	ND	ND	ND	499.529	499.490	499.487	499.493	ND	ND	ND
11	ND	ND	ND	ND	ND	499.533	499.491	499.490	499.498	ND	ND	ND
12	ND	ND	ND	ND	ND	499.527	499.490	499.493	499.505	ND	ND	ND
13	ND	ND	ND	ND	ND	499.521	499.491	499.513	499.501	ND	ND	ND
14	ND	ND	ND	ND	ND	499.525	499.493	499.512	499.494	ND	ND	ND
15	ND	ND	ND	ND	ND	499.532	499.493	499.514	499.492	ND	ND	ND
16	ND	ND	ND	ND	ND	499.535	499.499	499.510	499.484	ND	ND	ND
17	ND	ND	ND	ND	ND	499.537	499.499	499.509	499.485	ND	ND	ND
18	ND	ND	ND	ND	ND	499.531	499.516	499.511	499.479	ND	ND	ND
19	ND	ND	ND	ND	ND	499.529	499.528	499.517	499.482	ND	ND	ND
20	ND	ND	ND	ND	ND	499.518	499.528	499.522	499.482	ND	ND	ND
21	ND	ND	ND	ND	ND	499.512	499.535	499.519	499.483	ND	ND	ND
22	ND	ND	ND	ND	ND	499.508	499.539	499.519	499.482	ND	ND	ND
23	ND	ND	ND	ND	ND	499.500	499.531	499.546	499.477	ND	ND	ND
24	ND	ND	ND	ND	ND	499.501	499.528	499.546	ND	ND	ND	ND
25	ND	ND	ND	ND	ND	499.498	499.519	499.544	ND	ND	ND	ND
26	ND	ND	ND	ND	ND	499.495	499.517	499.545	ND	ND	ND	ND
27	ND	ND	ND	ND	ND	499.493	499.512	499.541	ND	ND	ND	ND
28	ND	ND	ND	ND	ND	499.493	499.511	499.537	ND	ND	ND	ND
29	ND	ND	ND	ND	ND	499.506	499.497	499.532	ND	ND	ND	ND
30	ND	-	ND	ND	ND	499.503	499.488	499.539	ND	ND	ND	ND
31	ND	-	ND	-	ND	-	499.486	499.530	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-11: 2020 Daily Water Surface Elevation for HC-WB-MS-01												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	ND	99.323	99.341	99.398	ND	ND	ND
2	ND	ND	ND	ND	ND	ND	99.326	99.334	99.399	ND	ND	ND
3	ND	ND	ND	ND	ND	ND	99.322	99.334	99.395	ND	ND	ND
4	ND	ND	ND	ND	ND	ND	99.322	99.332	99.392	ND	ND	ND
5	ND	ND	ND	ND	ND	ND	99.319	99.326	99.391	ND	ND	ND
6	ND	ND	ND	ND	ND	ND	99.314	99.322	99.391	ND	ND	ND
7	ND	ND	ND	ND	ND	ND	99.312	99.318	99.385	ND	ND	ND
8	ND	ND	ND	ND	ND	99.289	99.308	99.327	99.378	ND	ND	ND
9	ND	ND	ND	ND	ND	99.292	99.300	99.331	99.378	ND	ND	ND
10	ND	ND	ND	ND	ND	99.307	99.294	99.355	99.377	ND	ND	ND
11	ND	ND	ND	ND	ND	99.311	99.291	99.356	99.383	ND	ND	ND
12	ND	ND	ND	ND	ND	99.312	99.293	99.357	99.388	ND	ND	ND
13	ND	ND	ND	ND	ND	99.308	99.291	99.363	99.390	ND	ND	ND
14	ND	ND	ND	ND	ND	99.309	99.298	99.366	99.388	ND	ND	ND
15	ND	ND	ND	ND	ND	99.325	99.302	99.369	99.384	ND	ND	ND
16	ND	ND	ND	ND	ND	99.336	99.303	99.367	99.380	ND	ND	ND
17	ND	ND	ND	ND	ND	99.338	99.304	99.366	99.379	ND	ND	ND
18	ND	ND	ND	ND	ND	99.336	99.319	99.367	99.375	ND	ND	ND
19	ND	ND	ND	ND	ND	99.337	99.316	99.363	99.375	ND	ND	ND
20	ND	ND	ND	ND	ND	99.334	99.315	99.362	99.375	ND	ND	ND
21	ND	ND	ND	ND	ND	99.327	99.319	99.359	99.373	ND	ND	ND
22	ND	ND	ND	ND	ND	99.323	99.342	99.358	99.373	ND	ND	ND
23	ND	ND	ND	ND	ND	99.322	99.355	99.378	99.371	ND	ND	ND
24	ND	ND	ND	ND	ND	99.321	99.363	99.380	99.372	ND	ND	ND
25	ND	ND	ND	ND	ND	99.318	99.366	99.381	99.370	ND	ND	ND
26	ND	ND	ND	ND	ND	99.315	99.362	99.385	99.375	ND	ND	ND
27	ND	ND	ND	ND	ND	99.318	99.358	99.385	99.376	ND	ND	ND
28	ND	ND	ND	ND	ND	99.319	99.357	99.387	99.355	ND	ND	ND
29	ND	ND	ND	ND	ND	99.326	99.357	99.389	ND	ND	ND	ND
30	ND	-	ND	ND	ND	99.321	99.352	99.397	ND	ND	ND	ND
31	ND	-	ND	-	ND	-	99.346	99.396	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-12a: 2018 Daily Water Surface Elevation for CR-WC

DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	526.750	ND	526.662	526.648
2	ND	526.747	526.694	526.663	526.649
3	ND	526.743	526.686	526.667	526.665
4	ND	526.739	526.684	526.654	526.648
5	ND	526.736	526.678	526.651	526.645
6	ND	526.728	526.677	526.648	526.647
7	526.818	526.723	526.675	526.646	526.645
8	526.820	526.723	526.674	526.645	526.648
9	526.816	526.736	526.677	526.641	526.653
10	526.815	526.736	526.678	526.643	526.653
11	526.809	526.735	526.680	526.643	526.653
12	526.799	526.736	526.676	526.643	526.660
13	526.793	526.733	526.669	526.647	526.654
14	526.788	526.729	526.675	526.649	526.649
15	526.783	526.726	526.681	526.641	526.660
16	526.772	526.726	526.675	526.649	526.669
17	526.769	526.724	526.679	526.645	526.657
18	526.770	526.720	526.685	526.646	526.655
19	526.762	526.714	526.675	526.652	526.655
20	526.758	526.710	526.682	526.650	526.657
21	526.754	526.707	526.680	526.662	526.655
22	526.748	526.704	526.673	526.655	526.650
23	526.737	526.697	526.675	526.643	526.645
24	526.738	526.697	526.670	526.642	526.643
25	526.739	526.692	526.672	526.644	526.642
26	526.737	526.697	526.673	526.646	526.641
27	526.735	526.700	526.670	526.647	526.640
28	526.731	526.697	526.668	526.645	526.638
29	526.729	526.699	526.666	526.650	526.637
30	526.734	526.699	526.666	526.648	526.637
31	526.746	-	526.665	-	526.637

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-12b: 2019 Daily Water Surface Elevation for CR-WC-MS-01												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	526.651	526.637	526.622	526.815	526.827	526.833	526.813	526.788	526.869	ND	ND	ND
2	526.658	526.637	526.620	526.794	526.841	526.840	526.818	526.793	526.867	ND	ND	ND
3	526.660	526.635	526.633	526.788	526.844	526.834	526.807	526.810	526.867	ND	ND	ND
4	526.654	526.633	526.647	526.793	526.845	526.826	526.802	526.819	526.868	ND	ND	ND
5	526.647	526.633	526.646	526.797	526.847	526.817	526.800	526.823	526.886	ND	ND	ND
6	526.651	526.633	526.652	526.815	526.849	526.810	526.804	526.824	526.876	ND	ND	ND
7	526.647	526.636	526.660	526.815	526.849	526.811	526.805	526.811	526.872	ND	ND	ND
8	526.642	526.638	526.666	526.813	526.854	526.812	526.799	526.808	526.871	ND	ND	ND
9	526.641	526.641	526.674	526.819	526.856	526.808	526.798	526.828	526.868	ND	ND	ND
10	526.647	526.644	526.686	526.822	526.856	526.799	526.796	526.825	526.866	ND	ND	ND
11	526.649	526.647	526.704	526.830	526.859	526.780	526.796	526.818	526.863	ND	ND	ND
12	526.655	526.650	526.706	526.833	526.861	526.776	526.797	526.817	526.859	ND	ND	ND
13	526.649	526.645	526.710	526.835	526.859	526.780	526.794	526.819	526.857	ND	ND	ND
14	526.648	526.644	526.724	526.836	526.863	526.784	526.795	526.820	526.857	ND	ND	ND
15	526.644	526.645	526.746	526.832	526.854	526.785	526.795	526.819	526.856	ND	ND	ND
16	526.645	526.644	526.751	526.835	526.857	526.787	526.793	526.846	526.852	ND	ND	ND
17	526.641	526.641	526.772	526.839	526.864	526.788	526.791	526.893	526.844	ND	ND	ND
18	526.638	526.641	526.784	526.842	526.867	526.792	526.789	526.893	526.840	ND	ND	ND
19	526.637	526.646	526.801	526.844	526.866	526.801	526.786	526.891	526.830	ND	ND	ND
20	526.642	526.642	526.815	526.839	526.865	526.802	526.785	526.888	526.828	ND	ND	ND
21	526.644	526.638	526.819	526.850	526.863	526.807	526.787	526.879	526.822	ND	ND	ND
22	526.644	526.638	526.820	526.858	526.857	526.809	526.786	526.880	526.821	ND	ND	ND
23	526.638	526.635	526.806	526.860	526.856	526.816	526.784	526.876	526.828	ND	ND	ND
24	526.635	526.631	526.806	526.855	526.852	526.818	526.784	526.875	526.833	ND	ND	ND
25	526.638	526.629	526.817	526.847	526.844	526.818	526.792	526.878	526.827	ND	ND	ND
26	526.643	526.636	526.818	526.845	526.855	526.815	526.798	526.875	526.824	ND	ND	ND
27	526.647	526.639	526.809	526.841	526.853	526.809	526.788	526.882	526.821	ND	ND	ND
28	526.639	526.632	526.814	526.842	526.852	526.805	526.790	526.883	526.819	ND	ND	ND
29	526.635	-	526.810	526.842	526.843	526.809	526.786	526.880	526.815	ND	ND	ND
30	526.638	-	526.811	526.828	526.838	526.817	526.784	526.874	ND	ND	ND	ND
31	526.640	-	526.815	-	526.835	-	526.783	526.871	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-12c: 2020 Daily Water Surface Elevation for CR-WC-MS-01												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	526.953	527.027	527.035	526.991	ND	ND	ND
2	ND	ND	ND	ND	ND	526.948	527.043	527.029	526.992	ND	ND	ND
3	ND	ND	ND	ND	526.933	526.941	527.044	527.025	526.980	ND	ND	ND
4	ND	ND	ND	ND	526.935	526.936	527.038	527.025	526.980	ND	ND	ND
5	ND	ND	ND	ND	526.934	526.937	527.037	527.012	526.981	ND	ND	ND
6	ND	ND	ND	ND	526.932	526.934	527.025	527.002	526.986	ND	ND	ND
7	ND	ND	ND	ND	526.931	526.947	527.012	527.000	526.981	ND	ND	ND
8	ND	ND	ND	ND	526.930	526.975	527.005	527.012	526.976	ND	ND	ND
9	ND	ND	ND	ND	526.928	526.981	527.003	527.032	526.972	ND	ND	ND
10	ND	ND	ND	ND	526.929	526.982	526.994	526.990	526.971	ND	ND	ND
11	ND	ND	ND	ND	526.928	526.982	526.996	526.975	526.980	ND	ND	ND
12	ND	ND	ND	ND	526.925	526.982	527.006	526.975	526.971	ND	ND	ND
13	ND	ND	ND	ND	526.921	526.990	527.013	526.992	526.962	ND	ND	ND
14	ND	ND	ND	ND	526.939	526.991	527.017	526.989	526.957	ND	ND	ND
15	ND	ND	ND	ND	526.938	527.015	527.014	526.979	526.952	ND	ND	ND
16	ND	ND	ND	ND	526.929	527.027	527.007	526.970	526.943	ND	ND	ND
17	ND	ND	ND	ND	526.925	527.028	527.003	526.972	526.944	ND	ND	ND
18	ND	ND	ND	ND	526.923	527.028	527.018	526.978	526.944	ND	ND	ND
19	ND	ND	ND	ND	526.926	527.024	527.039	526.984	526.947	ND	ND	ND
20	ND	ND	ND	ND	526.923	527.021	527.037	526.980	526.946	ND	ND	ND
21	ND	ND	ND	ND	526.929	527.023	527.040	526.974	526.933	ND	ND	ND
22	ND	ND	ND	ND	526.940	527.020	527.070	526.974	526.924	ND	ND	ND
23	ND	ND	ND	ND	526.941	527.019	527.073	527.003	526.917	ND	ND	ND
24	ND	ND	ND	ND	526.939	527.017	527.081	527.004	526.918	ND	ND	ND
25	ND	ND	ND	ND	526.938	527.013	527.077	527.007	ND	ND	ND	ND
26	ND	ND	ND	ND	526.933	527.004	527.075	527.007	ND	ND	ND	ND
27	ND	ND	ND	ND	526.941	527.005	527.065	527.000	ND	ND	ND	ND
28	ND	ND	ND	ND	526.939	527.013	527.061	526.997	ND	ND	ND	ND
29	ND	ND	ND	ND	526.939	527.021	527.058	527.002	ND	ND	ND	ND
30	ND	-	ND	ND	526.935	527.015	527.053	527.008	ND	ND	ND	ND
31	ND	-	ND	-	526.931	-	527.042	526.999	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-13a: 2018 Mean Daily Discharge for CR-WC-MS-01					
DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	0.198	ND	0.106	0.095
2	ND	0.195	0.136	0.107	0.095
3	ND	0.189	0.128	0.110	0.108
4	ND	0.185	0.126	0.099	0.095
5	ND	0.181	0.121	0.097	0.092
6	ND	0.173	0.120	0.095	0.094
7	0.293	0.166	0.118	0.093	0.092
8	0.295	0.167	0.117	0.093	0.094
9	0.289	0.180	0.120	0.089	0.098
10	0.287	0.181	0.121	0.091	0.098
11	0.279	0.180	0.122	0.091	0.098
12	0.264	0.181	0.119	0.091	0.103
13	0.257	0.177	0.113	0.094	0.099
14	0.249	0.173	0.118	0.096	0.095
15	0.242	0.169	0.124	0.089	0.104
16	0.228	0.169	0.118	0.095	0.112
17	0.223	0.167	0.121	0.092	0.101
18	0.224	0.163	0.127	0.093	0.100
19	0.214	0.156	0.118	0.098	0.099
20	0.209	0.152	0.124	0.096	0.101
21	0.204	0.149	0.122	0.106	0.099
22	0.197	0.146	0.116	0.100	0.095
23	0.184	0.139	0.118	0.091	0.091
24	0.186	0.139	0.114	0.090	0.090
25	0.186	0.134	0.115	0.092	0.090
26	0.184	0.139	0.116	0.093	0.088
27	0.181	0.142	0.114	0.093	0.087
28	0.177	0.139	0.111	0.092	0.086
29	0.175	0.141	0.109	0.096	0.085
30	0.180	0.141	0.110	0.094	0.085
31	0.194	-	0.108	-	0.086

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-13b: 2019 Mean Daily Discharge for CR-WC-MS-01												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.096	0.085	0.074	0.274	0.291	0.298	0.269	0.234	0.351	ND	ND	ND
2	0.102	0.085	0.072	0.246	0.312	0.309	0.276	0.240	0.348	ND	ND	ND
3	0.103	0.083	0.081	0.238	0.317	0.301	0.260	0.264	0.349	ND	ND	ND
4	0.099	0.082	0.092	0.244	0.318	0.288	0.253	0.276	0.349	ND	ND	ND
5	0.093	0.082	0.091	0.251	0.321	0.275	0.251	0.281	0.379	ND	ND	ND
6	0.096	0.082	0.095	0.275	0.324	0.265	0.256	0.283	0.362	ND	ND	ND
7	0.093	0.084	0.102	0.274	0.325	0.267	0.257	0.264	0.356	ND	ND	ND
8	0.089	0.085	0.107	0.271	0.333	0.269	0.250	0.260	0.354	ND	ND	ND
9	0.088	0.087	0.113	0.280	0.335	0.262	0.247	0.289	0.350	ND	ND	ND
10	0.093	0.090	0.124	0.284	0.335	0.250	0.245	0.284	0.346	ND	ND	ND
11	0.094	0.092	0.141	0.296	0.340	0.225	0.245	0.274	0.341	ND	ND	ND
12	0.099	0.094	0.144	0.300	0.344	0.220	0.246	0.273	0.335	ND	ND	ND
13	0.094	0.090	0.148	0.303	0.340	0.224	0.242	0.275	0.332	ND	ND	ND
14	0.094	0.090	0.162	0.305	0.347	0.230	0.244	0.277	0.331	ND	ND	ND
15	0.090	0.091	0.186	0.299	0.332	0.231	0.243	0.276	0.329	ND	ND	ND
16	0.091	0.090	0.192	0.303	0.336	0.234	0.241	0.317	0.323	ND	ND	ND
17	0.088	0.088	0.218	0.309	0.347	0.235	0.238	0.392	0.311	ND	ND	ND
18	0.086	0.087	0.233	0.315	0.353	0.240	0.235	0.392	0.305	ND	ND	ND
19	0.085	0.091	0.255	0.318	0.352	0.253	0.231	0.390	0.291	ND	ND	ND
20	0.088	0.088	0.275	0.310	0.350	0.254	0.230	0.383	0.288	ND	ND	ND
21	0.091	0.085	0.281	0.326	0.346	0.260	0.232	0.368	0.279	ND	ND	ND
22	0.090	0.085	0.283	0.340	0.337	0.264	0.232	0.370	0.277	ND	ND	ND
23	0.085	0.083	0.262	0.342	0.334	0.273	0.229	0.362	0.287	ND	ND	ND
24	0.083	0.080	0.263	0.335	0.328	0.276	0.228	0.362	0.295	ND	ND	ND
25	0.085	0.079	0.277	0.322	0.316	0.276	0.239	0.367	0.285	ND	ND	ND
26	0.089	0.083	0.280	0.318	0.333	0.272	0.248	0.361	0.281	ND	ND	ND
27	0.092	0.086	0.267	0.312	0.330	0.262	0.234	0.373	0.276	ND	ND	ND
28	0.086	0.080	0.273	0.313	0.328	0.258	0.236	0.376	0.273	ND	ND	ND
29	0.084	-	0.268	0.314	0.313	0.263	0.231	0.370	0.268	ND	ND	ND
30	0.085	-	0.269	0.292	0.306	0.275	0.229	0.360	ND	ND	ND	ND
31	0.087	-	0.275	-	0.302	-	0.228	0.355	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-13c: 2020 Mean Daily Discharge for CR-WC-MS-01												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	0.559	0.719	0.707	0.579	ND	ND	ND
2	ND	ND	ND	ND	ND	0.551	0.758	0.692	0.580	ND	ND	ND
3	ND	ND	ND	ND	0.454	0.540	0.759	0.683	0.555	ND	ND	ND
4	ND	ND	ND	ND	0.460	0.531	0.743	0.682	0.552	ND	ND	ND
5	ND	ND	ND	ND	0.460	0.536	0.740	0.649	0.555	ND	ND	ND
6	ND	ND	ND	ND	0.458	0.532	0.709	0.627	0.563	ND	ND	ND
7	ND	ND	ND	ND	0.458	0.559	0.676	0.620	0.553	ND	ND	ND
8	ND	ND	ND	ND	0.458	0.618	0.659	0.648	0.541	ND	ND	ND
9	ND	ND	ND	ND	0.457	0.631	0.654	0.694	0.533	ND	ND	ND
10	ND	ND	ND	ND	0.462	0.633	0.633	0.595	0.529	ND	ND	ND
11	ND	ND	ND	ND	0.462	0.631	0.635	0.563	0.547	ND	ND	ND
12	ND	ND	ND	ND	0.458	0.632	0.658	0.563	0.529	ND	ND	ND
13	ND	ND	ND	ND	0.452	0.648	0.673	0.598	0.508	ND	ND	ND
14	ND	ND	ND	ND	0.490	0.649	0.683	0.590	0.497	ND	ND	ND
15	ND	ND	ND	ND	0.489	0.704	0.675	0.568	0.487	ND	ND	ND
16	ND	ND	ND	ND	0.474	0.734	0.656	0.548	0.469	ND	ND	ND
17	ND	ND	ND	ND	0.468	0.734	0.648	0.551	0.469	ND	ND	ND
18	ND	ND	ND	ND	0.468	0.735	0.682	0.563	0.469	ND	ND	ND
19	ND	ND	ND	ND	0.475	0.723	0.732	0.575	0.475	ND	ND	ND
20	ND	ND	ND	ND	0.471	0.714	0.725	0.566	0.472	ND	ND	ND
21	ND	ND	ND	ND	0.485	0.719	0.730	0.553	0.445	ND	ND	ND
22	ND	ND	ND	ND	0.509	0.711	0.805	0.552	0.429	ND	ND	ND
23	ND	ND	ND	ND	0.513	0.708	0.813	0.612	0.416	ND	ND	ND
24	ND	ND	ND	ND	0.512	0.702	0.833	0.614	0.417	ND	ND	ND
25	ND	ND	ND	ND	0.512	0.691	0.821	0.621	ND	ND	ND	ND
26	ND	ND	ND	ND	0.504	0.668	0.815	0.619	ND	ND	ND	ND
27	ND	ND	ND	ND	0.523	0.671	0.787	0.603	ND	ND	ND	ND
28	ND	ND	ND	ND	0.521	0.688	0.776	0.596	ND	ND	ND	ND
29	ND	ND	ND	ND	0.524	0.705	0.767	0.605	ND	ND	ND	ND
30	ND	-	ND	ND	0.517	0.692	0.753	0.619	ND	ND	ND	ND
31	ND	-	ND	-	0.511	-	0.726	0.597	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-14a: 2018 Daily Water Surface Elevation for CR-WC

DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	498.624	498.589	498.570	498.555
2	ND	498.623	498.621	498.575	498.544
3	498.648	498.617	498.605	498.586	ND
4	498.648	498.615	498.600	498.562	498.549
5	498.634	498.620	498.606	498.558	498.541
6	498.647	498.597	498.614	498.556	498.546
7	498.666	498.587	498.606	498.555	498.540
8	498.665	498.587	498.600	498.554	498.536
9	498.661	498.611	498.604	498.553	498.556
10	498.656	498.609	498.601	498.558	498.557
11	498.666	498.616	498.601	498.558	498.553
12	498.638	498.610	498.590	498.557	ND
13	498.639	498.610	498.573	498.565	498.553
14	498.636	498.617	498.579	498.562	498.543
15	498.642	498.602	498.589	498.542	498.547
16	498.622	498.595	498.573	498.558	ND
17	498.619	498.594	498.577	498.559	ND
18	498.632	498.606	498.585	498.560	498.552
19	498.618	498.596	498.564	498.567	498.552
20	498.612	498.599	498.580	498.563	498.556
21	498.612	498.586	498.578	ND	498.557
22	498.603	498.579	498.567	498.566	498.546
23	498.584	498.579	498.574	498.546	498.529
24	498.592	498.588	498.567	498.542	498.527
25	498.599	498.577	498.573	498.548	498.525
26	498.598	498.596	498.576	498.554	498.520
27	498.594	498.589	498.575	498.555	498.517
28	498.588	498.594	498.571	498.547	498.516
29	498.584	498.596	498.570	498.558	498.516
30	498.592	498.591	498.574	498.555	498.515
31	498.610	-	498.573	-	498.515

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-14b: 2019 Daily Water Surface Elevation for CR-WC-MS-02												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	498.534	498.517	498.506	498.561	498.558	498.565	498.585	498.530	498.644	498.631	498.585	498.556
2	498.543	498.517	498.507	498.539	498.571	498.573	498.594	498.542	498.645	498.636	498.578	498.561
3	498.545	498.514	498.514	498.532	498.575	498.572	498.584	498.564	498.646	498.627	498.589	498.568
4	498.538	498.511	498.523	498.537	498.575	498.617	498.572	498.579	498.642	498.608	498.597	498.578
5	498.528	498.509	498.515	498.541	498.576	498.612	498.567	498.576	498.668	498.611	498.588	498.564
6	498.534	498.510	498.515	498.558	498.578	498.601	498.567	498.586	498.657	498.611	498.576	498.559
7	498.529	498.517	498.517	498.558	498.578	498.593	498.566	498.569	498.655	498.605	498.572	498.573
8	498.522	498.520	498.516	498.555	498.582	498.609	498.564	498.559	498.653	498.625	498.581	498.557
9	498.521	498.526	498.517	498.561	498.583	498.600	498.564	498.584	498.651	498.619	498.590	498.570
10	498.529	498.532	498.522	498.564	498.583	498.592	498.552	498.587	498.650	498.608	498.581	498.565
11	498.532	498.539	498.528	498.571	498.586	498.591	498.553	498.572	498.649	498.602	498.562	498.557
12	498.539	498.544	498.512	498.573	498.587	498.582	498.557	498.573	498.650	498.598	498.582	498.558
13	498.532	498.537	498.497	498.575	498.585	498.585	498.551	498.576	498.648	498.602	498.590	498.563
14	498.531	498.536	498.496	498.576	498.588	498.591	498.550	498.576	498.652	498.606	498.588	498.549
15	498.525	498.539	498.507	498.571	498.579	498.593	498.548	498.571	498.649	498.595	498.569	498.562
16	498.526	498.539	498.508	498.573	498.579	498.586	498.546	498.586	498.643	498.590	498.585	498.573
17	498.521	498.535	498.525	498.577	498.580	498.583	498.542	498.639	498.647	498.591	498.570	498.548
18	498.517	498.535	498.522	498.580	498.585	498.585	498.539	498.642	498.644	498.603	498.590	498.578
19	498.516	498.545	498.529	498.582	498.585	498.583	498.532	498.646	498.639	498.601	498.588	498.558
20	498.522	498.539	498.533	498.576	498.585	498.576	498.533	498.648	498.642	498.606	498.574	498.566
21	498.526	498.533	498.541	498.586	498.584	498.574	498.535	498.636	498.637	498.603	498.563	498.566
22	498.525	498.531	498.549	498.594	498.579	498.567	498.533	498.651	498.642	498.594	498.574	498.576
23	498.517	498.527	498.541	498.595	498.579	498.566	498.529	498.641	498.644	498.600	498.565	498.565
24	498.513	498.519	498.549	498.590	498.576	498.570	498.525	498.642	498.651	498.582	498.572	498.572
25	498.517	498.516	498.565	498.581	498.570	498.566	498.525	498.649	498.642	498.597	498.575	498.570
26	498.524	498.525	498.567	498.579	498.581	498.566	498.558	498.644	498.640	498.605	498.589	498.574
27	498.529	498.531	498.558	498.574	498.580	498.563	498.537	498.648	498.638	498.581	498.573	498.579
28	498.519	498.518	498.562	498.574	498.581	498.558	498.538	498.651	498.637	498.595	498.562	498.583
29	498.514	-	498.558	498.574	498.572	498.562	498.537	498.658	498.627	498.582	498.564	498.581
30	498.518	-	498.558	498.560	498.569	498.583	498.535	498.652	498.624	498.575	498.561	498.564
31	498.521	-	498.561	-	498.567	-	498.531	498.645	-	498.590	-	498.562

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-14c: 2020 Daily Water Surface Elevation for CR-WC-MS-02												
DATE	**2020**											
	JAN	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
1	498.573	498.551	498.554	498.570	498.697	498.772	498.834	498.887	498.897	ND	ND	ND
2	498.576	498.574	498.565	498.569	498.714	498.771	498.861	498.885	498.897	ND	ND	ND
3	498.572	498.564	498.564	498.573	498.720	498.765	498.870	498.880	498.888	ND	ND	ND
4	498.555	498.548	498.576	498.573	498.734	498.767	498.866	498.883	498.885	ND	ND	ND
5	498.569	498.555	498.567	498.573	498.740	498.771	498.865	498.875	498.882	ND	ND	ND
6	498.574	498.553	498.568	498.567	498.750	498.766	498.861	498.861	498.877	ND	ND	ND
7	498.563	498.559	498.565	498.584	498.752	498.757	498.853	498.857	498.872	ND	ND	ND
8	498.554	498.558	498.554	498.602	498.750	498.789	498.842	498.871	498.873	ND	ND	ND
9	498.564	498.551	498.555	498.581	498.748	498.805	498.844	498.903	498.868	ND	ND	ND
10	498.551	498.555	498.547	498.606	498.743	498.810	498.847	498.888	498.864	ND	ND	ND
11	498.555	498.569	498.571	498.603	498.739	498.815	498.843	498.884	498.876	ND	ND	ND
12	498.556	498.552	498.573	498.603	498.738	498.817	498.847	498.882	498.879	ND	ND	ND
13	498.563	498.529	498.569	498.591	498.737	498.815	498.862	498.903	498.875	ND	ND	ND
14	498.562	498.566	498.556	498.604	498.746	498.813	498.851	498.895	498.869	ND	ND	ND
15	498.566	498.566	498.543	498.611	498.742	498.838	498.853	498.880	498.870	ND	ND	ND
16	498.556	498.565	498.556	498.587	498.740	498.851	498.845	498.871	498.864	ND	ND	ND
17	498.559	498.572	498.564	498.609	498.738	498.844	498.838	498.871	498.857	ND	ND	ND
18	498.567	498.564	498.560	498.612	498.736	498.852	498.847	498.872	498.857	ND	ND	ND
19	498.549	498.550	498.565	498.619	498.742	498.850	498.873	498.878	498.856	ND	ND	ND
20	498.548	498.553	498.550	498.629	498.741	498.848	498.875	498.869	498.859	ND	ND	ND
21	498.560	498.559	498.552	498.626	498.730	498.850	498.878	498.858	498.860	ND	ND	ND
22	498.567	498.569	498.564	498.632	498.746	498.849	498.891	498.852	498.856	ND	ND	ND
23	498.561	498.574	498.567	498.650	498.758	498.849	498.890	498.880	498.852	ND	ND	ND
24	498.563	498.582	498.566	498.646	498.756	498.846	498.897	498.884	ND	ND	ND	ND
25	498.569	498.563	498.555	498.633	498.756	498.845	498.894	498.890	ND	ND	ND	ND
26	498.567	498.558	498.555	498.652	498.757	498.842	498.895	498.896	ND	ND	ND	ND
27	498.562	498.564	498.576	498.655	498.758	498.834	498.891	498.896	ND	ND	ND	ND
28	498.563	498.564	498.580	498.668	498.758	498.840	498.890	498.892	ND	ND	ND	ND
29	498.550	498.572	498.566	498.668	498.757	498.848	498.886	498.897	ND	ND	ND	ND
30	498.556	-	498.573	498.674	498.754	498.840	498.892	498.905	ND	ND	ND	ND
31	498.554	-	498.570	-	498.751	-	498.889	498.900	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-15a: 2018 Mean Daily Discharge for CR-WC-MS-02					
DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	0.473	0.279	0.239	0.219
2	ND	0.470	0.481	0.263	0.175
3	0.635	0.426	0.368	0.324	ND
4	0.634	0.413	0.341	0.205	0.200
5	0.528	0.452	0.383	0.191	0.168
6	0.627	0.311	0.434	0.182	0.190
7	0.784	0.256	0.386	0.181	0.167
8	0.776	0.257	0.361	0.177	0.153
9	0.747	0.393	0.380	0.176	0.241
10	0.705	0.380	0.365	0.197	0.244
11	0.790	0.424	0.366	0.200	0.228
12	0.562	0.390	0.301	0.196	ND
13	0.567	0.386	0.220	0.234	0.234
14	0.547	0.433	0.257	0.225	0.190
15	0.593	0.340	0.303	0.143	0.210
16	0.450	0.300	0.222	0.208	ND
17	0.432	0.298	0.242	0.214	ND
18	0.520	0.367	0.290	0.221	0.234
19	0.426	0.312	0.190	0.253	0.239
20	0.388	0.325	0.266	0.237	0.259
21	0.389	0.257	0.260	ND	0.266
22	0.338	0.226	0.206	0.256	0.216
23	0.236	0.225	0.240	0.170	0.147
24	0.277	0.271	0.210	0.152	0.141
25	0.317	0.220	0.239	0.181	0.133
26	0.306	0.313	0.257	0.207	0.117
27	0.290	0.276	0.251	0.212	0.110
28	0.259	0.300	0.239	0.182	0.106
29	0.240	0.312	0.232	0.231	0.107
30	0.281	0.287	0.253	0.220	0.105
31	0.382	-	0.251	-	0.108

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-15b: 2019 Mean Daily Discharge for CR-WC-MS-02												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.180	0.157	0.155	0.489	0.422	0.498	0.580	0.179	0.869	0.655	0.335	0.190
2	0.221	0.159	0.159	0.352	0.501	0.563	0.643	0.237	0.878	0.694	0.297	0.212
3	0.232	0.148	0.191	0.316	0.524	0.552	0.561	0.354	0.877	0.622	0.358	0.250
4	0.200	0.137	0.234	0.338	0.521	0.940	0.471	0.437	0.838	0.486	0.415	0.296
5	0.160	0.133	0.199	0.365	0.529	0.888	0.437	0.416	1.10	0.503	0.355	0.227
6	0.184	0.139	0.198	0.464	0.537	0.779	0.431	0.482	0.974	0.506	0.288	0.205
7	0.168	0.165	0.213	0.456	0.536	0.711	0.420	0.365	0.956	0.464	0.266	0.271
8	0.141	0.181	0.209	0.436	0.568	0.846	0.405	0.309	0.933	0.608	0.314	0.195
9	0.140	0.207	0.213	0.476	0.573	0.766	0.402	0.461	0.904	0.559	0.368	0.257
10	0.172	0.236	0.241	0.490	0.564	0.693	0.333	0.474	0.892	0.480	0.314	0.232
11	0.184	0.274	0.270	0.538	0.587	0.676	0.336	0.375	0.879	0.440	0.217	0.196
12	0.219	0.301	0.195	0.558	0.597	0.602	0.356	0.380	0.884	0.413	0.321	0.202
13	0.187	0.266	0.139	0.565	0.575	0.625	0.321	0.397	0.862	0.440	0.366	0.223
14	0.184	0.267	0.135	0.570	0.600	0.671	0.313	0.393	0.894	0.471	0.356	0.164
15	0.162	0.282	0.182	0.535	0.528	0.681	0.298	0.364	0.868	0.400	0.253	0.219
16	0.170	0.283	0.184	0.550	0.532	0.626	0.284	0.465	0.807	0.369	0.338	0.272
17	0.149	0.262	0.269	0.572	0.539	0.600	0.264	0.876	0.840	0.371	0.259	0.162
18	0.137	0.267	0.257	0.595	0.581	0.612	0.247	0.905	0.807	0.452	0.364	0.312
19	0.134	0.320	0.295	0.603	0.587	0.590	0.212	0.938	0.766	0.436	0.354	0.201
20	0.160	0.294	0.315	0.560	0.590	0.539	0.214	0.952	0.787	0.470	0.280	0.239
21	0.176	0.261	0.368	0.631	0.584	0.516	0.219	0.837	0.739	0.445	0.225	0.237
22	0.176	0.252	0.417	0.698	0.556	0.467	0.212	0.976	0.782	0.390	0.279	0.288
23	0.145	0.235	0.372	0.705	0.554	0.456	0.190	0.872	0.795	0.428	0.235	0.234
24	0.131	0.203	0.426	0.659	0.540	0.484	0.173	0.883	0.849	0.321	0.266	0.265
25	0.147	0.189	0.533	0.589	0.498	0.454	0.172	0.941	0.769	0.410	0.284	0.257
26	0.175	0.234	0.547	0.566	0.597	0.451	0.337	0.895	0.745	0.466	0.359	0.278
27	0.200	0.261	0.476	0.532	0.586	0.430	0.222	0.921	0.724	0.316	0.273	0.306
28	0.160	0.203	0.504	0.533	0.592	0.396	0.221	0.948	0.715	0.398	0.216	0.329
29	0.143	-	0.475	0.529	0.533	0.417	0.218	1.02	0.629	0.321	0.228	0.316
30	0.157	-	0.473	0.426	0.513	0.562	0.206	0.951	0.607	0.281	0.215	0.231
31	0.171	-	0.498	-	0.504	-	0.186	0.886	-	0.365	-	0.218

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-15c: 2020 Mean Daily Discharge for CR-WC-MS-02												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.274	0.170	0.190	0.258	1.83	1.50	1.19	1.54	1.67	ND	ND	ND
2	0.289	0.278	0.243	0.251	2.10	1.44	1.47	1.51	1.67	ND	ND	ND
3	0.268	0.230	0.225	0.270	2.24	1.33	1.54	1.46	1.56	ND	ND	ND
4	0.192	0.159	0.291	0.270	2.49	1.30	1.46	1.50	1.51	ND	ND	ND
5	0.260	0.190	0.245	0.271	2.53	1.32	1.41	1.39	1.49	ND	ND	ND
6	0.278	0.179	0.254	0.240	2.63	1.22	1.34	1.24	1.42	ND	ND	ND
7	0.224	0.205	0.235	0.334	2.60	1.10	1.21	1.19	1.36	ND	ND	ND
8	0.184	0.201	0.182	0.442	2.50	1.44	1.06	1.35	1.37	ND	ND	ND
9	0.229	0.173	0.186	0.315	2.41	1.59	1.05	1.76	1.31	ND	ND	ND
10	0.172	0.187	0.155	0.471	2.28	1.61	1.08	1.55	1.26	ND	ND	ND
11	0.186	0.257	0.265	0.446	2.16	1.65	1.04	1.51	1.41	ND	ND	ND
12	0.192	0.179	0.270	0.450	2.08	1.63	1.08	1.48	1.44	ND	ND	ND
13	0.221	0.095	0.253	0.373	2.01	1.57	1.24	1.75	1.40	ND	ND	ND
14	0.216	0.240	0.194	0.454	2.09	1.51	1.12	1.65	1.32	ND	ND	ND
15	0.236	0.239	0.141	0.504	1.98	1.79	1.15	1.46	1.34	ND	ND	ND
16	0.194	0.231	0.193	0.365	1.90	1.93	1.06	1.35	1.26	ND	ND	ND
17	0.206	0.265	0.229	0.534	1.82	1.80	0.989	1.34	1.19	ND	ND	ND
18	0.242	0.226	0.209	0.571	1.74	1.87	1.08	1.36	1.19	ND	ND	ND
19	0.165	0.166	0.233	0.649	1.76	1.81	1.37	1.43	1.17	ND	ND	ND
20	0.158	0.181	0.166	0.751	1.70	1.73	1.40	1.32	1.21	ND	ND	ND
21	0.215	0.203	0.174	0.744	1.51	1.73	1.43	1.20	1.22	ND	ND	ND
22	0.243	0.249	0.229	0.818	1.67	1.68	1.59	1.14	1.17	ND	ND	ND
23	0.216	0.278	0.240	1.02	1.76	1.64	1.58	1.45	1.13	ND	ND	ND
24	0.224	0.321	0.237	1.01	1.70	1.56	1.67	1.50	ND	ND	ND	ND
25	0.252	0.224	0.186	0.903	1.64	1.51	1.63	1.58	ND	ND	ND	ND
26	0.240	0.201	0.186	1.13	1.60	1.45	1.64	1.66	ND	ND	ND	ND
27	0.217	0.225	0.292	1.18	1.56	1.32	1.59	1.65	ND	ND	ND	ND
28	0.222	0.234	0.310	1.36	1.52	1.35	1.58	1.61	ND	ND	ND	ND
29	0.167	0.268	0.237	1.40	1.46	1.42	1.53	1.68	ND	ND	ND	ND
30	0.192	-	0.271	1.49	1.37	1.29	1.60	1.78	ND	ND	ND	ND
31	0.193	-	0.258	-	1.30	-	1.57	1.71	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-16a: 2018 Daily Water Surface Elevation for CR-WC					
DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	498.530	498.480	498.441	498.419
2	ND	498.526	498.484	498.437	498.416
3	498.575	498.528	498.473	498.441	498.411
4	498.586	498.519	498.466	498.440	498.413
5	498.562	498.521	498.469	498.433	498.408
6	498.567	498.503	498.467	498.440	498.411
7	498.582	498.486	498.463	498.429	498.402
8	498.576	498.497	498.463	498.426	498.406
9	498.570	498.528	498.467	498.431	498.407
10	498.568	498.517	498.461	498.434	498.407
11	498.580	498.531	498.469	498.426	498.406
12	498.554	498.524	498.468	498.426	498.409
13	498.540	498.522	498.462	498.430	498.408
14	498.536	498.515	498.458	498.431	498.407
15	498.554	498.508	498.470	498.421	498.409
16	498.525	498.501	498.458	498.422	498.407
17	498.528	498.495	498.461	498.423	498.409
18	498.545	498.504	498.464	498.422	498.405
19	498.527	498.497	498.456	498.425	498.406
20	498.511	498.503	498.456	498.422	498.407
21	498.508	498.490	498.455	498.423	498.406
22	498.516	498.478	498.446	498.427	498.409
23	498.500	498.464	498.454	498.421	498.405
24	498.498	498.488	498.442	498.416	498.400
25	498.511	498.472	498.444	498.418	498.408
26	498.509	498.504	498.445	498.419	498.404
27	498.501	498.495	498.444	498.418	498.409
28	498.488	498.483	498.441	498.417	498.402
29	498.490	498.507	498.443	498.420	498.398
30	498.508	498.478	498.445	498.419	498.387
31	498.521	-	498.439	-	498.386

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-16b: 2019 Daily Water Surface Elevation for CR-WC-MS-03												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	498.408	498.386	498.369	498.527	498.516	498.514	498.509	498.465	498.592	498.568	498.509	498.459
2	498.408	498.382	498.377	498.513	498.523	498.515	498.516	498.480	498.587	498.569	498.498	498.464
3	498.407	498.382	498.383	498.507	498.527	498.520	498.502	498.502	498.588	498.564	498.515	498.472
4	498.399	498.383	498.386	498.508	498.525	498.541	498.499	498.511	498.587	498.547	498.501	498.481
5	498.390	498.384	498.380	498.514	498.525	498.534	498.492	498.513	498.611	498.554	498.510	498.466
6	498.400	498.384	498.383	498.524	498.526	498.531	498.490	498.520	498.606	498.555	498.494	498.460
7	498.396	498.380	498.382	498.524	498.523	498.532	498.493	498.505	498.604	498.547	498.487	498.478
8	498.385	498.377	498.380	498.521	498.526	498.532	498.489	498.498	498.607	498.576	498.499	498.459
9	498.386	498.383	498.382	498.525	498.530	498.519	498.488	498.525	498.599	498.560	498.508	498.474
10	498.397	498.385	498.386	498.525	498.529	498.522	498.480	498.518	498.596	498.545	498.494	498.470
11	498.400	498.388	498.389	498.529	498.531	498.512	498.479	498.509	498.593	498.538	498.469	498.459
12	498.402	498.391	498.385	498.530	498.531	498.508	498.481	498.507	498.586	498.532	498.494	498.463
13	498.396	498.372	498.381	498.528	498.527	498.515	498.474	498.514	498.592	498.542	498.489	498.465
14	498.398	498.380	498.381	498.528	498.533	498.523	498.477	498.507	498.595	498.543	498.492	498.449
15	498.386	498.385	498.383	498.524	498.532	498.519	498.481	498.510	498.595	498.528	498.472	498.463
16	498.389	498.383	498.389	498.522	498.536	498.515	498.470	498.546	498.586	498.521	498.489	498.475
17	498.379	498.378	498.410	498.523	498.539	498.510	498.468	498.583	498.586	498.525	498.468	498.441
18	498.371	498.385	498.439	498.526	498.538	498.508	498.467	498.580	498.581	498.536	498.495	498.479
19	498.380	498.393	498.448	498.526	498.539	498.510	498.468	498.580	498.582	498.533	498.492	498.454
20	498.398	498.385	498.459	498.523	498.539	498.507	498.462	498.579	498.588	498.540	498.480	498.464
21	498.399	498.384	498.473	498.529	498.537	498.513	498.460	498.564	498.582	498.533	498.466	498.459
22	498.397	498.385	498.486	498.537	498.539	498.502	498.460	498.572	498.580	498.521	498.476	498.468
23	498.385	498.379	498.483	498.535	498.537	498.506	498.459	498.574	498.586	498.531	498.470	498.452
24	498.377	498.375	498.482	498.530	498.533	498.508	498.465	498.574	498.599	498.504	498.479	498.460
25	498.389	498.378	498.492	498.527	498.528	498.507	498.476	498.582	498.592	498.527	498.482	498.458
26	498.398	498.391	498.525	498.523	498.525	498.500	498.470	498.585	498.597	498.542	498.484	498.461
27	498.395	498.390	498.525	498.519	498.530	498.496	498.467	498.586	498.592	498.510	498.479	498.463
28	498.375	498.372	498.527	498.519	498.529	498.495	498.478	498.594	498.582	498.510	498.464	498.466
29	498.376	-	498.523	498.520	498.524	498.492	498.462	498.598	498.575	498.477	498.467	498.464
30	498.391	-	498.523	498.512	498.525	498.508	498.463	498.594	498.562	498.497	498.463	498.445
31	498.396	-	498.528	-	498.516	-	498.463	498.592	-	498.517	-	498.442

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-16c: 2020 Daily Water Surface Elevation for CR-WC-MS-03												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	498.460	498.435	498.430	498.447	498.652	498.754	498.815	498.823	498.860	ND	ND	ND
2	498.463	498.472	498.446	498.442	498.661	498.758	498.830	498.820	498.863	ND	ND	ND
3	498.460	498.456	498.445	498.445	498.670	498.763	498.839	498.815	498.853	ND	ND	ND
4	498.442	498.436	498.462	498.441	498.682	498.757	498.835	498.818	498.847	ND	ND	ND
5	498.458	498.449	498.450	498.443	498.684	498.751	498.827	498.808	498.843	ND	ND	ND
6	498.468	498.448	498.453	498.439	498.693	498.749	498.819	498.803	498.849	ND	ND	ND
7	498.455	498.454	498.449	498.464	498.700	498.762	498.813	498.803	498.840	ND	ND	ND
8	498.446	498.452	498.438	498.488	498.701	498.789	498.799	498.814	498.826	ND	ND	ND
9	498.460	498.443	498.441	498.461	498.695	498.790	498.795	498.835	498.833	ND	ND	ND
10	498.445	498.447	498.430	498.497	498.691	498.797	498.793	498.829	498.829	ND	ND	ND
11	498.449	498.466	498.462	498.497	498.695	498.793	498.795	498.820	498.840	ND	ND	ND
12	498.450	498.445	498.463	498.505	498.704	498.794	498.793	498.816	498.849	ND	ND	ND
13	498.458	498.417	498.459	498.498	498.713	498.801	498.797	498.827	498.839	ND	ND	ND
14	498.455	498.464	498.442	498.515	498.713	498.802	498.807	498.830	498.833	ND	ND	ND
15	498.459	498.456	498.425	498.526	498.704	498.815	498.806	498.835	498.836	ND	ND	ND
16	498.446	498.453	498.442	498.522	498.703	498.832	498.801	498.824	498.822	ND	ND	ND
17	498.448	498.462	498.451	498.539	498.707	498.827	498.796	498.823	498.816	ND	ND	ND
18	498.459	498.451	498.445	498.546	498.704	498.828	498.814	498.822	498.813	ND	ND	ND
19	498.433	498.433	498.450	498.555	498.713	498.833	498.828	498.833	498.816	ND	ND	ND
20	498.431	498.436	498.430	498.564	498.710	498.829	498.828	498.829	498.816	ND	ND	ND
21	498.445	498.440	498.431	498.569	498.714	498.826	498.825	498.824	498.816	ND	ND	ND
22	498.453	498.451	498.446	498.578	498.729	498.827	498.843	498.822	498.815	ND	ND	ND
23	498.443	498.457	498.446	498.590	498.730	498.825	498.840	498.846	498.803	ND	ND	ND
24	498.442	498.466	498.443	498.594	498.737	498.827	498.847	498.846	498.806	ND	ND	ND
25	498.449	498.440	498.428	498.596	498.745	498.824	498.845	498.845	498.835	ND	ND	ND
26	498.444	498.435	498.428	498.613	498.746	498.813	498.843	498.853	498.833	ND	ND	ND
27	498.440	498.442	498.454	498.616	498.747	498.810	498.838	498.854	ND	ND	ND	ND
28	498.444	498.444	498.461	498.626	498.738	498.810	498.839	498.854	ND	ND	ND	ND
29	498.430	498.454	498.441	498.631	498.741	498.819	498.837	498.853	ND	ND	ND	ND
30	498.444	-	498.450	498.639	498.745	498.815	498.837	498.864	ND	ND	ND	ND
31	498.440	-	498.446	-	498.744	-	498.830	498.858	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-17a: 2018 Mean Daily Discharge for CR-WC-MS-03					
DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	0.990	0.830	0.720	0.668
2	ND	0.978	0.844	0.709	0.662
3	1.23	0.982	0.808	0.720	0.648
4	1.16	0.953	0.784	0.718	0.654
5	1.08	0.960	0.794	0.698	0.642
6	1.10	0.897	0.787	0.720	0.648
7	1.15	0.839	0.777	0.688	0.626
8	1.13	0.877	0.779	0.681	0.637
9	1.11	0.986	0.789	0.695	0.640
10	1.11	0.949	0.771	0.703	0.641
11	1.15	0.997	0.797	0.681	0.637
12	1.06	0.974	0.793	0.682	0.646
13	1.02	0.969	0.777	0.694	0.643
14	1.00	0.945	0.764	0.695	0.640
15	1.06	0.920	0.801	0.670	0.646
16	0.968	0.896	0.764	0.673	0.641
17	0.979	0.874	0.775	0.676	0.646
18	1.03	0.908	0.784	0.672	0.637
19	0.975	0.881	0.760	0.681	0.640
20	0.921	0.904	0.761	0.672	0.643
21	0.911	0.857	0.758	0.677	0.642
22	0.936	0.818	0.732	0.688	0.647
23	0.882	0.776	0.755	0.671	0.638
24	0.876	0.852	0.720	0.658	0.625
25	0.923	0.803	0.726	0.664	0.647
26	0.916	0.908	0.729	0.667	0.636
27	0.885	0.878	0.727	0.665	0.649
28	0.842	0.836	0.718	0.662	0.632
29	0.850	0.920	0.724	0.670	0.623
30	0.914	0.821	0.729	0.668	0.597
31	0.959	-	0.714	-	0.596

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-17b: 2019 Mean Daily Discharge for CR-WC-MS-03												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.648	0.602	0.571	1.06	1.20	1.27	1.01	0.853	1.29	1.20	1.01	0.832
2	0.649	0.594	0.589	1.02	1.24	1.27	1.03	0.906	1.27	1.20	0.971	0.849
3	0.647	0.594	0.604	0.996	1.27	1.29	0.984	0.982	1.27	1.19	1.03	0.877
4	0.627	0.596	0.610	1.00	1.27	1.35	0.974	1.01	1.27	1.13	0.979	0.911
5	0.605	0.598	0.598	1.02	1.29	1.32	0.950	1.02	1.37	1.15	1.01	0.855
6	0.629	0.601	0.605	1.05	1.30	1.30	0.942	1.04	1.34	1.15	0.955	0.835
7	0.619	0.591	0.603	1.05	1.31	1.29	0.955	0.995	1.34	1.13	0.930	0.897
8	0.593	0.583	0.599	1.04	1.33	1.28	0.937	0.970	1.35	1.23	0.974	0.832
9	0.597	0.599	0.604	1.05	1.36	1.22	0.936	1.06	1.32	1.17	1.00	0.885
10	0.624	0.603	0.613	1.05	1.37	1.22	0.905	1.03	1.30	1.12	0.957	0.870
11	0.632	0.610	0.622	1.07	1.39	1.18	0.901	1.01	1.29	1.10	0.868	0.834
12	0.637	0.619	0.611	1.07	1.41	1.15	0.910	1.00	1.27	1.08	0.958	0.846
13	0.621	0.574	0.603	1.06	1.41	1.17	0.882	1.02	1.29	1.11	0.940	0.853
14	0.627	0.592	0.603	1.07	1.44	1.19	0.895	1.00	1.30	1.11	0.949	0.801
15	0.598	0.604	0.607	1.06	1.45	1.17	0.910	1.01	1.30	1.07	0.876	0.846
16	0.606	0.600	0.623	1.06	1.45	1.14	0.869	1.13	1.27	1.04	0.939	0.887
17	0.583	0.589	0.678	1.07	1.45	1.12	0.863	1.26	1.27	1.05	0.864	0.775
18	0.564	0.606	0.760	1.10	1.45	1.10	0.859	1.24	1.25	1.09	0.961	0.902
19	0.586	0.625	0.788	1.11	1.44	1.10	0.862	1.25	1.25	1.08	0.950	0.816
20	0.630	0.606	0.825	1.10	1.44	1.08	0.842	1.24	1.27	1.10	0.906	0.850
21	0.631	0.604	0.871	1.14	1.43	1.09	0.835	1.19	1.25	1.08	0.858	0.833
22	0.626	0.607	0.918	1.17	1.42	1.05	0.836	1.22	1.25	1.04	0.891	0.863
23	0.598	0.593	0.907	1.18	1.41	1.05	0.831	1.22	1.27	1.08	0.871	0.811
24	0.579	0.583	0.903	1.17	1.39	1.05	0.854	1.22	1.32	0.992	0.901	0.837
25	0.610	0.591	0.939	1.17	1.37	1.04	0.891	1.25	1.29	1.06	0.914	0.828
26	0.630	0.623	1.05	1.17	1.35	1.01	0.871	1.26	1.31	1.11	0.919	0.838
27	0.624	0.619	1.05	1.17	1.36	0.989	0.860	1.27	1.29	1.01	0.900	0.847
28	0.575	0.578	1.06	1.18	1.35	0.976	0.899	1.30	1.25	1.01	0.850	0.858
29	0.579	-	1.04	1.19	1.33	0.955	0.844	1.31	1.23	0.898	0.859	0.851
30	0.615	-	1.04	1.17	1.32	1.00	0.848	1.30	1.18	0.967	0.847	0.787
31	0.626	-	1.06	-	1.29	-	0.845	1.29	-	1.03	-	0.779

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-17c: 2020 Mean Daily Discharge for CR-WC-MS-03												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.835	0.756	0.745	0.795	1.54	2.19	2.52	2.31	2.40	ND	ND	ND
2	0.846	0.878	0.796	0.778	1.59	2.22	2.63	2.28	2.42	ND	ND	ND
3	0.837	0.822	0.787	0.787	1.64	2.25	2.69	2.24	2.35	ND	ND	ND
4	0.780	0.759	0.843	0.777	1.70	2.20	2.65	2.25	2.30	ND	ND	ND
5	0.832	0.800	0.804	0.782	1.71	2.16	2.58	2.18	2.27	ND	ND	ND
6	0.865	0.797	0.815	0.769	1.76	2.15	2.51	2.14	2.31	ND	ND	ND
7	0.822	0.817	0.800	0.851	1.80	2.23	2.45	2.13	2.25	ND	ND	ND
8	0.792	0.810	0.767	0.934	1.81	2.41	2.34	2.19	2.15	ND	ND	ND
9	0.837	0.783	0.776	0.840	1.78	2.41	2.31	2.33	2.19	ND	ND	ND
10	0.789	0.794	0.743	0.967	1.76	2.46	2.28	2.28	2.16	ND	ND	ND
11	0.800	0.860	0.845	0.970	1.78	2.43	2.29	2.21	2.23	ND	ND	ND
12	0.804	0.790	0.845	0.996	1.83	2.43	2.27	2.18	2.29	ND	ND	ND
13	0.828	0.706	0.832	0.970	1.89	2.48	2.29	2.24	2.22	ND	ND	ND
14	0.818	0.849	0.780	1.02	1.89	2.49	2.35	2.25	2.18	ND	ND	ND
15	0.834	0.824	0.727	1.06	1.84	2.58	2.34	2.28	2.19	ND	ND	ND
16	0.791	0.814	0.777	1.05	1.84	2.70	2.29	2.20	2.10	ND	ND	ND
17	0.797	0.843	0.806	1.10	1.87	2.66	2.25	2.20	2.06	ND	ND	ND
18	0.831	0.808	0.786	1.13	1.85	2.67	2.36	2.19	2.05	ND	ND	ND
19	0.751	0.752	0.806	1.16	1.90	2.70	2.46	2.26	2.06	ND	ND	ND
20	0.745	0.760	0.741	1.19	1.89	2.66	2.45	2.22	2.07	ND	ND	ND
21	0.792	0.771	0.746	1.21	1.92	2.64	2.42	2.19	2.07	ND	ND	ND
22	0.813	0.808	0.791	1.24	2.00	2.64	2.54	2.17	2.06	ND	ND	ND
23	0.782	0.826	0.790	1.28	2.02	2.62	2.51	2.33	1.99	ND	ND	ND
24	0.778	0.858	0.783	1.30	2.06	2.63	2.56	2.33	2.01	ND	ND	ND
25	0.801	0.774	0.736	1.30	2.11	2.61	2.53	2.32	2.18	ND	ND	ND
26	0.786	0.757	0.735	1.37	2.12	2.52	2.51	2.37	2.17	ND	ND	ND
27	0.771	0.779	0.820	1.38	2.13	2.49	2.46	2.38	ND	ND	ND	ND
28	0.785	0.786	0.840	1.43	2.07	2.49	2.46	2.37	ND	ND	ND	ND
29	0.744	0.816	0.774	1.45	2.10	2.56	2.44	2.36	ND	ND	ND	ND
30	0.786	-	0.802	1.48	2.13	2.52	2.43	2.44	ND	ND	ND	ND
31	0.777	-	0.790	-	2.12	-	2.37	2.39	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-18a: 2018 Daily Water Surface Elevation for CR-WC					
DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	498.219	498.180	498.148	498.161
2	ND	498.221	498.182	498.146	498.158
3	ND	498.219	498.173	498.160	498.132
4	ND	498.216	498.147	498.134	498.147
5	498.252	498.212	498.158	498.143	498.134
6	498.257	498.201	498.174	498.148	498.142
7	498.262	498.199	498.166	498.150	498.125
8	498.263	498.206	498.159	498.150	498.135
9	498.262	498.217	498.166	498.154	498.146
10	498.261	498.217	498.168	498.158	498.145
11	498.246	498.226	498.175	498.152	498.140
12	498.234	498.227	498.173	498.157	498.159
13	498.236	498.217	498.160	498.164	498.157
14	498.248	498.211	498.159	498.165	498.150
15	498.228	498.209	498.175	498.138	498.145
16	498.222	498.202	498.171	498.126	498.121
17	498.228	498.200	498.175	498.131	498.137
18	498.214	498.207	498.181	498.130	498.140
19	498.207	498.198	498.169	498.138	498.146
20	498.210	498.200	498.171	498.140	498.154
21	498.216	498.186	498.181	498.144	498.160
22	498.215	498.182	498.165	498.156	498.154
23	498.178	498.186	498.172	498.145	498.145
24	498.186	498.192	498.167	498.137	498.133
25	498.197	498.183	498.163	498.144	498.137
26	498.192	498.196	498.167	498.149	498.132
27	498.194	498.183	498.165	498.151	498.132
28	498.187	498.179	498.161	498.146	498.124
29	498.186	498.183	498.157	498.153	498.123
30	498.196	498.173	498.156	498.157	498.116
31	498.213	-	498.153	-	498.113

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-18b: 2019 Daily Water Surface Elevation for CR-WC-MS-04												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	498.152	498.122	498.115	498.319	498.214	498.162	498.231	498.198	498.312	498.295	498.267	498.265
2	498.170	498.124	498.130	498.299	498.227	498.193	498.240	498.214	498.315	498.287	498.261	498.252
3	498.175	498.117	498.155	498.288	498.228	498.207	498.236	498.238	498.317	498.281	498.272	498.259
4	498.156	498.114	498.172	498.284	498.227	498.232	498.228	498.247	498.315	498.275	498.265	498.268
5	498.135	498.112	498.172	498.288	498.223	498.234	498.218	498.241	498.331	498.280	498.271	498.254
6	498.150	498.111	498.183	498.299	498.226	498.231	498.221	498.241	498.327	498.281	498.261	498.249
7	498.140	498.113	498.197	498.288	498.225	498.228	498.222	498.237	498.328	498.268	498.259	498.264
8	498.128	498.113	498.204	498.277	498.228	498.219	498.214	498.232	498.325	498.293	498.268	498.248
9	498.126	498.124	498.217	498.276	498.228	498.219	498.213	498.242	498.319	498.290	498.277	498.261
10	498.142	498.127	498.238	498.273	498.231	498.217	498.211	498.244	498.320	498.279	498.269	498.256
11	498.149	498.131	498.267	498.274	498.232	498.216	498.212	498.242	498.321	498.273	498.251	498.247
12	498.162	498.139	498.270	498.273	498.231	498.224	498.214	498.242	498.324	498.267	498.270	498.247
13	498.147	498.124	498.274	498.269	498.222	498.224	498.206	498.244	498.324	498.275	498.270	498.251
14	498.149	498.125	498.280	498.265	498.223	498.228	498.210	498.243	498.323	498.279	498.269	498.239
15	498.131	498.131	498.293	498.260	498.215	498.230	498.207	498.243	498.320	498.266	498.256	498.249
16	498.136	498.132	498.307	498.257	498.210	498.231	498.203	498.261	498.310	498.260	498.267	498.259
17	498.128	498.126	498.317	498.255	498.212	498.231	498.203	498.283	498.316	498.264	498.254	498.237
18	498.124	498.136	498.335	498.256	498.208	498.230	498.206	498.301	498.313	498.277	498.276	498.259
19	498.123	498.156	498.345	498.259	498.208	498.227	498.200	498.302	498.310	498.276	498.275	498.242
20	498.138	498.143	498.350	498.259	498.207	498.223	498.196	498.305	498.314	498.282	498.266	498.250
21	498.145	498.140	498.360	498.263	498.205	498.218	498.201	498.298	498.310	498.278	498.253	498.248
22	498.145	498.142	498.364	498.268	498.202	498.218	498.202	498.306	498.309	498.270	498.262	498.256
23	498.128	498.131	498.349	498.268	498.193	498.214	498.203	498.302	498.313	498.275	498.258	498.244
24	498.121	498.132	498.348	498.261	498.188	498.213	498.202	498.305	498.320	498.258	498.265	498.250
25	498.132	498.136	498.358	498.253	498.182	498.218	498.205	498.307	498.310	498.271	498.268	498.248
26	498.148	498.154	498.357	498.248	498.177	498.212	498.196	498.304	498.306	498.276	498.271	498.250
27	498.148	498.154	498.346	498.240	498.182	498.216	498.205	498.310	498.299	498.259	498.269	498.253
28	498.123	498.129	498.346	498.237	498.186	498.219	498.202	498.313	498.291	498.275	498.256	498.252
29	498.118	-	498.339	498.231	498.179	498.221	498.194	498.320	498.292	498.261	498.257	498.255
30	498.128	-	498.333	498.214	498.164	498.231	498.198	498.318	498.289	498.255	498.253	498.238
31	498.133	-	498.329	-	498.163	-	498.197	498.313	-	498.273	-	498.237

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-18c: 2020 Daily Water Surface Elevation for CR-WC-MS-04												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	498.256	498.218	498.243	498.230	498.419	498.439	498.467	498.488	498.533	ND	ND	ND
2	498.254	498.252	498.240	498.232	498.417	498.442	498.485	498.485	498.536	ND	ND	ND
3	498.253	498.243	498.232	498.231	498.429	498.439	498.497	498.482	498.526	ND	ND	ND
4	498.237	498.228	498.246	498.231	498.437	498.437	498.501	498.484	498.519	ND	ND	ND
5	498.243	498.238	498.236	498.222	498.428	498.436	498.501	498.478	498.516	ND	ND	ND
6	498.254	498.236	498.238	498.235	498.420	498.437	498.496	498.469	498.519	ND	ND	ND
7	498.247	498.240	498.237	498.244	498.420	498.435	498.490	498.460	498.505	ND	ND	ND
8	498.239	498.239	498.227	498.248	498.415	498.448	498.478	498.476	498.500	ND	ND	ND
9	498.249	498.231	498.229	498.222	498.416	498.469	498.468	498.507	498.506	ND	ND	ND
10	498.236	498.234	498.220	498.244	498.404	498.480	498.469	498.509	498.498	ND	ND	ND
11	498.239	498.239	498.244	498.239	498.397	498.477	498.468	498.494	498.507	ND	ND	ND
12	498.239	498.232	498.245	498.238	498.390	498.470	498.463	498.482	498.526	ND	ND	ND
13	498.245	498.210	498.242	498.227	498.391	498.473	498.476	498.507	498.514	ND	ND	ND
14	498.243	498.244	498.229	498.236	498.408	498.474	498.479	498.518	498.503	ND	ND	ND
15	498.247	498.237	498.215	498.239	498.395	498.486	498.481	498.512	498.509	ND	ND	ND
16	498.236	498.235	498.227	498.225	498.387	498.507	498.470	498.493	498.495	ND	ND	ND
17	498.238	498.241	498.234	498.252	498.383	498.500	498.460	498.490	498.494	ND	ND	ND
18	498.246	498.233	498.229	498.262	498.366	498.496	498.468	498.490	498.488	ND	ND	ND
19	498.227	498.218	498.234	498.280	498.381	498.498	498.480	498.496	498.491	ND	ND	ND
20	498.225	498.221	498.218	498.299	498.389	498.494	498.490	498.501	498.492	ND	ND	ND
21	498.237	498.225	498.219	498.312	498.396	498.493	498.493	498.494	498.495	ND	ND	ND
22	498.244	498.234	498.230	498.330	498.412	498.493	498.506	498.483	498.494	ND	ND	ND
23	498.237	498.239	498.232	498.356	498.423	498.487	498.508	498.509	498.482	ND	ND	ND
24	498.237	498.247	498.230	498.366	498.435	498.486	498.512	498.515	498.481	ND	ND	ND
25	498.242	498.228	498.218	498.368	498.439	498.481	498.510	498.520	498.509	ND	ND	ND
26	498.239	498.223	498.218	498.397	498.442	498.476	498.507	498.529	ND	ND	ND	ND
27	498.235	498.229	498.232	498.395	498.445	498.470	498.503	498.534	ND	ND	ND	ND
28	498.239	498.230	498.239	498.414	498.435	498.475	498.504	498.531	ND	ND	ND	ND
29	498.227	498.239	498.229	498.402	498.432	498.481	498.502	498.525	ND	ND	ND	ND
30	498.237	-	498.235	498.402	498.425	498.478	498.499	498.540	ND	ND	ND	ND
31	498.234	-	498.232	-	498.416	-	498.493	498.534	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-19a: 2018 Mean Daily Discharge for CR-WC-MS-04					
DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	1.79	1.64	1.22	1.17
2	ND	1.81	1.66	1.20	1.14
3	ND	1.80	1.57	1.30	0.975
4	ND	1.77	1.36	1.12	1.06
5	1.90	1.75	1.44	1.17	0.977
6	1.95	1.66	1.56	1.19	1.02
7	2.01	1.64	1.49	1.21	0.918
8	2.03	1.71	1.44	1.20	0.974
9	2.03	1.83	1.48	1.22	1.04
10	2.02	1.83	1.49	1.25	1.02
11	1.88	1.93	1.54	1.20	0.986
12	1.77	1.95	1.51	1.23	1.10
13	1.80	1.85	1.41	1.27	1.08
14	1.92	1.80	1.40	1.27	1.04
15	1.75	1.79	1.52	1.09	1.00
16	1.70	1.74	1.47	1.01	0.863
17	1.75	1.72	1.51	1.03	0.944
18	1.63	1.79	1.55	1.03	0.959
19	1.58	1.71	1.45	1.07	0.991
20	1.62	1.75	1.46	1.08	1.03
21	1.68	1.63	1.53	1.10	1.06
22	1.68	1.60	1.40	1.18	1.03
23	1.38	1.64	1.45	1.09	0.965
24	1.44	1.70	1.40	1.04	0.897
25	1.54	1.62	1.37	1.08	0.914
26	1.51	1.75	1.39	1.11	0.884
27	1.53	1.64	1.37	1.12	0.880
28	1.48	1.62	1.34	1.08	0.834
29	1.47	1.66	1.30	1.12	0.825
30	1.57	1.58	1.29	1.14	0.785
31	1.72	-	1.26	-	0.766

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-19b: 2019 Mean Daily Discharge for CR-WC-MS-04												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.974	0.704	0.591	1.88	1.72	2.20	2.34	1.61	2.47	1.95	1.77	1.84
2	1.08	0.710	0.648	1.73	1.85	2.56	2.43	1.75	2.50	1.87	1.71	1.72
3	1.11	0.677	0.762	1.65	1.90	2.70	2.35	1.97	2.51	1.81	1.81	1.79
4	0.986	0.657	0.841	1.64	1.91	3.02	2.24	2.05	2.48	1.76	1.75	1.87
5	0.860	0.646	0.836	1.71	1.91	3.02	2.11	1.98	2.66	1.81	1.81	1.75
6	0.942	0.639	0.895	1.83	1.96	2.96	2.12	1.97	2.60	1.82	1.72	1.70
7	0.879	0.645	0.973	1.75	1.98	2.88	2.12	1.92	2.59	1.70	1.71	1.84
8	0.814	0.644	1.01	1.68	2.05	2.73	2.00	1.86	2.55	1.94	1.79	1.69
9	0.801	0.687	1.08	1.70	2.08	2.71	1.98	1.95	2.46	1.91	1.88	1.82
10	0.879	0.698	1.22	1.69	2.13	2.66	1.93	1.96	2.46	1.81	1.81	1.77
11	0.912	0.713	1.42	1.73	2.19	2.63	1.93	1.93	2.47	1.76	1.65	1.69
12	0.987	0.748	1.44	1.75	2.21	2.70	1.95	1.92	2.49	1.71	1.83	1.70
13	0.896	0.674	1.47	1.74	2.15	2.68	1.86	1.93	2.47	1.78	1.83	1.73
14	0.906	0.676	1.52	1.72	2.20	2.70	1.88	1.91	2.45	1.83	1.82	1.63
15	0.803	0.702	1.62	1.70	2.14	2.70	1.85	1.90	2.40	1.71	1.70	1.73
16	0.828	0.699	1.74	1.70	2.13	2.69	1.80	2.09	2.28	1.66	1.81	1.82
17	0.781	0.673	1.82	1.72	2.19	2.67	1.79	2.32	2.33	1.69	1.69	1.62
18	0.757	0.714	2.00	1.75	2.18	2.63	1.81	2.51	2.28	1.81	1.90	1.83
19	0.752	0.806	2.09	1.81	2.22	2.58	1.74	2.51	2.25	1.81	1.90	1.67
20	0.824	0.741	2.14	1.84	2.25	2.49	1.70	2.53	2.27	1.87	1.81	1.75
21	0.853	0.723	2.25	1.90	2.27	2.41	1.74	2.44	2.22	1.83	1.70	1.73
22	0.849	0.728	2.27	1.98	2.27	2.39	1.74	2.52	2.20	1.76	1.78	1.81
23	0.759	0.676	2.11	2.00	2.21	2.32	1.73	2.46	2.23	1.82	1.75	1.70
24	0.726	0.676	2.09	1.97	2.19	2.29	1.72	2.48	2.30	1.66	1.82	1.76
25	0.773	0.691	2.18	1.91	2.15	2.32	1.74	2.50	2.18	1.78	1.85	1.74
26	0.852	0.773	2.16	1.89	2.14	2.24	1.64	2.45	2.12	1.83	1.88	1.77
27	0.847	0.770	2.04	1.85	2.23	2.26	1.72	2.50	2.04	1.67	1.86	1.80
28	0.720	0.653	2.04	1.85	2.31	2.27	1.68	2.54	1.95	1.83	1.74	1.79
29	0.695	-	1.99	1.81	2.28	2.27	1.61	2.60	1.95	1.70	1.76	1.82
30	0.737	-	1.96	1.68	2.15	2.36	1.63	2.56	1.91	1.65	1.72	1.67
31	0.757	-	1.96	-	2.19	-	1.61	2.49	-	1.82	-	1.66

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-19c: 2020 Mean Daily Discharge for CR-WC-MS-04												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	1.84	1.59	1.90	1.87	4.72	5.48	5.15	4.29	4.60	ND	ND	ND
2	1.83	1.90	1.88	1.89	4.69	5.55	5.51	4.19	4.68	ND	ND	ND
3	1.82	1.82	1.80	1.88	4.94	5.48	5.74	4.10	4.51	ND	ND	ND
4	1.67	1.68	1.94	1.88	5.12	5.46	5.80	4.10	4.40	ND	ND	ND
5	1.73	1.77	1.84	1.80	4.94	5.42	5.75	3.96	4.36	ND	ND	ND
6	1.84	1.75	1.87	1.94	4.79	5.41	5.59	3.76	4.44	ND	ND	ND
7	1.77	1.80	1.85	2.03	4.79	5.35	5.41	3.57	4.21	ND	ND	ND
8	1.70	1.79	1.76	2.07	4.71	5.60	5.13	3.81	4.13	ND	ND	ND
9	1.80	1.72	1.78	1.81	4.74	6.06	4.89	4.33	4.26	ND	ND	ND
10	1.68	1.75	1.71	2.03	4.52	6.27	4.87	4.32	4.14	ND	ND	ND
11	1.71	1.81	1.94	1.98	4.38	6.17	4.80	4.00	4.33	ND	ND	ND
12	1.72	1.74	1.95	1.98	4.26	5.95	4.65	3.76	4.70	ND	ND	ND
13	1.77	1.55	1.93	1.87	4.29	5.98	4.88	4.15	4.49	ND	ND	ND
14	1.75	1.86	1.80	1.96	4.62	5.95	4.89	4.32	4.30	ND	ND	ND
15	1.79	1.79	1.67	2.00	4.39	6.21	4.89	4.17	4.44	ND	ND	ND
16	1.70	1.77	1.79	1.86	4.25	6.71	4.62	3.80	4.21	ND	ND	ND
17	1.72	1.84	1.86	2.15	4.18	6.49	4.39	3.70	4.20	ND	ND	ND
18	1.80	1.77	1.82	2.26	3.89	6.34	4.50	3.68	4.11	ND	ND	ND
19	1.63	1.63	1.86	2.47	4.16	6.34	4.69	3.74	4.20	ND	ND	ND
20	1.61	1.66	1.71	2.71	4.32	6.20	4.84	3.79	4.23	ND	ND	ND
21	1.73	1.70	1.73	2.89	4.47	6.13	4.85	3.68	4.30	ND	ND	ND
22	1.79	1.78	1.84	3.14	4.79	6.09	5.08	3.52	4.30	ND	ND	ND
23	1.72	1.84	1.85	3.55	5.02	5.92	5.07	3.97	4.10	ND	ND	ND
24	1.73	1.92	1.84	3.72	5.29	5.85	5.11	4.11	4.11	ND	ND	ND
25	1.78	1.74	1.73	3.75	5.39	5.68	5.03	4.22	4.65	ND	ND	ND
26	1.75	1.70	1.74	4.28	5.47	5.54	4.92	4.40	ND	ND	ND	ND
27	1.72	1.76	1.87	4.25	5.55	5.36	4.80	4.51	ND	ND	ND	ND
28	1.75	1.77	1.94	4.60	5.32	5.43	4.77	4.47	ND	ND	ND	ND
29	1.66	1.85	1.85	4.38	5.27	5.54	4.70	4.39	ND	ND	ND	ND
30	1.75	ND	1.91	4.39	5.13	5.42	4.59	4.69	ND	ND	ND	ND
31	1.73	ND	1.88	ND	4.95	ND	4.44	4.61	ND	ND	ND	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-20a: 2018 Daily Water Surface Elevation for CR-WC

DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	498.172	498.124	498.100	498.105
2	ND	498.184	498.138	498.098	498.103
3	498.199	498.171	498.138	498.099	498.088
4	498.200	498.169	498.132	498.088	498.098
5	498.181	498.167	498.129	498.094	498.086
6	498.189	498.155	498.128	498.095	498.094
7	498.203	498.141	498.124	498.091	498.082
8	498.207	498.141	498.129	498.092	498.081
9	498.200	498.161	498.123	498.104	498.087
10	498.196	498.164	498.123	498.101	498.086
11	498.202	498.171	498.130	498.097	498.083
12	498.179	498.165	498.129	498.105	498.093
13	498.172	498.159	498.116	498.114	498.094
14	498.177	498.162	498.116	498.118	498.091
15	498.182	498.162	498.123	498.094	498.089
16	498.159	498.154	498.120	498.086	498.084
17	498.156	498.151	498.121	498.088	498.086
18	498.166	498.157	498.124	498.087	498.084
19	498.156	498.150	498.119	498.092	498.084
20	498.148	498.150	498.118	498.093	498.085
21	498.146	498.142	498.124	498.100	498.087
22	498.137	498.137	498.118	498.112	498.085
23	498.107	498.125	498.121	498.099	498.084
24	498.112	498.139	498.118	498.093	498.080
25	498.125	498.131	498.114	498.096	498.082
26	498.124	498.143	498.118	498.102	498.079
27	498.121	498.144	498.113	498.108	498.079
28	498.116	498.141	498.114	498.103	498.073
29	498.118	498.144	498.110	498.102	498.072
30	498.131	498.131	498.107	498.102	498.067
31	498.161	-	498.106	-	498.064

Note: elevations in table are in metres (arbitrary datum).
- = day not present in month; ND = no data.

Table D-20b: 2019 Daily Water Surface Elevation for CR-WC-MS-05												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	498.081	498.049	498.040	498.085	498.148	498.077	498.145	498.094	498.236	498.221	498.160	498.117
2	498.091	498.050	498.043	498.086	498.152	498.094	498.160	498.111	498.241	498.220	498.146	498.121
3	498.096	498.046	498.049	498.084	498.152	498.100	498.154	498.139	498.243	498.208	498.155	498.129
4	498.089	498.045	498.051	498.089	498.147	498.148	498.134	498.162	498.241	498.188	498.154	498.136
5	498.079	498.044	498.045	498.101	498.144	498.146	498.114	498.161	498.255	498.208	498.157	498.122
6	498.086	498.043	498.045	498.109	498.146	498.142	498.114	498.155	498.260	498.212	498.158	498.118
7	498.079	498.043	498.047	498.103	498.145	498.134	498.112	498.152	498.255	498.172	498.154	498.129
8	498.072	498.042	498.045	498.102	498.150	498.129	498.107	498.145	498.251	498.208	498.161	498.110
9	498.070	498.047	498.045	498.106	498.151	498.131	498.107	498.154	498.245	498.199	498.167	498.122
10	498.076	498.048	498.050	498.112	498.159	498.130	498.107	498.161	498.244	498.185	498.158	498.115
11	498.079	498.050	498.059	498.120	498.155	498.124	498.106	498.161	498.244	498.179	498.135	498.105
12	498.085	498.053	498.056	498.129	498.155	498.130	498.105	498.158	498.251	498.173	498.152	498.103
13	498.078	498.046	498.054	498.136	498.150	498.130	498.102	498.157	498.253	498.182	498.151	498.106
14	498.077	498.047	498.052	498.142	498.147	498.130	498.101	498.158	498.251	498.187	498.153	498.089
15	498.069	498.050	498.053	498.148	498.137	498.124	498.101	498.160	498.249	498.173	498.134	498.103
16	498.074	498.050	498.053	498.147	498.128	498.127	498.098	498.169	498.240	498.165	498.149	498.113
17	498.070	498.048	498.053	498.148	498.124	498.129	498.098	498.208	498.238	498.169	498.130	498.088
18	498.067	498.053	498.057	498.150	498.124	498.127	498.098	498.227	498.237	498.182	498.149	498.117
19	498.066	498.063	498.058	498.151	498.124	498.128	498.090	498.228	498.235	498.180	498.151	498.095
20	498.071	498.056	498.058	498.149	498.124	498.119	498.081	498.230	498.236	498.185	498.144	498.103
21	498.072	498.054	498.059	498.153	498.122	498.112	498.080	498.229	498.235	498.178	498.129	498.102
22	498.071	498.055	498.059	498.156	498.115	498.111	498.083	498.230	498.234	498.168	498.135	498.112
23	498.063	498.050	498.051	498.159	498.111	498.106	498.084	498.233	498.236	498.173	498.129	498.102
24	498.059	498.051	498.051	498.157	498.105	498.110	498.085	498.235	498.244	498.152	498.134	498.110
25	498.063	498.053	498.063	498.155	498.100	498.118	498.091	498.238	498.239	498.171	498.139	498.109
26	498.070	498.061	498.072	498.154	498.100	498.110	498.084	498.232	498.235	498.179	498.147	498.113
27	498.069	498.061	498.074	498.152	498.105	498.116	498.094	498.237	498.221	498.149	498.143	498.118
28	498.058	498.048	498.081	498.153	498.103	498.119	498.092	498.241	498.220	498.177	498.128	498.121
29	498.054	-	498.083	498.153	498.093	498.127	498.089	498.246	498.222	498.157	498.128	498.119
30	498.056	-	498.085	498.148	498.096	498.142	498.090	498.246	498.219	498.148	498.124	498.103
31	498.055	-	498.088	-	498.084	-	498.090	498.240	-	498.168	-	498.102

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-20c: 2020 Daily Water Surface Elevation for CR-WC-MS-05												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	498.115	498.085	498.054	498.152	498.421	498.414	498.387	498.427	498.491	ND	ND	ND
2	498.119	498.113	498.067	498.154	498.444	498.419	498.406	498.423	498.496	ND	ND	ND
3	498.118	498.101	498.067	498.161	498.447	498.412	498.425	498.421	498.487	ND	ND	ND
4	498.101	498.085	498.082	498.166	498.466	498.408	498.431	498.429	498.476	ND	ND	ND
5	498.113	498.095	498.074	498.171	498.462	498.399	498.432	498.424	498.472	ND	ND	ND
6	498.118	498.092	498.077	498.168	498.433	498.387	498.429	498.415	498.477	ND	ND	ND
7	498.108	498.096	498.078	498.186	498.436	498.382	498.419	498.404	498.464	ND	ND	ND
8	498.098	498.094	498.069	498.203	498.439	498.396	498.406	498.430	498.459	ND	ND	ND
9	498.106	498.086	498.072	498.183	498.440	498.427	498.397	498.485	498.467	ND	ND	ND
10	498.091	498.088	498.065	498.210	498.434	498.435	498.399	498.481	498.458	ND	ND	ND
11	498.092	498.103	498.088	498.210	498.431	498.429	498.405	498.455	498.470	ND	ND	ND
12	498.090	498.086	498.091	498.215	498.431	498.421	498.398	498.439	498.498	ND	ND	ND
13	498.095	498.063	498.089	498.209	498.429	498.426	498.417	498.465	498.478	ND	ND	ND
14	498.091	498.091	498.077	498.223	498.444	498.417	498.424	498.486	498.467	ND	ND	ND
15	498.094	498.068	498.063	498.230	498.433	498.431	498.430	498.483	498.476	ND	ND	ND
16	498.083	498.053	498.078	498.213	498.427	498.456	498.412	498.457	498.460	ND	ND	ND
17	498.084	498.060	498.089	498.235	498.421	498.446	498.396	498.451	498.456	ND	ND	ND
18	498.091	498.053	498.088	498.245	498.406	498.442	498.404	498.449	498.450	ND	ND	ND
19	498.073	498.039	498.096	498.264	498.421	498.441	498.420	498.457	498.453	ND	ND	ND
20	498.070	498.041	498.084	498.284	498.412	498.433	498.430	498.458	498.455	ND	ND	ND
21	498.082	498.046	498.088	498.296	498.391	498.431	498.432	498.441	498.457	ND	ND	ND
22	498.090	498.055	498.103	498.315	498.393	498.431	498.447	498.427	498.457	ND	ND	ND
23	498.083	498.062	498.109	498.341	498.419	498.431	498.448	498.459	498.444	ND	ND	ND
24	498.084	498.071	498.112	498.349	498.406	498.429	498.452	498.466	498.443	ND	ND	ND
25	498.091	498.054	498.106	498.346	498.413	498.422	498.448	498.470	498.477	ND	ND	ND
26	498.090	498.051	498.110	498.361	498.418	498.415	498.447	498.483	ND	ND	ND	ND
27	498.088	498.058	498.136	498.354	498.420	498.407	498.442	498.489	ND	ND	ND	ND
28	498.093	498.059	498.144	498.362	498.410	498.410	498.440	498.486	ND	ND	ND	ND
29	498.084	498.070	498.135	498.376	498.407	498.412	498.440	498.481	ND	ND	ND	ND
30	498.094	-	498.145	498.388	498.399	498.405	498.438	498.498	ND	ND	ND	ND
31	498.092	-	498.147	-	498.386	-	498.434	498.500	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-21a: 2018 Mean Daily Discharge for CR-WC-MS-05					
DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	3.23	3.03	2.83	2.96
2	ND	3.38	3.19	2.81	2.94
3	3.18	3.24	3.20	2.82	2.77
4	3.20	3.22	3.13	2.71	2.89
5	2.99	3.22	3.09	2.78	2.76
6	3.10	3.09	3.09	2.79	2.84
7	3.27	2.93	3.05	2.75	2.72
8	3.33	2.95	3.11	2.76	2.72
9	3.26	3.20	3.04	2.90	2.78
10	3.22	3.24	3.05	2.86	2.77
11	3.31	3.34	3.13	2.82	2.74
12	3.05	3.27	3.12	2.91	2.85
13	2.99	3.22	2.97	3.02	2.86
14	3.06	3.26	2.96	3.06	2.83
15	3.12	3.29	3.05	2.80	2.82
16	2.88	3.20	3.02	2.71	2.76
17	2.86	3.17	3.04	2.74	2.78
18	2.98	3.26	3.06	2.73	2.77
19	2.88	3.19	3.01	2.79	2.76
20	2.80	3.20	3.01	2.80	2.78
21	2.79	3.12	3.08	2.88	2.80
22	2.71	3.07	3.01	3.01	2.79
23	2.41	2.95	3.05	2.87	2.78
24	2.48	3.12	3.02	2.81	2.73
25	2.62	3.04	2.98	2.84	2.76
26	2.61	3.20	3.01	2.92	2.73
27	2.59	3.21	2.97	2.98	2.73
28	2.55	3.20	2.99	2.93	2.67
29	2.59	3.25	2.94	2.92	2.66
30	2.74	3.10	2.91	2.92	2.61
31	3.08	-	2.90	-	2.59

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-21b: 2019 Mean Daily Discharge for CR-WC-MS-05												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	2.77	2.50	2.47	3.01	3.79	2.92	3.41	2.52	3.87	3.32	2.78	2.50
2	2.87	2.51	2.49	3.02	3.83	3.10	3.58	2.69	3.92	3.30	2.64	2.55
3	2.93	2.47	2.56	2.99	3.85	3.16	3.49	2.98	3.93	3.17	2.75	2.63
4	2.85	2.46	2.59	3.05	3.77	3.76	3.24	3.24	3.90	2.94	2.74	2.71
5	2.75	2.45	2.53	3.20	3.74	3.71	2.99	3.21	4.08	3.18	2.78	2.58
6	2.83	2.45	2.53	3.29	3.76	3.65	2.98	3.14	4.13	3.24	2.79	2.53
7	2.76	2.45	2.55	3.21	3.74	3.54	2.95	3.08	4.05	2.79	2.75	2.66
8	2.69	2.44	2.53	3.21	3.81	3.47	2.89	2.99	3.99	3.19	2.83	2.47
9	2.67	2.49	2.53	3.25	3.83	3.48	2.87	3.09	3.89	3.10	2.90	2.59
10	2.73	2.51	2.58	3.33	3.93	3.45	2.86	3.17	3.86	2.94	2.82	2.52
11	2.76	2.52	2.68	3.42	3.88	3.36	2.84	3.15	3.86	2.88	2.58	2.43
12	2.83	2.56	2.65	3.53	3.88	3.42	2.82	3.10	3.94	2.82	2.77	2.42
13	2.75	2.49	2.63	3.63	3.81	3.41	2.78	3.08	3.95	2.92	2.76	2.45
14	2.75	2.50	2.61	3.71	3.77	3.40	2.76	3.08	3.91	2.99	2.78	2.30
15	2.67	2.54	2.62	3.78	3.64	3.32	2.74	3.09	3.87	2.84	2.58	2.43
16	2.72	2.54	2.63	3.78	3.52	3.34	2.71	3.19	3.74	2.76	2.76	2.54
17	2.68	2.52	2.63	3.79	3.47	3.36	2.70	3.66	3.70	2.80	2.56	2.30
18	2.66	2.58	2.68	3.81	3.47	3.32	2.69	3.91	3.67	2.95	2.76	2.59
19	2.64	2.68	2.69	3.83	3.48	3.32	2.59	3.92	3.64	2.94	2.79	2.38
20	2.70	2.61	2.69	3.79	3.47	3.21	2.50	3.93	3.64	2.99	2.72	2.46
21	2.71	2.59	2.71	3.86	3.45	3.11	2.48	3.91	3.62	2.93	2.57	2.46
22	2.71	2.61	2.71	3.90	3.36	3.10	2.50	3.91	3.58	2.82	2.63	2.56
23	2.62	2.56	2.63	3.93	3.31	3.03	2.50	3.94	3.60	2.88	2.58	2.47
24	2.59	2.57	2.62	3.91	3.24	3.06	2.50	3.94	3.70	2.66	2.64	2.55
25	2.62	2.59	2.76	3.88	3.18	3.14	2.55	3.98	3.62	2.87	2.70	2.55
26	2.70	2.68	2.85	3.87	3.19	3.04	2.47	3.89	3.55	2.97	2.79	2.59
27	2.69	2.67	2.88	3.84	3.24	3.10	2.56	3.93	3.37	2.64	2.75	2.64
28	2.58	2.55	2.96	3.85	3.22	3.12	2.53	3.99	3.34	2.96	2.59	2.69
29	2.54	-	2.99	3.85	3.10	3.20	2.49	4.04	3.36	2.74	2.60	2.67
30	2.56	-	3.01	3.79	3.14	3.38	2.49	4.02	3.31	2.65	2.56	2.51
31	2.55	-	3.04	-	3.00	-	2.48	3.93	-	2.87	-	2.50

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-21c: 2020 Mean Daily Discharge for CR-WC-MS-05												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	2.64	2.50	2.34	3.62	8.42	8.67	6.64	6.04	6.78	ND	ND	ND
2	2.69	2.80	2.48	3.65	8.81	8.77	6.97	5.92	6.92	ND	ND	ND
3	2.68	2.67	2.48	3.76	8.96	8.60	7.32	5.84	6.77	ND	ND	ND
4	2.51	2.52	2.63	3.82	9.29	8.52	7.39	5.94	6.57	ND	ND	ND
5	2.64	2.62	2.56	3.90	9.35	8.29	7.37	5.82	6.52	ND	ND	ND
6	2.70	2.59	2.60	3.87	9.08	7.97	7.25	5.61	6.64	ND	ND	ND
7	2.60	2.64	2.61	4.13	9.19	7.81	7.00	5.39	6.43	ND	ND	ND
8	2.50	2.63	2.52	4.39	9.27	8.07	6.68	5.80	6.36	ND	ND	ND
9	2.59	2.55	2.56	4.11	9.28	8.72	6.44	6.83	6.53	ND	ND	ND
10	2.45	2.58	2.49	4.50	9.14	8.85	6.44	6.69	6.38	ND	ND	ND
11	2.46	2.74	2.74	4.51	9.07	8.65	6.52	6.14	6.66	ND	ND	ND
12	2.45	2.57	2.77	4.60	9.06	8.41	6.33	5.81	7.24	ND	ND	ND
13	2.50	2.34	2.76	4.52	9.02	8.46	6.67	6.25	6.87	ND	ND	ND
14	2.47	2.63	2.63	4.73	9.39	8.20	6.75	6.61	6.68	ND	ND	ND
15	2.50	2.40	2.50	4.86	9.13	8.47	6.82	6.51	6.89	ND	ND	ND
16	2.40	2.26	2.66	4.60	8.97	9.01	6.43	5.97	6.59	ND	ND	ND
17	2.41	2.33	2.79	4.95	8.82	8.70	6.08	5.81	6.55	ND	ND	ND
18	2.49	2.27	2.78	5.12	8.47	8.54	6.19	5.75	6.46	ND	ND	ND
19	2.32	2.14	2.87	5.46	8.82	8.45	6.46	5.84	6.55	ND	ND	ND
20	2.30	2.17	2.74	5.80	8.62	8.22	6.60	5.83	6.60	ND	ND	ND
21	2.42	2.22	2.79	6.05	8.12	8.11	6.59	5.55	6.68	ND	ND	ND
22	2.49	2.31	2.96	6.41	8.16	8.07	6.85	5.33	6.72	ND	ND	ND
23	2.43	2.38	3.04	6.93	8.78	8.00	6.83	5.93	6.48	ND	ND	ND
24	2.44	2.48	3.08	7.11	8.48	7.89	6.86	6.08	6.49	ND	ND	ND
25	2.52	2.31	3.01	7.06	8.63	7.69	6.74	6.19	7.20	ND	ND	ND
26	2.52	2.29	3.07	7.39	8.74	7.48	6.68	6.46	ND	ND	ND	ND
27	2.50	2.36	3.38	7.24	8.80	7.25	6.54	6.60	ND	ND	ND	ND
28	2.56	2.39	3.49	7.43	8.56	7.27	6.46	6.58	ND	ND	ND	ND
29	2.47	2.49	3.38	7.70	8.49	7.26	6.42	6.51	ND	ND	ND	ND
30	2.58	-	3.52	7.94	8.32	7.06	6.32	6.88	ND	ND	ND	ND
31	2.57	-	3.55	-	8.01	-	6.20	6.93	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-22a: 2018 Daily Water Surface Elevation for CR-WC

DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	97.178	97.2088	ND	ND
2	ND	97.183	97.203	ND	ND
3	97.1884	97.191	ND	ND	ND
4	97.1802	97.195	ND	ND	ND
5	97.185	97.189	ND	ND	ND
6	97.1889	97.189	ND	ND	ND
7	97.199	97.196	ND	ND	ND
8	97.206	97.194	ND	ND	ND
9	97.205	97.204	ND	ND	ND
10	97.199	97.224	ND	ND	ND
11	97.180	97.228	ND	ND	ND
12	97.184	97.222	ND	ND	ND
13	97.180	97.224	ND	ND	ND
14	97.182	97.215	ND	ND	ND
15	97.170	97.223	ND	ND	ND
16	97.164	97.222	ND	ND	ND
17	97.170	97.222	ND	ND	ND
18	97.154	97.222	ND	ND	ND
19	97.153	97.217	ND	ND	ND
20	97.162	97.207	ND	ND	ND
21	97.167	97.198	ND	ND	ND
22	97.161	97.205	ND	ND	ND
23	97.139	97.212	ND	ND	ND
24	97.135	97.209	ND	ND	ND
25	97.142	97.203	ND	ND	ND
26	97.139	97.207	ND	ND	ND
27	97.143	97.198	ND	ND	ND
28	97.147	97.199	ND	ND	ND
29	97.150	97.200	ND	ND	ND
30	97.159	97.2063	ND	ND	ND
31	97.174	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-22b: 2019 Daily Water Surface Elevation for CR-WC-MS-06												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	97.093	97.143	97.121	97.548	97.5788	ND	ND
2	ND	ND	ND	ND	ND	97.088	97.157	97.128	97.547	97.5759	ND	ND
3	ND	ND	ND	ND	ND	97.090	97.172	97.147	97.547	97.572	ND	ND
4	ND	ND	ND	ND	ND	97.113	97.173	97.169	97.552	97.5709	ND	ND
5	ND	ND	ND	ND	ND	97.135	97.163	97.188	97.566	ND	ND	ND
6	ND	ND	ND	ND	ND	97.146	97.153	97.202	97.576	ND	ND	ND
7	ND	ND	ND	ND	ND	97.143	97.144	97.203	97.584	ND	ND	ND
8	ND	ND	ND	ND	ND	97.131	97.137	97.202	97.593	ND	ND	ND
9	ND	ND	ND	ND	ND	97.126	97.133	97.218	97.592	ND	ND	ND
10	ND	ND	ND	ND	ND	97.120	97.129	97.227	97.588	ND	ND	ND
11	ND	ND	ND	ND	ND	97.112	97.126	97.232	97.584	ND	ND	ND
12	ND	ND	ND	ND	ND	97.106	97.124	97.230	97.582	ND	ND	ND
13	ND	ND	ND	ND	ND	97.110	97.124	97.225	97.580	ND	ND	ND
14	ND	ND	ND	ND	ND	97.139	97.122	97.220	97.582	ND	ND	ND
15	ND	ND	ND	ND	ND	97.151	97.124	97.220	97.581	ND	ND	ND
16	ND	ND	ND	ND	ND	97.152	97.120	97.247	97.578	ND	ND	ND
17	ND	ND	ND	ND	97.214	97.146	97.118	97.336	97.574	ND	ND	ND
18	ND	ND	ND	ND	97.204	97.139	97.116	97.406	97.568	ND	ND	ND
19	ND	ND	ND	ND	97.191	97.133	97.115	97.444	97.565	ND	ND	ND
20	ND	ND	ND	ND	97.183	97.128	97.109	97.457	97.562	ND	ND	ND
21	ND	ND	ND	ND	97.179	97.123	97.105	97.462	97.559	ND	ND	ND
22	ND	ND	ND	ND	97.176	97.125	97.104	97.465	97.557	ND	ND	ND
23	ND	ND	ND	ND	97.166	97.131	97.103	97.467	97.561	ND	ND	ND
24	ND	ND	ND	ND	97.157	97.131	97.103	97.476	97.577	ND	ND	ND
25	ND	ND	ND	ND	97.148	97.133	97.113	97.496	97.585	ND	ND	ND
26	ND	ND	ND	ND	97.135	97.132	97.111	97.506	97.592	ND	ND	ND
27	ND	ND	ND	ND	97.131	97.130	97.115	97.516	97.592	ND	ND	ND
28	ND	ND	ND	ND	97.125	97.128	97.121	97.527	97.587	ND	ND	ND
29	ND	-	ND	ND	97.118	97.126	97.118	97.535	97.5861	ND	ND	ND
30	ND	-	ND	ND	97.108	97.1344	97.119	97.541	97.5833	ND	ND	ND
31	ND	-	ND	-	97.099	-	97.116	97.545	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-22c: 2020 Daily Water Surface Elevation for CR-WC-MS-06												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	97.947	97.873	97.818	97.970	ND	ND	ND
2	ND	ND	ND	ND	ND	97.946	ND	97.811	97.973	ND	ND	ND
3	ND	ND	ND	ND	ND	97.942	ND	97.800	97.972	ND	ND	ND
4	ND	ND	ND	ND	97.977	97.948	ND	97.785	97.972	ND	ND	ND
5	ND	ND	ND	ND	97.967	97.945	ND	97.774	97.969	ND	ND	ND
6	ND	ND	ND	ND	97.959	97.942	ND	97.762	97.975	ND	ND	ND
7	ND	ND	ND	ND	97.949	97.940	ND	97.750	97.971	ND	ND	ND
8	ND	ND	ND	ND	97.941	97.944	ND	97.741	97.966	ND	ND	ND
9	ND	ND	ND	ND	97.940	97.951	ND	97.745	97.968	ND	ND	ND
10	ND	ND	ND	ND	97.944	97.964	ND	97.775	97.968	ND	ND	ND
11	ND	ND	ND	ND	97.948	97.970	97.799	97.794	97.975	ND	ND	ND
12	ND	ND	ND	ND	97.945	97.970	97.797	97.795	97.987	ND	ND	ND
13	ND	ND	ND	ND	97.949	97.984	97.791	97.807	97.994	ND	ND	ND
14	ND	ND	ND	ND	97.948	98.000	97.785	97.811	97.992	ND	ND	ND
15	ND	ND	ND	ND	97.950	97.990	97.777	97.821	97.991	ND	ND	ND
16	ND	ND	ND	ND	97.951	97.986	97.785	97.832	97.987	ND	ND	ND
17	ND	ND	ND	ND	97.949	98.003	97.778	97.838	97.984	ND	ND	ND
18	ND	ND	ND	ND	97.947	97.991	97.788	97.844	97.975	ND	ND	ND
19	ND	ND	ND	ND	97.945	97.989	97.806	97.847	97.972	ND	ND	ND
20	ND	ND	ND	ND	97.938	97.975	97.816	97.843	97.968	ND	ND	ND
21	ND	ND	ND	ND	97.936	97.959	97.832	97.845	97.965	ND	ND	ND
22	ND	ND	ND	ND	97.953	97.946	97.845	97.849	97.965	ND	ND	ND
23	ND	ND	ND	ND	97.950	97.932	97.851	97.877	97.958	ND	ND	ND
24	ND	ND	ND	ND	97.961	97.931	97.864	97.890	97.953	ND	ND	ND
25	ND	ND	ND	ND	97.969	97.928	97.855	97.904	ND	ND	ND	ND
26	ND	ND	ND	ND	97.967	97.915	97.858	97.914	ND	ND	ND	ND
27	ND	ND	ND	ND	97.962	97.915	97.857	97.923	ND	ND	ND	ND
28	ND	ND	ND	ND	97.962	97.902	97.856	97.929	ND	ND	ND	ND
29	ND	ND	ND	ND	97.957	97.892	97.847	97.937	ND	ND	ND	ND
30	ND	-	ND	ND	97.952	97.890	97.838	97.953	ND	ND	ND	ND
31	ND	-	ND	-	97.955	-	97.830	97.955	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-23a: 2018 Mean Daily Discharge for CR-WC-MS-06					
DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	4.19	4.81	ND	ND
2	ND	4.24	4.78	ND	ND
3	3.85	4.30	ND	ND	ND
4	3.81	4.34	ND	ND	ND
5	3.85	4.32	ND	ND	ND
6	3.89	4.33	ND	ND	ND
7	3.96	4.39	ND	ND	ND
8	4.02	4.39	ND	ND	ND
9	4.03	4.47	ND	ND	ND
10	4.01	4.61	ND	ND	ND
11	3.90	4.65	ND	ND	ND
12	3.94	4.63	ND	ND	ND
13	3.93	4.66	ND	ND	ND
14	3.96	4.61	ND	ND	ND
15	3.90	4.68	ND	ND	ND
16	3.88	4.69	ND	ND	ND
17	3.93	4.71	ND	ND	ND
18	3.84	4.72	ND	ND	ND
19	3.85	4.70	ND	ND	ND
20	3.92	4.65	ND	ND	ND
21	3.96	4.61	ND	ND	ND
22	3.94	4.67	ND	ND	ND
23	3.82	4.73	ND	ND	ND
24	3.82	4.72	ND	ND	ND
25	3.87	4.70	ND	ND	ND
26	3.87	4.74	ND	ND	ND
27	3.90	4.70	ND	ND	ND
28	3.94	4.72	ND	ND	ND
29	3.97	4.74	ND	ND	ND
30	4.05	4.79	ND	ND	ND
31	4.15	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-23b: 2019 Mean Daily Discharge for CR-WC-MS-06												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	5.74	6.10	5.43	6.37	5.84	ND	ND
2	ND	ND	ND	ND	ND	5.71	6.19	5.46	6.33	5.84	ND	ND
3	ND	ND	ND	ND	ND	5.72	6.30	5.55	6.30	5.82	ND	ND
4	ND	ND	ND	ND	ND	5.89	6.31	5.67	6.31	5.82	ND	ND
5	ND	ND	ND	ND	ND	6.04	6.24	5.78	6.39	ND	ND	ND
6	ND	ND	ND	ND	ND	6.11	6.16	5.84	6.43	ND	ND	ND
7	ND	ND	ND	ND	ND	6.10	6.11	5.82	6.47	ND	ND	ND
8	ND	ND	ND	ND	ND	6.01	6.05	5.78	6.50	ND	ND	ND
9	ND	ND	ND	ND	ND	5.97	6.02	5.86	6.47	ND	ND	ND
10	ND	ND	ND	ND	ND	5.93	5.99	5.89	6.41	ND	ND	ND
11	ND	ND	ND	ND	ND	5.87	5.98	5.89	6.35	ND	ND	ND
12	ND	ND	ND	ND	ND	5.84	5.96	5.85	6.31	ND	ND	ND
13	ND	ND	ND	ND	ND	5.86	5.96	5.78	6.27	ND	ND	ND
14	ND	ND	ND	ND	ND	6.06	5.95	5.71	6.25	ND	ND	ND
15	ND	ND	ND	ND	ND	6.15	5.96	5.68	6.22	ND	ND	ND
16	ND	ND	ND	ND	ND	6.16	5.93	5.84	6.17	ND	ND	ND
17	ND	ND	ND	ND	6.61	6.12	5.89	6.44	6.11	ND	ND	ND
18	ND	ND	ND	ND	6.53	6.06	5.84	6.92	6.05	ND	ND	ND
19	ND	ND	ND	ND	6.44	6.03	5.80	7.09	5.99	ND	ND	ND
20	ND	ND	ND	ND	6.38	5.99	5.73	7.06	5.94	ND	ND	ND
21	ND	ND	ND	ND	6.35	5.95	5.67	6.96	5.90	ND	ND	ND
22	ND	ND	ND	ND	6.33	5.97	5.63	6.85	5.86	ND	ND	ND
23	ND	ND	ND	ND	6.26	6.01	5.60	6.74	5.86	ND	ND	ND
24	ND	ND	ND	ND	6.19	6.01	5.57	6.68	5.94	ND	ND	ND
25	ND	ND	ND	ND	6.13	6.02	5.60	6.70	5.97	ND	ND	ND
26	ND	ND	ND	ND	6.04	6.02	5.56	6.64	6.00	ND	ND	ND
27	ND	ND	ND	ND	6.01	6.01	5.55	6.58	5.97	ND	ND	ND
28	ND	ND	ND	ND	5.97	5.99	5.56	6.53	5.90	ND	ND	ND
29	ND	-	ND	ND	5.92	5.97	5.51	6.47	5.88	ND	ND	ND
30	ND	-	ND	ND	5.85	6.03	5.48	6.39	5.86	ND	ND	ND
31	ND	-	ND	-	5.79	-	5.43	6.37	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-23c: 2020 Mean Daily Discharge for CR-WC-MS-06												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	12.6	11.4	9.80	10.0	ND	ND	ND
2	ND	ND	ND	ND	ND	12.6	ND	9.70	10.0	ND	ND	ND
3	ND	ND	ND	ND	ND	12.6	ND	9.57	9.97	ND	ND	ND
4	ND	ND	ND	ND	12.4	12.7	ND	9.41	9.95	ND	ND	ND
5	ND	ND	ND	ND	12.3	12.7	ND	9.28	9.89	ND	ND	ND
6	ND	ND	ND	ND	12.3	12.7	ND	9.14	9.91	ND	ND	ND
7	ND	ND	ND	ND	12.2	12.7	ND	9.01	9.84	ND	ND	ND
8	ND	ND	ND	ND	12.1	12.7	ND	8.90	9.77	ND	ND	ND
9	ND	ND	ND	ND	12.2	12.7	ND	8.90	9.76	ND	ND	ND
10	ND	ND	ND	ND	12.2	12.8	ND	9.11	9.73	ND	ND	ND
11	ND	ND	ND	ND	12.3	12.8	10.4	9.22	9.77	ND	ND	ND
12	ND	ND	ND	ND	12.3	12.8	10.4	9.20	9.84	ND	ND	ND
13	ND	ND	ND	ND	12.3	12.9	10.3	9.26	9.87	ND	ND	ND
14	ND	ND	ND	ND	12.3	13.0	10.2	9.26	9.82	ND	ND	ND
15	ND	ND	ND	ND	12.4	12.9	10.1	9.30	9.79	ND	ND	ND
16	ND	ND	ND	ND	12.4	12.8	10.1	9.35	9.73	ND	ND	ND
17	ND	ND	ND	ND	12.4	13.0	10.0	9.37	9.67	ND	ND	ND
18	ND	ND	ND	ND	12.4	12.8	10.1	9.38	9.57	ND	ND	ND
19	ND	ND	ND	ND	12.4	12.8	10.2	9.37	9.51	ND	ND	ND
20	ND	ND	ND	ND	12.3	12.6	10.2	9.30	9.45	ND	ND	ND
21	ND	ND	ND	ND	12.3	12.4	10.3	9.29	9.40	ND	ND	ND
22	ND	ND	ND	ND	12.5	12.3	10.4	9.29	9.36	ND	ND	ND
23	ND	ND	ND	ND	12.5	12.1	10.4	9.49	9.31	ND	ND	ND
24	ND	ND	ND	ND	12.6	12.1	10.5	9.57	9.26	ND	ND	ND
25	ND	ND	ND	ND	12.7	12.0	10.4	9.66	ND	ND	ND	ND
26	ND	ND	ND	ND	12.7	11.9	10.4	9.72	ND	ND	ND	ND
27	ND	ND	ND	ND	12.7	11.8	10.3	9.76	ND	ND	ND	ND
28	ND	ND	ND	ND	12.7	11.7	10.3	9.79	ND	ND	ND	ND
29	ND	ND	ND	ND	12.7	11.6	10.2	9.82	ND	ND	ND	ND
30	ND	-	ND	ND	12.6	11.5	10.0	9.93	ND	ND	ND	ND
31	ND	-	ND	-	12.7	-	9.93	9.92	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-24a: 2018 Daily Water Surface Elevation for CR-WC					
DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	97.951	97.965	97.948	97.918
2	ND	97.953	97.981	97.954	97.916
3	ND	97.938	97.957	97.960	97.902
4	97.994	97.950	97.943	97.942	97.909
5	97.996	97.947	97.941	97.939	97.904
6	97.993	97.933	97.942	97.930	97.913
7	97.993	97.933	97.940	97.921	97.901
8	97.988	97.933	97.942	97.918	97.910
9	97.980	97.948	97.947	97.918	97.913
10	97.980	97.958	97.950	97.908	97.917
11	97.984	97.955	97.960	97.899	97.913
12	97.957	97.949	97.950	97.904	97.925
13	97.963	97.955	97.947	97.907	97.921
14	97.959	97.963	97.956	97.901	97.915
15	97.959	97.953	97.962	97.878	97.905
16	97.944	97.947	97.954	97.881	97.894
17	97.943	97.957	97.960	97.883	97.913
18	97.956	97.968	97.964	97.884	97.904
19	97.939	97.961	97.959	97.893	97.907
20	97.940	97.964	97.961	97.895	97.912
21	97.937	97.956	97.974	97.905	97.906
22	97.922	97.954	97.951	97.908	97.908
23	97.901	97.956	97.957	97.896	97.901
24	97.907	97.969	97.951	97.897	97.890
25	97.918	97.970	97.948	97.906	97.896
26	97.912	97.977	97.956	97.915	97.884
27	97.917	97.977	97.957	97.913	97.889
28	97.914	97.983	97.954	97.910	97.871
29	97.913	97.975	97.951	97.913	97.870
30	97.912	97.973	97.953	97.911	97.856
31	97.937	-	97.953	-	97.863

Note: elevations in table are in metres (arbitrary datum).
- = day not present in month; ND = no data.

Table D-24b: 2019 Daily Water Surface Elevation for CR-WC-MS-08 at Golder Hydrometric Station												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	97.909	97.849	97.826	97.881	98.010	97.974	97.907	97.937	98.095	98.134	98.085	98.019
2	97.916	97.850	97.830	97.869	98.016	97.926	97.893	97.918	98.058	98.127	98.067	97.984
3	97.914	97.853	97.847	97.868	98.018	97.929	97.907	97.920	98.060	98.123	98.077	97.971
4	97.896	97.851	97.852	97.870	98.016	97.944	97.928	97.932	98.058	98.112	98.092	98.026
5	97.883	97.848	97.844	97.883	98.021	97.953	97.969	97.938	98.082	98.105	98.105	98.048
6	97.899	97.846	97.854	97.898	98.023	97.960	97.946	97.967	98.132	98.109	98.114	98.030
7	97.878	97.840	97.855	97.899	98.021	97.949	97.905	97.962	98.114	98.090	98.081	98.038
8	97.865	97.827	97.845	97.902	98.028	97.963	97.913	97.955	98.123	98.126	98.048	98.044
9	97.865	97.847	97.851	97.913	98.034	97.979	97.936	97.953	98.136	98.144	98.096	98.067
10	97.887	97.851	97.867	97.914	98.036	97.970	97.924	97.982	98.145	98.142	98.128	98.075
11	97.900	97.849	97.877	97.922	98.032	97.978	97.895	97.982	98.146	98.142	98.075	98.077
12	97.897	97.858	97.863	97.927	98.037	97.944	97.879	97.980	98.113	98.105	98.028	98.051
13	97.880	97.824	97.857	97.929	98.037	97.900	97.898	97.979	98.069	98.093	98.046	98.069
14	97.885	97.842	97.856	97.929	98.033	97.919	97.884	97.953	98.047	98.114	98.072	98.015
15	97.858	97.845	97.862	97.932	98.022	97.951	97.888	97.941	98.062	98.128	98.028	98.009
16	97.867	97.840	97.862	97.953	98.035	97.965	97.886	97.907	98.054	98.065	98.034	98.031
17	97.863	97.836	97.866	97.972	98.034	97.962	97.871	97.961	98.075	98.026	97.985	98.014
18	97.856	97.857	97.874	97.987	98.048	97.932	97.859	97.969	98.092	98.019	98.000	98.005
19	97.858	97.864	97.871	97.994	98.046	97.922	97.876	98.008	98.087	98.039	98.050	98.023
20	97.879	97.847	97.867	97.989	98.025	97.933	97.903	98.056	98.068	98.077	98.072	98.000
21	97.878	97.852	97.873	98.001	98.018	97.951	97.911	98.032	98.070	98.100	98.016	98.007
22	97.877	97.850	97.873	98.017	98.023	97.941	97.912	97.992	98.042	98.094	97.983	98.007
23	97.855	97.837	97.857	98.020	98.003	97.906	97.902	98.028	98.037	98.123	97.962	98.008
24	97.843	97.833	97.866	98.014	97.992	97.901	97.881	97.991	98.068	98.081	97.972	97.997
25	97.863	97.838	97.880	98.012	98.003	97.916	97.874	98.004	98.085	98.056	98.014	97.994
26	97.884	97.860	97.874	98.012	98.014	97.939	97.888	98.038	98.082	98.136	98.059	97.986
27	97.870	97.860	97.866	98.010	97.979	97.972	97.889	98.057	98.139	98.123	98.105	97.971
28	97.854	97.821	97.875	98.014	97.955	97.968	97.913	98.031	98.185	98.132	98.104	98.019
29	97.855	-	97.871	98.017	97.933	97.922	97.907	98.078	98.201	98.134	98.081	98.015
30	97.867	-	97.874	98.007	97.983	97.918	97.904	98.080	98.166	98.074	98.069	98.015
31	97.866	-	97.882	-	98.003	-	97.922	98.083	-	98.063	-	97.937

Note: elevations in table are in metres (arbitrary datum).
- = day not present in month; ND = no data.

Table D-24c: 2020 Daily Water Surface Elevation for CR-WC-MS-08 at Golder Hydrometric Station												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	97.921	97.911	97.952	98.008	97.954	98.522	ND	ND	ND	ND	ND	ND
2	97.948	97.958	97.879	98.003	97.995	98.522	ND	ND	ND	ND	ND	ND
3	97.998	98.010	97.900	97.995	98.011	98.501	ND	ND	ND	ND	ND	ND
4	97.959	97.964	97.919	97.981	98.056	98.501	ND	ND	ND	ND	ND	ND
5	97.987	97.960	97.980	97.969	98.162	98.493	ND	ND	ND	ND	ND	ND
6	97.992	97.951	97.961	97.937	98.188	98.473	ND	ND	ND	ND	ND	ND
7	98.038	97.964	98.008	97.911	98.218	ND	ND	ND	ND	ND	ND	ND
8	98.010	97.975	97.989	97.963	98.243	ND	ND	ND	ND	ND	ND	ND
9	98.026	97.958	97.964	97.959	98.269	ND	ND	ND	ND	ND	ND	ND
10	98.030	97.971	97.925	97.954	98.286	ND	ND	ND	ND	ND	ND	ND
11	98.014	97.981	97.915	97.980	98.305	ND	ND	ND	ND	ND	ND	ND
12	98.006	98.041	97.992	97.994	98.326	ND	ND	ND	ND	ND	ND	ND
13	98.026	97.956	98.049	97.988	98.338	ND	ND	ND	ND	ND	ND	ND
14	98.037	97.928	98.074	97.963	98.372	ND	ND	ND	ND	ND	ND	ND
15	98.063	97.973	98.014	97.996	98.370	ND	ND	ND	ND	ND	ND	ND
16	98.071	97.972	97.974	97.958	98.376	ND	ND	ND	ND	ND	ND	ND
17	98.040	98.014	97.993	97.901	98.380	ND	ND	ND	ND	ND	ND	ND
18	98.079	98.039	97.999	97.934	98.379	ND	ND	ND	ND	ND	ND	ND
19	98.059	97.999	98.033	97.903	98.418	ND	ND	ND	ND	ND	ND	ND
20	97.985	97.943	98.005	97.934	98.413	ND	ND	ND	ND	ND	ND	ND
21	97.935	97.917	97.961	97.910	98.386	ND	ND	ND	ND	ND	ND	ND
22	97.976	97.914	97.944	97.909	98.424	ND	ND	ND	ND	ND	ND	ND
23	97.984	97.949	97.959	97.923	98.484	ND	ND	ND	ND	ND	ND	ND
24	97.961	98.010	97.972	97.949	98.486	ND	ND	ND	ND	ND	ND	ND
25	97.980	98.039	97.936	97.930	98.484	ND	ND	ND	ND	ND	ND	ND
26	97.996	97.982	97.878	97.901	98.489	ND	ND	ND	ND	ND	ND	ND
27	97.987	97.959	97.918	97.930	98.509	ND	ND	ND	ND	ND	ND	ND
28	97.986	97.931	97.951	97.934	98.508	ND	ND	ND	ND	ND	ND	ND
29	97.977	97.948	97.976	97.936	98.499	ND	ND	ND	ND	ND	ND	ND
30	97.947	ND	97.987	97.935	98.492	ND	ND	ND	ND	ND	ND	ND
31	97.920	ND	98.000	ND	98.471	ND	ND	ND	ND	ND	ND	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-24d: 2020 Daily Water Surface Elevation for CR-WC-MS-08 at Historical WSC Station												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	ND	96.763	96.668	96.686	ND	ND	ND
2	ND	ND	ND	ND	ND	ND	96.777	96.656	96.707	ND	ND	ND
3	ND	ND	ND	ND	ND	ND	96.790	96.646	96.687	ND	ND	ND
4	ND	ND	ND	ND	ND	ND	96.785	96.664	96.678	ND	ND	ND
5	ND	ND	ND	ND	ND	ND	96.785	96.654	96.681	ND	ND	ND
6	ND	ND	ND	ND	ND	ND	96.773	96.633	96.692	ND	ND	ND
7	ND	ND	ND	ND	ND	96.769	96.759	96.628	96.696	ND	ND	ND
8	ND	ND	ND	ND	ND	96.814	96.752	96.661	96.686	ND	ND	ND
9	ND	ND	ND	ND	ND	96.804	96.733	96.723	96.698	ND	ND	ND
10	ND	ND	ND	ND	ND	96.805	96.717	96.661	96.685	ND	ND	ND
11	ND	ND	ND	ND	ND	96.796	96.713	96.634	96.716	ND	ND	ND
12	ND	ND	ND	ND	ND	96.784	96.697	96.609	96.747	ND	ND	ND
13	ND	ND	ND	ND	ND	96.807	96.714	96.640	96.719	ND	ND	ND
14	ND	ND	ND	ND	ND	96.802	96.718	96.647	96.710	ND	ND	ND
15	ND	ND	ND	ND	ND	96.809	96.723	96.652	96.734	ND	ND	ND
16	ND	ND	ND	ND	ND	96.832	96.685	96.618	96.707	ND	ND	ND
17	ND	ND	ND	ND	ND	96.823	96.664	96.615	96.700	ND	ND	ND
18	ND	ND	ND	ND	ND	96.816	96.687	96.618	96.696	ND	ND	ND
19	ND	ND	ND	ND	ND	96.812	96.715	96.633	96.701	ND	ND	ND
20	ND	ND	ND	ND	ND	96.804	96.714	96.636	96.709	ND	ND	ND
21	ND	ND	ND	ND	ND	96.803	96.710	96.615	96.715	ND	ND	ND
22	ND	ND	ND	ND	ND	96.801	96.717	96.598	96.709	ND	ND	ND
23	ND	ND	ND	ND	ND	96.799	96.716	96.649	96.689	ND	ND	ND
24	ND	ND	ND	ND	ND	96.803	96.723	96.645	96.676	ND	ND	ND
25	ND	ND	ND	ND	ND	96.808	96.714	96.646	ND	ND	ND	ND
26	ND	ND	ND	ND	ND	96.801	96.717	96.674	ND	ND	ND	ND
27	ND	ND	ND	ND	ND	96.796	96.700	96.678	ND	ND	ND	ND
28	ND	ND	ND	ND	ND	96.801	96.690	96.676	ND	ND	ND	ND
29	ND	ND	ND	ND	ND	96.784	96.695	96.668	ND	ND	ND	ND
30	ND	-	ND	ND	ND	96.770	96.693	96.692	ND	ND	ND	ND
31	ND	-	ND	-	ND	-	96.681	96.694	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-25a: 2018 Mean Daily Discharge for CR-WC-MS-08					
DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	22.7	23.2	22.6	20.2
2	ND	22.8	23.9	22.8	20.1
3	ND	22.2	23.0	23.1	19.6
4	24.4	22.7	22.4	22.3	19.7
5	24.5	22.6	22.3	22.2	19.6
6	24.4	22.0	22.4	22.0	19.8
7	24.4	22.0	22.3	21.7	19.5
8	24.2	22.0	22.4	21.6	19.7
9	23.8	22.6	22.5	21.6	19.8
10	23.8	23.0	22.7	21.4	19.9
11	24.0	22.9	23.1	21.1	19.8
12	22.9	22.6	22.7	21.2	20.1
13	23.2	22.9	22.5	21.3	20.0
14	23.0	23.2	22.9	21.1	19.8
15	23.0	22.8	23.1	20.5	19.6
16	22.4	22.6	22.8	20.5	19.3
17	22.4	22.9	23.1	20.5	19.8
18	22.9	23.4	23.2	20.4	19.6
19	22.2	23.1	23.0	20.6	19.6
20	22.3	23.2	23.1	20.5	19.8
21	22.2	22.9	23.6	20.7	19.6
22	21.6	22.8	22.7	20.7	19.6
23	20.8	22.9	22.9	20.3	19.5
24	21.0	23.4	22.7	20.3	19.2
25	21.4	23.4	22.6	20.4	19.3
26	21.2	23.7	22.9	20.5	19.0
27	21.4	23.7	22.9	20.4	19.1
28	21.3	24.0	22.8	20.3	18.7
29	21.3	23.6	22.7	20.2	18.7
30	21.2	23.6	22.8	20.1	18.3
31	22.2	-	22.8	-	17.8

Note: elevations in table are in metres (arbitrary datum).
- = day not present in month; ND = no data.

Table D-25b: 2019 Mean Daily Discharge for CR-WC-MS-08												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	18.6	17.4	15.9	19.5	25.1	23.6	21.0	22.1	28.7	30.5	27.4	24.8
2	18.8	17.5	15.9	19.2	25.3	21.8	20.5	21.5	27.1	30.2	26.9	23.9
3	18.8	17.6	16.3	19.4	25.4	21.9	21.0	21.5	27.2	30.0	27.2	23.6
4	18.3	17.5	16.3	19.7	25.3	22.5	21.8	22.0	27.1	29.5	27.5	24.9
5	18.0	17.5	16.1	20.2	25.5	22.8	23.4	22.2	28.2	29.2	27.8	25.4
6	18.4	17.4	16.3	20.7	25.6	23.1	22.5	23.3	30.4	29.4	28.1	24.9
7	17.9	17.3	16.3	20.7	25.5	22.6	21.0	23.1	29.6	28.5	27.1	25.1
8	17.6	16.9	16.0	20.9	25.8	23.2	21.3	22.9	30.0	29.3	26.2	25.2
9	17.6	17.3	16.1	21.3	26.1	23.8	22.1	22.8	30.6	29.8	27.5	25.8
10	18.2	17.4	16.4	21.3	26.2	23.4	21.7	23.9	31.1	29.7	28.3	26.0
11	18.5	17.3	16.6	21.6	26.0	23.8	20.6	23.9	31.1	29.7	26.9	26.0
12	18.4	17.5	16.2	21.8	26.2	22.4	20.0	23.9	29.6	28.6	25.6	25.3
13	18.0	16.6	16.0	21.9	26.2	20.8	20.7	23.8	27.6	28.2	26.0	25.7
14	18.1	17.0	16.0	21.9	26.0	21.5	20.2	22.8	26.6	28.8	26.7	24.3
15	17.5	17.0	16.2	22.0	25.6	22.7	20.3	22.3	27.3	29.1	25.5	24.1
16	17.7	16.8	16.3	22.8	26.1	23.3	20.3	21.0	26.9	27.4	25.6	24.6
17	17.6	16.7	16.6	23.5	26.1	23.1	19.7	23.1	27.9	26.4	24.4	24.2
18	17.5	17.2	17.0	24.1	26.7	22.0	19.3	23.4	28.6	26.2	24.7	23.9
19	17.5	17.3	17.1	24.4	26.6	21.6	19.9	25.0	28.4	26.6	26.0	24.3
20	18.1	16.8	17.1	24.2	25.7	22.0	20.9	27.0	27.5	27.6	26.5	23.7
21	18.0	16.9	17.5	24.7	25.4	22.7	21.2	26.0	27.6	28.2	25.0	23.9
22	18.0	16.8	17.6	25.4	25.6	22.3	21.2	24.3	26.4	28.0	24.2	23.8
23	17.5	16.4	17.2	25.5	24.8	21.0	20.9	25.8	26.2	28.7	23.7	23.8
24	17.2	16.3	17.7	25.2	24.3	20.8	20.1	24.3	27.5	27.6	23.9	23.5
25	17.7	16.4	18.3	25.2	24.8	21.4	19.9	24.8	28.3	26.9	24.9	23.4
26	18.3	16.8	18.3	25.1	25.2	22.2	20.3	26.2	28.2	29.0	26.0	23.2
27	17.9	16.8	18.2	25.1	23.8	23.5	20.4	27.1	30.8	28.6	27.2	22.8
28	17.5	15.8	18.6	25.2	22.9	23.4	21.3	25.9	33.0	28.8	27.1	24.0
29	17.5	-	18.6	25.3	22.0	21.6	21.0	28.0	33.8	28.9	26.5	23.8
30	17.9	-	18.9	24.9	24.0	21.5	20.9	28.1	32.0	27.2	26.1	23.8
31	17.9	-	19.4	-	24.8	-	21.6	28.2	-	26.9	-	21.9

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-25c: 2020 Mean Daily Discharge for CR-WC-MS-08												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	21.5	20.4	20.7	21.4	22.8	52.2	47.4	40.6	42.6	ND	ND	ND
2	22.1	21.5	19.0	21.3	24.5	52.2	48.4	39.8	44.2	ND	ND	ND
3	23.2	22.7	19.5	21.2	25.1	50.9	49.3	39.2	42.8	ND	ND	ND
4	22.3	21.6	19.9	21.0	27.0	50.8	49.0	40.3	42.3	ND	ND	ND
5	22.9	21.5	21.3	20.8	31.9	50.4	48.9	39.6	42.6	ND	ND	ND
6	23.0	21.2	20.8	20.1	33.1	49.1	48.0	38.3	43.4	ND	ND	ND
7	24.1	21.5	21.9	19.6	34.6	50.7	47.0	37.9	43.8	ND	ND	ND
8	23.4	21.8	21.4	20.9	35.9	53.4	46.6	40.2	43.2	ND	ND	ND
9	23.8	21.3	20.8	20.9	37.3	53.2	45.2	42.6	44.1	ND	ND	ND
10	23.8	21.6	19.9	20.8	38.2	53.2	44.0	40.1	43.3	ND	ND	ND
11	23.4	21.8	19.6	21.5	39.2	52.3	43.7	38.3	45.7	ND	ND	ND
12	23.2	23.3	21.4	21.9	40.4	51.2	42.6	36.9	48.0	ND	ND	ND
13	23.6	21.2	22.8	21.9	41.0	52.9	43.3	38.7	46.1	ND	ND	ND
14	23.9	20.5	23.5	21.4	43.0	52.4	43.5	39.2	45.5	ND	ND	ND
15	24.5	21.5	21.9	22.2	42.9	52.8	43.8	39.5	47.3	ND	ND	ND
16	24.7	21.5	20.9	21.4	43.2	54.4	42.6	37.3	45.4	ND	ND	ND
17	23.9	22.5	21.3	20.2	43.4	53.6	42.0	37.1	45.0	ND	ND	ND
18	24.9	23.1	21.4	21.0	43.4	52.9	42.9	37.3	44.8	ND	ND	ND
19	24.3	22.1	22.3	20.4	45.7	52.5	43.9	38.3	45.3	ND	ND	ND
20	22.4	20.7	21.5	21.2	45.4	51.8	43.8	38.5	46.0	ND	ND	ND
21	21.2	20.1	20.5	20.7	43.8	51.6	43.5	37.1	46.5	ND	ND	ND
22	22.2	20.0	20.0	20.8	46.1	51.2	44.0	36.0	46.2	ND	ND	ND
23	22.3	20.8	20.4	21.2	49.8	51.0	43.9	39.3	44.8	ND	ND	ND
24	21.8	22.2	20.7	21.8	49.9	51.1	44.4	39.1	43.9	ND	ND	ND
25	22.2	23.0	19.8	21.5	49.8	51.4	43.8	39.3	ND	ND	ND	ND
26	22.5	21.5	18.5	20.9	50.1	50.8	44.0	41.3	ND	ND	ND	ND
27	22.3	20.9	19.3	21.7	51.3	50.3	42.7	41.6	ND	ND	ND	ND
28	22.3	20.3	20.1	21.8	51.3	50.5	42.1	41.6	ND	ND	ND	ND
29	22.0	20.6	20.6	21.9	50.7	49.1	42.5	41.1	ND	ND	ND	ND
30	21.3	-	20.9	22.0	50.2	48.0	42.3	42.9	ND	ND	ND	ND
31	20.7	-	21.2	-	49.0	-	41.4	43.1	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-26a: 2018 Daily Water Surface Elevation for CR-WC

DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	398.655	398.766	ND	ND
2	ND	398.668	398.777	ND	ND
3	ND	398.668	398.770	ND	ND
4	ND	398.694	398.779	ND	ND
5	ND	398.697	ND	ND	ND
6	ND	398.694	ND	ND	ND
7	ND	398.689	ND	ND	ND
8	398.741	398.682	ND	ND	ND
9	398.732	398.710	ND	ND	ND
10	398.724	398.729	ND	ND	ND
11	398.711	398.737	ND	ND	ND
12	398.697	398.748	ND	ND	ND
13	398.698	398.763	ND	ND	ND
14	398.692	398.778	ND	ND	ND
15	398.674	398.772	ND	ND	ND
16	398.670	398.765	ND	ND	ND
17	398.664	398.768	ND	ND	ND
18	398.657	398.768	ND	ND	ND
19	398.649	398.766	ND	ND	ND
20	398.645	398.763	ND	ND	ND
21	398.645	398.760	ND	ND	ND
22	398.631	398.756	ND	ND	ND
23	398.616	398.756	ND	ND	ND
24	398.625	398.749	ND	ND	ND
25	398.634	398.750	ND	ND	ND
26	398.626	398.750	ND	ND	ND
27	398.623	398.756	ND	ND	ND
28	398.621	398.760	ND	ND	ND
29	398.613	398.765	ND	ND	ND
30	398.613	398.772	ND	ND	ND
31	398.649	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-26b: 2019 Daily Water Surface Elevation for CR-WC-MS-09												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	398.706	398.725	398.617	399.265	399.087	ND	ND
2	ND	ND	ND	ND	ND	398.717	398.737	398.618	399.255	399.075	ND	ND
3	ND	ND	ND	ND	ND	398.712	398.744	398.671	399.232	399.064	ND	ND
4	ND	ND	ND	ND	ND	398.741	398.736	398.709	399.213	399.053	ND	ND
5	ND	ND	ND	ND	ND	398.757	398.740	398.735	399.215	ND	ND	ND
6	ND	ND	ND	ND	ND	398.765	398.738	398.758	399.205	ND	ND	ND
7	ND	ND	ND	ND	ND	398.755	398.717	398.775	399.202	ND	ND	ND
8	ND	ND	ND	ND	ND	398.760	398.698	398.780	399.212	ND	ND	ND
9	ND	ND	ND	ND	ND	398.770	398.697	398.798	399.213	ND	ND	ND
10	ND	ND	ND	ND	ND	398.769	398.687	398.819	399.211	ND	ND	ND
11	ND	ND	ND	ND	ND	398.764	398.690	398.814	399.205	ND	ND	ND
12	ND	ND	ND	ND	ND	398.752	398.686	398.820	399.209	ND	ND	ND
13	ND	ND	ND	ND	ND	398.740	398.665	398.826	399.201	ND	ND	ND
14	ND	ND	ND	ND	398.820	398.737	398.665	398.828	399.194	ND	ND	ND
15	ND	ND	ND	ND	398.835	398.744	398.667	398.816	399.174	ND	ND	ND
16	ND	ND	ND	ND	398.828	398.753	398.678	398.847	399.166	ND	ND	ND
17	ND	ND	ND	ND	398.820	398.763	398.675	398.941	399.157	ND	ND	ND
18	ND	ND	ND	ND	398.806	398.771	398.664	399.053	399.142	ND	ND	ND
19	ND	ND	ND	ND	398.800	398.753	398.639	399.136	399.136	ND	ND	ND
20	ND	ND	ND	ND	398.791	398.735	398.632	399.205	399.130	ND	ND	ND
21	ND	ND	ND	ND	398.780	398.724	398.630	399.253	399.126	ND	ND	ND
22	ND	ND	ND	ND	398.779	398.722	398.624	399.292	399.124	ND	ND	ND
23	ND	ND	ND	ND	398.778	398.720	398.623	399.301	399.123	ND	ND	ND
24	ND	ND	ND	ND	398.775	398.712	398.616	399.324	399.109	ND	ND	ND
25	ND	ND	ND	ND	398.758	398.711	398.601	399.332	399.103	ND	ND	ND
26	ND	ND	ND	ND	398.760	398.707	398.604	399.320	399.101	ND	ND	ND
27	ND	ND	ND	ND	398.754	398.710	398.608	399.325	399.105	ND	ND	ND
28	ND	ND	ND	ND	398.744	398.701	398.635	399.320	399.105	ND	ND	ND
29	ND	-	ND	ND	398.746	398.712	398.644	399.312	399.100	ND	ND	ND
30	ND	-	ND	ND	398.728	398.719	398.639	399.292	399.090	ND	ND	ND
31	ND	-	ND	-	398.717	-	398.628	399.271	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-26c: 2020 Daily Water Surface Elevation for CR-WC-MS-09												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	399.545	399.454	399.525	399.529	ND	ND	ND
2	ND	ND	ND	ND	ND	399.542	399.486	399.494	399.528	ND	ND	ND
3	ND	ND	ND	ND	ND	399.522	399.501	399.460	399.520	ND	ND	ND
4	ND	ND	ND	ND	ND	399.520	399.496	399.438	399.511	ND	ND	ND
5	ND	ND	ND	ND	399.629	399.519	399.488	399.412	399.512	ND	ND	ND
6	ND	ND	ND	ND	399.668	399.505	399.473	399.390	399.518	ND	ND	ND
7	ND	ND	ND	ND	399.626	399.502	399.454	399.368	399.509	ND	ND	ND
8	ND	ND	ND	ND	399.569	399.532	399.434	399.371	399.497	ND	ND	ND
9	ND	ND	ND	ND	399.532	399.562	399.406	399.380	399.487	ND	ND	ND
10	ND	ND	ND	ND	399.500	399.590	399.384	399.400	399.478	ND	ND	ND
11	ND	ND	ND	ND	399.478	399.624	399.373	399.414	399.486	ND	ND	ND
12	ND	ND	ND	ND	399.460	399.630	399.357	399.428	399.495	ND	ND	ND
13	ND	ND	ND	ND	399.436	399.624	399.348	399.438	399.503	ND	ND	ND
14	ND	ND	ND	ND	399.434	399.617	399.365	399.432	399.508	ND	ND	ND
15	ND	ND	ND	ND	399.418	399.645	399.365	399.426	399.509	ND	ND	ND
16	ND	ND	ND	ND	399.404	399.648	399.365	399.417	399.505	ND	ND	ND
17	ND	ND	ND	ND	399.378	399.638	399.382	399.417	399.498	ND	ND	ND
18	ND	ND	ND	ND	399.363	399.614	399.459	399.417	399.490	ND	ND	ND
19	ND	ND	ND	ND	399.372	399.597	399.533	399.425	399.482	ND	ND	ND
20	ND	ND	ND	ND	399.366	399.574	399.585	399.422	399.472	ND	ND	ND
21	ND	ND	ND	ND	399.361	399.547	399.620	399.414	399.464	ND	ND	ND
22	ND	ND	ND	ND	399.402	399.522	399.642	399.416	399.456	ND	ND	ND
23	ND	ND	ND	ND	399.441	399.496	399.651	399.471	399.448	ND	ND	ND
24	ND	ND	ND	ND	399.472	399.478	399.653	399.499	399.442	ND	ND	ND
25	ND	ND	ND	ND	399.496	399.470	399.653	399.508	399.447	ND	ND	ND
26	ND	ND	ND	ND	399.516	399.461	399.667	399.508	399.447	ND	ND	ND
27	ND	ND	ND	ND	399.541	399.455	399.656	399.508	399.445	ND	ND	ND
28	ND	ND	ND	ND	399.562	399.450	399.645	399.505	399.444	ND	ND	ND
29	ND	ND	ND	ND	399.558	399.439	399.617	399.506	399.444	ND	ND	ND
30	ND	-	ND	ND	399.547	399.427	399.589	399.524	ND	ND	ND	ND
31	ND	-	ND	-	399.531	-	399.557	399.525	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-27a: 2018 Mean Daily Discharge for CR-WC-MS-09					
DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	41.3	47.9	ND	ND
2	ND	42.1	48.7	ND	ND
3	ND	42.1	48.2	ND	ND
4	ND	43.6	48.8	ND	ND
5	ND	43.7	ND	ND	ND
6	ND	43.5	ND	ND	ND
7	ND	43.3	ND	ND	ND
8	46.4	42.9	ND	ND	ND
9	45.8	44.5	ND	ND	ND
10	45.3	45.7	ND	ND	ND
11	44.6	46.1	ND	ND	ND
12	43.7	46.8	ND	ND	ND
13	43.8	47.8	ND	ND	ND
14	43.5	48.7	ND	ND	ND
15	42.4	48.3	ND	ND	ND
16	42.1	47.9	ND	ND	ND
17	41.8	48.1	ND	ND	ND
18	41.4	48.1	ND	ND	ND
19	41.0	47.9	ND	ND	ND
20	40.7	47.8	ND	ND	ND
21	40.7	47.6	ND	ND	ND
22	40.0	47.3	ND	ND	ND
23	39.1	47.3	ND	ND	ND
24	39.6	46.9	ND	ND	ND
25	40.1	47.0	ND	ND	ND
26	39.7	47.0	ND	ND	ND
27	39.5	47.3	ND	ND	ND
28	39.4	47.6	ND	ND	ND
29	39.0	47.9	ND	ND	ND
30	39.0	48.3	ND	ND	ND
31	41.0	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-27b: 2019 Mean Daily Discharge for CR-WC-MS-09												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	44.3	45.4	39.2	86.8	71.1	ND	ND
2	ND	ND	ND	ND	ND	45.0	46.2	39.2	85.9	70.2	ND	ND
3	ND	ND	ND	ND	ND	44.6	46.6	42.2	83.7	69.3	ND	ND
4	ND	ND	ND	ND	ND	46.4	46.1	44.5	82.0	68.4	ND	ND
5	ND	ND	ND	ND	ND	47.4	46.3	46.0	82.1	ND	ND	ND
6	ND	ND	ND	ND	ND	47.9	46.2	47.5	81.3	ND	ND	ND
7	ND	ND	ND	ND	ND	47.3	44.9	48.5	81.0	ND	ND	ND
8	ND	ND	ND	ND	ND	47.6	43.8	48.8	81.9	ND	ND	ND
9	ND	ND	ND	ND	ND	48.2	43.7	50.0	82.0	ND	ND	ND
10	ND	ND	ND	ND	ND	48.2	43.1	51.4	81.8	ND	ND	ND
11	ND	ND	ND	ND	ND	47.8	43.3	51.1	81.3	ND	ND	ND
12	ND	ND	ND	ND	ND	47.1	43.1	51.4	81.6	ND	ND	ND
13	ND	ND	ND	ND	ND	46.3	41.9	51.9	81.0	ND	ND	ND
14	ND	ND	ND	ND	51.4	46.2	41.9	52.0	80.3	ND	ND	ND
15	ND	ND	ND	ND	52.4	46.6	42.0	51.2	78.5	ND	ND	ND
16	ND	ND	ND	ND	52.0	47.2	42.6	53.3	77.8	ND	ND	ND
17	ND	ND	ND	ND	51.5	47.8	42.5	59.9	77.0	ND	ND	ND
18	ND	ND	ND	ND	50.5	48.3	41.8	68.4	75.8	ND	ND	ND
19	ND	ND	ND	ND	50.2	47.1	40.4	75.3	75.2	ND	ND	ND
20	ND	ND	ND	ND	49.5	46.0	40.0	81.3	74.7	ND	ND	ND
21	ND	ND	ND	ND	48.8	45.4	39.9	85.7	74.4	ND	ND	ND
22	ND	ND	ND	ND	48.8	45.3	39.6	89.4	74.2	ND	ND	ND
23	ND	ND	ND	ND	48.7	45.1	39.5	90.2	74.2	ND	ND	ND
24	ND	ND	ND	ND	48.5	44.7	39.1	92.4	72.9	ND	ND	ND
25	ND	ND	ND	ND	47.4	44.6	38.3	93.2	72.5	ND	ND	ND
26	ND	ND	ND	ND	47.6	44.3	38.5	92.0	72.3	ND	ND	ND
27	ND	ND	ND	ND	47.2	44.5	38.7	92.5	72.6	ND	ND	ND
28	ND	ND	ND	ND	46.6	44.0	40.2	92.0	72.6	ND	ND	ND
29	ND	-	ND	ND	46.7	44.7	40.7	91.2	72.2	ND	ND	ND
30	ND	-	ND	ND	45.6	45.1	40.4	89.4	71.4	ND	ND	ND
31	ND	-	ND	-	45.0	-	39.8	87.3	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-27c: 2020 Mean Daily Discharge for CR-WC-MS-09												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	116	106	113	114	ND	ND	ND
2	ND	ND	ND	ND	ND	115	109	110	114	ND	ND	ND
3	ND	ND	ND	ND	ND	113	111	106	113	ND	ND	ND
4	ND	ND	ND	ND	ND	113	110	104	112	ND	ND	ND
5	ND	ND	ND	ND	126	113	109	101	112	ND	ND	ND
6	ND	ND	ND	ND	130	111	108	99.0	113	ND	ND	ND
7	ND	ND	ND	ND	125	111	106	96.8	112	ND	ND	ND
8	ND	ND	ND	ND	118	114	104	97.1	110	ND	ND	ND
9	ND	ND	ND	ND	114	118	101	98.0	109	ND	ND	ND
10	ND	ND	ND	ND	111	121	98.4	100	108	ND	ND	ND
11	ND	ND	ND	ND	108	125	97.3	101	109	ND	ND	ND
12	ND	ND	ND	ND	106	126	95.7	103	110	ND	ND	ND
13	ND	ND	ND	ND	104	125	94.8	104	111	ND	ND	ND
14	ND	ND	ND	ND	104	124	96.5	103	112	ND	ND	ND
15	ND	ND	ND	ND	102	128	96.5	103	112	ND	ND	ND
16	ND	ND	ND	ND	100	128	96.5	102	111	ND	ND	ND
17	ND	ND	ND	ND	97.8	127	98.2	102	110	ND	ND	ND
18	ND	ND	ND	ND	96.3	124	106	102	110	ND	ND	ND
19	ND	ND	ND	ND	97.2	122	114	103	109	ND	ND	ND
20	ND	ND	ND	ND	96.6	119	120	102	108	ND	ND	ND
21	ND	ND	ND	ND	96.1	116	124	101	107	ND	ND	ND
22	ND	ND	ND	ND	100	113	127	102	106	ND	ND	ND
23	ND	ND	ND	ND	104	110	128	108	105	ND	ND	ND
24	ND	ND	ND	ND	108	108	128	111	104	ND	ND	ND
25	ND	ND	ND	ND	110	107	128	112	105	ND	ND	ND
26	ND	ND	ND	ND	112	106	130	112	105	ND	ND	ND
27	ND	ND	ND	ND	115	106	129	112	105	ND	ND	ND
28	ND	ND	ND	ND	118	105	127	111	105	ND	ND	ND
29	ND	ND	ND	ND	117	104	124	111	105	ND	ND	ND
30	ND	-	ND	ND	116	103	121	113	ND	ND	ND	ND
31	ND	-	ND	-	114	-	117	114	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-28a: 2018 Daily Water Surface Elevation for CR-WC					
DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	499.336	499.274	ND	ND
2	ND	499.332	499.277	ND	ND
3	ND	499.329	ND	ND	ND
4	499.370	499.330	ND	ND	ND
5	499.443	499.328	ND	ND	ND
6	499.383	499.320	ND	ND	ND
7	499.388	499.328	ND	ND	ND
8	499.367	499.341	ND	ND	ND
9	499.369	499.334	ND	ND	ND
10	499.376	499.377	ND	ND	ND
11	499.369	499.342	ND	ND	ND
12	499.391	499.376	ND	ND	ND
13	499.377	499.369	ND	ND	ND
14	499.357	499.338	ND	ND	ND
15	499.351	499.325	ND	ND	ND
16	499.339	499.354	ND	ND	ND
17	499.354	499.349	ND	ND	ND
18	499.346	499.323	ND	ND	ND
19	499.325	499.317	ND	ND	ND
20	499.325	499.316	ND	ND	ND
21	499.338	499.314	ND	ND	ND
22	499.336	499.332	ND	ND	ND
23	499.384	499.311	ND	ND	ND
24	499.348	499.317	ND	ND	ND
25	499.333	499.293	ND	ND	ND
26	499.318	499.315	ND	ND	ND
27	499.376	499.299	ND	ND	ND
28	499.332	499.304	ND	ND	ND
29	499.313	499.296	ND	ND	ND
30	499.321	499.302	ND	ND	ND
31	499.351	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-28b: 2019 Daily Water Surface Elevation for CR-WC-TI-01												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	499.318	ND	ND	ND	ND	ND	ND
2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
16	ND	ND	ND	ND	499.348	ND	ND	ND	ND	ND	ND	ND
17	ND	ND	ND	ND	499.479	ND	ND	ND	ND	ND	ND	ND
18	ND	ND	ND	ND	499.560	ND	ND	ND	ND	ND	ND	ND
19	ND	ND	ND	ND	499.621	ND	ND	ND	ND	ND	ND	ND
20	ND	ND	ND	ND	499.627	ND	ND	ND	ND	ND	ND	ND
21	ND	ND	ND	ND	499.683	ND	ND	ND	ND	ND	ND	ND
22	ND	ND	ND	ND	499.680	ND	ND	ND	ND	ND	ND	ND
23	ND	ND	ND	ND	499.759	ND	ND	ND	ND	ND	ND	ND
24	ND	ND	ND	ND	499.766	ND	ND	ND	ND	ND	ND	ND
25	ND	ND	ND	ND	499.818	ND	ND	ND	ND	ND	ND	ND
26	ND	ND	ND	ND	499.816	ND	ND	ND	ND	ND	ND	ND
27	ND	ND	ND	ND	499.862	ND	ND	ND	ND	ND	ND	ND
28	ND	ND	ND	ND	499.879	ND	ND	ND	ND	ND	ND	ND
29	ND	-	ND	ND	499.879	ND	ND	ND	ND	ND	ND	ND
30	ND	-	ND	ND	499.865	ND	ND	ND	ND	ND	ND	ND
31	ND	-	ND	-	499.858	-	ND	ND	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-29a: 2018 Mean Daily Discharge for CR-WC-TI-01					
DATE	**2018**				
	AUG	**SEP**	**OCT**	**NOV**	**DEC**
1	ND	0.043	0.036	ND	ND
2	ND	0.043	0.037	ND	ND
3	ND	0.043	ND	ND	ND
4	0.029	0.044	ND	ND	ND
5	0.045	0.044	ND	ND	ND
6	0.034	0.043	ND	ND	ND
7	0.036	0.045	ND	ND	ND
8	0.032	0.048	ND	ND	ND
9	0.033	0.048	ND	ND	ND
10	0.035	0.055	ND	ND	ND
11	0.035	0.049	ND	ND	ND
12	0.040	0.055	ND	ND	ND
13	0.038	0.054	ND	ND	ND
14	0.034	0.049	ND	ND	ND
15	0.034	0.047	ND	ND	ND
16	0.032	0.051	ND	ND	ND
17	0.036	0.051	ND	ND	ND
18	0.035	0.046	ND	ND	ND
19	0.031	0.045	ND	ND	ND
20	0.032	0.045	ND	ND	ND
21	0.035	0.044	ND	ND	ND
22	0.036	0.047	ND	ND	ND
23	0.046	0.044	ND	ND	ND
24	0.040	0.045	ND	ND	ND
25	0.037	0.040	ND	ND	ND
26	0.035	0.044	ND	ND	ND
27	0.047	0.041	ND	ND	ND
28	0.039	0.042	ND	ND	ND
29	0.036	0.041	ND	ND	ND
30	0.039	0.042	ND	ND	ND
31	0.045	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-29b: 2019 Mean Daily Discharge for CR-WC-TI-01												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
16	ND	ND	ND	ND	0.039	ND	ND	ND	ND	ND	ND	ND
17	ND	ND	ND	ND	0.039	ND	ND	ND	ND	ND	ND	ND
18	ND	ND	ND	ND	0.043	ND	ND	ND	ND	ND	ND	ND
19	ND	ND	ND	ND	0.045	ND	ND	ND	ND	ND	ND	ND
20	ND	ND	ND	ND	0.045	ND	ND	ND	ND	ND	ND	ND
21	ND	ND	ND	ND	0.048	ND	ND	ND	ND	ND	ND	ND
22	ND	ND	ND	ND	0.047	ND	ND	ND	ND	ND	ND	ND
23	ND	ND	ND	ND	0.049	ND	ND	ND	ND	ND	ND	ND
24	ND	ND	ND	ND	0.048	ND	ND	ND	ND	ND	ND	ND
25	ND	ND	ND	ND	0.050	ND	ND	ND	ND	ND	ND	ND
26	ND	ND	ND	ND	0.048	ND	ND	ND	ND	ND	ND	ND
27	ND	ND	ND	ND	0.050	ND	ND	ND	ND	ND	ND	ND
28	ND	ND	ND	ND	0.049	ND	ND	ND	ND	ND	ND	ND
29	ND	-	ND	ND	0.048	ND	ND	ND	ND	ND	ND	ND
30	ND	-	ND	ND	0.044	ND	ND	ND	ND	ND	ND	ND
31	ND	-	ND	-	0.041	-	ND	ND	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-30a: 2018 Daily Water Surface Elevation for CR-WC

DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	498.237	498.217	498.148	498.158
2	ND	498.253	498.227	498.152	498.151
3	ND	498.243	498.231	498.152	498.119
4	ND	498.240	498.206	498.135	498.130
5	498.259	498.235	498.183	498.130	498.111
6	498.263	498.237	498.185	498.133	498.116
7	498.272	498.236	498.179	498.130	498.098
8	498.284	498.224	498.177	498.132	498.110
9	498.281	498.230	498.185	498.148	498.121
10	498.277	498.247	498.189	498.141	498.122
11	498.264	498.246	498.199	498.135	498.118
12	498.266	498.245	498.182	498.146	498.140
13	498.266	498.243	498.175	498.154	498.139
14	498.262	498.247	498.190	498.159	498.132
15	498.245	498.247	498.182	498.122	498.126
16	498.251	498.245	498.182	498.112	498.100
17	498.241	498.242	498.195	498.125	498.118
18	498.229	498.235	498.186	498.118	498.124
19	498.233	498.235	498.173	498.130	498.131
20	498.234	498.228	498.196	498.126	498.137
21	498.233	498.233	498.177	498.139	498.144
22	498.222	498.233	498.178	498.154	498.139
23	498.199	498.235	498.186	498.126	498.129
24	498.196	498.222	498.178	498.116	498.117
25	498.210	498.219	498.171	498.121	498.122
26	498.209	498.214	498.172	498.128	498.119
27	498.209	498.223	498.166	498.133	498.120
28	498.217	498.226	498.169	498.129	498.111
29	498.213	498.225	498.163	498.141	498.109
30	498.220	498.228	498.156	498.150	498.102
31	498.240	-	498.155	-	498.092

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-30b: 2019 Daily Water Surface Elevation for CR-WC-TI-02												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	498.134	498.118	498.091	498.174	498.174	498.136	498.201	498.184	498.335	498.314	498.280	498.254
2	498.154	498.121	498.094	498.150	498.185	498.152	498.215	498.201	498.337	498.313	498.273	498.258
3	498.160	498.114	498.109	498.145	498.181	498.168	498.215	498.234	498.340	498.310	498.282	498.267
4	498.142	498.109	498.115	498.159	498.187	498.190	498.212	498.256	498.339	498.280	498.275	498.274
5	498.120	498.105	498.104	498.170	498.197	498.197	498.203	498.255	498.357	498.288	498.281	498.260
6	498.135	498.104	498.107	498.192	498.195	498.195	498.202	498.247	498.355	498.285	498.271	498.256
7	498.127	498.107	498.111	498.191	498.194	498.179	498.202	498.242	498.350	498.280	498.268	498.270
8	498.114	498.108	498.109	498.186	498.197	498.177	498.198	498.234	498.349	498.299	498.278	498.253
9	498.110	498.117	498.113	498.184	498.200	498.175	498.199	498.248	498.340	498.298	498.286	498.265
10	498.126	498.120	498.123	498.184	498.193	498.178	498.194	498.254	498.339	498.290	498.277	498.260
11	498.132	498.126	498.140	498.211	498.205	498.179	498.196	498.250	498.341	498.284	498.257	498.251
12	498.147	498.134	498.132	498.186	498.197	498.180	498.196	498.250	498.344	498.283	498.277	498.252
13	498.130	498.120	498.125	498.172	498.191	498.187	498.194	498.249	498.343	498.287	498.276	498.254
14	498.135	498.122	498.121	498.167	498.194	498.192	498.194	498.249	498.343	498.292	498.277	498.241
15	498.118	498.129	498.129	498.162	498.180	498.194	498.194	498.248	498.343	498.282	498.261	498.253
16	498.122	498.129	498.138	498.162	498.178	498.195	498.191	498.264	498.331	498.282	498.276	498.263
17	498.110	498.123	498.143	498.161	498.180	498.196	498.190	498.303	498.333	498.282	498.260	498.237
18	498.105	498.130	498.155	498.165	498.180	498.197	498.192	498.321	498.329	498.292	498.282	498.269
19	498.104	498.151	498.159	498.167	498.177	498.196	498.188	498.323	498.327	498.290	498.280	498.247
20	498.119	498.138	498.161	498.167	498.175	498.194	498.177	498.326	498.328	498.295	498.269	498.256
21	498.130	498.133	498.166	498.178	498.168	498.189	498.176	498.322	498.324	498.292	498.258	498.253
22	498.132	498.135	498.171	498.184	498.167	498.186	498.179	498.332	498.324	498.285	498.267	498.262
23	498.116	498.122	498.161	498.185	498.158	498.183	498.179	498.332	498.326	498.287	498.264	498.250
24	498.109	498.119	498.164	498.185	498.151	498.184	498.180	498.333	498.335	498.270	498.271	498.256
25	498.120	498.121	498.178	498.183	498.141	498.187	498.195	498.339	498.328	498.287	498.273	498.254
26	498.137	498.140	498.187	498.183	498.145	498.189	498.188	498.335	498.326	498.294	498.277	498.257
27	498.140	498.135	498.184	498.180	498.148	498.191	498.185	498.336	498.314	498.278	498.274	498.264
28	498.107	498.108	498.187	498.177	498.148	498.193	498.181	498.343	498.313	498.292	498.261	498.269
29	498.099	-	498.183	498.178	498.140	498.191	498.177	498.347	498.312	498.273	498.264	498.270
30	498.112	-	498.181	498.167	498.119	498.200	498.181	498.344	498.308	498.269	498.260	498.253
31	498.124	-	498.180	-	498.121	-	498.180	498.339	-	498.286	-	498.254

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-30c: 2020 Daily Water Surface Elevation for CR-WC-TI-02												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	498.268	498.238	498.252	498.319	498.490	498.456	498.474	498.511	498.547	ND	ND	ND
2	498.274	498.265	498.268	498.319	498.461	498.464	498.490	498.513	498.542	ND	ND	ND
3	498.271	498.251	498.266	498.328	498.458	498.458	498.501	498.511	498.538	ND	ND	ND
4	498.259	498.238	498.281	498.332	498.481	498.456	498.506	498.504	498.532	ND	ND	ND
5	498.269	498.248	498.271	498.338	498.490	498.452	498.502	498.500	498.528	ND	ND	ND
6	498.278	498.247	498.275	498.329	498.494	498.443	498.498	498.489	498.525	ND	ND	ND
7	498.267	498.252	498.272	498.358	498.498	498.433	498.492	498.479	498.513	ND	ND	ND
8	498.259	498.252	498.264	498.377	498.504	498.446	498.477	498.491	498.516	ND	ND	ND
9	498.267	498.246	498.267	498.342	498.511	498.467	498.473	498.508	498.514	ND	ND	ND
10	498.253	498.249	498.259	498.383	498.507	498.475	498.479	498.530	498.509	ND	ND	ND
11	498.254	498.267	498.284	498.379	498.503	498.476	ND	498.517	498.511	ND	ND	ND
12	498.255	498.250	498.283	498.384	498.498	498.478	ND	498.510	498.528	ND	ND	ND
13	498.259	498.230	498.280	498.372	498.496	498.476	498.506	498.541	498.522	ND	ND	ND
14	498.257	498.266	498.266	498.396	498.505	498.476	498.495	498.544	498.510	ND	ND	ND
15	498.259	498.258	498.253	498.404	498.498	498.493	498.495	498.533	498.510	ND	ND	ND
16	498.247	498.258	498.265	498.375	498.488	498.506	498.490	498.520	498.506	ND	ND	ND
17	498.250	498.265	498.271	498.414	498.476	498.497	498.481	498.514	498.501	ND	ND	ND
18	498.256	498.257	498.267	498.417	498.469	498.499	498.484	498.518	498.494	ND	ND	ND
19	498.237	498.244	498.270	498.431	498.475	498.501	498.500	498.523	498.495	ND	ND	ND
20	498.235	498.249	498.256	498.441	498.474	498.497	498.511	498.525	498.494	ND	ND	ND
21	498.248	498.254	498.255	498.444	498.463	498.498	498.518	498.516	498.497	ND	ND	ND
22	498.252	498.264	498.289	498.453	498.463	498.497	498.534	498.504	498.496	ND	ND	ND
23	498.245	498.269	498.296	498.476	498.465	498.497	498.531	498.526	498.489	ND	ND	ND
24	498.245	498.277	498.290	498.472	498.458	498.493	498.533	498.535	498.486	ND	ND	ND
25	498.250	498.258	498.261	498.456	498.465	498.485	498.531	498.544	498.508	ND	ND	ND
26	498.246	498.255	498.268	498.486	498.466	498.484	498.528	498.548	498.509	ND	ND	ND
27	498.243	498.260	498.304	498.478	498.460	498.477	498.527	498.551	498.510	ND	ND	ND
28	498.246	498.262	498.317	498.498	498.458	498.477	498.529	498.547	ND	ND	ND	ND
29	498.236	498.270	498.299	498.493	498.455	498.485	498.523	498.544	ND	ND	ND	ND
30	498.246	-	498.314	498.485	498.451	498.482	498.518	498.554	ND	ND	ND	ND
31	498.244	-	498.314	-	498.448	-	498.514	498.545	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-31a: 2018 Mean Daily Discharge for CR-WC-TI-02					
DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	0.537	0.612	0.430	0.419
2	ND	0.589	0.645	0.439	0.411
3	ND	0.562	0.662	0.441	0.374
4	ND	0.559	0.583	0.400	0.385
5	0.484	0.548	0.517	0.390	0.364
6	0.498	0.559	0.521	0.396	0.369
7	0.526	0.561	0.508	0.392	0.351
8	0.563	0.530	0.503	0.396	0.363
9	0.558	0.554	0.523	0.415	0.374
10	0.552	0.608	0.535	0.405	0.375
11	0.521	0.609	0.561	0.398	0.370
12	0.531	0.610	0.515	0.411	0.394
13	0.535	0.608	0.497	0.420	0.392
14	0.528	0.625	0.537	0.426	0.384
15	0.488	0.630	0.514	0.382	0.377
16	0.506	0.629	0.514	0.372	0.350
17	0.485	0.623	0.550	0.385	0.367
18	0.458	0.607	0.527	0.377	0.373
19	0.474	0.612	0.491	0.391	0.381
20	0.479	0.595	0.556	0.385	0.387
21	0.480	0.617	0.502	0.399	0.395
22	0.456	0.622	0.506	0.417	0.389
23	0.406	0.631	0.526	0.385	0.378
24	0.403	0.599	0.507	0.373	0.365
25	0.439	0.594	0.486	0.378	0.370
26	0.440	0.584	0.490	0.385	0.366
27	0.444	0.616	0.473	0.390	0.366
28	0.467	0.628	0.481	0.385	0.356
29	0.462	0.629	0.468	0.399	0.355
30	0.485	0.646	0.449	0.410	0.347
31	0.541	-	0.448	-	0.337

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-31b: 2019 Mean Daily Discharge for CR-WC-TI-02												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.380	0.352	0.316	0.505	0.508	0.417	0.590	0.543	1.10	1.01	0.809	0.669
2	0.404	0.355	0.323	0.461	0.538	0.455	0.630	0.592	1.10	0.998	0.782	0.680
3	0.411	0.348	0.351	0.459	0.527	0.494	0.632	0.695	1.12	0.985	0.813	0.706
4	0.388	0.342	0.364	0.471	0.545	0.555	0.621	0.769	1.11	0.862	0.784	0.729
5	0.364	0.338	0.342	0.480	0.573	0.576	0.596	0.765	1.20	0.891	0.804	0.682
6	0.380	0.337	0.348	0.499	0.567	0.570	0.593	0.738	1.19	0.875	0.766	0.665
7	0.370	0.339	0.358	0.499	0.563	0.524	0.592	0.721	1.17	0.856	0.756	0.709
8	0.356	0.340	0.355	0.496	0.571	0.520	0.581	0.694	1.16	0.928	0.788	0.654
9	0.352	0.348	0.361	0.495	0.582	0.515	0.582	0.743	1.12	0.924	0.814	0.689
10	0.368	0.352	0.382	0.497	0.562	0.522	0.569	0.762	1.11	0.889	0.780	0.674
11	0.375	0.358	0.420	0.521	0.597	0.525	0.575	0.749	1.12	0.864	0.711	0.642
12	0.391	0.366	0.403	0.501	0.572	0.528	0.576	0.749	1.14	0.857	0.778	0.642
13	0.372	0.351	0.387	0.500	0.556	0.546	0.570	0.745	1.13	0.871	0.771	0.648
14	0.377	0.353	0.378	0.489	0.565	0.560	0.568	0.746	1.13	0.888	0.776	0.606
15	0.358	0.360	0.397	0.475	0.526	0.566	0.569	0.744	1.13	0.849	0.718	0.642
16	0.362	0.359	0.415	0.477	0.521	0.571	0.559	0.802	1.08	0.846	0.766	0.674
17	0.350	0.352	0.427	0.474	0.527	0.572	0.559	0.953	1.08	0.844	0.711	0.590
18	0.344	0.360	0.457	0.483	0.524	0.577	0.564	1.03	1.07	0.880	0.784	0.691
19	0.342	0.384	0.467	0.489	0.518	0.574	0.552	1.04	1.06	0.872	0.775	0.616
20	0.357	0.369	0.471	0.489	0.512	0.567	0.521	1.05	1.06	0.888	0.736	0.644
21	0.369	0.363	0.486	0.518	0.494	0.554	0.520	1.03	1.05	0.874	0.697	0.633
22	0.371	0.364	0.497	0.536	0.490	0.545	0.527	1.08	1.05	0.844	0.724	0.659
23	0.354	0.350	0.473	0.536	0.468	0.538	0.528	1.08	1.06	0.851	0.713	0.620
24	0.346	0.346	0.481	0.538	0.450	0.539	0.532	1.08	1.10	0.786	0.734	0.638
25	0.357	0.348	0.518	0.533	0.427	0.549	0.572	1.11	1.07	0.847	0.742	0.630
26	0.376	0.368	0.541	0.532	0.438	0.553	0.553	1.09	1.06	0.873	0.752	0.638
27	0.379	0.363	0.531	0.523	0.444	0.560	0.545	1.10	1.01	0.810	0.739	0.660
28	0.342	0.333	0.540	0.517	0.444	0.564	0.533	1.13	0.998	0.861	0.696	0.671
29	0.334	-	0.529	0.519	0.426	0.558	0.524	1.15	0.995	0.789	0.702	0.675
30	0.347	-	0.523	0.491	0.377	0.587	0.533	1.14	0.978	0.774	0.687	0.620
31	0.359	-	0.523	-	0.383	-	0.530	1.11	-	0.834	-	0.620

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-31c: 2020 Mean Daily Discharge for CR-WC-TI-02												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.662	0.527	0.528	0.682	1.58	1.76	1.05	1.12	1.58	ND	ND	ND
2	0.679	0.605	0.571	0.680	1.44	1.81	1.10	1.14	1.55	ND	ND	ND
3	0.670	0.562	0.563	0.706	1.44	1.77	1.12	1.14	1.53	ND	ND	ND
4	0.629	0.525	0.606	0.719	1.59	1.75	1.11	1.13	1.49	ND	ND	ND
5	0.661	0.549	0.574	0.737	1.66	1.73	1.07	1.12	1.47	ND	ND	ND
6	0.688	0.545	0.587	0.706	1.71	1.66	1.02	1.08	1.45	ND	ND	ND
7	0.649	0.557	0.575	0.806	1.75	1.57	0.973	1.04	1.39	ND	ND	ND
8	0.623	0.556	0.550	0.878	1.82	1.61	0.889	1.11	1.40	ND	ND	ND
9	0.647	0.539	0.556	0.747	1.88	1.70	0.851	1.20	1.39	ND	ND	ND
10	0.601	0.546	0.534	0.895	1.88	1.72	0.851	1.33	1.36	ND	ND	ND
11	0.604	0.597	0.604	0.878	1.88	1.69	ND	1.28	1.38	ND	ND	ND
12	0.605	0.546	0.601	0.895	1.87	1.66	ND	1.25	1.47	ND	ND	ND
13	0.617	0.492	0.589	0.846	1.87	1.61	0.892	1.43	1.44	ND	ND	ND
14	0.607	0.590	0.549	0.940	1.96	1.58	0.858	1.46	1.37	ND	ND	ND
15	0.612	0.565	0.512	0.971	1.93	1.64	0.867	1.42	1.37	ND	ND	ND
16	0.576	0.564	0.541	0.854	1.89	1.69	0.859	1.36	1.35	ND	ND	ND
17	0.583	0.583	0.557	1.01	1.83	1.60	0.835	1.34	1.32	ND	ND	ND
18	0.598	0.558	0.545	1.02	1.81	1.57	0.854	1.38	1.29	ND	ND	ND
19	0.543	0.521	0.551	1.09	1.86	1.55	0.929	1.41	1.29	ND	ND	ND
20	0.537	0.532	0.511	1.13	1.88	1.49	0.983	1.44	1.29	ND	ND	ND
21	0.571	0.544	0.510	1.16	1.80	1.46	1.03	1.40	1.30	ND	ND	ND
22	0.582	0.572	0.605	1.22	1.80	1.43	1.11	1.34	1.30	ND	ND	ND
23	0.559	0.584	0.622	1.36	1.81	1.39	1.11	1.46	1.26	ND	ND	ND
24	0.560	0.607	0.606	1.35	1.77	1.34	1.13	1.51	1.25	ND	ND	ND
25	0.571	0.549	0.518	1.29	1.82	1.27	1.13	1.56	1.36	ND	ND	ND
26	0.559	0.541	0.538	1.47	1.82	1.24	1.13	1.58	1.37	ND	ND	ND
27	0.548	0.554	0.642	1.44	1.78	1.17	1.14	1.60	1.37	ND	ND	ND
28	0.557	0.558	0.682	1.57	1.77	1.14	1.16	1.58	ND	ND	ND	ND
29	0.526	0.580	0.622	1.56	1.75	1.15	1.14	1.56	ND	ND	ND	ND
30	0.553	-	0.670	1.54	1.72	1.11	1.13	1.62	ND	ND	ND	ND
31	0.547	-	0.667	-	1.71	-	1.13	1.57	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-32a: 2018 Daily Water Surface Elevation for CR-WC

DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	498.341	498.308	498.259	498.271
2	ND	498.347	498.325	498.258	498.269
3	ND	498.341	498.332	498.257	498.253
4	ND	498.336	498.306	498.251	498.266
5	498.347	498.335	498.292	498.287	498.257
6	498.345	498.325	498.292	498.289	498.260
7	498.362	498.317	498.284	498.266	498.250
8	498.374	498.321	498.282	498.258	498.255
9	498.369	498.344	498.286	498.259	498.260
10	498.365	498.343	498.286	498.264	498.259
11	498.363	498.346	498.289	498.261	498.256
12	498.350	498.343	498.286	498.263	498.267
13	498.347	498.338	498.277	498.266	498.265
14	498.354	498.336	498.286	498.268	498.261
15	498.345	498.334	498.289	498.254	498.255
16	498.338	498.328	498.284	498.247	498.235
17	498.341	498.324	498.287	498.251	498.251
18	498.331	498.330	498.291	498.252	498.253
19	498.330	498.326	498.282	498.256	498.258
20	498.330	498.326	498.285	498.258	498.260
21	498.335	498.317	498.288	498.258	498.261
22	498.321	498.310	498.278	498.266	498.257
23	498.289	498.307	498.282	498.260	498.254
24	498.303	498.317	498.278	498.255	498.250
25	498.314	498.313	498.275	498.258	498.253
26	498.308	498.324	498.276	498.260	498.253
27	498.310	498.322	498.275	498.261	498.255
28	498.307	498.321	498.272	498.259	498.252
29	498.307	498.321	498.269	498.263	498.253
30	498.317	498.312	498.266	498.267	498.250
31	498.345	-	498.264	-	498.243

Note: elevations in table are in metres (arbitrary datum).
- = day not present in month; ND = no data.

Table D-32b: 2019 Daily Water Surface Elevation for CR-WC-TI-03												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	498.260	498.205	498.176	498.241	498.276	498.238	498.306	498.294	498.438	498.413	498.372	498.349
2	498.268	498.206	498.185	498.241	498.284	498.245	498.328	498.313	498.439	498.414	498.364	498.352
3	498.272	498.199	498.199	498.251	498.285	498.257	498.314	498.350	498.445	498.407	498.373	498.361
4	498.263	498.196	498.206	498.273	498.285	498.300	498.312	498.374	498.441	498.384	498.366	498.368
5	498.253	498.195	498.195	498.268	498.283	498.296	498.294	498.373	498.474	498.385	498.373	498.354
6	498.259	498.196	498.195	498.278	498.284	498.292	498.291	498.377	498.462	498.386	498.363	498.349
7	498.253	498.199	498.200	498.281	498.284	498.288	498.298	498.361	498.455	498.382	498.361	498.363
8	498.244	498.201	498.199	498.284	498.288	498.291	498.295	498.351	498.453	498.405	498.372	498.345
9	498.239	498.209	498.203	498.287	498.289	498.279	498.296	498.380	498.444	498.398	498.380	498.357
10	498.245	498.212	498.211	498.290	498.297	498.277	498.287	498.380	498.443	498.386	498.371	498.353
11	498.246	498.218	498.229	498.293	498.295	498.270	498.291	498.366	498.442	498.380	498.351	498.344
12	498.251	498.222	498.224	498.293	498.295	498.268	498.295	498.365	498.442	498.376	498.372	498.346
13	498.242	498.206	498.219	498.291	498.293	498.275	498.291	498.366	498.445	498.383	498.371	498.348
14	498.241	498.207	498.215	498.297	498.292	498.282	498.295	498.366	498.447	498.389	498.373	498.335
15	498.230	498.213	498.220	498.293	498.283	498.284	498.298	498.365	498.449	498.375	498.357	498.347
16	498.231	498.213	498.221	498.292	498.278	498.280	498.288	498.395	498.435	498.371	498.371	498.358
17	498.225	498.207	498.219	498.292	498.277	498.274	498.286	498.443	498.442	498.372	498.356	498.331
18	498.220	498.214	498.224	498.293	498.278	498.276	498.292	498.444	498.437	498.385	498.379	498.364
19	498.217	498.234	498.223	498.293	498.278	498.282	498.293	498.441	498.429	498.383	498.376	498.341
20	498.224	498.220	498.219	498.291	498.276	498.278	498.282	498.440	498.438	498.387	498.365	498.349
21	498.229	498.214	498.220	498.297	498.274	498.277	498.280	498.415	498.429	498.382	498.354	498.346
22	498.228	498.215	498.220	498.300	498.268	498.269	498.279	498.433	498.432	498.373	498.363	498.355
23	498.212	498.203	498.201	498.303	498.264	498.272	498.279	498.431	498.441	498.377	498.361	498.343
24	498.206	498.201	498.194	498.300	498.259	498.278	498.278	498.434	498.458	498.357	498.368	498.350
25	498.218	498.204	498.209	498.297	498.254	498.283	498.295	498.446	498.441	498.376	498.372	498.348
26	498.233	498.223	498.216	498.294	498.256	498.281	498.294	498.441	498.439	498.386	498.374	498.352
27	498.234	498.218	498.206	498.289	498.261	498.280	498.299	498.439	498.434	498.375	498.370	498.360
28	498.204	498.186	498.214	498.289	498.261	498.276	498.304	498.450	498.430	498.400	498.358	498.364
29	498.202	-	498.219	498.288	498.255	498.282	498.286	498.456	498.420	498.368	498.360	498.365
30	498.213	-	498.223	498.276	498.253	498.306	498.290	498.449	498.410	498.362	498.355	498.347
31	498.216	-	498.236	-	498.245	-	498.291	498.444	-	498.379	-	498.347

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-32c: 2020 Daily Water Surface Elevation for CR-WC-TI-03												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	498.360	498.322	498.318	498.325	498.493	498.489	498.531	498.581	498.617	ND	ND	ND
2	498.365	498.350	498.333	498.321	498.489	498.501	498.550	498.577	498.620	ND	ND	ND
3	498.361	498.339	498.329	498.323	498.482	498.500	498.569	498.575	498.610	ND	ND	ND
4	498.348	498.328	498.344	498.323	498.497	498.500	498.575	498.581	498.600	ND	ND	ND
5	498.358	498.337	498.332	498.323	498.486	498.493	498.578	498.577	498.597	ND	ND	ND
6	498.367	498.336	498.336	498.315	498.484	498.484	498.577	498.566	498.598	ND	ND	ND
7	498.355	498.341	498.332	498.329	498.486	498.482	498.568	498.557	498.588	ND	ND	ND
8	498.347	498.340	498.323	498.339	498.489	498.496	498.556	498.584	498.585	ND	ND	ND
9	498.355	498.333	498.324	498.315	498.490	498.524	498.549	498.632	498.588	ND	ND	ND
10	498.341	498.335	498.315	498.338	498.487	498.531	498.550	498.623	498.581	ND	ND	ND
11	498.342	498.352	498.339	498.334	498.485	498.528	498.553	498.600	498.593	ND	ND	ND
12	498.342	498.333	498.338	498.335	498.485	498.525	498.550	498.588	498.612	ND	ND	ND
13	498.346	498.310	498.334	498.325	498.482	498.529	498.568	498.612	498.597	ND	ND	ND
14	498.343	498.343	498.320	498.336	498.496	498.524	498.573	498.626	498.587	ND	ND	ND
15	498.346	498.335	498.306	498.338	498.486	498.540	498.577	498.620	498.593	ND	ND	ND
16	498.335	498.333	498.317	498.318	498.479	498.562	498.560	498.596	498.581	ND	ND	ND
17	498.337	498.339	498.323	498.342	498.471	498.553	498.546	498.591	498.576	ND	ND	ND
18	498.343	498.330	498.319	498.343	498.459	498.553	498.554	498.592	498.571	ND	ND	ND
19	498.324	498.316	498.323	498.352	498.471	498.553	498.571	498.598	498.572	ND	ND	ND
20	498.323	498.318	498.308	498.357	498.465	498.549	498.580	498.596	498.572	ND	ND	ND
21	498.335	498.322	498.310	498.359	498.446	498.549	498.584	498.578	498.574	ND	ND	ND
22	498.340	498.332	498.320	498.365	498.464	498.552	498.600	498.566	498.573	ND	ND	ND
23	498.332	498.337	498.322	498.382	498.486	498.555	498.599	498.594	498.563	ND	ND	ND
24	498.333	498.345	498.321	498.383	498.475	498.553	498.604	498.600	498.564	ND	ND	ND
25	498.337	498.326	498.312	498.377	498.481	498.548	498.600	498.606	498.593	ND	ND	ND
26	498.334	498.324	498.314	498.382	498.483	498.545	498.599	498.615	498.589	ND	ND	ND
27	498.330	498.329	498.332	498.379	498.484	498.539	498.595	498.618	ND	ND	ND	ND
28	498.333	498.329	498.337	498.408	498.476	498.544	498.594	498.615	ND	ND	ND	ND
29	498.322	498.337	498.323	498.430	498.474	498.548	498.592	498.613	ND	ND	ND	ND
30	498.331	-	498.329	498.451	498.470	498.542	498.590	498.626	ND	ND	ND	ND
31	498.328	-	498.326	-	498.462	-	498.585	498.625	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-33a: 2018 Mean Daily Discharge for CR-WC-TI-03					
DATE	2018				
	AUG	SEP	OCT	NOV	DEC
1	ND	0.336	0.374	0.305	0.325
2	ND	0.348	0.404	0.304	0.323
3	ND	0.343	0.409	0.302	0.300
4	ND	0.338	0.371	0.294	0.318
5	0.274	0.339	0.352	0.348	0.306
6	0.273	0.327	0.352	0.350	0.310
7	0.298	0.318	0.340	0.316	0.296
8	0.318	0.326	0.338	0.304	0.303
9	0.314	0.364	0.344	0.306	0.310
10	0.310	0.365	0.344	0.314	0.309
11	0.311	0.374	0.348	0.309	0.305
12	0.296	0.372	0.344	0.312	0.320
13	0.294	0.367	0.330	0.317	0.318
14	0.306	0.366	0.344	0.320	0.312
15	0.296	0.366	0.348	0.300	0.304
16	0.289	0.360	0.341	0.291	0.277
17	0.296	0.358	0.345	0.296	0.299
18	0.285	0.370	0.352	0.298	0.302
19	0.286	0.366	0.338	0.303	0.308
20	0.289	0.369	0.342	0.306	0.311
21	0.298	0.358	0.347	0.306	0.313
22	0.281	0.351	0.332	0.317	0.307
23	0.243	0.348	0.338	0.309	0.303
24	0.263	0.367	0.333	0.303	0.298
25	0.280	0.363	0.328	0.307	0.302
26	0.274	0.384	0.330	0.309	0.302
27	0.280	0.384	0.328	0.310	0.305
28	0.278	0.386	0.324	0.307	0.301
29	0.281	0.389	0.319	0.314	0.302
30	0.297	0.377	0.316	0.319	0.297
31	0.340	-	0.312	-	0.288

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-33b: 2019 Mean Daily Discharge for CR-WC-TI-03												
DATE	2019											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.312	0.241	0.210	0.293	0.346	0.294	0.384	0.350	0.599	0.531	0.460	0.428
2	0.324	0.244	0.220	0.294	0.359	0.304	0.419	0.380	0.600	0.532	0.446	0.433
3	0.329	0.235	0.238	0.308	0.360	0.320	0.395	0.444	0.613	0.519	0.462	0.449
4	0.317	0.231	0.245	0.339	0.360	0.385	0.391	0.485	0.603	0.475	0.450	0.462
5	0.302	0.231	0.232	0.332	0.358	0.379	0.362	0.483	0.678	0.476	0.463	0.437
6	0.311	0.232	0.232	0.347	0.359	0.371	0.358	0.489	0.650	0.478	0.446	0.429
7	0.303	0.235	0.239	0.352	0.359	0.365	0.368	0.461	0.632	0.472	0.442	0.454
8	0.290	0.238	0.238	0.356	0.365	0.370	0.363	0.441	0.628	0.515	0.462	0.424
9	0.284	0.248	0.242	0.361	0.367	0.351	0.363	0.495	0.607	0.502	0.478	0.444
10	0.292	0.252	0.253	0.365	0.380	0.347	0.349	0.494	0.605	0.479	0.461	0.437
11	0.293	0.259	0.276	0.371	0.376	0.336	0.354	0.468	0.602	0.469	0.426	0.422
12	0.301	0.264	0.268	0.371	0.378	0.331	0.360	0.465	0.601	0.461	0.463	0.425
13	0.288	0.245	0.263	0.368	0.374	0.342	0.354	0.467	0.607	0.475	0.462	0.430
14	0.287	0.246	0.257	0.377	0.372	0.353	0.360	0.466	0.611	0.486	0.466	0.407
15	0.272	0.254	0.264	0.370	0.358	0.355	0.364	0.463	0.613	0.461	0.437	0.428
16	0.274	0.253	0.265	0.369	0.350	0.349	0.348	0.522	0.584	0.454	0.463	0.448
17	0.265	0.245	0.264	0.369	0.348	0.340	0.344	0.619	0.597	0.456	0.436	0.402
18	0.260	0.254	0.269	0.371	0.350	0.342	0.353	0.621	0.586	0.480	0.478	0.459
19	0.256	0.281	0.267	0.371	0.350	0.351	0.355	0.614	0.570	0.476	0.472	0.419
20	0.266	0.262	0.263	0.368	0.348	0.343	0.338	0.610	0.588	0.485	0.454	0.433
21	0.272	0.255	0.265	0.378	0.345	0.342	0.334	0.558	0.569	0.475	0.434	0.428
22	0.271	0.257	0.265	0.383	0.335	0.329	0.332	0.595	0.574	0.459	0.450	0.444
23	0.249	0.241	0.240	0.388	0.330	0.334	0.331	0.590	0.593	0.467	0.447	0.424
24	0.243	0.239	0.232	0.384	0.323	0.343	0.330	0.595	0.628	0.432	0.459	0.436
25	0.257	0.243	0.250	0.378	0.316	0.349	0.355	0.622	0.592	0.466	0.467	0.432
26	0.277	0.266	0.260	0.374	0.319	0.347	0.353	0.608	0.587	0.484	0.471	0.440
27	0.279	0.260	0.248	0.367	0.326	0.344	0.361	0.604	0.576	0.464	0.465	0.455
28	0.241	0.222	0.257	0.366	0.326	0.338	0.368	0.628	0.566	0.513	0.443	0.462
29	0.238	-	0.263	0.364	0.317	0.346	0.340	0.640	0.545	0.453	0.446	0.464
30	0.252	-	0.269	0.346	0.315	0.384	0.345	0.624	0.525	0.443	0.438	0.433
31	0.256	-	0.286	-	0.304	-	0.347	0.613	-	0.473	-	0.433

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-33c: 2020 Mean Daily Discharge for CR-WC-TI-03												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.457	0.398	0.400	0.419	0.788	0.749	0.697	0.709	0.799	ND	ND	ND
2	0.465	0.448	0.425	0.413	0.777	0.778	0.737	0.699	0.810	ND	ND	ND
3	0.459	0.427	0.420	0.417	0.760	0.774	0.778	0.691	0.790	ND	ND	ND
4	0.435	0.409	0.445	0.417	0.798	0.774	0.788	0.702	0.769	ND	ND	ND
5	0.454	0.426	0.425	0.417	0.769	0.755	0.789	0.689	0.764	ND	ND	ND
6	0.470	0.424	0.433	0.404	0.764	0.727	0.780	0.663	0.771	ND	ND	ND
7	0.449	0.432	0.426	0.429	0.766	0.716	0.752	0.640	0.750	ND	ND	ND
8	0.435	0.431	0.410	0.446	0.772	0.747	0.718	0.698	0.748	ND	ND	ND
9	0.449	0.420	0.412	0.405	0.776	0.811	0.695	0.816	0.760	ND	ND	ND
10	0.425	0.423	0.397	0.445	0.766	0.823	0.693	0.789	0.745	ND	ND	ND
11	0.427	0.453	0.438	0.439	0.760	0.809	0.697	0.730	0.782	ND	ND	ND
12	0.428	0.420	0.436	0.441	0.758	0.794	0.686	0.697	0.833	ND	ND	ND
13	0.435	0.383	0.431	0.423	0.750	0.799	0.728	0.753	0.798	ND	ND	ND
14	0.430	0.438	0.406	0.443	0.785	0.780	0.736	0.786	0.778	ND	ND	ND
15	0.435	0.424	0.384	0.446	0.759	0.816	0.743	0.768	0.797	ND	ND	ND
16	0.416	0.422	0.402	0.412	0.740	0.868	0.701	0.708	0.771	ND	ND	ND
17	0.420	0.432	0.412	0.455	0.719	0.837	0.666	0.693	0.763	ND	ND	ND
18	0.430	0.417	0.406	0.457	0.690	0.830	0.682	0.691	0.755	ND	ND	ND
19	0.399	0.393	0.413	0.473	0.718	0.824	0.720	0.703	0.761	ND	ND	ND
20	0.396	0.398	0.388	0.483	0.703	0.807	0.739	0.698	0.765	ND	ND	ND
21	0.418	0.404	0.391	0.487	0.659	0.802	0.746	0.660	0.775	ND	ND	ND
22	0.426	0.421	0.408	0.498	0.700	0.804	0.782	0.637	0.777	ND	ND	ND
23	0.413	0.430	0.413	0.531	0.750	0.803	0.779	0.705	0.756	ND	ND	ND
24	0.415	0.445	0.411	0.534	0.722	0.792	0.786	0.723	0.763	ND	ND	ND
25	0.423	0.412	0.396	0.523	0.736	0.775	0.776	0.740	0.841	ND	ND	ND
26	0.417	0.408	0.399	0.534	0.740	0.762	0.770	0.767	0.833	ND	ND	ND
27	0.411	0.417	0.432	0.527	0.743	0.739	0.758	0.780	ND	ND	ND	ND
28	0.417	0.419	0.441	0.587	0.722	0.746	0.751	0.776	ND	ND	ND	ND
29	0.397	0.432	0.416	0.636	0.714	0.750	0.744	0.775	ND	ND	ND	ND
30	0.413	-	0.426	0.684	0.705	0.731	0.736	0.814	ND	ND	ND	ND
31	0.410	-	0.422	-	0.686	-	0.723	0.814	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-34: 2020 Daily Water Surface Elevation for HC-WC-MS-01												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	ND	99.310	99.357	99.393	ND	ND	ND
2	ND	ND	ND	ND	ND	ND	99.312	99.351	99.393	ND	ND	ND
3	ND	ND	ND	ND	ND	ND	99.308	99.343	99.389	ND	ND	ND
4	ND	ND	ND	ND	ND	ND	99.307	99.341	99.386	ND	ND	ND
5	ND	ND	ND	ND	ND	ND	99.304	99.335	99.384	ND	ND	ND
6	ND	ND	ND	ND	ND	ND	99.299	99.333	99.383	ND	ND	ND
7	ND	ND	ND	ND	ND	ND	99.297	99.329	99.379	ND	ND	ND
8	ND	ND	ND	ND	ND	99.276	99.293	99.334	99.370	ND	ND	ND
9	ND	ND	ND	ND	ND	99.281	99.288	99.343	99.371	ND	ND	ND
10	ND	ND	ND	ND	ND	99.292	99.281	99.367	99.370	ND	ND	ND
11	ND	ND	ND	ND	ND	99.296	99.277	99.369	99.374	ND	ND	ND
12	ND	ND	ND	ND	ND	99.295	99.292	99.374	99.380	ND	ND	ND
13	ND	ND	ND	ND	ND	99.303	99.305	99.378	99.381	ND	ND	ND
14	ND	ND	ND	ND	ND	99.301	99.311	99.379	99.379	ND	ND	ND
15	ND	ND	ND	ND	ND	99.303	99.314	99.383	99.375	ND	ND	ND
16	ND	ND	ND	ND	ND	99.311	99.316	99.381	99.371	ND	ND	ND
17	ND	ND	ND	ND	ND	99.318	99.318	99.380	99.370	ND	ND	ND
18	ND	ND	ND	ND	ND	99.314	99.328	99.383	99.366	ND	ND	ND
19	ND	ND	ND	ND	ND	99.313	99.331	99.378	99.366	ND	ND	ND
20	ND	ND	ND	ND	ND	99.310	99.330	99.377	99.367	ND	ND	ND
21	ND	ND	ND	ND	ND	99.304	99.335	99.376	99.364	ND	ND	ND
22	ND	ND	ND	ND	ND	99.300	99.358	99.368	99.362	ND	ND	ND
23	ND	ND	ND	ND	ND	99.300	99.369	99.382	99.359	ND	ND	ND
24	ND	ND	ND	ND	ND	99.299	99.377	99.380	99.357	ND	ND	ND
25	ND	ND	ND	ND	ND	99.296	99.380	99.381	99.358	ND	ND	ND
26	ND	ND	ND	ND	ND	99.294	99.376	99.382	99.362	ND	ND	ND
27	ND	ND	ND	ND	ND	99.296	99.373	99.383	99.363	ND	ND	ND
28	ND	ND	ND	ND	ND	99.298	99.372	99.384	99.339	ND	ND	ND
29	ND	ND	ND	ND	ND	99.306	99.373	99.385	ND	ND	ND	ND
30	ND	-	ND	ND	ND	99.304	99.368	99.392	ND	ND	ND	ND
31	ND	-	ND	-	ND	-	99.362	99.392	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

Table D-35: 2020 Mean Daily Discharge for HC-WC-MS-01												
DATE	2020											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	ND	ND	ND	ND	ND	ND	0.655	0.764	0.902	ND	ND	ND
2	ND	ND	ND	ND	ND	ND	0.661	0.747	0.904	ND	ND	ND
3	ND	ND	ND	ND	ND	ND	0.656	0.725	0.891	ND	ND	ND
4	ND	ND	ND	ND	ND	ND	0.654	0.721	0.883	ND	ND	ND
5	ND	ND	ND	ND	ND	ND	0.647	0.702	0.878	ND	ND	ND
6	ND	ND	ND	ND	ND	ND	0.633	0.698	0.875	ND	ND	ND
7	ND	ND	ND	ND	ND	ND	0.625	0.695	0.861	ND	ND	ND
8	ND	ND	ND	ND	ND	0.567	0.616	0.705	0.837	ND	ND	ND
9	ND	ND	ND	ND	ND	0.581	0.601	0.733	0.839	ND	ND	ND
10	ND	ND	ND	ND	ND	0.613	0.580	0.805	0.835	ND	ND	ND
11	ND	ND	ND	ND	ND	0.623	0.570	0.811	0.849	ND	ND	ND
12	ND	ND	ND	ND	ND	0.622	0.575	0.830	0.868	ND	ND	ND
13	ND	ND	ND	ND	ND	0.645	0.592	0.842	0.870	ND	ND	ND
14	ND	ND	ND	ND	ND	0.641	0.610	0.848	0.866	ND	ND	ND
15	ND	ND	ND	ND	ND	0.643	0.619	0.859	0.854	ND	ND	ND
16	ND	ND	ND	ND	ND	0.663	0.626	0.855	0.843	ND	ND	ND
17	ND	ND	ND	ND	ND	0.679	0.637	0.854	0.840	ND	ND	ND
18	ND	ND	ND	ND	ND	0.677	0.656	0.856	0.827	ND	ND	ND
19	ND	ND	ND	ND	ND	0.674	0.669	0.845	0.829	ND	ND	ND
20	ND	ND	ND	ND	ND	0.665	0.670	0.847	0.832	ND	ND	ND
21	ND	ND	ND	ND	ND	0.647	0.685	0.846	0.823	ND	ND	ND
22	ND	ND	ND	ND	ND	0.636	0.756	0.821	0.818	ND	ND	ND
23	ND	ND	ND	ND	ND	0.636	0.788	0.865	0.809	ND	ND	ND
24	ND	ND	ND	ND	ND	0.633	0.816	0.860	0.802	ND	ND	ND
25	ND	ND	ND	ND	ND	0.624	0.824	0.865	0.805	ND	ND	ND
26	ND	ND	ND	ND	ND	0.617	0.814	0.868	0.819	ND	ND	ND
27	ND	ND	ND	ND	ND	0.623	0.806	0.871	0.821	ND	ND	ND
28	ND	ND	ND	ND	ND	0.629	0.804	0.872	0.751	ND	ND	ND
29	ND	ND	ND	ND	ND	0.651	0.810	0.878	ND	ND	ND	ND
30	ND	-	ND	ND	ND	0.645	0.795	0.900	ND	ND	ND	ND
31	ND	-	ND	-	ND	-	0.779	0.899	-	ND	-	ND

Note: elevations in table are in metres (arbitrary datum).

- = day not present in month; ND = no data.

APPENDIX E

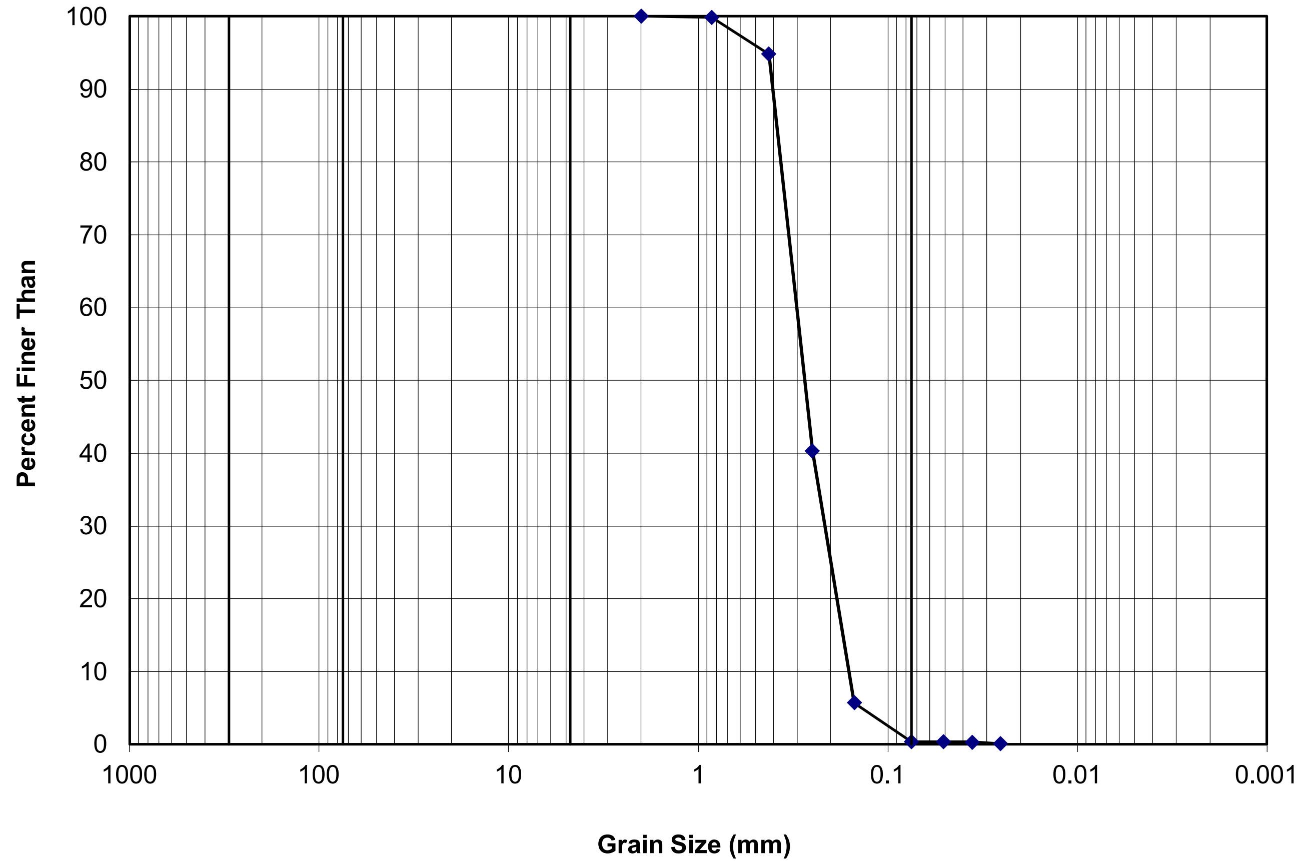
Total Suspended Solids and Bed Load Laboratory Results

GRAIN SIZE ANALYSIS
(Mechanical & Hydrometer)

Project #: 1899581 Phase: 3
Short Title: NexGen / Rook I Project / Env Baselines
Tested by: T.B. Date: August 28, 2018

Sample #: SL6312
Source: Sampled below Patterson Lake.
Date Sample Received: August 5, 2018

Graphical Analysis



BOULDERS	COBBLES	GRAVEL		SAND			SILT / CLAY
		Coarse	Fine	Coarse	Medium	Fine	

Grain Size Analysis Results:

Opening (mm)	Percent Passing (%)
51	100
38	100
25	100
19	100
9.5	100
4.75	100
2.0	100
0.850	100
0.425	95
0.250	40
0.150	5.7
0.075	0.4
0.051	0.4
0.036	0.3
0.025	0.1

Comments:

1721 8th Street E.,
Saskatoon, Saskatchewan S7N 0T4

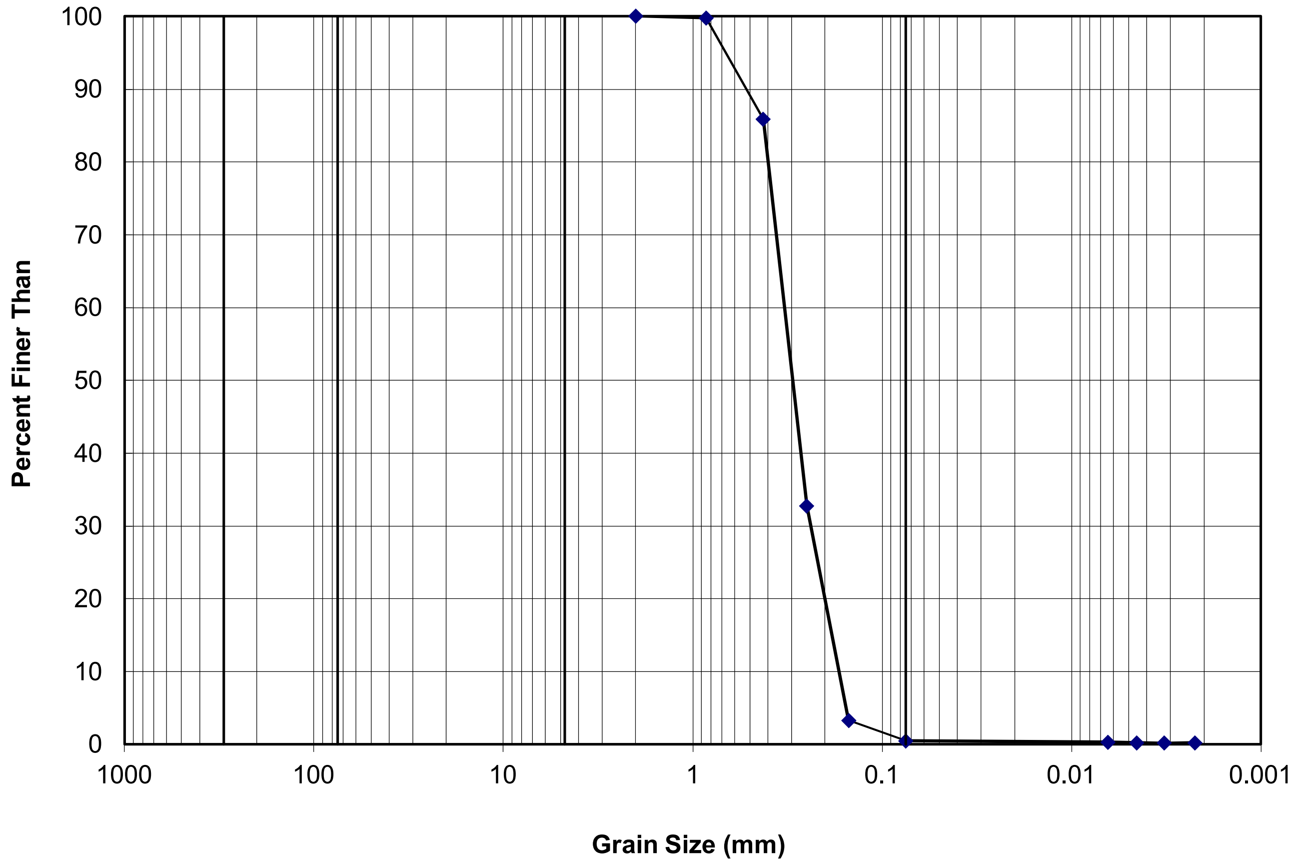
Reviewed by: ______

GRAIN SIZE ANALYSIS
(Mechanical & Hydrometer)

Project #: 1899581 Phase: 3
Short Title: NexGen / Rook I Project / Env Baselines
Tested by: T.B. Date: August 28, 2018

Sample #: SL6313
Source: Sampled below Beet Lake.
Date Sample Received: August 5, 2018

Graphical Analysis



BOULDERS	COBBLES	GRAVEL		SAND			SILT / CLAY
		Coarse	Fine	Coarse	Medium	Fine	

Grain Size Analysis Results:

Opening (mm)	Percent Passing (%)
51	100
38	100
25	100
19	100
9.5	100
4.75	100
2.0	100
0.850	100
0.425	86
0.250	33
0.150	3.3
0.075	0.5
0.006	0.3
0.005	0.2
0.003	0.2
0.002	0.2

Comments:

1721 8th Street E.,
Saskatoon, Saskatchewan S7N 0T4

Reviewed by:

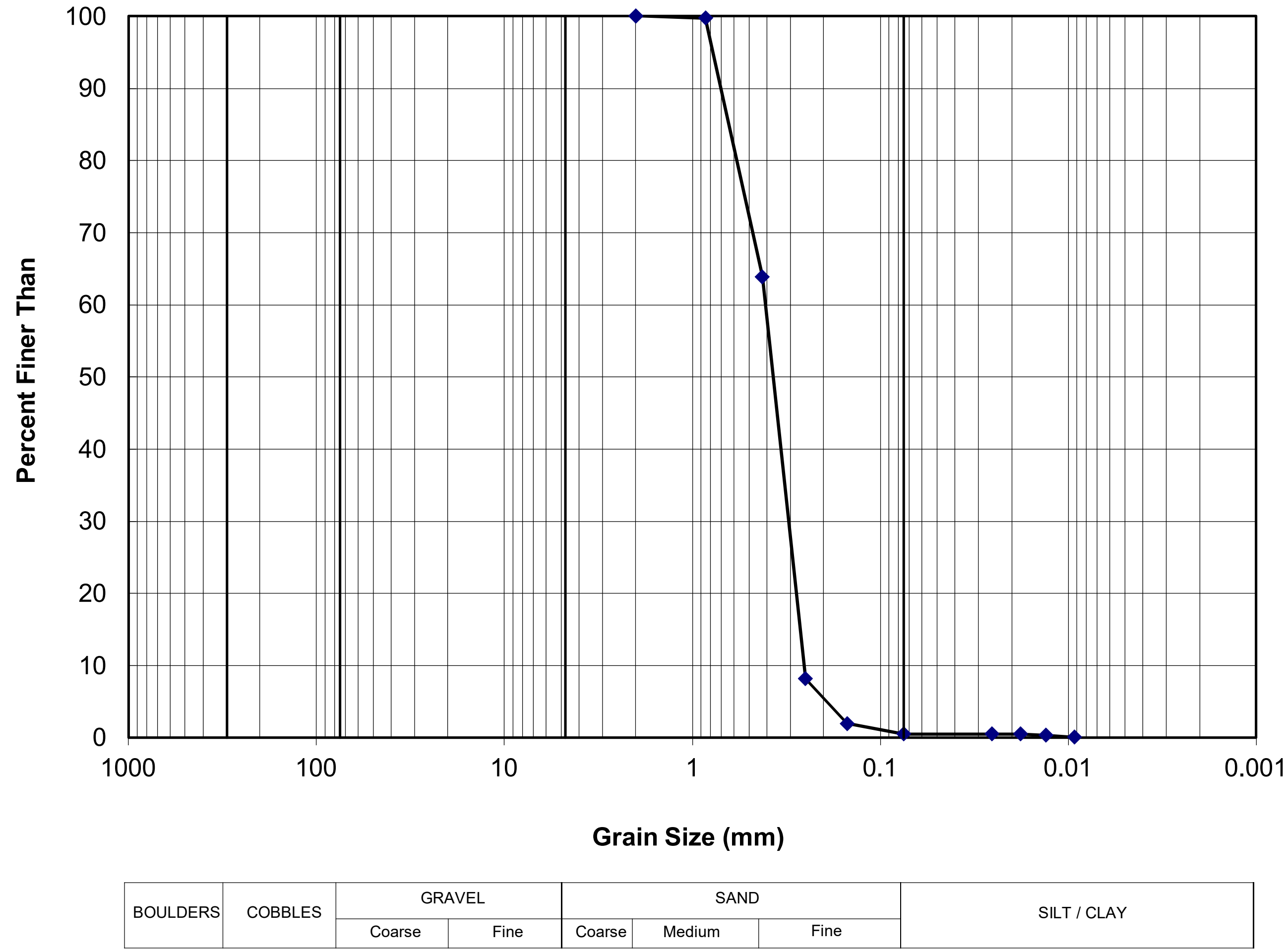
GRAIN SIZE ANALYSIS

(Mechanical & Hydrometer)

Project #: 1899581 Phase: 3
Short Title: NexGen / Rook I Project / Env Baselines
Tested by: T.B. Date: August 28, 2018

Sample #: SL6314
Source: Sampled below Naomi Lake.
Date Sample Received: August 5, 2018

Graphical Analysis



Grain Size Analysis Results:

Opening (mm)	Percent Passing (%)
51	100
38	100
25	100
19	100
9.5	100
4.75	100
2.0	100
0.850	100
0.425	64
0.250	8.2
0.150	2.0
0.075	0.5
0.025	0.5
0.018	0.5
0.013	0.3
0.009	0.1
0.007	0.0

Comments:

1721 8th Street E.,
Saskatoon, Saskatchewan S7N 0T4

Reviewed by: ____________

SASKATCHEWAN RESEARCH COUNCIL

Environmental Analytical Laboratories
143-111 Research Drive, Saskatoon, SK Canada S7N 3R2

T: 306-933-6932 F: 306-933-7922
Toll-free: 1-800-240-8808
E: analytical@src.sk.ca

www.src.sk.ca/analytical

SRC Group # 2018-10049

Aug 21, 2018

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Ross Phillips

Date Samples Received: Aug-15-2018 Client P.O.: 1899581/3/3006

All results have been reviewed and approved by a Qualified Person in accordance with the Saskatchewan Environmental Code, Corrective Action Plan Chapter, for the purposes of certifying a laboratory analysis

Results from Lab Sections 1 and 2 have been authorized by Keith Gipman, Supervisor
Results from Lab Section 3 have been authorized by Pat Moser, Supervisor
Results from Lab Sections 4 and 5 have been authorized by Vicky Snook, Supervisor
Results from Lab Section 6 have been authorized by Marion McConnell, Supervisor

* Test methods and data are validated by the laboratory's Quality Assurance Program.

* Routine methods follow recognized procedures from sources such as
  * Standard Methods for the Examination of Water and Wastewater APHA AWWA WEF
  * Environment Canada
  * US EPA
  * CANMET

* The results reported relate only to the test samples as provided by the client.

* Samples will be kept for 30 days after the final report is sent. Please contact the lab if you have any special requirements.

* Additional information is available upon request.

This is a final report.

SASKATCHEWAN RESEARCH COUNCIL

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143-111 Research Drive, Saskatoon, SK Canada S7N 3R2

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SRC Group # 2018-10049

Aug 21, 2018

Golder

1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Ross Phillips

Date Samples Received: Aug-15-2018

Client P.O.: 1899581/3/3006

32091 **08/04/2018 CLEARWATER RIVER BELOW PATTERSON LAKE *WATER***
32092 **08/05/2018 CLEARWATER RIVER BELOW BEET LAKE *WATER***
32093 **08/05/2018 CLEARWATER RIVER BELOW NAOMI LAKE *WATER***

Analyte	Units	32091	32092	32093
Lab Section 1 (Inorganics)				
Total suspended solids	mg/L	<1	<1	<1

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

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Environmental Analytical Laboratories
143-111 Research Drive, Saskatoon, SK Canada S7N 3R2
T: 306-933-6932 F: 306-933-7922
Toll-free: 1-800-240-8808
E: analytical@src.sk.ca
www.src.sk.ca/analytical

SRC Group # 2018-12657

Oct 15, 2018

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Ross Phillips

Date Samples Received: Oct-10-2018 Client P.O.: 1899581/2003/2003

All results have been reviewed and approved by a Qualified Person in accordance with the Saskatchewan Environmental Code, Corrective Action Plan Chapter, for the purposes of certifying a laboratory analysis

Results from Lab Sections 1 and 2 have been authorized by Keith Gipman, Supervisor
Results from Lab Section 3 have been authorized by Pat Moser, Supervisor
Results from Lab Sections 4 and 5 have been authorized by Vicky Snook, Supervisor
Results from Lab Section 6 have been authorized by Marion McConnell, Supervisor

* Test methods and data are validated by the laboratory's Quality Assurance Program.

* Routine methods follow recognized procedures from sources such as
    * Standard Methods for the Examination of Water and Wastewater APHA AWWA WEF
    * Environment Canada
    * US EPA
    * CANMET

* The results reported relate only to the test samples as provided by the client.

* Samples will be kept for 30 days after the final report is sent. Please contact the lab if you have any special requirements.

* Additional information is available upon request.

This is a final report.

SRC SASKATCHEWAN RESEARCH COUNCIL
Environmental Analytical Laboratories
143-111 Research Drive, Saskatoon, SK Canada S7N 3R2
T: 306-933-6932 F: 306-933-7922
Toll-free: 1-800-240-8808
E: analytical@src.sk.ca
www.src.sk.ca/analytical

SRC Group # 2018-12657

Oct 15, 2018

Golder

1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Ross Phillips

Date Samples Received: Oct-10-2018

Client P.O.: 1899581/2003/2003

41121 **10/01/2018 17:00 CLEARWATER RIVER BELOW BEET LAKE *WATER***
41122 **10/03/2018 09:00 CLEARWATER RIVER BELOW PATTERSON LAKE *WATER***
41123 **10/01/2018 16:00 CLEARWATER RIVER BELOW NAOMI LAKE *WATER***

Analyte	Units	41121	41122	41123
Lab Section 1 (Inorganics)				
Total suspended solids	mg/L	<1	<1	<1

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

SASKATCHEWAN RESEARCH COUNCIL

Environmental Analytical Laboratories
143-111 Research Drive, Saskatoon, SK Canada S7N 3R2

T: 306-933-6932 F: 306-933-7922
Toll-free: 1-800-240-8808
E: analytical@src.sk.ca

www.src.sk.ca/analytical

SRC Group # 2020-6763

Jun 27, 2020

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Jacoby Donnelly

Date Samples Received: Jun-18-2020 Client P.O.: 20138965/1000/1003

All results have been reviewed and approved by a Qualified Person in accordance with the Saskatchewan Environmental Code, Corrective Action Plan Chapter, for the purposes of certifying a laboratory analysis

Results from Lab Section 1 authorized by Keith Gipman, Supervisor

---

* Test methods and data are validated by the laboratory's Quality Assurance Program.

* Routine methods follow recognized procedures from sources such as
    * Standard Methods for the Examination of Water and Wastewater APHA AWWA WEF
    * Environment Canada
    * US EPA
    * CANMET

* The results reported relate only to the test samples as provided by the client.

* Samples will be kept for 30 days after the final report is sent. Please contact the lab if you have any special requirements.

* Additional information is available upon request.

* Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

This is a final report.

SASKATCHEWAN RESEARCH COUNCIL

Environmental Analytical Laboratories
143-111 Research Drive, Saskatoon, SK Canada S7N 3R2
T: 306-933-6932 **F:** 306-933-7922
Toll-free: 1-800-240-8808
E: analytical@src.sk.ca
www.src.sk.ca/analytical

SRC Group # 2020-6763

Jun 27, 2020

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Jacoby Donnelly

Date Samples Received: Jun-18-2020

Client P.O.: 20138965/1000/1003

30649 **06/08/2020 CR-WC-MS-03 *WATER***
30650 **06/06/2020 CR-WC-MS-04 *WATER***
30651 **06/05/2020 CR-WC-MS-05 *WATER***

Analyte	Units	30649	30650	30651
Lab Section 1				
Total suspended solids	mg/L	<1	3±1	3±1

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

The temperature of the cooler was 18.6 °C upon receipt.

SRC Group # 2020-6763

Jun 27, 2020

Golder

Analyte Methods

Name	Units	Method
Total suspended solids	mg/L	Chm-206

SASKATCHEWAN RESEARCH COUNCIL
Environmental Analytical Laboratories
143-111 Research Drive, Saskatoon, SK Canada S7N 3R2
T: 306-933-6932 F: 306-933-7922
Toll-free: 1-800-240-8808
E: analytical@src.sk.ca
www.src.sk.ca/analytical

SRC Group # 2020-7971

Jul 27, 2020

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Jacoby Donnelly

Date Samples Received: Jul-15-2020 Client P.O.: 20138965

All results have been reviewed and approved by a Qualified Person in accordance with the Saskatchewan Environmental Code, Corrective Action Plan Chapter, for the purposes of certifying a laboratory analysis

Results from Lab Section 1 authorized by Keith Gipman, Supervisor

---

* Test methods and data are validated by the laboratory's Quality Assurance Program.

* Routine methods follow recognized procedures from sources such as
    * Standard Methods for the Examination of Water and Wastewater APHA AWWA WEF
    * Environment Canada
    * US EPA
    * CANMET

* The results reported relate only to the test samples as provided by the client.

* Samples will be kept for 30 days after the final report is sent. Please contact the lab if you have any special requirements.

* Additional information is available upon request.

* Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

This is a final report.

SASKATCHEWAN RESEARCH COUNCIL
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SRC Group # 2020-7971

Jul 27, 2020

Golder

1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Jacoby Donnelly

Date Samples Received: Jul-15-2020

Client P.O.: 20138965

34159 **07/14/2020 CR-WC-MS-03 *WATER***
34160 **07/13/2020 CR-WC-MS-04 *WATER***
34161 **07/10/2020 CR-WC-MS-05 *WATER***

Analyte	Units	34159	34160	34161
Lab Section 1				
Total suspended solids	mg/L	1±1	2±1	2±1

The temperature of the cooler was 14.8 °C upon receipt.

SASKATCHEWAN RESEARCH COUNCIL

Environmental Analytical Laboratories
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E: analytical@src.sk.ca

www.src.sk.ca/analytical

SRC Group # 2020-7971

Jul 27, 2020

Golder

Analyte Methods

Name	Units	Method
Total suspended solids	mg/L	Chm-206

SASKATCHEWAN RESEARCH COUNCIL
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Toll-free: 1-800-240-8808
E: analytical@src.sk.ca
www.src.sk.ca/analytical

SRC Group # 2020-10042

Sep 04, 2020

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Jacoby Donnelly

Date Samples Received: Aug-26-2020 Client P.O.: 20138965/1000/1005

All results have been reviewed and approved by a Qualified Person in accordance with the Saskatchewan Environmental Code, Corrective Action Plan Chapter, for the purposes of certifying a laboratory analysis

Results from Lab Section 1 authorized by Keith Gipman, Supervisor

---

* Test methods and data are validated by the laboratory's Quality Assurance Program.

* Routine methods follow recognized procedures from sources such as
    * Standard Methods for the Examination of Water and Wastewater APHA AWWA WEF
    * Environment Canada
    * US EPA
    * CANMET

* The results reported relate only to the test samples as provided by the client.

* Samples will be kept for 30 days after the final report is sent. Please contact the lab if you have any special requirements.

* Additional information is available upon request.

* Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

This is a final report.

SASKATCHEWAN RESEARCH COUNCIL
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Toll-free: 1-800-240-8808
E: analytical@src.sk.ca
www.src.sk.ca/analytical

SRC Group # 2020-10042

Sep 04, 2020

Golder

1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Jacoby Donnelly

Date Samples Received: Aug-26-2020

Client P.O.: 20138965/1000/1005

41338 **08/25/2020 07:50 CR-WC-MS-03 *WATER***
41339 **08/21/2020 10:36 CR-WC-MS-04 *WATER***
41340 **08/20/2020 15:50 CR-WC-MS-05 *WATER***

Analyte	Units	41338	41339	41340
Lab Section 1				
Total suspended solids	mg/L	<1	<1	<1

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

The temperature of the cooler was 16.7 °C upon receipt.

Environmental Analytical Laboratories
143-111 Research Drive, Saskatoon, SK Canada S7N 3R2
T: 306-933-6932 F: 306-933-7922
Toll-free: 1-800-240-8808
E: analytical@src.sk.ca
www.src.sk.ca/analytical

SRC Group # 2020-10042

Sep 04, 2020

Golder

Analyte Methods

Name	Units	Method
Total suspended solids	mg/L	Chm-206

SASKATCHEWAN RESEARCH COUNCIL
Environmental Analytical Laboratories
143-111 Research Drive, Saskatoon, SK Canada S7N 3R2
T: 306-933-6932 F: 306-933-7922
Toll-free: 1-800-240-8808
E: analytical@src.sk.ca
www.src.sk.ca/analytical

SRC Group # 2020-11797

Oct 13, 2020

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Jacoby Donnelly

Date Samples Received: Oct-01-2020 Client P.O.: 20138965/1000/1006

All results have been reviewed and approved by a Qualified Person in accordance with the Saskatchewan Environmental Code, Corrective Action Plan Chapter, for the purposes of certifying a laboratory analysis

Results from Lab Section 1 authorized by Keith Gipman, Supervisor

---

* Test methods and data are validated by the laboratory's Quality Assurance Program.

* Routine methods follow recognized procedures from sources such as
    * Standard Methods for the Examination of Water and Wastewater APHA AWWA WEF
    * Environment Canada
    * US EPA
    * CANMET

* The results reported relate only to the test samples as provided by the client.

* Samples will be kept for 30 days after the final report is sent. Please contact the lab if you have any special requirements.

* Additional information is available upon request.

* Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

This is a final report.

SRC SASKATCHEWAN RESEARCH COUNCIL
Environmental Analytical Laboratories
143-111 Research Drive, Saskatoon, SK Canada S7N 3R2
T: 306-933-6932 **F:** 306-933-7922
Toll-free: 1-800-240-8808
E: analytical@src.sk.ca
www.src.sk.ca/analytical

SRC Group # 2020-11797

Oct 13, 2020

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Jacoby Donnelly

Date Samples Received: Oct-01-2020

Client P.O.: 20138965/1000/1006

50174 **09/28/2020 10:18 CR-WC-MS-03 *WATER***
50175 **09/26/2020 08:43 CR-WC-MS-04 *WATER***
50176 **09/27/2020 09:40 CR-WC-MS-05 *WATER***

Analyte	Units	50174	50175	50176
Lab Section 1				
Total suspended solids	mg/L	<1	<1	2±1

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

The temperature of the cooler was 22.8 °C upon receipt.

SRC Group # 2020-11797

Oct 13, 2020

Golder

Analyte Methods

Name	Units	Method
Total suspended solids	mg/L	Chm-206

wsp.com

Rook I Project

Environmental Impact Statement

Annex IV.3: Geomorphology Characterization Report

GEOMORPHOLOGY CHARACTERIZATION REPORT FOR THE ROOK I PROJECT

Prepared for:

NexGen Energy Ltd.

Prepared by:

WSP Canada Inc.

March 2024

Executive Summary

The geomorphology baseline study was completed as part of the hydrology program to support the Environmental Assessment (EA) for the Rook I Project (Project). The study incorporated existing, publicly available desktop geomorphology information such as surficial geology and glacial landforms as well as results from field studies to characterize baseline geomorphology of waterbodies and watercourses that may be most influenced by proposed Project activities. The study focused on the area of Patterson Lake and the Clearwater River between Patterson and Forrest lakes, as these are the areas expected to be most influenced by proposed Project activities. The objectives of the baseline study were two-fold: 1) to characterize existing geomorphology of Patterson Lake's shorelines and the Clearwater River channel downstream of the Patterson Lake outlet; and 2) to identify areas that may be vulnerable to increased erosion due to proposed Project activities.

The field survey sites included the following locations:

- the shoreline near the sand bar/spit that divides the Patterson Lake – North Arm into two basins;
- two shoreline locations in Patterson Lake – South Arm; and
- multiple channel cross-sections between Patterson Lake (upstream) and Forrest Lake (downstream).

The field surveys included observations of landform, shoreline slope, bank and bed materials, and vegetation, as well as photographic documentation. Information collected during the field surveys was used to classify erosion susceptibility at the field survey sites. Erosion susceptibility at other portions of the Patterson Lake shoreline was assessed using a combination of field survey, geospatial data, and aerial imagery. Channel erosion susceptibility in the Clearwater River below Patterson Lake was also assessed based on field observations.

The results from the baseline characterization of Patterson Lake showed that several shoreline segments along Patterson Lake were observed to be subject to modification by ongoing sediment transport processes. These processes include accretion (i.e., gradual build-up of sediment) resulting from longshore drift, with historical shoreline alignments different than current shoreline locations visible in the aerial imagery, as well as likely ice-thrust modification of sedimentary shorelines. The active sediment transport areas are expected to be most sensitive to possible changes in the lake hydrologic regime. The localized bank erosion sites observed along the lake shoreline in sections with ice-thrust berms were also identified as sensitive areas.

The corresponding results from the baseline characterization of Clearwater River identified a single channel upstream and multiple meandering channels farther downstream, with typical channel cross-section geometries (i.e., deep banks on the outside of the meander) and fluvial morphology (i.e., point bars). The river has an active sediment transport regime, capable of transporting mostly small size materials (i.e., fine to medium sand), as indicated by the delta feature at its mouth into Forrest Lake.

Overall, this baseline geomorphological characterization has established that there are portions of both the Patterson Lake shoreline and the Clearwater River channel below Patterson Lake that are subject to active sediment transport regimes and may be susceptible to future erosion. The potential for future changes to erosion-sedimentation processes at these areas of erosion susceptibility would depend on changes to the water surface elevation of Patterson Lake. The magnitude, direction, and duration of any future changes in lake levels and the corresponding influence on baseline sediment transport regimes in the areas of interest would be evaluated as part of the EA.

If referencing this report, please use for the following citation:

WSP (WSP Canada Inc.). 2024. Geomorphology Characterization Report for the Rook I Project. Prepared for NexGen Energy Ltd.

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Shoreline Erosion Susceptibility Calculations

APPENDIX C
Transect Cross-Sections

Abbreviations and Units of Measure

Acronym	Definition
EA	Environmental Assessment
GIS	geographic information system
LiDAR	Light Detection and Ranging
LSA	local study area
NexGen	NexGen Energy Ltd.
NHC	Northwest Hydraulics Consultants Ltd.
Project	Rook I Project
RSA	regional study area
TLU	traditional land use

Units	Definition
°	degree (angle)
%	percent
<	less than
>	more than
≥	more than or equal to
km	kilometre
km^2	square kilometre
m	metre
m/s	metres per second
masl	metres above sea level

1.0 INTRODUCTION

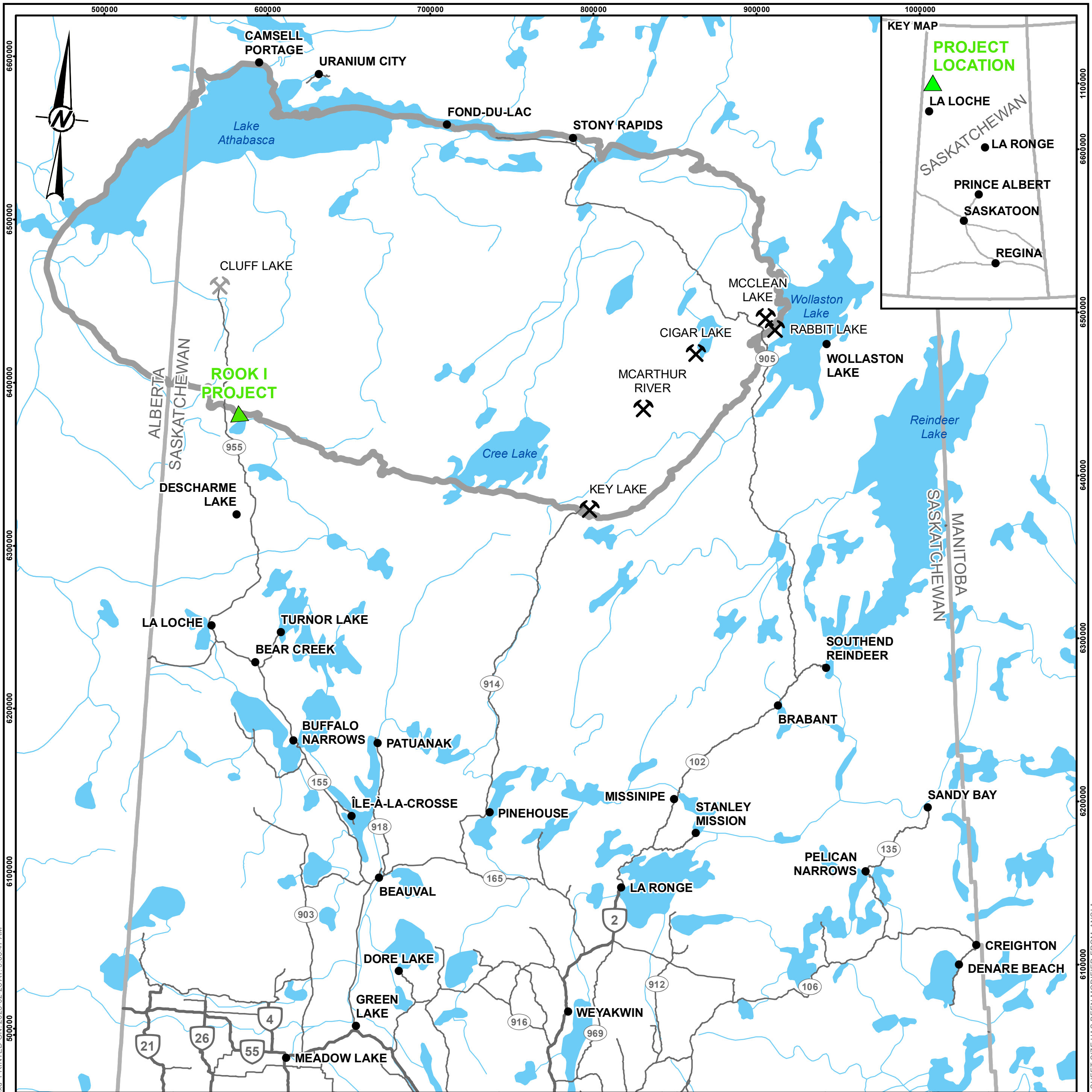
The Rook I Project (Project) is a proposed new uranium mining and milling operation that is 100% owned by NexGen Energy Ltd. (NexGen). The Project would be located in northwestern Saskatchewan, approximately 40 km east of the Saskatchewan-Alberta border, 130 km north of the town of La Loche, and 640 km northwest of the city of Saskatoon (Figure 1). The Project would reside within Treaty 8 territory and within the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, and along the upper Clearwater River system (Figure 2). Access to the Project would be from an existing road off Highway 955. The Project would include underground and surface facilities to support the extraction and processing of uranium ore from the Arrow deposit, a land-based, basement-hosted, high-grade uranium deposit.

The geomorphology baseline report represents a component of a comprehensive baseline program that documents the natural and socio-economic environments in the anticipated area of the Project. The hydrology baseline program, of which the geomorphology baseline study is a part, was undertaken to provide context from which Project environmental hydrological effects could be assessed in the Environmental Impact Statement.

Since exploration at the Project commenced in 2013, NexGen has engaged regularly and established relationships with local First Nation and Métis Groups (collectively referred to as Indigenous Groups) and northern communities, specifically those closest and with greatest access to the proposed Project. NexGen respects the rights of Indigenous Peoples and the unique relationship Indigenous Peoples have with the environment, and recognizes the importance of full and open discussion with interested or potentially affected Indigenous communities regarding the development, operation, and decommissioning of the proposed Project. Engagement activities to date, as well as future planned engagement activities, reflect the value NexGen places on meaningful engagement with Indigenous Groups and northern communities who could be potentially affected by the proposed Project. Engagement mechanisms have included, but are not limited to: meetings with leadership, workshops and community information sessions, Project site tours, establishing Joint Working Groups to support the gathering and incorporation of Indigenous and Local Knowledge throughout the Environmental Assessment (EA) process, and providing funding for Traditional Land Use (TLU) Studies[1] to understand how the proposed Project may interact with the Indigenous communities' traditional use of the anticipated area of the Project.

Feedback received during engagement activities was documented for contribution to the Environmental Impact Statement for the Project; examples of feedback received include discussion of concerns, interests, potential adverse effects, mitigation, and design alternatives. Many baseline studies were initiated in advance of formal engagement on the EA for the Project; however, engagement during the execution of baseline studies has helped inform the understanding of baseline conditions and confirmed components of the natural and socio-economic environments that required study. A summary of feedback related to the hydrology baseline program is presented in Appendix A of the Hydrology Baseline Road Map (Annex IV).

[1] Traditional Land Use (TLU) Studies include all land use studies developed by the Project's affected Indigenous Groups, including Traditional Land Use and Occupancy studies, Traditional Knowledge and Use studies, and Indigenous Rights and Knowledge studies, henceforth referred collectively as TLU Studies.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- ATHABASCA BASIN BOUNDARY
- PROJECT LOCATION

0 100 200

1:3,500,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

LOCATION OF THE ROOK I PROJECT, SASKATCHEWAN

CONSULTANT

wsp

YYYY-MM-DD	2023-02-28
DESIGNED	SS
PREPARED	NO/AK
REVIEWED	JMC
APPROVED	MM

PROJECT NO.	PHASE	REV.	FIGURE
20138965		0	1

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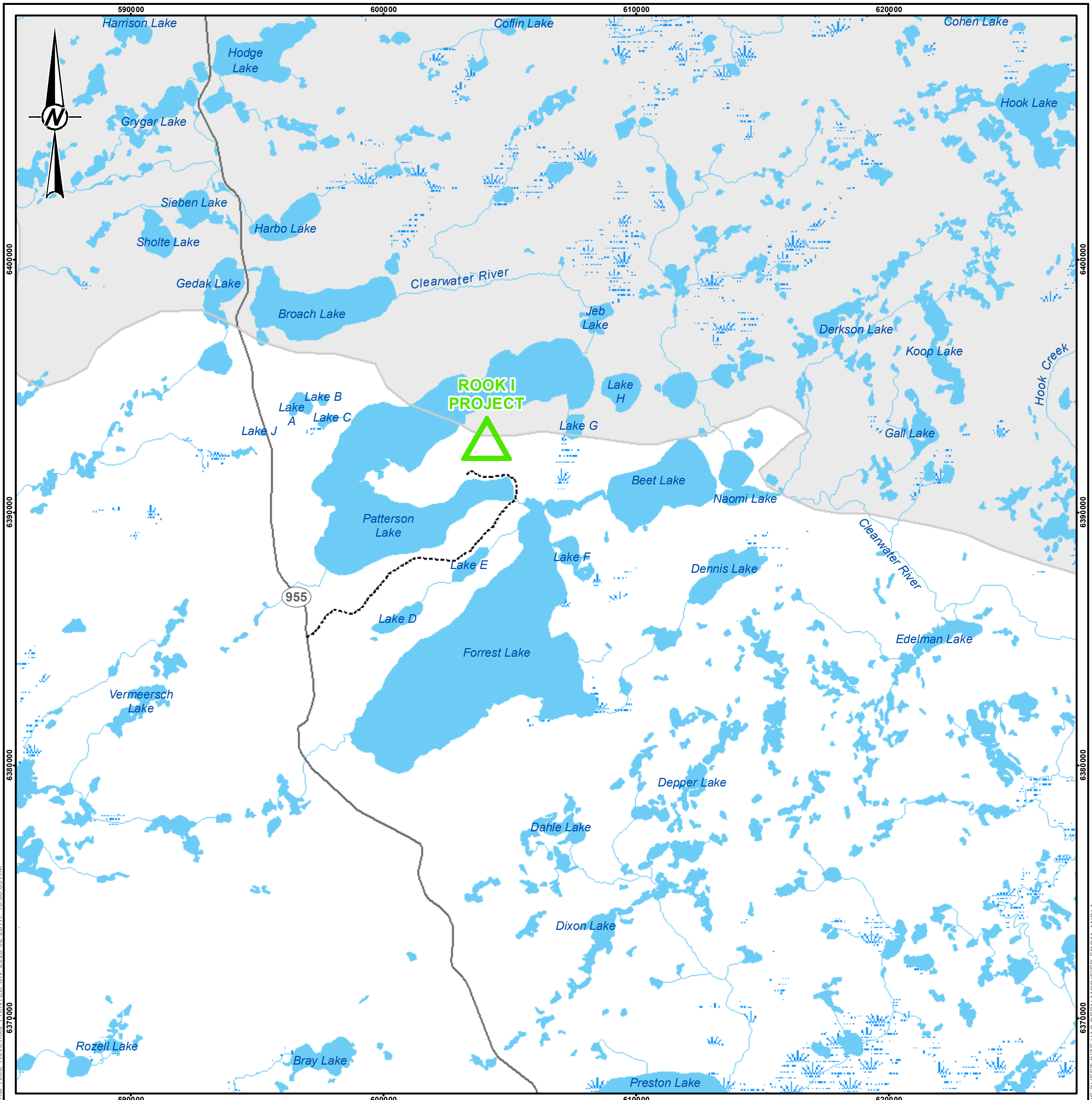

LEGEND

- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- WETLAND
- ATHABASCA BASIN
- PROJECT LOCATION
- EXISTING ACCESS ROAD

0 5,000 10,000

1:225,000 METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

REGIONAL AREA OF THE ROOK I PROJECT

CONSULTANT

wsp

YYYY-MM-DD	2023-02-28
DESIGNED	JMC
PREPARED	NO/AK
REVIEWED	JMC
APPROVED	MM

PROJECT NO.	PHASE	REV.	FIGURE
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A

25mm

0

2.0 STUDY OBJECTIVES

The geomorphology baseline study was completed in conjunction with the hydrology baseline program. The specific objectives of the geomorphology baseline study were to:

- Summarize any existing geomorphology information collected near the proposed Project.
- Characterize existing geomorphology of waterbody shorelines that could be influenced by the Project, including the shoreline of Patterson Lake.
- Characterize existing geomorphology of watercourse channels that could be influenced by the Project, including the Clearwater River below Patterson Lake from the outlet of Patterson Lake to the inlet into Forrest Lake.
- Identify areas that may be vulnerable to increased erosion due to proposed Project activities.
- Acquire accurate baseline information that can support the Project EA.

3.0 STUDY AREAS

The baseline study areas considered in the hydrology baseline program include the following (Figure 3):

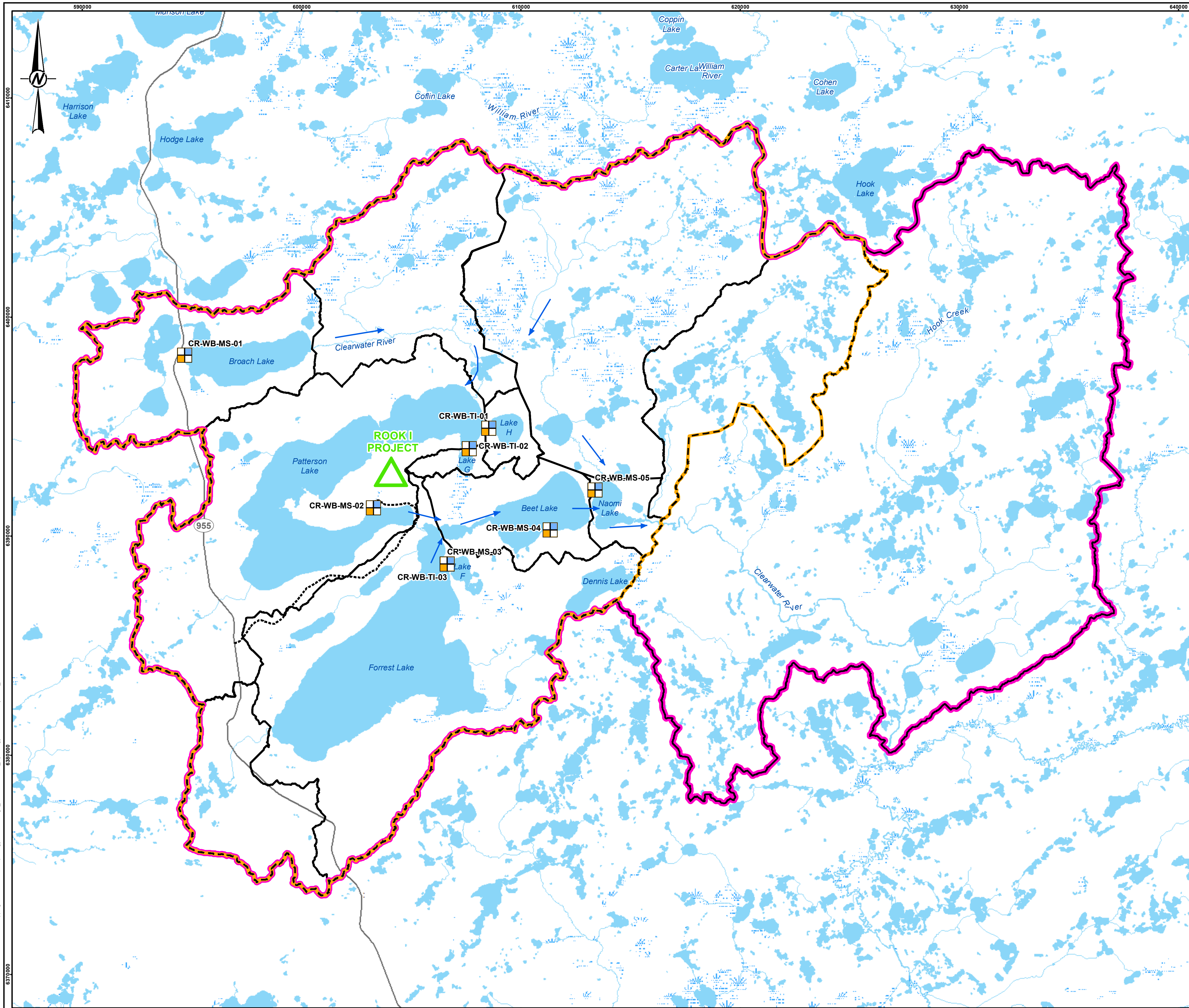
- local study area (LSA): the Clearwater River watershed to Naomi Lake outlet; and
- regional study area (RSA): the Clearwater River watershed above the confluence with the Mirror River.

The proposed Project would be located adjacent to Patterson Lake, which is in the upper portion of the Clearwater River system. The Clearwater River Upper Reach flows from Broach Lake through a series of lakes including Patterson Lake, Forrest Lake, Beet Lake, and Naomi Lake (listed in order from upstream to downstream). From Naomi Lake, the Clearwater River flows 20 km southeast before reaching the Mirror River confluence. Below the Mirror River confluence, the river deepens with higher flow volumes from the Mirror River, and the channel form changes to meandering within a well-defined river valley. Farther downstream, the Clearwater River flows through Lloyd Lake, which is immediately upstream of the Clearwater River Provincial Park; the downstream end of the park is at the Saskatchewan-Alberta border.

In general, the hydrological baseline studies focused on the Clearwater River watershed upstream of the Patterson Lake outlet and along the main lake chain downstream, including Forrest Lake, Beet Lake, Naomi Lake, and the reaches of the Clearwater River separating the lakes. Based on the potential effects of the Project and hydrologic characteristics of the region, the LSA is defined as the Clearwater River watershed to the Naomi Lake outlet (Figure 3). The Clearwater River watershed above the Naomi Lake outlet drains an area of 685 km^2. Eight waterbody monitoring locations are included in the LSA.

The RSA for hydrology includes waterbodies and watercourses within the Clearwater River watershed above the Mirror River confluence, which includes the LSA. The Clearwater River watershed above the Mirror River confluence drains an area of 1,070 km^2. The spatial extent of the Clearwater River watershed above the Mirror River confluence is expected to provide an ecologically relevant RSA for the EA. The RSA spans an area that provides habitat requirements for a discernible population unit for large-bodied fish species where cumulative effects may occur.

The baseline geomorphological characterization targeted Patterson Lake and the Clearwater River between Patterson and Forrest lakes as this waterbody and watercourse are expected to be most influenced geomorphologically by proposed Project activities. Patterson Lake can be divided into the North Arm and South Arm, oriented approximately southwest to northeast as shown in Figure 4. The North Arm can be further separated into the West Basin and East Basin separated by a narrow and shallow sand bar with spits forming on either side. Outflow from Patterson Lake is out of the east end of the South Arm via the Clearwater River.



LEGEND

- FLOW DIRECTION
- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- WETLAND

PROJECT FEATURES

- EXISTING ACCESS ROAD
- PROJECT LOCATION
- HYDROLOGY LOCAL STUDY AREA
- HYDROLOGY REGIONAL STUDY AREA
- WATERSHED

WATERBODY HYDROMETRIC STATIONS

- DISCHARGE
- SURVEYED BENCHMARK (GEODETIC DATUM)
- WATER SURFACE ELEVATION

0 3,500 7,000

1:175,000 METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. WATERSHEDS DELINEATED BY GOLDER USING GREENKENUE SOFTWARE BASED ON CANADIAN DIGITAL ELEVATION DATA AND NATIONAL HYDROGRAPHIC NETWORK WATERCOURSES.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

HYDROLOGY BASELINE STUDY AREA

CONSULTANT

YYYY-MM-DD	2023-02-28
DESIGNED	RP
PREPARED	PMT
REVIEWED	RWP
APPROVED	RA

PROJECT NO.	PHASE	REV.	FIGURE
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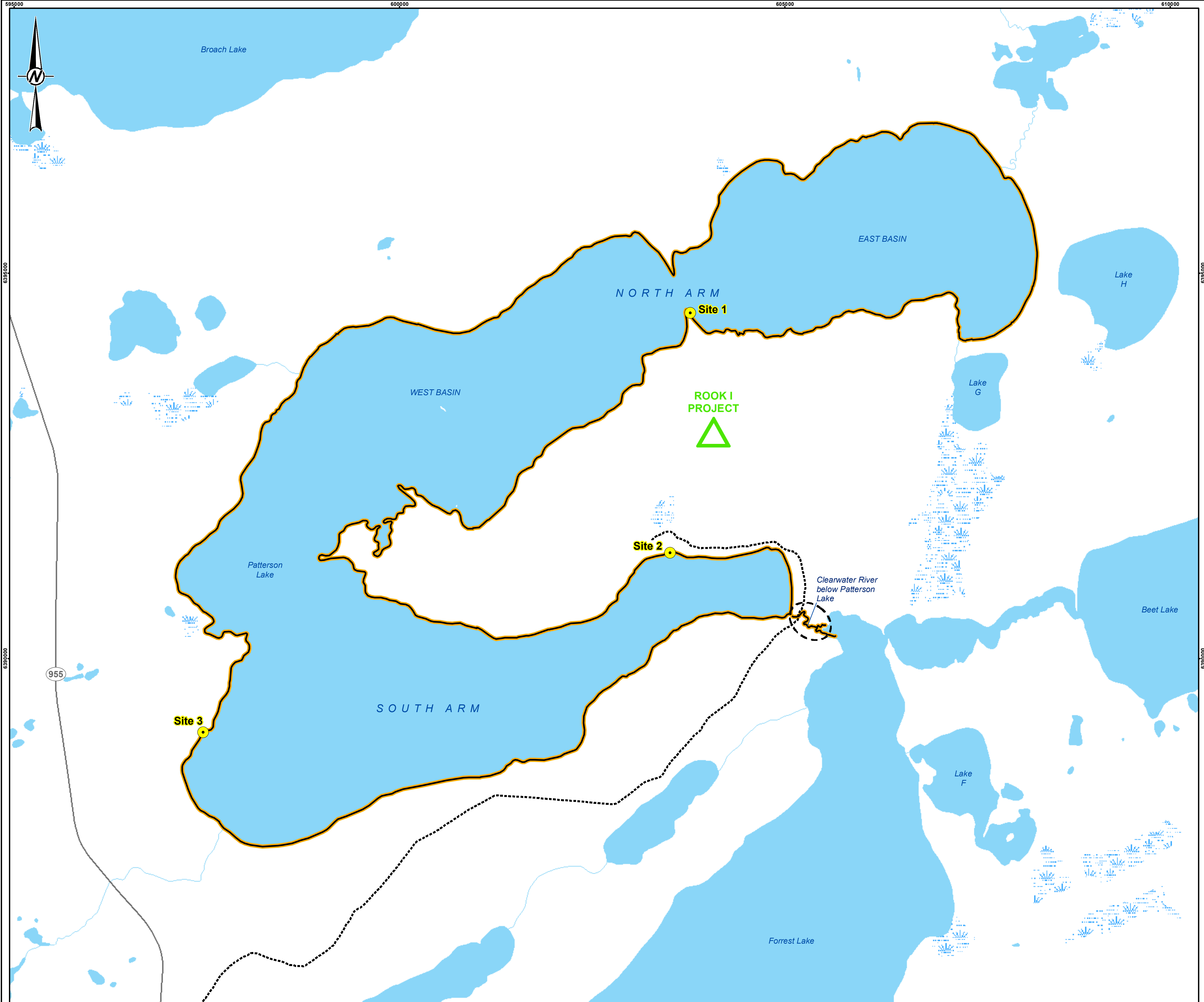
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

PATH: I:\CLIENTS\NexGen\20138965\Mapping\Products\Geomorphology\Baseline\Fig3_20138965-2000_Hydrology-Baseline-StudyAreas_Rev0.mxd



LEGEND

- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- WETLAND

PROJECT FEATURES

- EXISTING ACCESS ROAD
- PROJECT LOCATION

GEOMORPHOLOGY STUDY AREA

- SURVEY POINT LOCATION
- SURVEY AREA

0 1,000 2,000

1:50,000 METRES

REFERENCE(S)

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT
NexGen Energy Ltd.

PROJECT
ROOK I PROJECT

TITLE
GEOMORPHOLOGY BASELINE STUDY AREA

CONSULTANT
wsp

YYYY-MM-DD	2023-02-28
DESIGNED	DC
PREPARED	LMS
REVIEWED	RP
APPROVED	RWP

PROJECT NO.	PHASE	REV.	FIGURE
20138965	2000	0	4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

4.0 METHODS

The baseline geomorphological characterization used readily available desktop data and field data collected in October 2018.

4.1 Review of Existing Information

The desktop review focused on information relevant to local shoreline erosion and downstream fluvial geomorphology, including the following:

- **Meteorology data:** Wind speed and direction are the main meteorological parameters that affect lake shoreline erosion. Local wind data were measured at the NexGen Rook I Meteorological Station located near the existing exploration camp (Universal Transverse Mercator 12V 602795 E 6392291 N). Baseline meteorological monitoring data up to fall 2018 was used for field planning and initial analysis but later supplemented with data to September 2020. Wind speed and direction data were analyzed for the open-water period from May to October for a five-year period from 2016 to 2020. Windrose and direction frequency analysis were completed for the period with available data (i.e., 2016 to 2020). Local wind was reviewed to determine wind patterns at site for the open water season (i.e., May to October).
- **Surficial geology, terrain, and soils:** The review of surficial materials and soils for the area was completed using readily available data obtained from the Saskatchewan Mining and Petroleum GeoAtlas (MER 2018) and from the Department of Soil Science at the University of Saskatchewan (U of S 2018). These data were used to inform the geomorphological review for the lake shorelines and the outlet channels.
- **Available GIS data:** Aerial imagery, LiDAR data available in fall 2018, and other topographic data (NRCan 2018) were used to describe the site morphology along the lake shorelines and lake outlet channels. The LiDAR data provided by NexGen for the study area did not cover the entire shoreline of Patterson Lake nor provide sufficient resolution (i.e., typical vertical and horizontal is around 0.1 m) to be used in describing the shoreline geometry. Therefore, the LiDAR data were used as a guidance for describing the surrounding terrain and only for the portion of the shoreline with available data (i.e., east shores of Patterson Lake – South Arm, and partial areas of the south and east shores of Patterson Lake North Arm). The characterization of lake shorelines used other criteria such as shoreline geometry, inferred shoreline landforms, and vegetation type.
- **Previous studies:** Northwest Hydraulics Consultants Ltd. (NHC) completed a desktop hydrology and geomorphology analysis (NHC 2016) to review and compare options for potential treated effluent discharge points. The NHC analysis was based on desktop resources and provided background context but is not directly comparable to the current baseline study.

The baseline characterization study was largely completed based on the available information at the time of draft reporting. Baseline meteorological monitoring data up to fall 2018 was used for field planning and initial analysis but later supplemented with data to September 2020. Of the information listed above, only meteorological conditions are expected to have varied since 2019, and, as a result, the observations made in this study are not anticipated to be sensitive to surficial geology, terrain, and soils data or GIS data that may have become available since 2019.

4.2 Approach

4.2.1 Field Observations and Data Collection

Field surveys were completed between 28 September 2018 and 4 October 2018 and included the shoreline locations of Patterson Lake near the proposed mine infrastructure and the channel of Clearwater River below Patterson Lake extending to Forrest Lake.

The following methods were used for field data collection:

- The lakeshore survey area is comprised of the Patterson Lake shoreline. Three lakeshore survey sites were selected to be generally representative of larger sections of Patterson Lake and adjusted during the field visit to accommodate sites that were accessible. At each site, general characteristics of the shoreline were noted, including general bank slope, near-shore materials (i.e., materials below the water surface, in the shallow/wadable section of shore), and ice-thrust effects (e.g., ice-push berms at the shoreline, considered as evidence of thermal erosion at existing water level elevations). Photographs collected during the field surveys documented each homogenous shoreline section visited (Appendix A, Photographs). The locations of the three field survey sites are shown in Figure 4: Site 1 on the portion of Patterson Lake shoreline extending along the longshore drift feature in the vicinity of proposed mine infrastructure; Site 2 on the north shore of the South Arm; and Site 3 on the west shore of the South Arm. Weather conditions at the time of the field survey (i.e., snowfall and a continuous snow layer) prevented the field crew from fully observing the terrain on the shoreline banks at each site. However, sufficient data were collected to describe the lake shorelines and produce shoreline erosion susceptibility classifications for each site. Observations were verified during subsequent hydrometric field investigations in 2019 and 2020 when shoreline landforms were visually checked for ground truthing at randomized locations on the Patterson Lake shoreline.
- The geomorphology of the Clearwater River extending from the Patterson Lake outlet downstream to Forrest Lake was characterized based on measured cross-sectional profiles, water slope measurements, water level, bed and bank material, bank vegetation type, and active erosion or depositional areas. This reach of the Clearwater River is multi-threaded and has multiple channels for some of its length. Photographs collected during the field surveys document each homogenous channel section (Appendix A). The Clearwater River below Patterson Lake was surveyed from the Patterson Lake outlet to the Forrest Lake inlet (Figure 4). A total of 38 transects were surveyed from immediately upstream of the lake outlet, moving downstream at approximately 35 m intervals depending on channel morphology (Figure 13). The main outlet channel separates into two smaller channels (i.e., north channel and south channel) approximately 200 m upstream from Forrest Lake, carrying similar flow rates in each of the smaller channels. Both smaller channels were surveyed.

4.2.2 Erosion Susceptibility Assessment

Erosion susceptibility was assessed at a high level for the watercourse channels and waterbody shorelines located in the geomorphology baseline study area shown in Figure 4. A waterbody shoreline erosion susceptibility class system, ranking from “Very Low” to “Very High”, was developed using the geomorphological field data collected for shoreline characteristics. Erosion susceptibility was classified according to an erosion potential score (Table 1) derived as a function of bank and shoreline features, exposure characteristics, and attenuation characteristics. The details for determining waterbody shoreline erosion susceptibility are presented in Appendix B, Shoreline Erosion Susceptibility Calculations.

Table 1: Classification of Shoreline Erosion Susceptibility or Potential based on the Erosion Susceptibility Score

Erosion Susceptibility Class	Erosion Susceptibility Score
Very Low	<15
Low	15 to 20
Moderate	20 to 25
High	25 to 35
Very High	>35

< = less than; > = more than.

The Patterson Lake shoreline was delineated, as a desktop exercise, into areas with similar geomorphological characteristics using readily available data: satellite imagery, terrain elevation, and field observations. The main delineation criteria are summarized in Table 2.

Table 2: Lake Shoreline Delineation Criteria

Data Available	Delineation Criteria
Shoreline Exposure	Dominant wind, by quadrant Criterion looked at a combination of the most frequent wind direction and fetch length
Vegetation Type	Forested (i.e., trees) Shrubs Bare
Shoreline Landform including materials (inferred)	Sandy, beach Shallow, with berm Steep, rocky
Shoreline Geometry (i.e., shape)	Point (or headland) Straight (or irregular) Bay

The channels of the Clearwater River between the outlet of Patterson Lake and its outflow into Forrest Lake were evaluated using a channel assessment procedure adapted for northern environments that considers factors such as streambed and bank materials, channel slope, and development of ice formations.

5.0 RESULTS

The results of baseline geomorphological characterization desktop study and 2018 field study are presented in the subsections below.

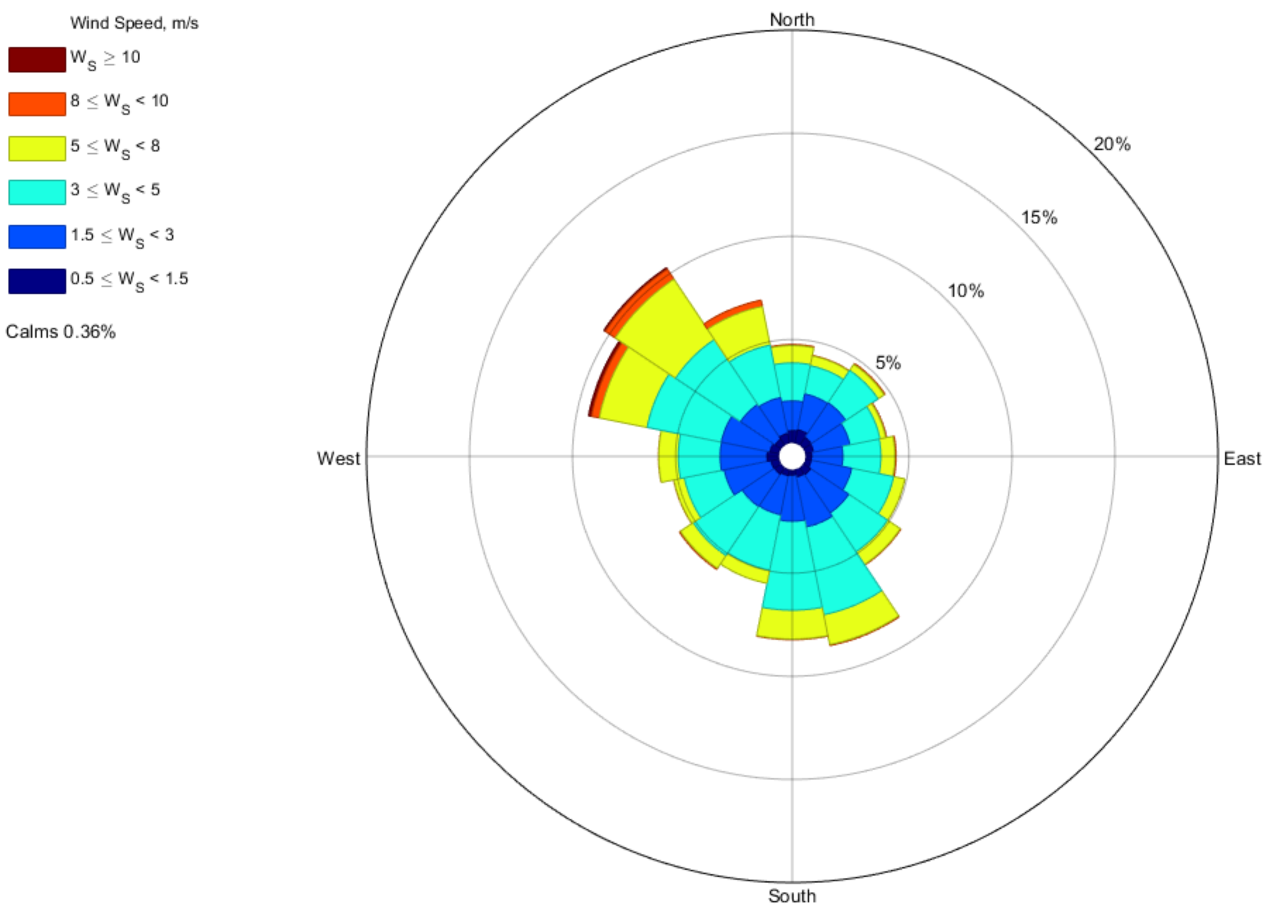
5.1 Review of Existing Information

5.1.1 Meteorological Observations

The main meteorological parameters that affect shoreline erosion potential are wind speed and wind direction. This is because wind blowing over open water generates waves. The uninterrupted length of the open water parallel to the direction the wind is blowing is referred to as the fetch. As wind speed and fetch increase, wave height typically increases; the height of the waves is related to the magnitude of persistent wind speed and the length of open water (i.e., fetch) over which the wind blows. As wave height increases, the erosive power of the waves increases. Water depth serves to modify this general relationship. Ice cover limits the generation of waves by winds by reducing the area of open water and, thus, the available fetch lengths. Wind-wave analysis is, therefore, typically limited to open water months (i.e., spring through fall).

Figure 5 presents the directions and the wind class frequency distribution measured during the period with available climate data. Prevailing winds were from the northwest and west-northwest as well as the south-southeast and south directions (Figure 5). Higher winds exceeding 5 m/s occurred 25% of the time and were most frequently from the west-northwest to north-northwest. The available wind data were sufficient to characterize the general range of wind speed and directions for the site.

Figure 5: Rook I Meteorological Station Wind Rose for the Open-Water Period, May 2016 to October 2020



> = more than.

5.1.2 Geology

5.1.2.1 Project Geology

The study area is located within the Athabasca Basin. The Athabasca Basin is a Paleoproterozoic-age, intracontinental, sedimentary basin covering a large portion of northwestern Saskatchewan and a smaller portion of northeastern Alberta. This basin consists of the Athabasca Supergroup and is composed primarily of sandstones with local conglomeratic beds. The general geology of the region around the Project includes 30 m to 100 m thick glacial drift deposited by the retreating glaciers that overlie Cretaceous mudstones. The glacial drift is composed primarily of sand mixed with gravels, cobbles, and boulders. The glacial deposits have formed topographic features in the anticipated area of the Project such as drumlins, outwashes, hummocky terrain, and kettle lakes.

5.1.2.2 Local Surficial Geology, Terrain, and Soils

Terrain is a comprehensive term used to describe a tract of landscape and the associated natural physical features. Terrain maps typically show surficial materials, material texture, surface expression, relief, elevation, drainage, or material-modifying processes. The surficial geology for the study area was obtained from the Saskatchewan Mining and Petroleum GeoAtlas (MER 2018) and was used to inform the geomorphological analysis for the lake shorelines and the channels of Clearwater River below Patterson Lake.

The local surficial geology in the study area presents the main characteristics of the Athabasca Basin, where the spatial and temporal patterns of deglaciation formed the main terrain landforms. The typical materials for the Athabasca Basin include sand mixed with gravels, cobbles, and boulders. The Patterson Lake watershed, together with the Broach Lake watershed (upstream) and parts of the Forrest Lake watershed (downstream), is located within a small area mainly glaciolacustrine plain deposits (Simpson 1997) with sand, silt, and clay accumulations deposited in glacial lakes. The Athabasca Basin borders glaciofluvial hummocky deposits to the east (i.e., downstream of Naomi Lake) and north, and morainal deposits to the west and south. The surficial materials in this area appear to be dominated by sediments deposited around the end of the last glaciation approximately 9,500 years ago, with a secondary component of fluvial and organic deposits that have accumulated in the last few thousand years.

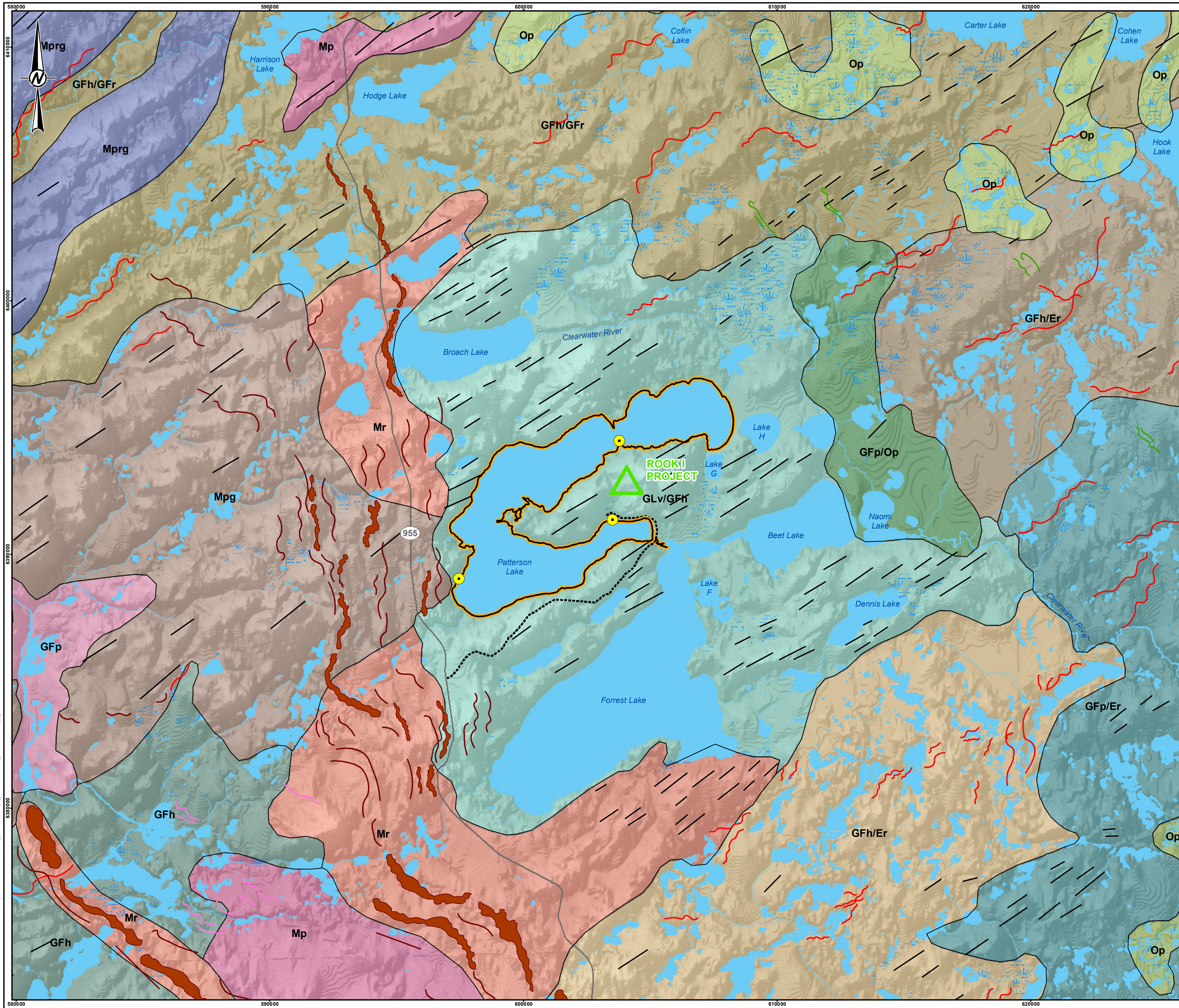
While glaciolacustrine and glaciofluvial materials are predominant in the area, they occur in association with other materials, especially where organic materials overlie the glacial and post-glacial sediments. Consequently, most map units describing terrain areas depict complexes of terrain with a mixture of types. The glacial landforms in the study area, from Norris et al. (2017), are shown in Figure 6. A summary of the terrain units within the surveyed watersheds is provided in Table 3.

Table 3: Surficial Geology within the Study Area

Terrain Symbol Unit (Dominant/Sub-dominant)	Description
GLv/GFh	Glaciolacustrine veneer and glaciofluvial hummocky landforms
GFh/GFr	Glaciofluvial hummocky landforms and ridges
GFp/Op	Glaciofluvial with outwash plain
Op	Outwash plains
Mr	Morainal ridged
Mpg	Morainal plain
GFh/Er	Glaciofluvial with hummocky landforms and eolian-ridged dunes
GFp/Er	Glaciofluvial with plains and eolian ridged dunes

Source: MER 2018.

Most of the surficial geology (more than 60%) in the vicinity of Patterson Lake, including its shoreline and banks, is made up of mineral soils (dominant Eluviated Dystric Brunisolic soils, with inclusions of Gleyed Eluviated Dystric Brunisolic and Gleysolic soils). These soils have developed in sandy glacial sediments under pine forests on undulating and rolling landscapes (i.e., more than 0.5% to 10% slopes) (Annex VI, Terrain and Soils Baseline Report). The areas dominated by a depressional landscape have Gleysolic soils and organic soils at the deepest part of the depression areas (Annex VI). Organic soils are present in the depressional areas with low slopes (i.e., less than 0.5%) and moderately decomposed organic materials (i.e., fen peat) overlying moderately coarse to coarse textured glaciofluvial deposits (i.e., loamy sand, sand, sandy loam). These areas include areas adjacent to watercourses, such as the Clearwater River below Patterson Lake, which also tend to occupy low lying areas in the landscape.



LEGEND

SECONDARY HIGHWAY
WATERCOURSE
WATERBODY
WETLAND

PROJECT FEATURES

EXISTING ACCESS ROAD
PROJECT LOCATION

GEOMORPHOLOGY STUDY AREA

SURVEY POINT LOCATION
SURVEY AREA

GLACIAL LANDFORMS

CREVASSE-FILL RIDGE
ESKER
ICE-THRUST RIDGE
LINEATION
MINOR MORAINE RIDGE
MAJOR MORAINE

SURFICIAL GEOLOGY

GFh - GLACIOFLUVIAL HUMMOCKY
GFh//Er - GLACIOFLUVIAL HUMMOCKY
GFh//GFr - GLACIOFLUVIAL HUMMOCKY
GFh/Er - GLACIOFLUVIAL HUMMOCKY
GFp - GLACIOFLUVIAL OUTWASH PLAIN
GFp/Er - GLACIOFLUVIAL
GFp/Op - GLACIOFLUVIAL OUTWASH PLAIN
GLv/GFh - GLACIOLACUSTRINE
Mp - MORAINAL PLAIN
Mpg - MORAINAL PLAIN
Mprg, MORAINAL PLAIN
Mr - MORAINAL RIDGED
Op - ORGANIC

0 2,500 5,000
1:150,000 METRES

REFERENCE(S)

1. SURFICIAL GEOLOGY OBTAINED FROM GEOLOGICAL ATLAS OF SASKATCHEWAN VIEWER © 2016, GOVERNMENT OF SASKATCHEWAN.
2. GLACIAL LANDFORMS: SOPHIE L. NORRIS, MARTIN MARGOLD & DUANE G. FROESE (2017) GLACIAL LANDFORMS OF NORTHWEST SASKATCHEWAN, JOURNAL OF MAPS, 13:2, 600-607, DOI: 10.1080/17445647.2017.1342212.
3. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT
NexGen Energy Ltd.

PROJECT
ROOK I PROJECT

TITLE
SURFICIAL GEOLOGY AND GLACIAL LANDFORMS IN THE STUDY AREA

CONSULTANT
wsp

YYYY-MM-DD	2023-02-28
DESIGNED	DC
PREPARED	LMS
REVIEWED	RP
APPROVED	RWP

PROJECT NO.	PHASE	REV.	FIGURE
20138965	2000	0	6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

5.2 Patterson Lake

5.2.1 Field Observations and Data

Patterson Lake is a U-shaped lake composed of two arms (i.e., the North Arm and the South Arm) oriented approximately southwest to northeast (Figure 4). The North Arm can be classified as two basins (i.e., West Basin and East Basin), which are separated by a narrow, shallow sand bar (Figure 7). The narrow, shallow sand bar appears to connect two spit-like sediment features that extend from either side of the lake. The sand bar/spit is composed of predominantly sand-sized sediment. The North Arm is the longer of the two arms, at approximately 12 km, while the South Arm is approximately 8 km.

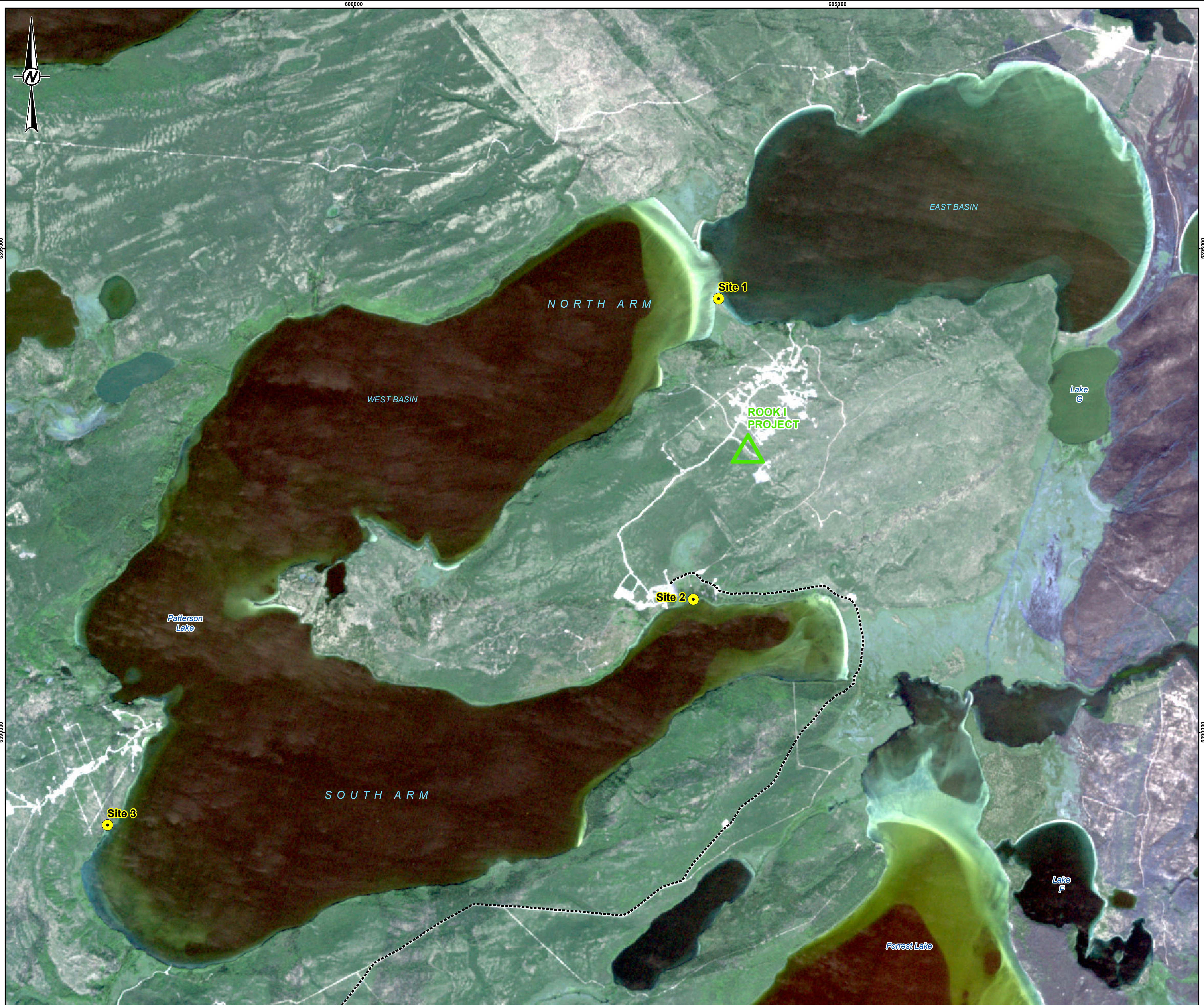
Three sites on the Patterson Lake shoreline were investigated during the site reconnaissance (Figure 7) to document shorelines in areas that were available for access. Weather conditions at the time of visit (i.e., snow cover) prevented detailed information from being collected. However, sufficient data were collected to describe the lake shorelines and produce shoreline erosion susceptibility classifications for each site.

The main observations for the three shoreline sites on Patterson Lake are summarized in Table 4.

Table 4: Patterson Lake Shoreline Sites Description

Site Number	Location	Site Description
Site 1	Southern shoreline of the North Arm at the narrows (Figure 8)	Site 1 is located along a sandy spit-like shoreline between the western and eastern basins of the North Arm. The shoreline is composed of a sand beach varying in width from approximately 1.5 m on the lakeward end of the spit, widening to 6 m shoreward. Elevated shoreline berms of sediments and organics were observed along the shoreline and were interpreted to be ice-thrust features. The height of the berms was measured at approximately 2 m above the top of bank. The bank height was measured at approximately 0.5 m to 0.7 m above the water level (498.510 masl) at the time of visit on 29 September 2018. The shoreline banks were steep (i.e., >45°) along the entire investigated shoreline section.
Site 2	Northeast shoreline of the South Arm (Figure 9)	Site 2 shoreline is composed of a mix of large cobble and boulder materials overlain with organic soils and a forest with mainly black spruce. Elevated shoreline berms were not observed at this location. The bank height was measured at approximately 0.5 m above the water level (498.510 masl) at the time of visit on 29 September 2018. The shoreline banks have a gentle slope (i.e., <25°) along the investigated shoreline section.
Site 3	Western shoreline of the South Arm (Figure 10)	Site 3 shoreline is composed of a mix of cobble and boulder materials overlain with organic soils and a forest with mainly conifers. Elevated shoreline berms were observed and measured to be approximately 3 m above the water level at the time of visit. These are interpreted to be ice-thrust features. The bank height was measured at approximately 0.5 m to 1.0 m above the water level (498.571 masl) on 1 October 2018. The shoreline banks are steep (i.e., >45°) along the investigated shoreline section.

> = more than; < = less than; masl = metres above sea level.



LEGEND

PROJECT FEATURES

EXISTING ACCESS ROAD

PROJECT LOCATION

SURVEY POINT LOCATION

0 1,000 2,000

1:40,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, DATED: SEPTEMBER 1, 2017.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

PATTERSON LAKE SHORELINE SURVEY LOCATIONS

CONSULTANT

YYYY-MM-DD	2023-02-28
DESIGNED	DC
PREPARED	LMS/AK
REVIEWED	RP
APPROVED	RWP

PROJECT NO.	PHASE	REV.	FIGURE
20138965	2000	0	7

Figure 8: Typical Photograph of the Shoreline at Site 1

Note: Universal Transverse Mercator 12V 603680 E 63943657 N facing northwest.

Figure 9: Typical Photograph of the Shoreline at Site 2

Note: Universal Transverse Mercator 12V 597619 E 6389251 N facing northwest.

Figure 10: Typical Photograph of the Shoreline at Site 3

Note: Universal Transverse Mercator 12V 604460 E 6394250 N facing east.

5.2.2 Shoreline Erosion Susceptibility

The main parameters derived for each Patterson Lake shoreline field survey site that were used to estimate the shoreline erosion susceptibility potential are summarized in Table 5 and presented in detail in Appendix B.

Table 5: Shoreline Parameters and Erosion Susceptibility Classes for Patterson Lake

Site Name	Shoreline Orientation	Bank Slope (º)	Fetch Length (m)	Erosion Susceptibility Score	
				Score	Class
Site 1	NE, ENE	>45	4,300	45	Very High
Site 2	S	<25	850	23	Moderate
Site 3	ESE, SE	>45	3,300	27	High

> = more than; < = less than; N = north; E = east; S = south.

Site 1 was classed as having a Very High erosion susceptibility. Site 1 is located along the narrow section in the North Arm that divides the East Basin and West Basin. The organic bank materials and sandy shoreline materials combined with the exposed nature of the shoreline to a fetch length of approximately 4.5 km make this section of the shoreline highly susceptible to processes that can include erosion (i.e., removal of bank material) and/or deposition/accretion (i.e., sediment is added to the shoreline). Figure 11 shows the shoreline at Site 1 in more detail using satellite imagery available from May 2013 (ESRI Digital Globe 2013). Historical shoreline alignments were inferred based on visible striated patterns in the vegetation. The alignment of the striations indicates that the shoreline at this location is advancing towards the north-northeast as a result of sediment transport, most likely carried by longshore currents. Overall, the shoreline of Patterson Lake at Site 1 showed signs of ongoing and active sediment transport in the form of accretion of the point at the narrows.

Site 2 was classed as having a Moderate erosion susceptibility. Site 2 is located near the active hydrometric station on Patterson Lake, CR-WB-MS-02, and is also near the existing exploration camp. The fetch length at Site 2 is approximately 0.9 km. The shores were armoured with large cobbles and boulders, and the banks were interpreted as stable (i.e., no erosion signs). The shoreline banks are covered by mature pine trees. No signs of other shoreline processes were observed.

Site 3 was classed as having a High erosion susceptibility. Site 3 is located on the western shoreline of the Patterson Lake – South Arm near the site of a former hydrometric station that was used for the monitoring of lake water levels. The fetch length at Site 3 is approximately 8 km. At this location, a large ice-thrust berm, approximately 3 m high, was interpreted from observations of mounded sediment and organic material along the shoreline. The berm forms the edge of the lake. Bank erosion and bank failures were also observed along this section of shoreline. The main shoreline processes at this location were attributed to thermal erosion (i.e., ice-push berms) where lake ice is the dominant factor. The bank materials were observed to be large cobble and boulders.

The results of the Patterson Lake shoreline delineation are presented in Figure 12. The variability in Patterson Lake shoreline exposure, surficial geology, landform, and geometry are shown in the complexity and variety of shoreline types inferred in the delineation. Relatively long wind fetches (i.e., over 3 km) are typical for most of the shoreline. These characteristic fetch lengths, combined with the observed shoreline landform (i.e., profile) and surficial materials, are expected to be the main indicator of shoreline susceptibility to erosion, recognizing that shoreline sections with similar erosion potential are expected to exhibit similar responses to changes in the hydrological regime of the lake. To that end, the areas most susceptible to erosion due to wave action are shorelines composed of sand with long wind fetches, especially with exposure to the directions with the most intense winds including the south and northwest. The shoreline classification in Figure 12 indicates such shorelines can be found on the end of the peninsula separating the North Arm – West Basin and South Arm as well as on the north shore of the North Arm – East Basin. The shoreline classification mapping was verified during subsequent hydrometric field investigations in 2019 and 2020 when shoreline landforms were visually checked for ground truthing at randomized locations on the Patterson Lake shoreline.

LEGEND

- SURVEY POINT LOCATION
- HISTORICAL SHORELINE

0 40 80

1:2,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, DATED: 2015.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

PATTERSON LAKE HISTORICAL SHORELINE ALIGNMENTS

CONSULTANT

wsp

YYYY-MM-DD	2023-02-28
DESIGNED	DC
PREPARED	LMS/AK
REVIEWED	RP
APPROVED	RWP

PROJECT NO.	PHASE	REV.	FIGURE
20138965	2000	0	**11**

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

5.3 Clearwater River below Patterson Lake

5.3.1 Field Observations and Data

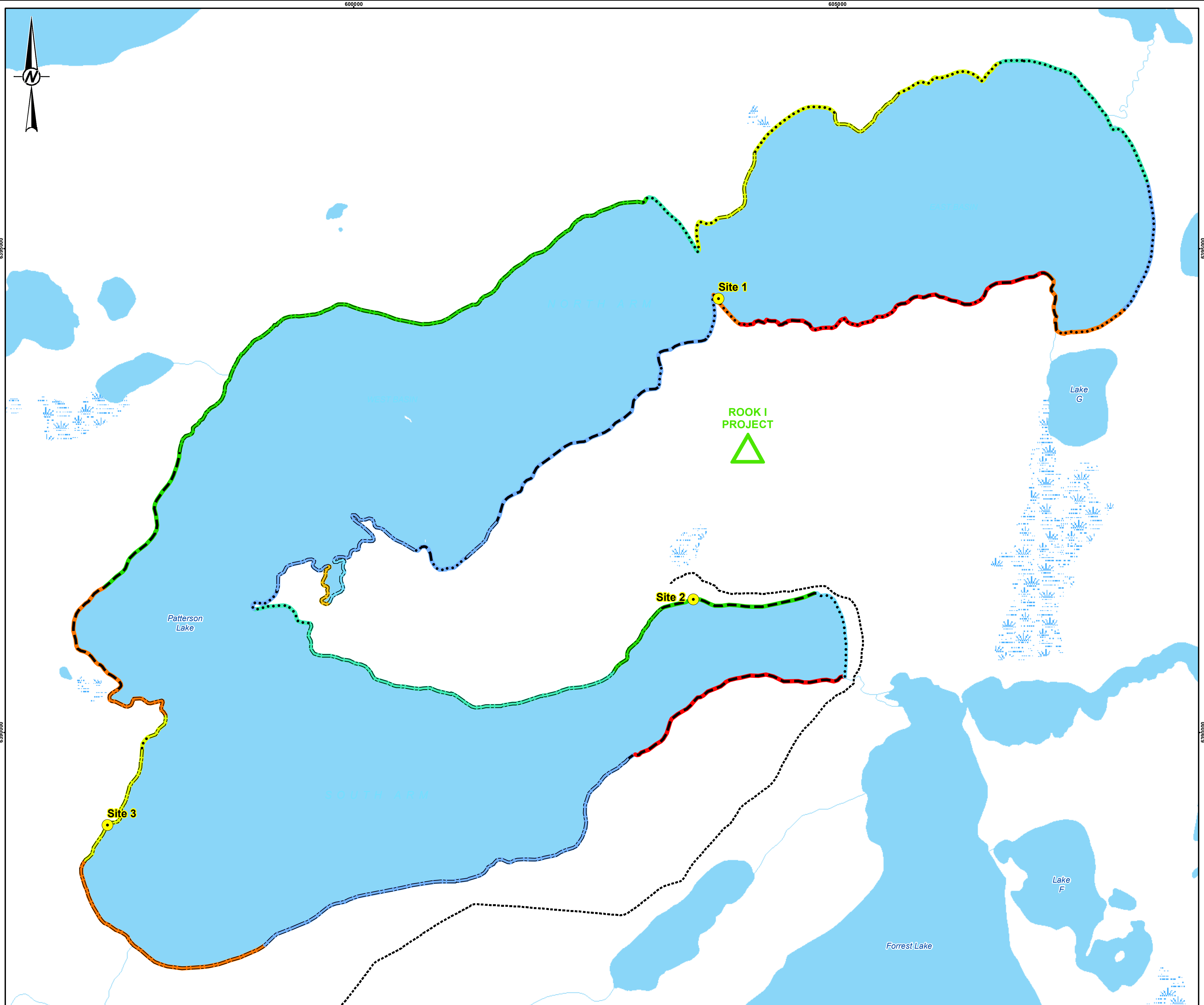
The Clearwater River flows through flat terrain, with surficial materials of hummocky glaciofluvial deposits covered by black spruce pine forests. Both banks of the channel have soils consisting of primarily organic materials fully covered by vegetation, which is predominantly black spruce. The channel is typically 5 m to 10 m wide with water depths less than 1.5 m deep relative to the surrounding terrain. The stream bed materials are primarily sand with sparse large boulders. The channel banks were observed to be a mixture of soils and organic materials. In straight run reaches, the bed was observed to be characterized by a typical ripple bed form pattern. This characterization is supported by comparison of hydraulic characteristics to the bed form charts presented in the *Handbook of Hydrology* (Maidment 1994) associated with fine to medium sand. The channel is made up of single and multi-threaded wandering meanders and its planform (i.e., shape when viewed from above) is sinuous (i.e., sinuosity coefficient of approximately 1.5), meaning that the curvilinear length along the stream is approximately 1.5 times longer than the straight-line length. The river meanders show typical channel geometries:

- steeper banks occurring on the outside of bends; and
- some erosion and deeper than average (i.e., 1.5 m to 1.9 m) riverbed pools at the apex and downstream of the apex of the meanders.

The full channel cross-sections of the surveyed transects are presented in Appendix C, Transect Cross-Sections. The average slope gradient of the water surface in the Clearwater River from Patterson Lake outlet to Forrest Lake inlet was measured at 0.05%.

Ongoing bank erosion was observed on the outside bend for most channel meanders and was confirmed by channel geometry cross-section measurements (Appendix C) and vegetation observations such as mature trees leaning over the channel, or already fallen in the channel. A typical channel-transects comparison example in Figure 14 shows the differences in bank slope and maximum bank full depth between a transect measured in a straight portion of the channel (i.e., Transect 13), and a transect measured at a meander (i.e., Transect 14). The maximum bank full depth is approximately double in the meander section.

Where trees were observed to have fallen from the bank, they were observed to typically remain attached to the bank (Figure 15) and have the potential to promote local scour during high flow periods in the spring.



LEGEND

- WATERCOURSE
- WATERBODY
- WETLAND

PROJECT FEATURES

- EXISTING ACCESS ROAD
- PROJECT LOCATION

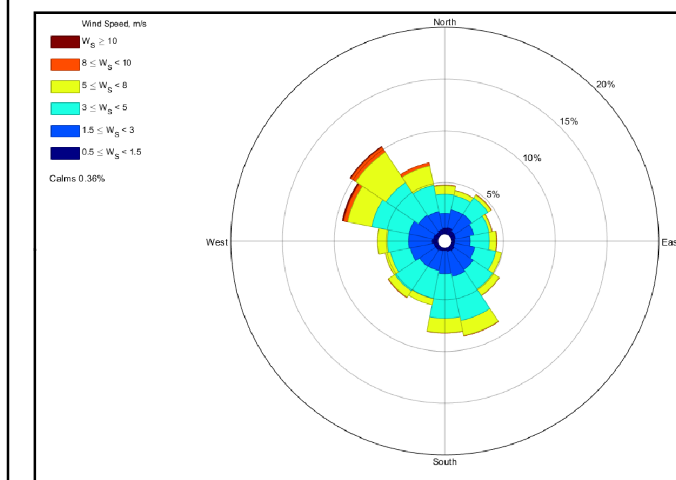
- SURVEY POINT LOCATION

DOMINANT WIND EXPOSURE (BY QUADRANT)

- NORTH
- NORTHEAST
- EAST
- SOUTHEAST
- SOUTH
- SOUTHWEST
- WEST
- NORTHWEST

SHORELINE LANDFORMS

- SANDY/BEACH
- SHALLOW WITH BERM
- STEEP/ROCKY



0 1,000 2,000

1:40,000 METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

PATTERSON LAKE GEOMORPHOLOGICAL SHORELINE DELINEATION

CONSULTANT

wsp

YYYY-MM-DD	2023-02-28
DESIGNED	DC
PREPARED	LMS
REVIEWED	RP
APPROVED	RWP

PROJECT NO.	PHASE	REV.	FIGURE
20138965	2000	0	12

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

LEGEND

PROJECT FEATURES

EXISTING ACCESS ROAD

FLOW DIRECTION

STREAM SURVEY TRANSECT

0 40 80

1:2,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, DATED: 2015.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

CLEARWATER RIVER SURVEY LOCATIONS

CONSULTANT

wsp

YYYY-MM-DD	2023-02-28
DESIGNED	DC
PREPARED	LMS
REVIEWED	RP
APPROVED	RWP

PROJECT NO.	PHASE	REV.	FIGURE
20138965	2000	0	13

Figure 14: Channel Cross-Section Comparison, Clearwater River below Patterson Lake

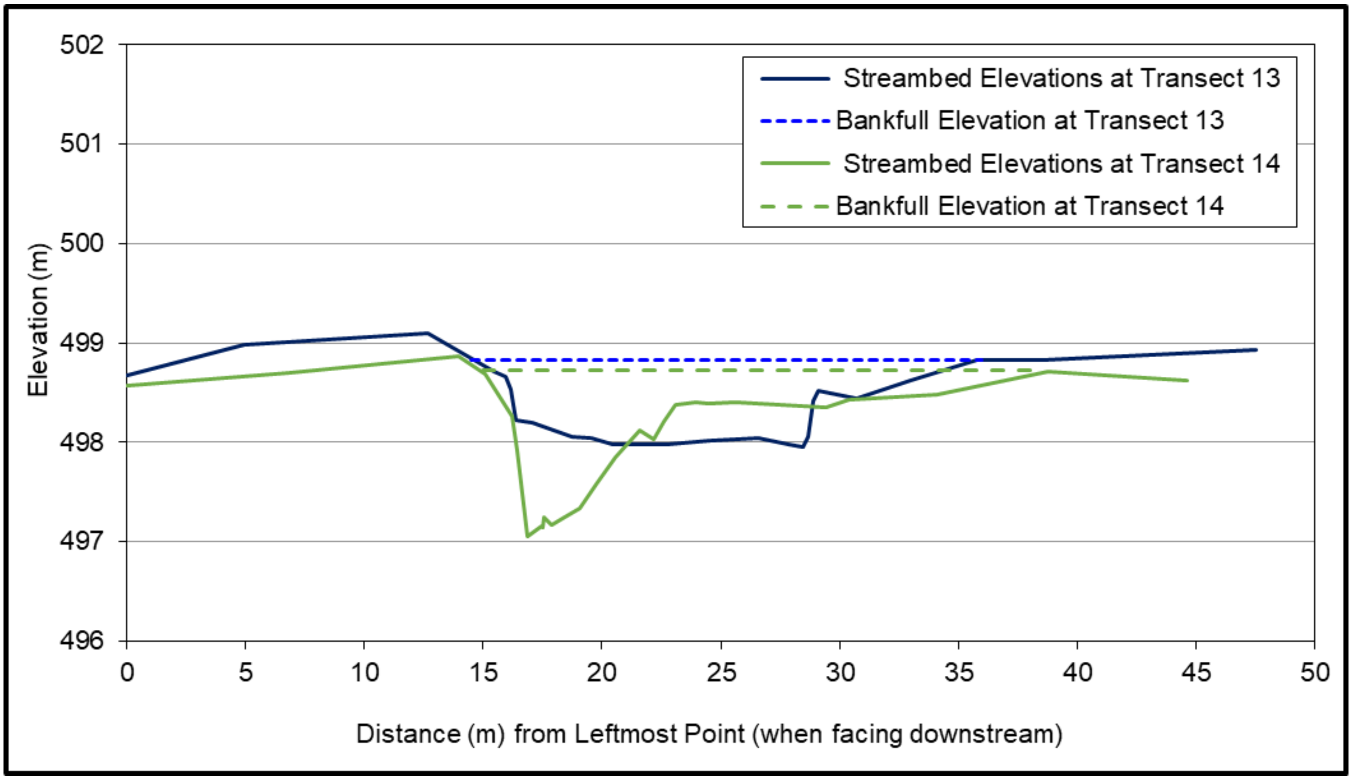


Figure 15: Typical Bank Erosion on Outside of Meander with Trees Leaning over the Channel

Note: Universal Transverse Mercator 12V 605322 E 6390403 N. View is from south to north, taken on 3 October 2018.

5.3.2 Channel Erosion Susceptibility

Sediment transport along the channel was interpreted at a high level using available imagery and visual observations made during the field visit. Channel bed materials over the surveyed area were observed to be mostly sand. The main channel splits into two smaller channels approximately 200 m upstream of the Forrest Lake inflow. The imagery suggests that the north channel is the main active sediment transport pathway of the Clearwater River, with visible and recent sediment deposits at the mouth and formation of a delta. Field observations for sediment transport indicated that the bulk of the sediment volume is delivered during the spring high flows as transport was not observed during low flow conditions. Sediment transport on the south channel is present but at a lower rate compared to the north channel, with no recent sediments visible at the mouth. However, older delta deposits at the mouth of the south channel were interpreted from the aerial imagery to be similar in morphology to the active deposits at the mouth of the north channel (Figure 16 and Figure 17). This finding implies that Clearwater River may switch between north and south channel alignments in this section during flood events. Sediment transport measurements, suspended or as bed load, were collected as part of the hydrometric monitoring and are summarized in the terrain and soils baseline report (Annex VI).

Overall, the Clearwater River below Patterson Lake is susceptible to bank erosion (with soils and organics materials on its banks) and has active sediment transport (mostly sand-size materials) indicated by the active delta at its mouth.

Figure 16: Patterson Lake Channel Outflow (Clearwater River below Patterson Lake) into Forrest Lake

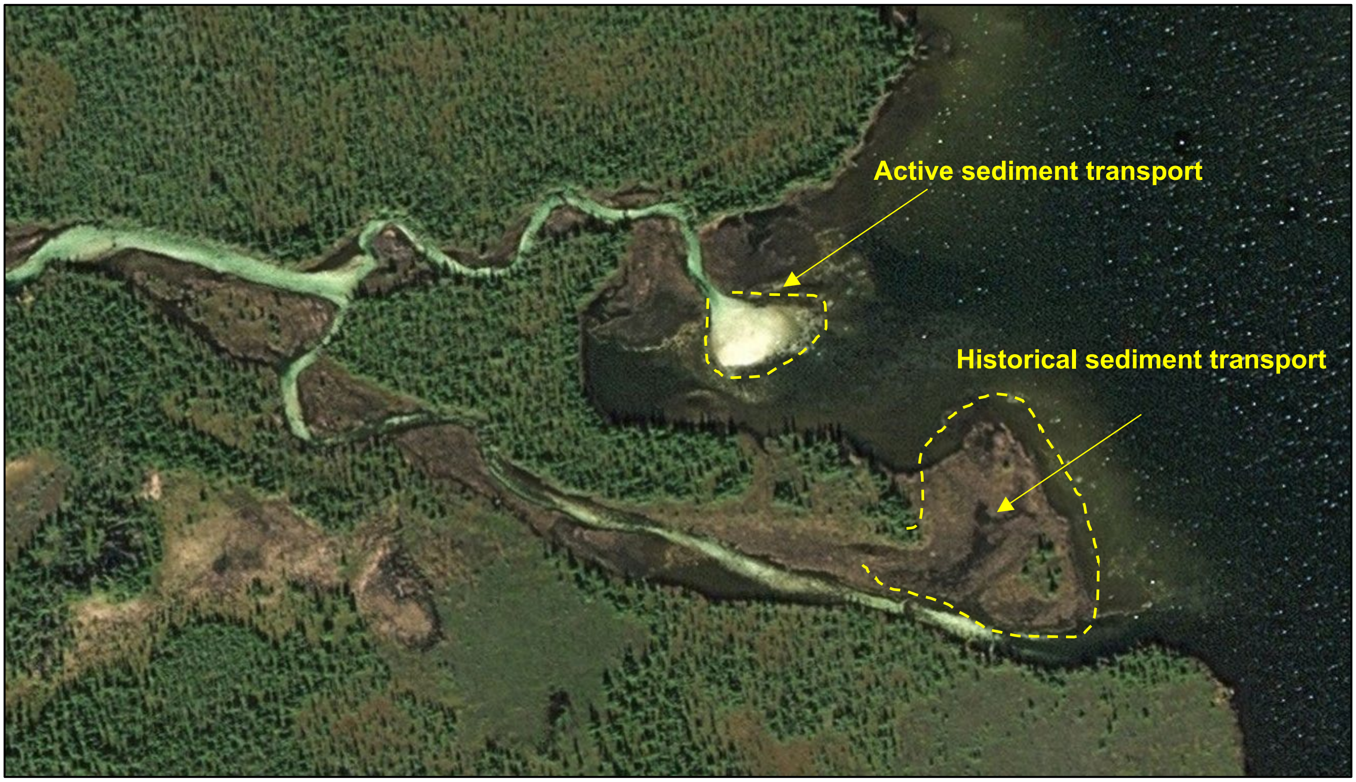


Figure 17: Patterson Lake Channel Outflow (Clearwater River below Patterson Lake) into Forrest Lake

Note: View is from east to west, the photo was taken from helicopter on 1 October 2019.

6.0 SUMMARY

A geomorphological baseline study was completed as part of the hydrology program to establish baseline conditions to support an Environmental Assessment (EA) of the Rook I Project (Project). The study consisted of a desktop geomorphological review, targeted field study, and preliminary analysis for erosion susceptibility. The baseline geomorphological characterization focused on Patterson Lake and the Clearwater River below Patterson Lake as these are areas expected to be most influenced by proposed Project activities.

The field survey sites visited on Patterson Lake included one location on the shoreline of Patterson Lake near the sand bar/spit that divides the Patterson Lake – North Arm into two basins, as well as two additional shoreline locations in the South Arm. The field survey of the Clearwater River included multiple channel cross-sections between Patterson Lake (upstream) and Forrest Lake (downstream). The field surveys included observations of landform, shoreline slope, bank and bed materials, and vegetation, as well as photographic documentation.

Information collected during the field survey was used to support classification of erosion susceptibility at the field survey sites as well as other portions of Patterson Lake shoreline and the Clearwater River below Patterson Lake. Several shoreline segments along Patterson Lake were observed to be subject to modification by ongoing sediment transport processes. These processes include accretion resulting from longshore drift, with historical shoreline alignments visible in the aerial imagery, as well as likely ice-thrust modification of sedimentary shorelines. These active sediment transport areas are expected to be most sensitive to possible changes in the lake hydrologic regime. The localized bank erosion sites observed along the lake shoreline in sections with ice-thrust berms were also identified as sensitive areas. The surveyed reach of the Clearwater River was observed to have a single to multi-thread meandering channel, with typical channel cross-section geometries (i.e., deep banks on the outside of the meander) and fluvial morphology (i.e., point bars). The river has an active sediment transport regime, capable of transporting mostly small size materials (i.e., fine to medium sand), as indicated by the delta feature at its mouth into Forrest Lake.

This baseline geomorphological characterization has established that there are portions of both the Patterson Lake shoreline and the Clearwater River below Patterson Lake that are subject to active sediment transport regimes and may be susceptible to future erosion. Actual future changes to sediment transport regimes and erosion of areas that have been identified as susceptible would depend on changes to the water surface elevation of Patterson Lake. Change to Patterson Lake water surface elevation would influence wave action and resultant shoreline erosion as well as deposition or accretion along different portions of the shoreline. Change to water level in Patterson Lake could also influence the flow regime in the Clearwater River below Patterson Lake, which may alter sediment transport regimes in the Clearwater River channel between Patterson Lake and Forrest Lake. The magnitude, direction, and duration of the changes in lake level and the resultant influence on baseline sediment transport regimes would be evaluated as part of the EA.

CLOSING

WSP is pleased to submit this report to NexGen in support of the environmental assessment for the Rook I Project. For details on the limitations and use of information presented in this report, please refer to the Study Limitations section following this page. If you have any questions or require additional details related to this study, please contact the undersigned.

WSP Canada Inc.

Prepared by:

PROFESSIONAL ENGINEER
R.W. PHILLIPS
MEMBER 22672
24 05 16
YR. MN. DAY
SASKATCHEWAN

Ross Phillips, M.Sc., P.Eng.
Senior Water Resource Engineer

Final revisions reviewed by:

Andrew Forbes, M.Sc.
Principal, Senior Geomorphologist

DC/RP/RA/rd/pls/jr/ld

Association of Professional Engineers & Geoscientists of Saskatchewan
CERTIFICATE OF AUTHORIZATION
WSP Canada Inc.
Number **C0868**
Permission to Consult held by:
Discipline Sk. Reg. No. Signature

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The scope and the period of WSP's services are as described in WSP's proposal, and are subject to restrictions and limitations. WSP did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the report. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by WSP in regard to it. Any assessments, designs and advice made in this report are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this report. Where data supplied by the Client or other external sources (including without limitation, other consultants, laboratories, public databases), including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by WSP for incomplete or inaccurate data supplied by others.

The passage of time affects the information and assessment provided in this report. WSP's opinions are based upon information that existed at the time of the production of the report. The Services provided allowed WSP to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to WSP by the Client, communications between WSP and the Client, and to any other reports prepared by WSP for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be to the foregoing and to the entirety of the report. WSP cannot be responsible for use of portions of the report without reference to the entire report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client and were prepared for the specific purpose set out herein. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, is the responsibility of such third parties. WSP accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

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APPENDIX A

Photographs

1.0 PATTERSON LAKE OUTLET CHANNEL (CLEARWATER RIVER)

Figure A1: Patterson Lake Outlet Channel, Transect 1 - Upstream of the Access Road Bridge Crossing

Figure A2: Patterson Lake Outlet Channel, Transect 11, View Downstream

Figure A3: Patterson Lake Outlet Channel, Transect 12, View Downstream

Figure A4: Patterson Lake Outlet Channel, Transect 17, View Upstream

Figure A5: Patterson Lake Outlet Channel, Transect 21, View Upstream

Figure A6: Patterson Lake Outlet Channel, Transect 21, View Upstream

Figure A7: Patterson Lake Outlet Channel, Transect 22, View Downstream

Figure A8: Patterson Lake Outlet Channel, Transect 21, View Upstream

Figure A9: Patterson Lake Outlet Channel, Transect 34, View Upstream

Figure A10: Patterson Lake Outlet Channel, Transect 29, View Downstream

Figure A11: Patterson Lake Outlet Channel, Transect 29, View Upstream

Figure A12: Patterson Lake Outlet Channel, Transect 31, View Downstream

Figure A13: Patterson Lake Outlet Channel, Transect 36, View Downstream

Figure A14: Patterson Lake Outlet Channel, Transect 38, View Upstream

Figure A15: Patterson Lake Outlet Channel, Inlet into Forest Lake, View Upstream

2.0 PATTERSON LAKE SHORELINE

Figure A16: Patterson Lake Shoreline, Site 1, Facing Northwest

Figure A17: Patterson Lake Shoreline, Site 1, Facing Northeast

Figure A18: Patterson Lake Shoreline, Site 1, Facing Northwest

Figure A19: Patterson Lake Shoreline, Site 1, Facing Northeast

Figure A20: Patterson Lake Shoreline, Site 1

Figure A21: Patterson Lake Shoreline, Site 1, Facing North

Figure A22: Patterson Lake Shoreline, Site 2, Facing East

Figure A23: Patterson Lake Shoreline, Site 2, Facing Southeast

Figure A24: Patterson Lake Shoreline, Site 3, Facing Northwest

Figure A25: Patterson Lake Shoreline, Site 3

APPENDIX B

Shoreline Erosion Susceptibility Calculations

This appendix presents the methods used to derive the erosion susceptibility class for the shoreline erosion assessment and the scores at each location for all parameters.

EROSION SUSCEPTIBILITY METHODS

To estimate the shoreline erosion susceptibility class, the parameters used were separated into three categories: bank and shoreline features, exposure characteristics, and attenuation characteristics, with each category having its own parameters (Table B1). The shoreline erosion susceptibility was classified into a five-class system, ranking from Very Low to Very High and the classification was based on a modified version of a tool developed to calculate Lakeshore erosion potential for Alberta Sustainable Resource Development.

Table B1: Final Score Calculation

Categories	Parameters
Bank and Shoreline Features	Bank Height Bank Vegetation Bank Stability Shoreline Geometry
Exposure Characteristics	Shore Orientation (wind direction) Fetch Length Depth at 6 m from shore Depth at 30 m from shore
Attenuation Characteristics	Aquatic Vegetation Bank Composition Bank Slope

For each parameter a score range and a number of class were assigned (Table B2). The class values for each parameter were determined based on field observations at site, including:

- bank height (collected at existing lake level at the time of survey);
- bank vegetation;
- bank stability;
- shoreline geometry;
- shore orientation (wind directions scores and class were calculated based on wind data collected at NexGen Rook I Hill Meteorological Station and presented in the main report);
- fetch length (based on map measurements in GIS);
- lake depth at 6 m and 30 m from shore (estimated from field data and aerial imageries);
- aquatic vegetation; and
- bank slope (calculated from cross-section profiles).

Table B2: Score Range and Classes for Shoreline Parameters

<table>
<tr><th colspan="2">Bank and Shoreline Features</th></tr>
<tr><th>Parameter</th><th>Score and Class</th></tr>
<tr><td>Bank Height (BH)</td><td>1 = <0.3 m
2 = 0.3 m to 1.5 m
3 = 1.5 m to 3.0 m
4 = 3.0 m to 6.0 m
5 = >6.0 m</td></tr>
<tr><td>Bank Vegetation (BV)</td><td>0 = rocky outcrop with little or no vegetation
1 = mixed boulders and cobbles with mature vegetation
4 = bog peat and brush vegetation on top of boulders
7 = organic materials with no rocky materials</td></tr>
<tr><td>Bank Stability (BSt)</td><td>0 = bedrock or boulder with no vegetation
1 = boulders or bedrock with mature forests
2 = boulders and cobbles with discontinued vegetation
4 = boulders and cobbles with vegetation on top (brush and fen)
6 = soils with thermo-erosion processes
7 = organic materials with bog and fen peat and not rocky materials</td></tr>
<tr><td>Shoreline Geometry (SG)</td><td>1 = coves or bays
4 = irregular or straight shorelines
8 = headland or islands</td></tr>
<tr><th colspan="2">Exposure Characteristics</th></tr>
<tr><th>Parameter</th><th>Score and Class</th></tr>
<tr><td>Shore Orientation (SO)
(wind direction)</td><td>0 = ESE
1 = NNE, NE, ENE, E
2 = N, SE, NNW
3 = SW, WSW, W
4 = SSE, S, SSW, WNW, NW</td></tr>
<tr><td>Fetch Length (FL) (m)</td><td>0 = < 50 m
1 = 50 m to 100 m
2 = 100 m to 200 m
3 = 200 m to 500 m
4 = 500 m to 1,000 m
5 = 1,000 m to 3,000 m
6 = > 3,000 m</td></tr>
<tr><td>Lake Depth (LD)
at 6 m and 30 m
from shore</td><td>
<table>
<tr><th></th><th colspan="5">Depth at 6 m</th></tr>
<tr><th>Depth at 30 m</th><td>0.0</td><td>0.3</td><td>0.9</td><td>1.8</td><td>3.7</td></tr>
<tr><td>0.0</td><td>-1</td><td>-1</td><td>-1</td><td>-2</td><td>-2</td></tr>
<tr><td>0.3</td><td>0</td><td>-1</td><td>-1</td><td>-2</td><td>-2</td></tr>
<tr><td>0.9</td><td>0</td><td>0</td><td>-1</td><td>-1</td><td>-1</td></tr>
<tr><td>1.8</td><td>1</td><td>1</td><td>0</td><td>-1</td><td>-1</td></tr>
<tr><td>3.7</td><td>1</td><td>1</td><td>0</td><td>-1</td><td>-1</td></tr>
</table>
</td></tr>
</table>

Table B2: Score Range and Classes for Shoreline Parameters

Attenuation Characteristics	
Parameter	**Score and Class**
Aquatic Vegetation (AV)	0 = no vegetation, spares or submerged -1 = moderate -2 = dense or abundant
Bank Slope (BSp)	0 = < 5 degrees 1 = 5 degrees to 25 degrees 2 = 25 degrees to 45 degrees 4 = > 45 degrees
Modified Bank Composition (MBC)	Bank Composition Scores (BC) 0 = bedrock or boulder with no vegetation 1 = boulders or bedrock with mature forests 2 = boulders and cobbles with discontinued vegetation 3 = boulders and cobbles with vegetation on top (brush and fen) 4 = soils with thermo-erosion processes 5 = organic materials with bog and fen peat and not rocky materials

	Bank Slope Score			
Bank Composition Score	0	1	2	4
0	0	0	0	0
1	-1	0	0	3
2	-1	0	1	3
3	-1	0	1	4
4	0	-1	1	4
5	0	-1	2	4

For each of the three categories a single score was calculated, and the final score was determined from the three combined scores indicating the susceptibility erosion class. The method to calculate the final score and associated classed are presented in Table B3.

Table B3: Final Score Calculation

Category	Score Description and Formulas
Bank and Shoreline Features (BSF)	The sum of score of all parameters BSF = BH + BV +BSt + SG
Exposure and Attenuation Characteristics (EAC)	The final score is the sum of the modified fetch length with the wind scores (MFLW) and the modified score of the bank composition modified score (BCMS) EAC = MFLW + BCMS where MFLW = SO * (FL + LD + AV) BCMS = BSp & MBC
Erosion Potential (EP)	EP = BSF + EAC EP Class: (see table below)

Erosion Potential Class	Erosion Potential Score
Very Low	< 15
Low	15 to 20
Moderate	20 to 25
High	25 to 35
Very High	> 35

BH = Bank Height; BV = Bank Vegetation; BSt = Bank Stability; SG = Shoreline Geometry; SO = Exposure Characteristics Shore Orientation; FL = Fetch Length; LD = Lake Depth; AV = Aquatic Vegetation; BSp = Bank Slope; MBC = Modified Bank Composition.

SCORES FOR CONTRIBUTING PARAMETERS

Table B4 presents the scores for each parameter measured at the transects surveyed at each location.

Table B4: Scores for each parameter

Parameter	Site 1	Site 2	Site 3
Score - Bank Height (BH)	3	1	3
Score - Bank Vegetation (BV)	7	1	1
Score - Bank Stability (BSt)	6	1	1
Score - Shoreline Geometry (SG)	8	4	4
Score - BSF Score	24	7	9
Score - Exposure Characteristics Shore Orientation (SO)	1	4	1
Score - Fetch Length (m) (FL)	6	4	6
Score - Lake Depth (LD)	-1	0	0
Score - MFLW Score	5	16	6
Score - Aquatic Vegetation (AV)	0	0	0
Score - Bank Slope (BSp)	4	1	4
Score - Bank Composition Scores (BC)	4	1	1
Score - Modified Bank Composition (MBC)	4	0	3
Score - BCMS Score	16	0	12
Score - Exposure and Attenuation Characteristics (EAC)	21	16	18
Score - Erosion Potential (EP)	45	23	27

APPENDIX C

Transect Cross-Sections

1.0 PATTERSON LAKE OUTLET CHANNEL (CLEARWATER RIVER)

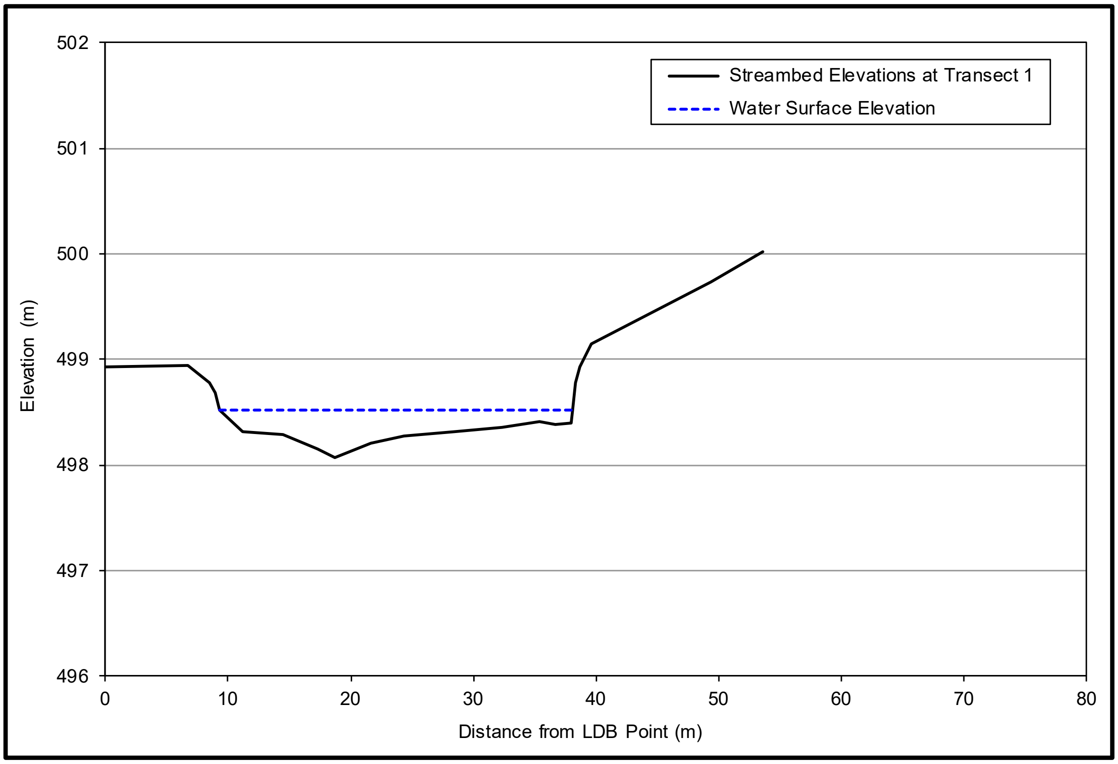


Figure C1: Patterson Lake Outlet Channel, Transect 1 Cross-Section

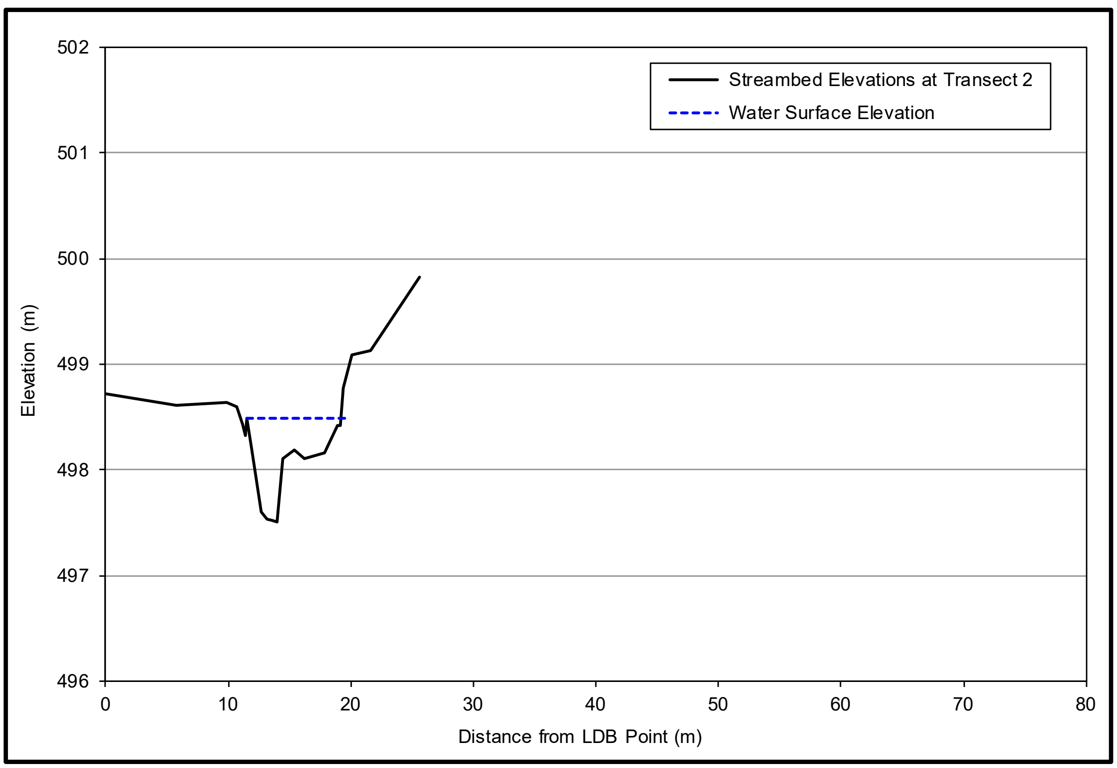


Figure C2: Patterson Lake Outlet Channel, Transect 2 Cross-Section

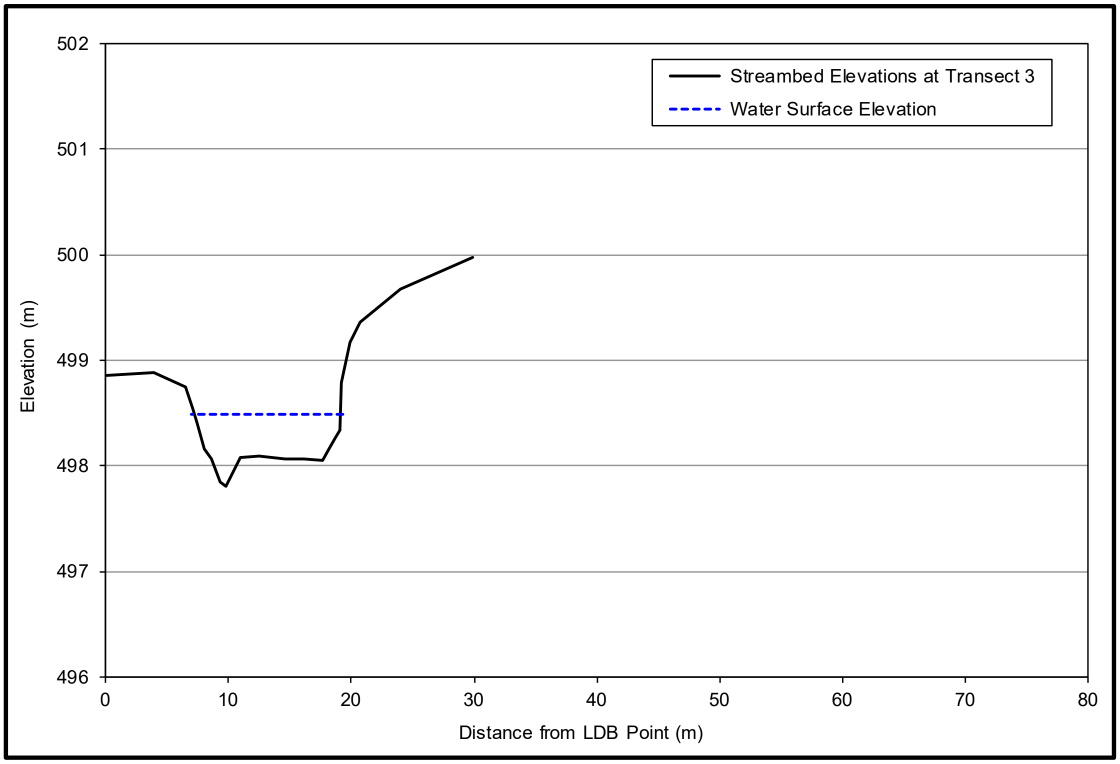


Figure C3: Patterson Lake Outlet Channel, Transect 3 Cross-Section

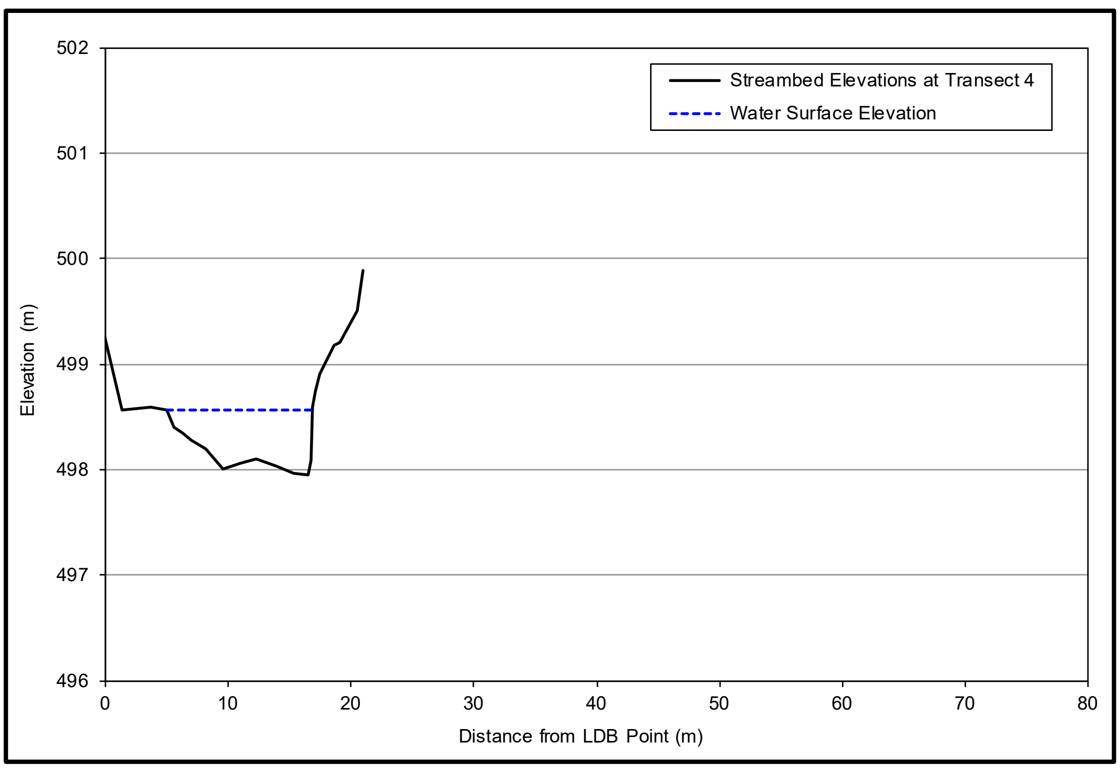


Figure C4: Patterson Lake Outlet Channel, Transect 4 Cross-Section

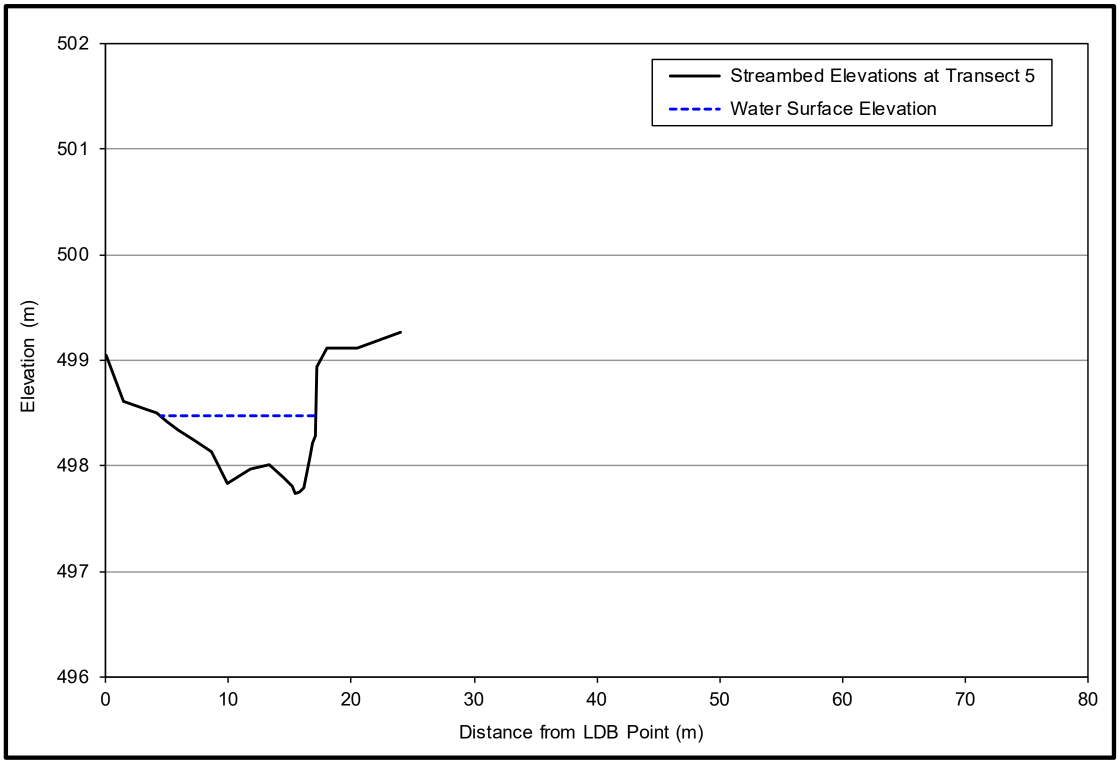


Figure C5: Patterson Lake Outlet Channel, Transect 5 Cross-Section

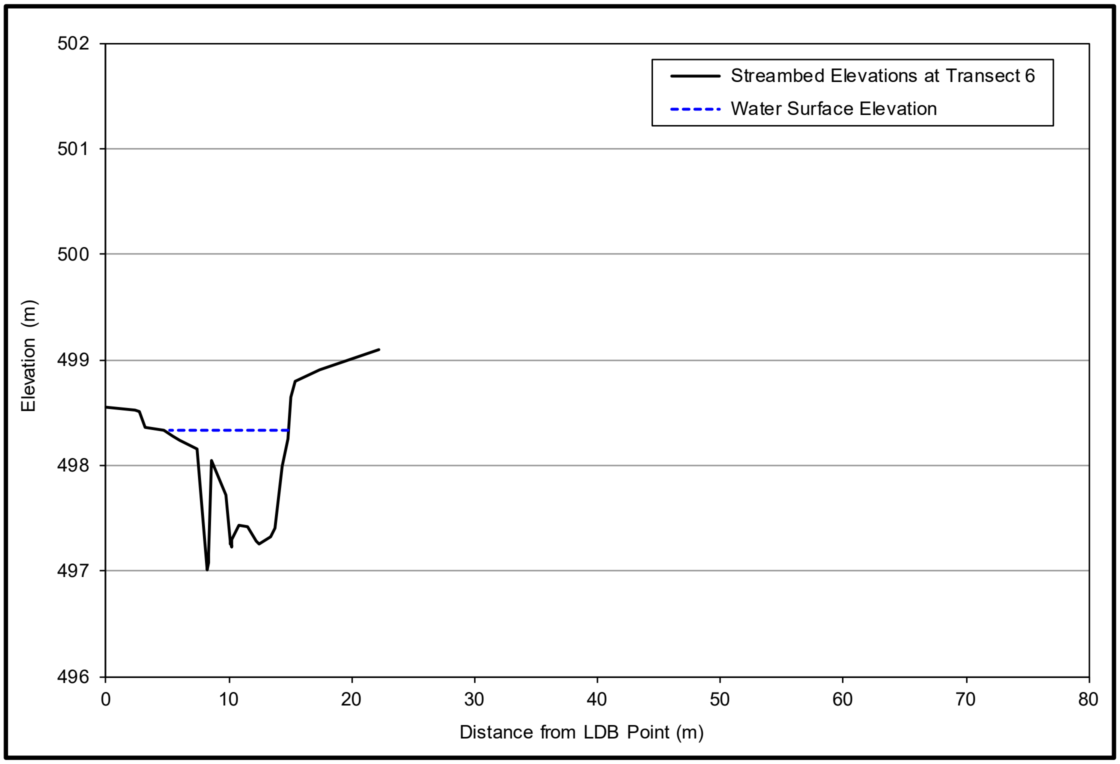


Figure C6: Patterson Lake Outlet Channel, Transect 6 Cross-Section

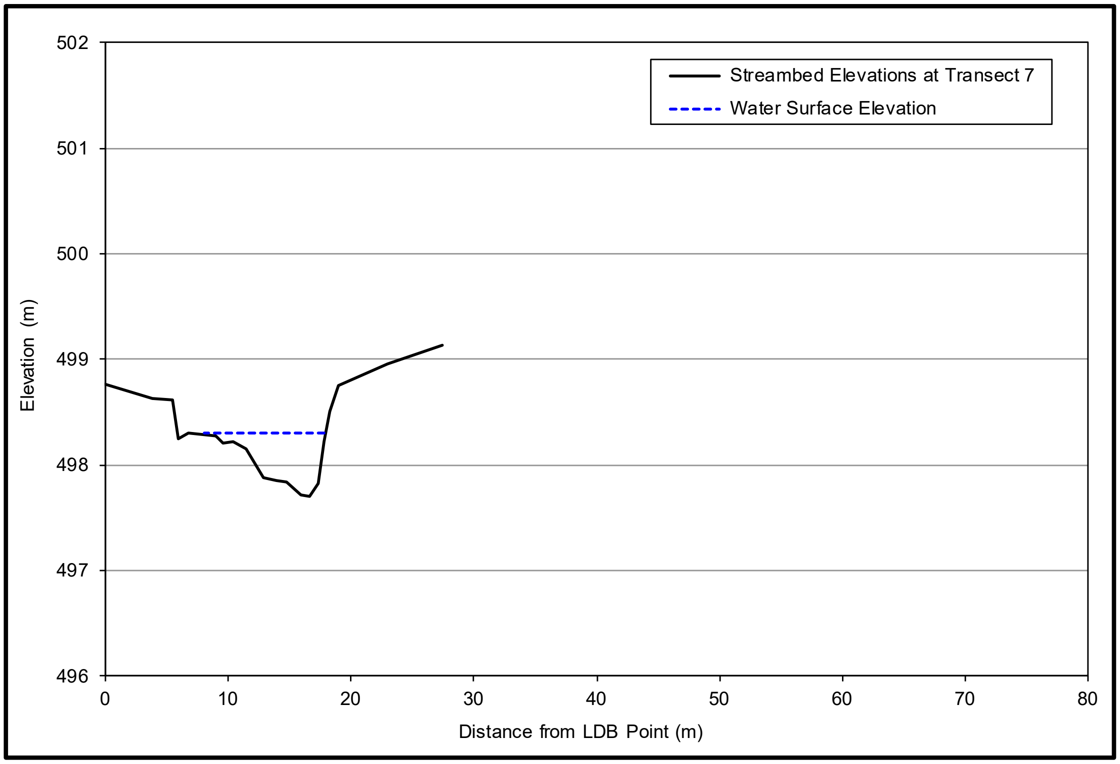


Figure C7: Patterson Lake Outlet Channel, Transect 7 Cross-Section

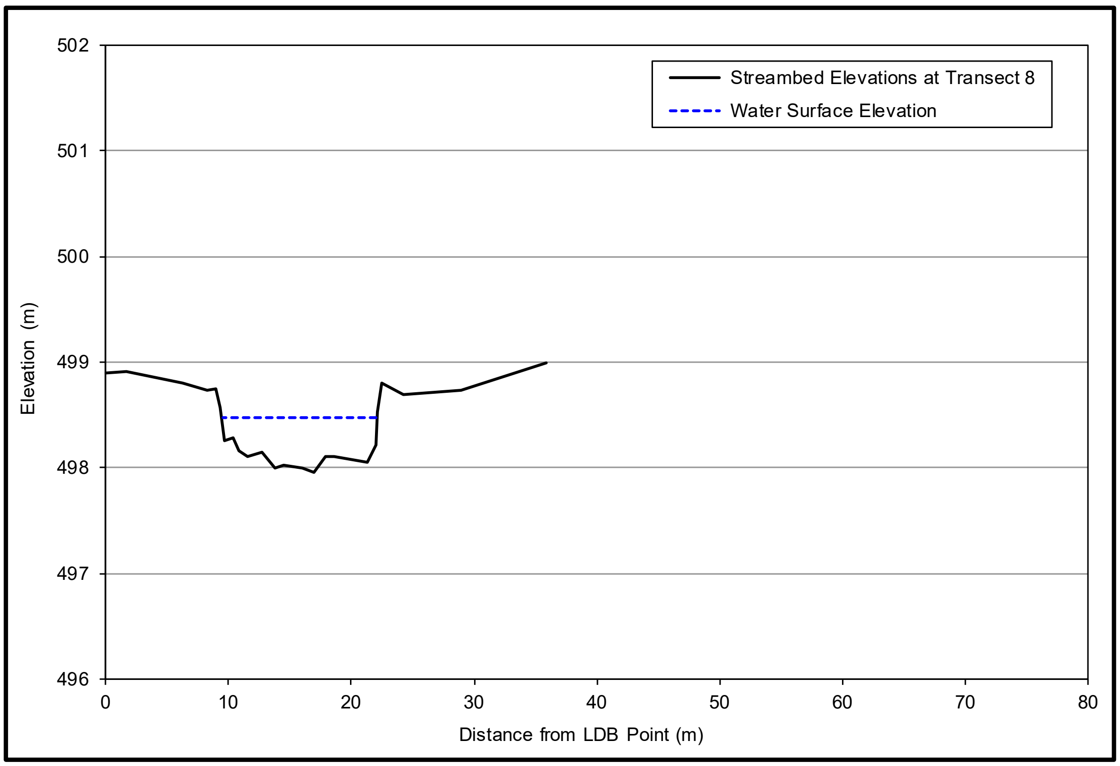


Figure C8: Patterson Lake Outlet Channel, Transect 8 Cross-Section

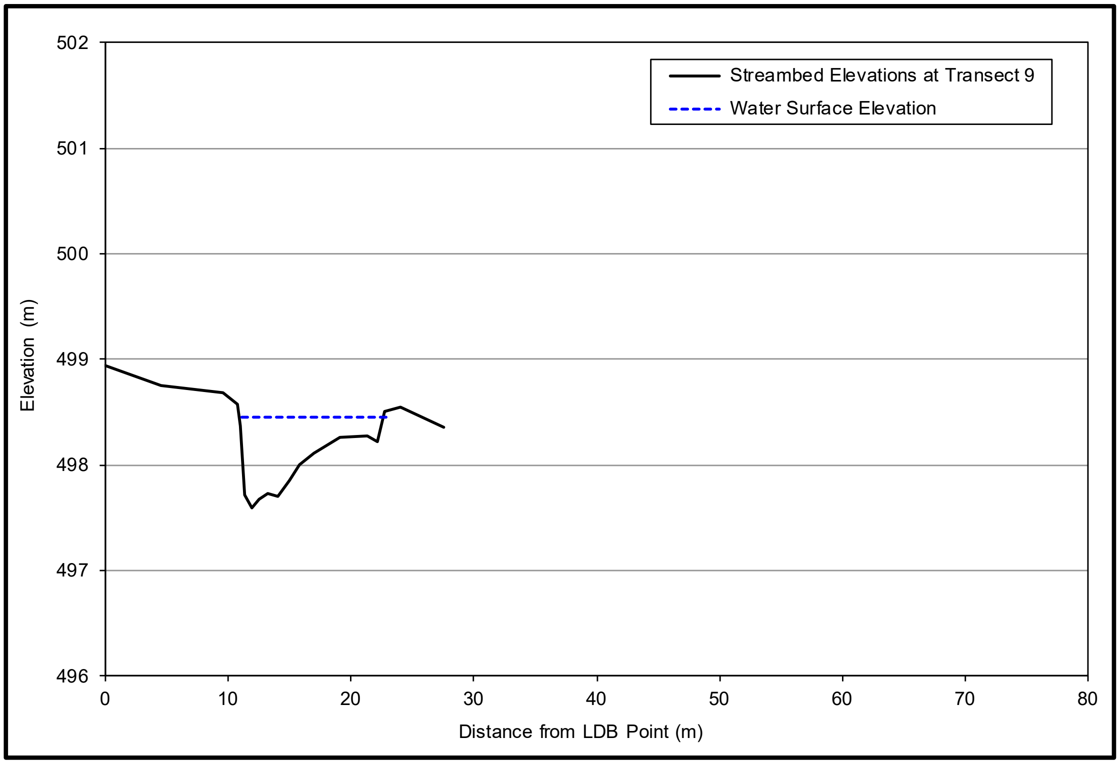


Figure C9: Patterson Lake Outlet Channel, Transect 9 Cross-Section

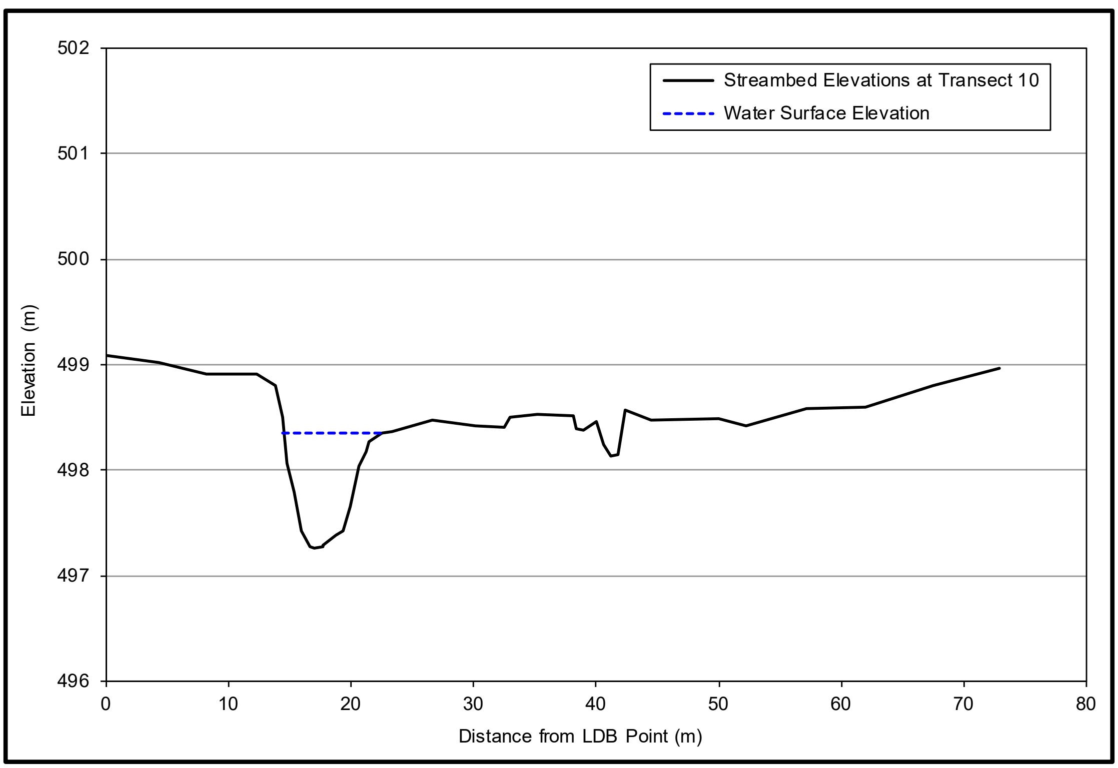


Figure C10: Patterson Lake Outlet Channel, Transect 10 Cross-Section

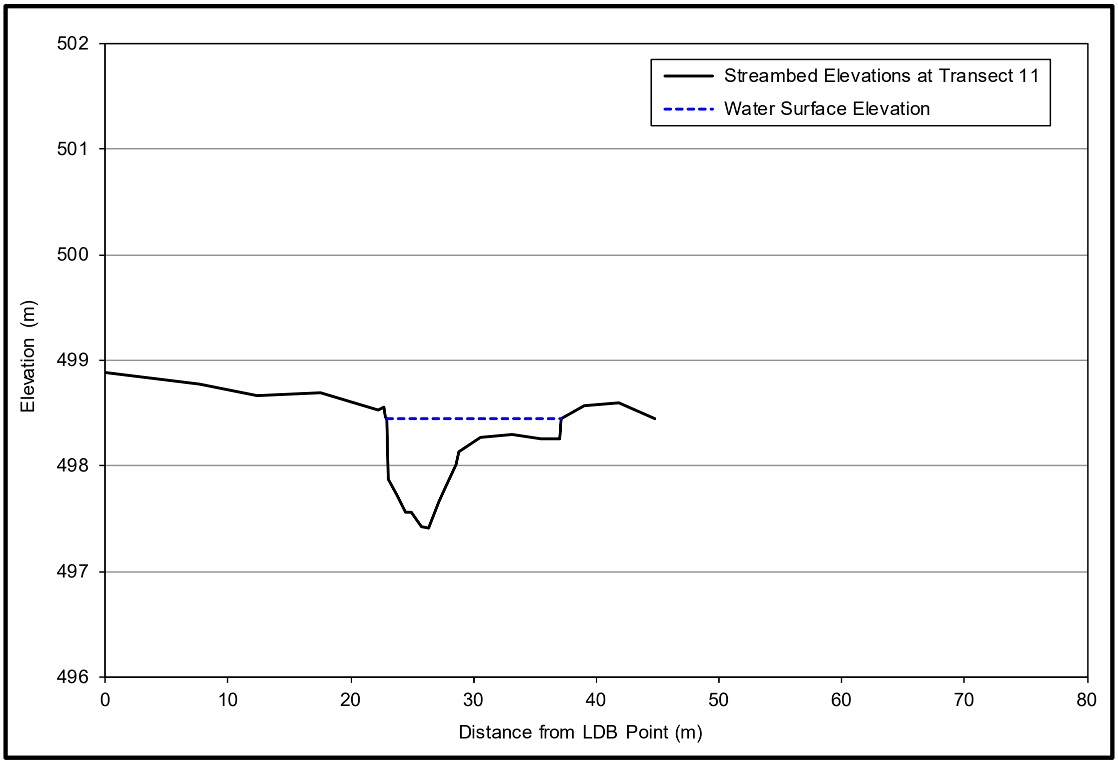


Figure C11: Patterson Lake Outlet Channel, Transect 11 Cross-Section

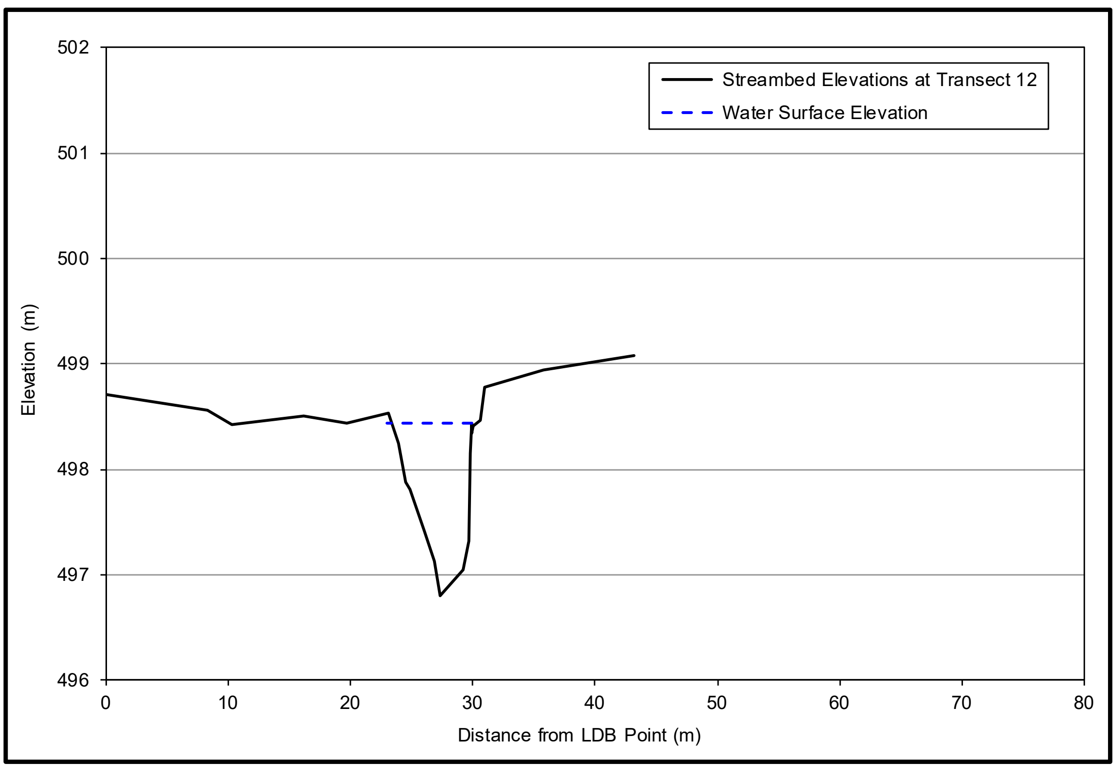


Figure C12: Patterson Lake Outlet Channel, Transect 12 Cross-Section

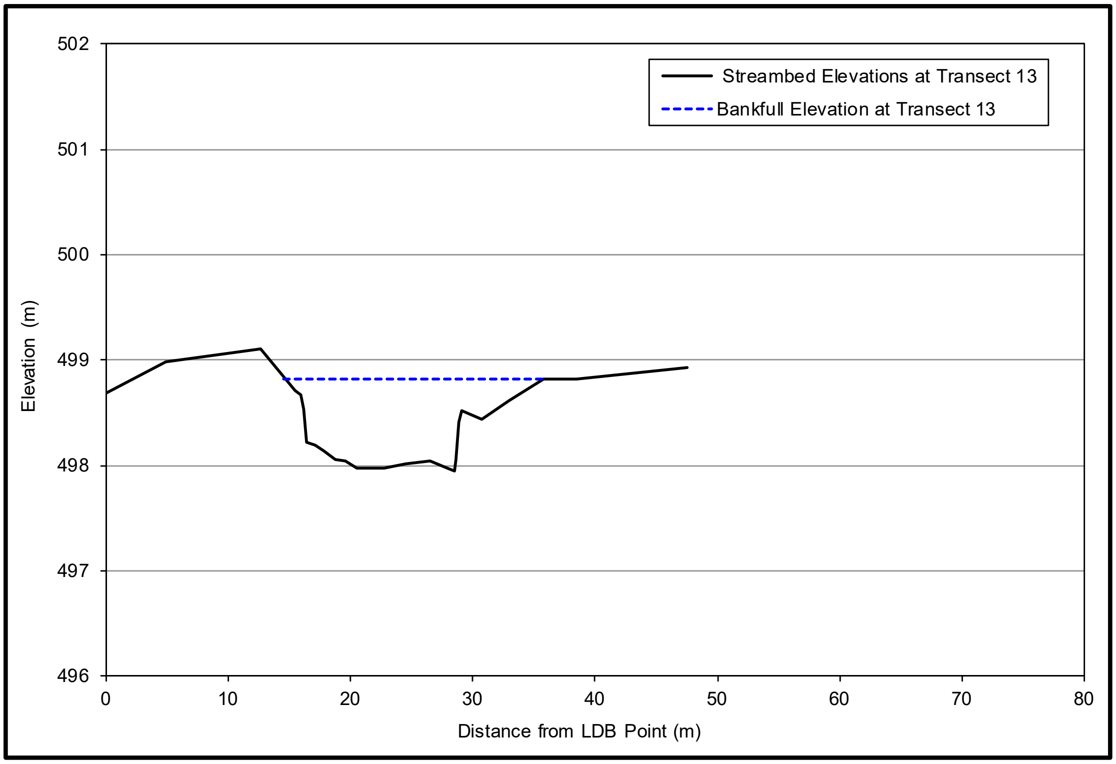


Figure 13: Patterson Lake Outlet Channel, Transect 13 Cross-Section

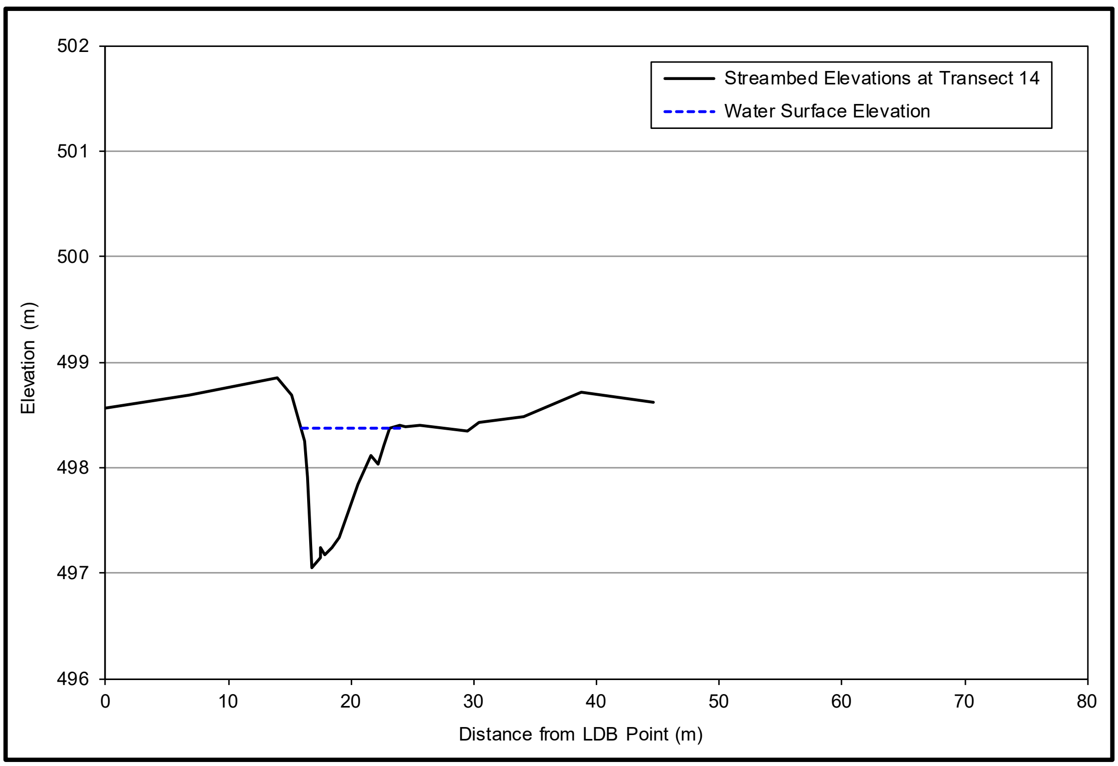


Figure C14: Patterson Lake Outlet Channel, Transect 14 Cross-Section

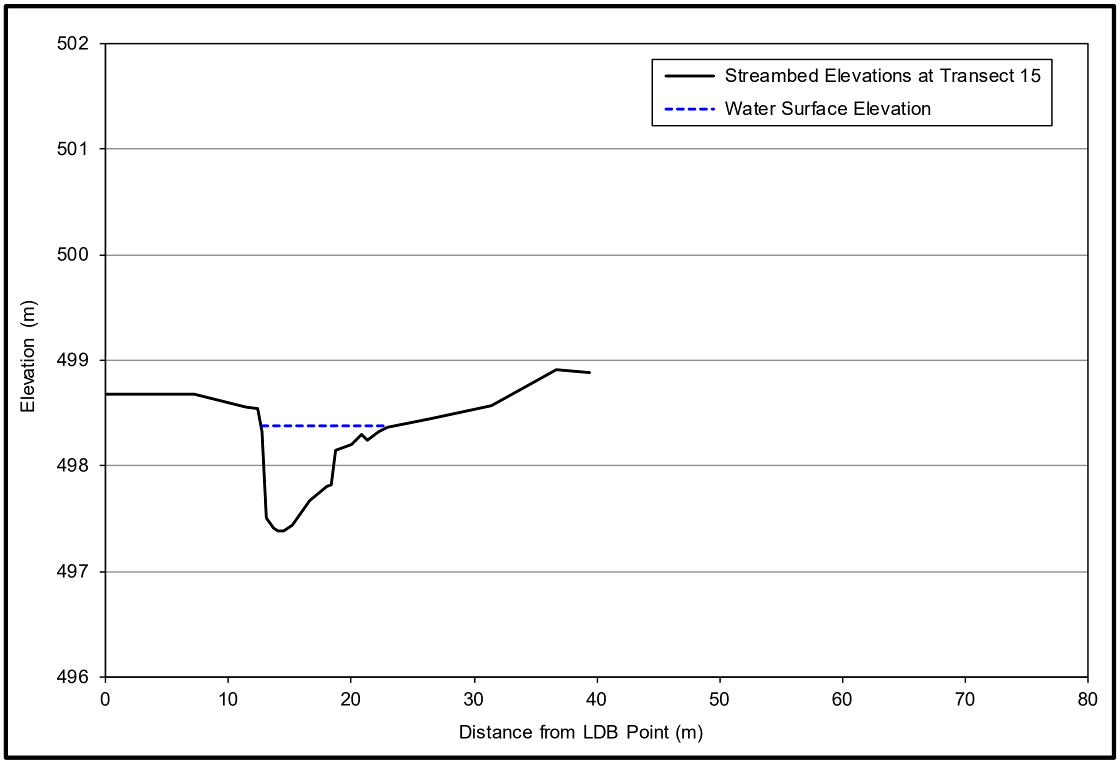


Figure C15: Patterson Lake Outlet Channel, Transect 15 Cross-Section

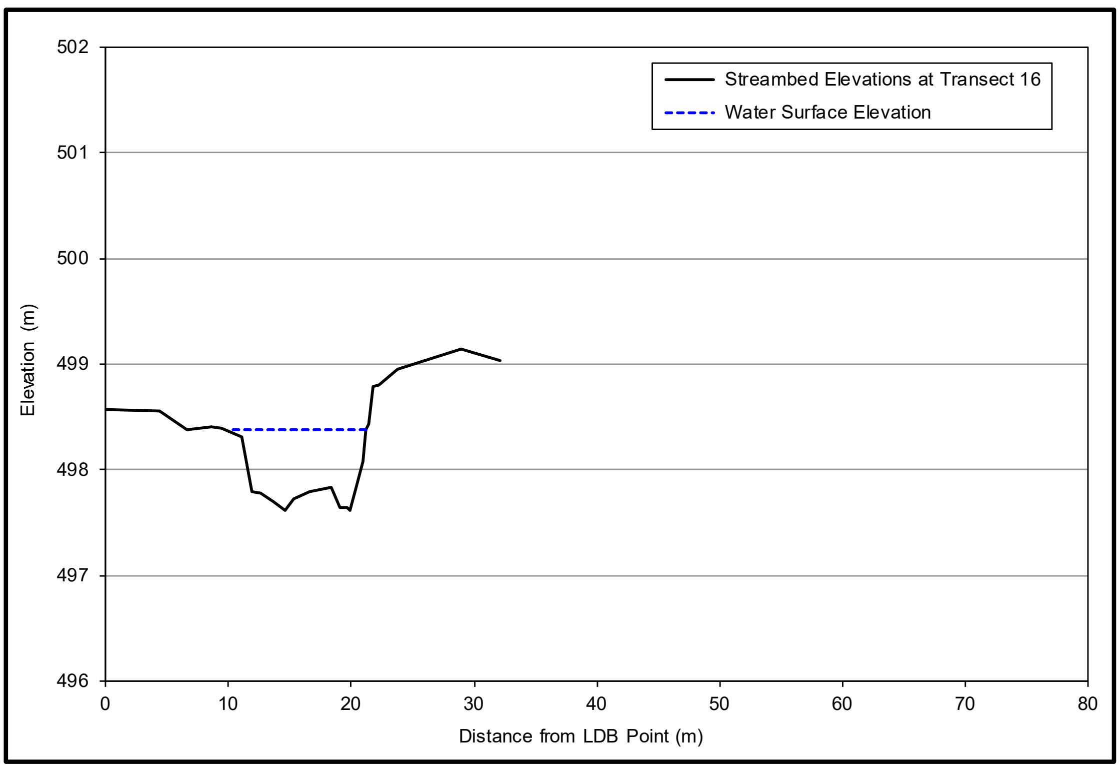


Figure C16: Patterson Lake Outlet Channel, Transect 16 Cross-Section

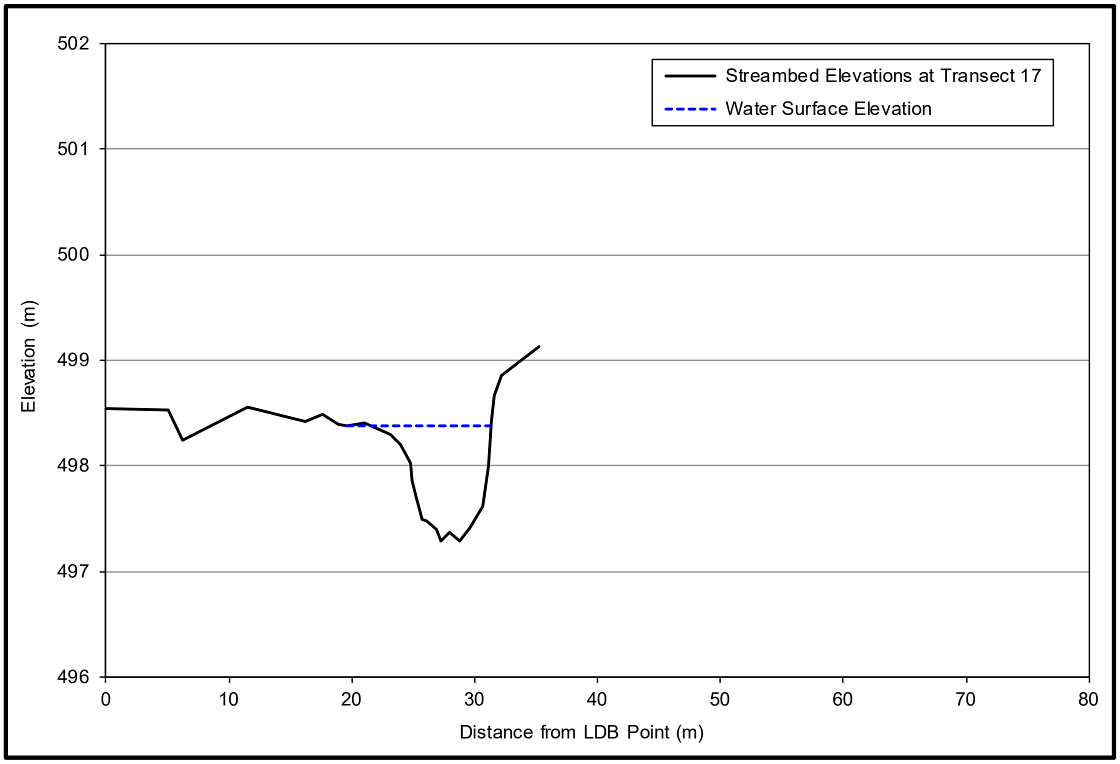


Figure C17: Patterson Lake Outlet Channel, Transect 17 Cross-Section

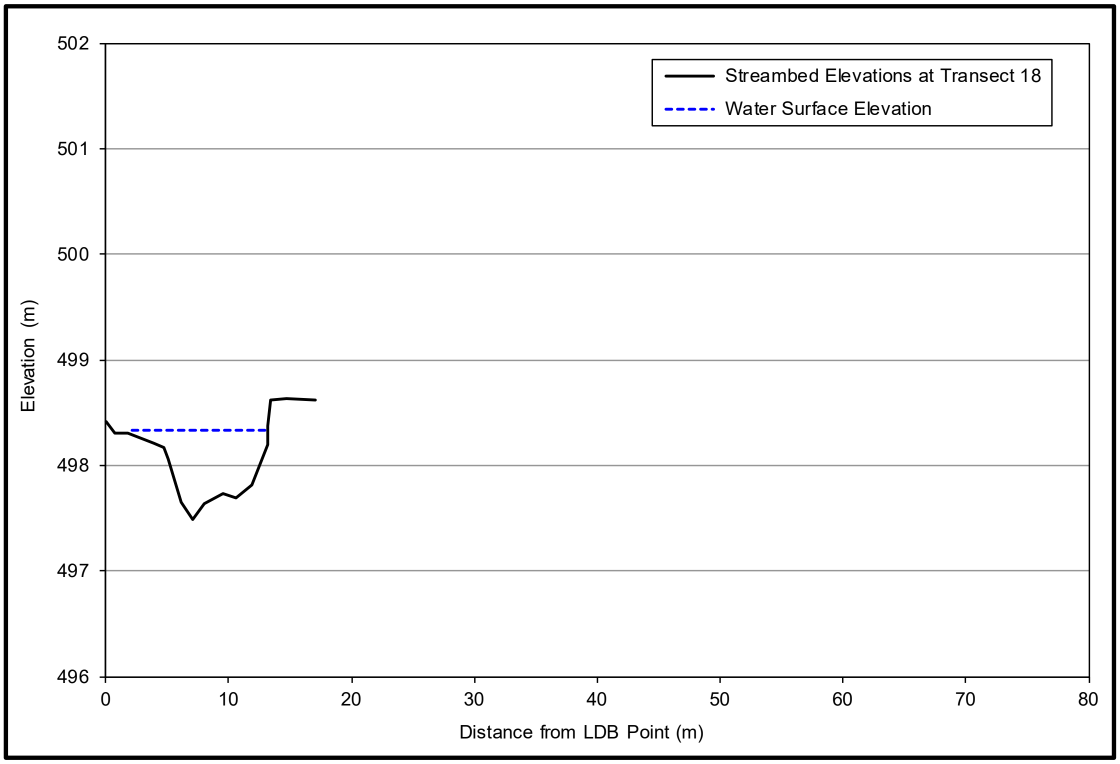


Figure C18: Patterson Lake Outlet Channel, Transect 18 Cross-Section

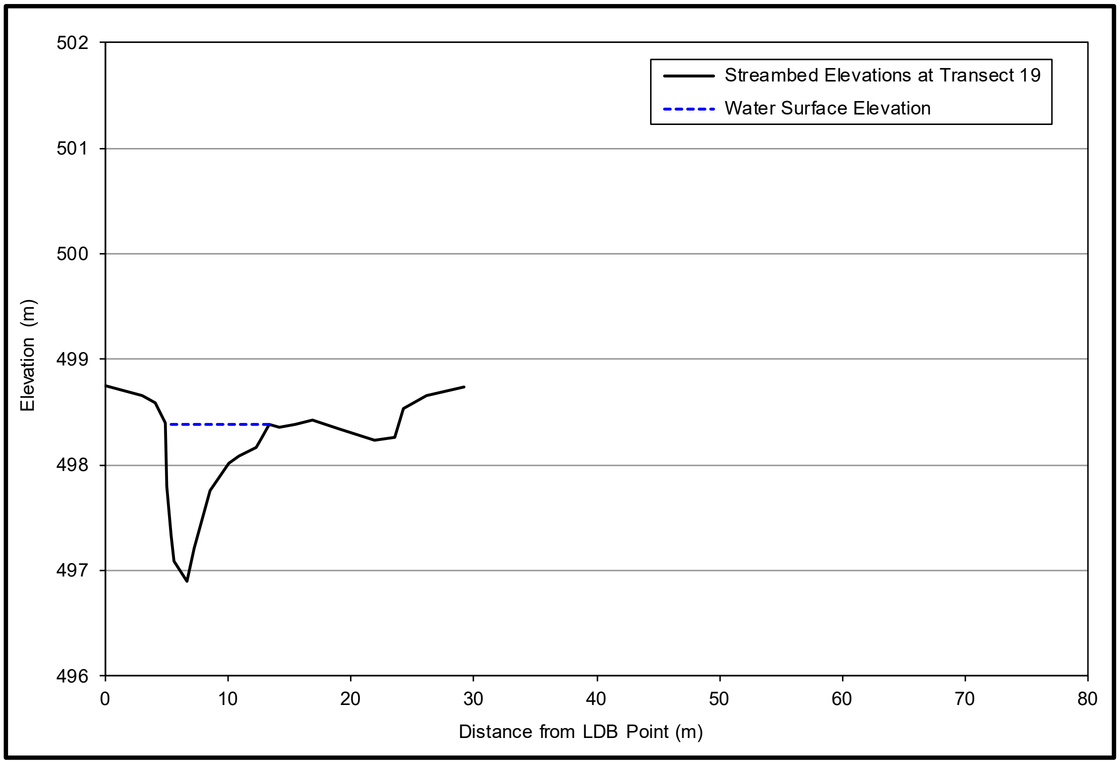


Figure C19: Patterson Lake Outlet Channel, Transect 19 Cross-Section

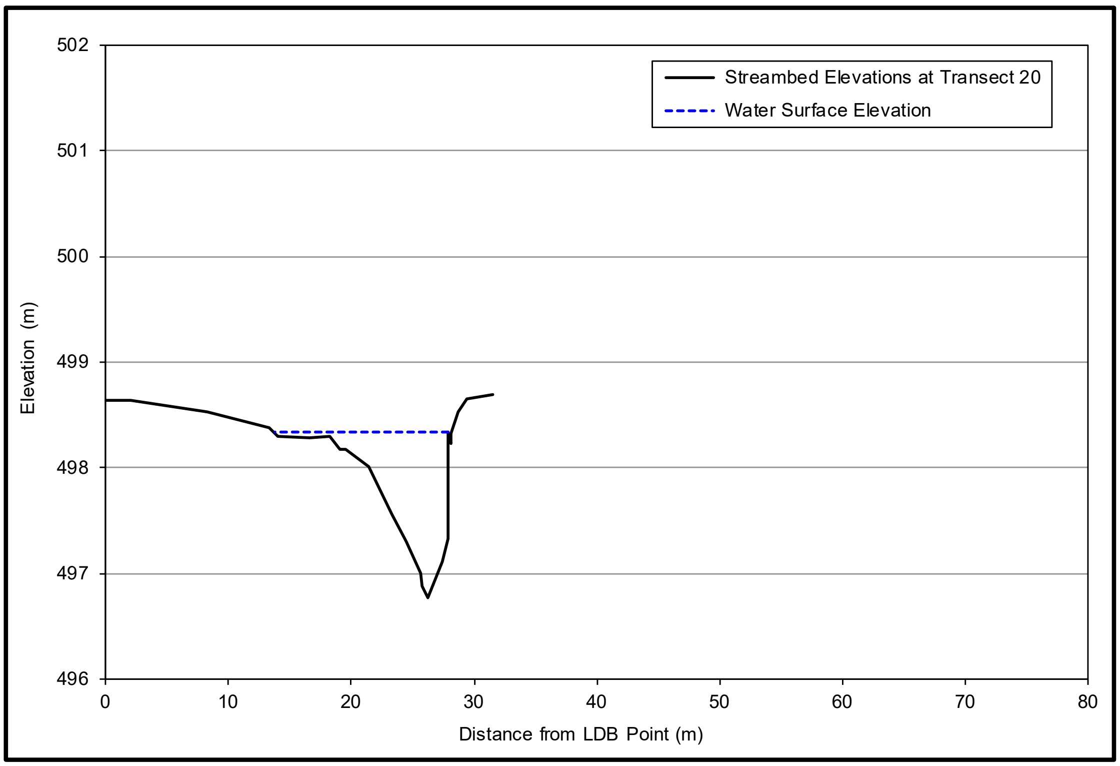


Figure C20: Patterson Lake Outlet Channel, Transect 20 Cross-Section

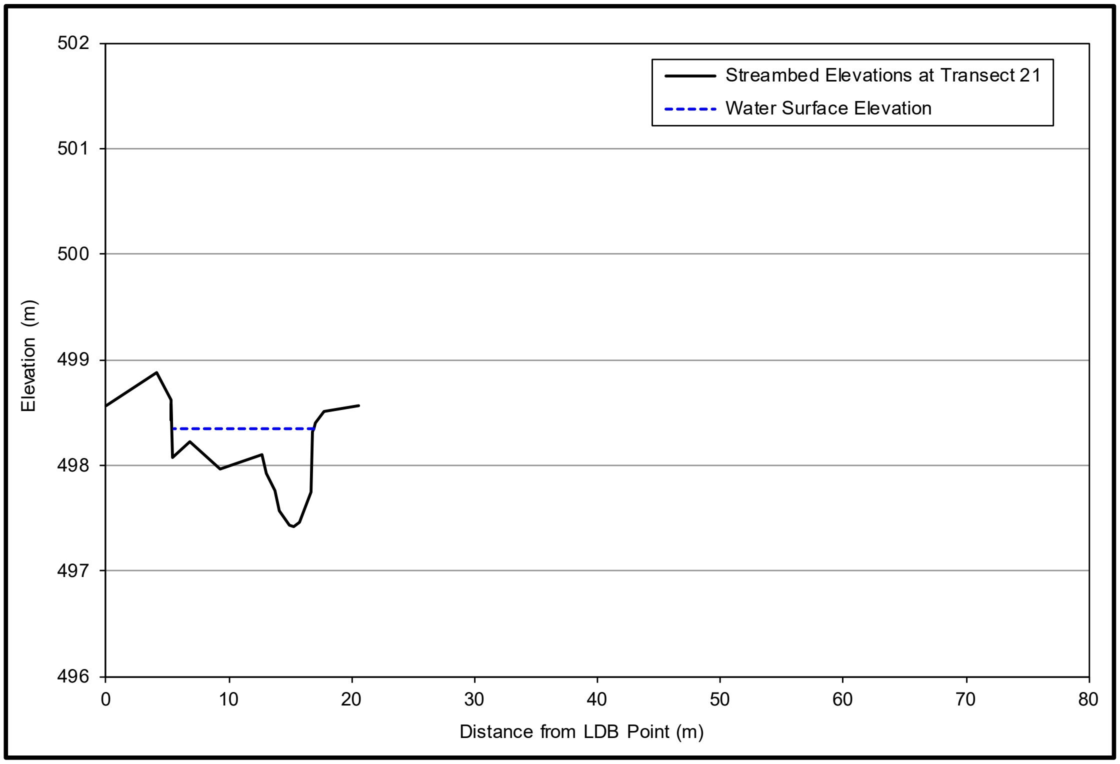


Figure C21: Patterson Lake Outlet Channel, Transect 21 Cross-Section

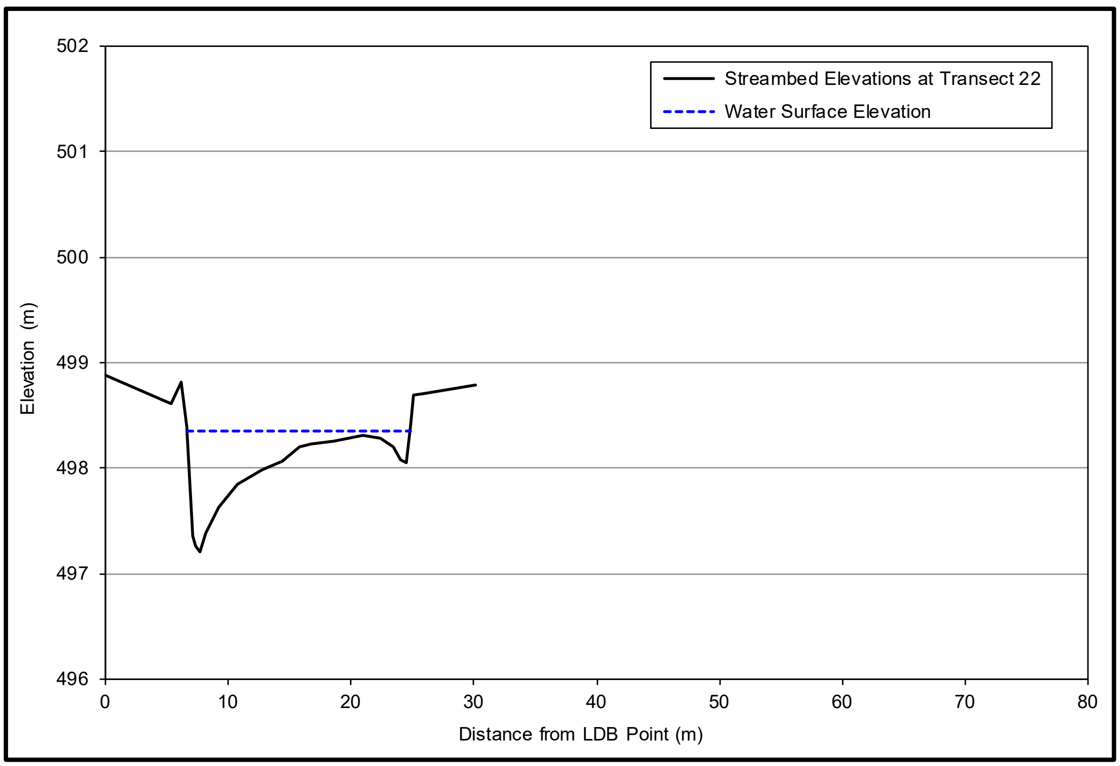


Figure C22: Patterson Lake Outlet Channel, Transect 22 Cross-Section

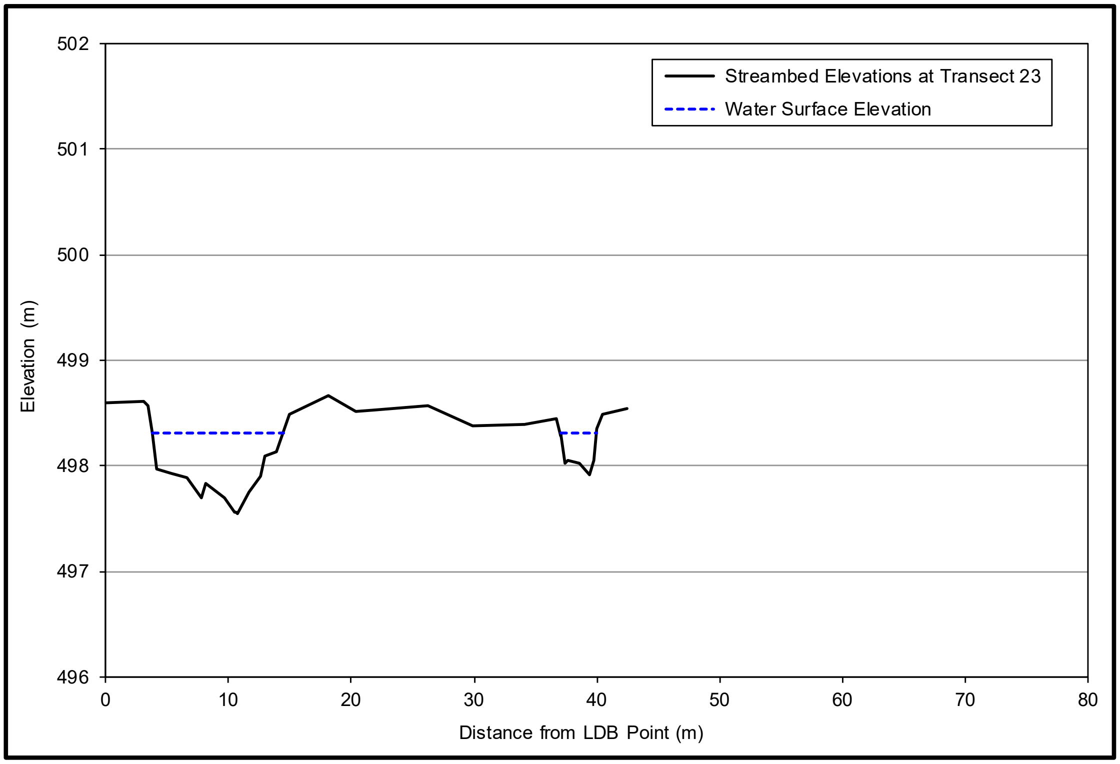


Figure C23: Patterson Lake Outlet Channel, Transect 23 Cross-Section

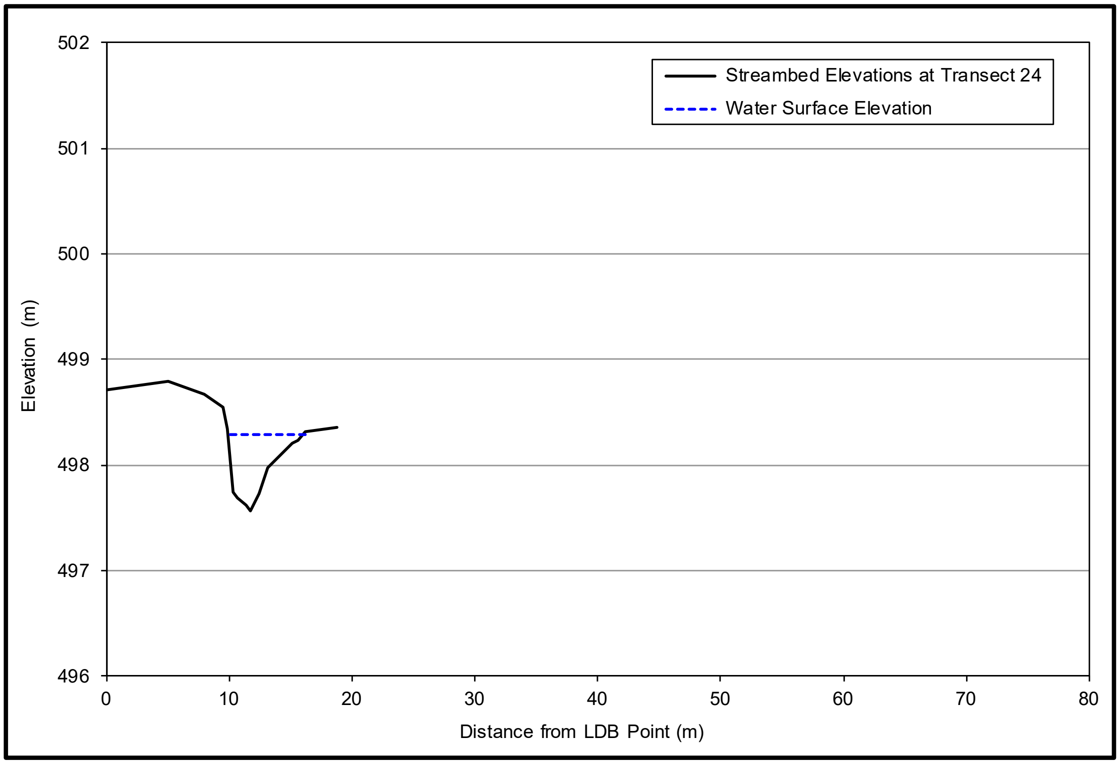


Figure C24: Patterson Lake Outlet Channel, Transect 24 Cross-Section

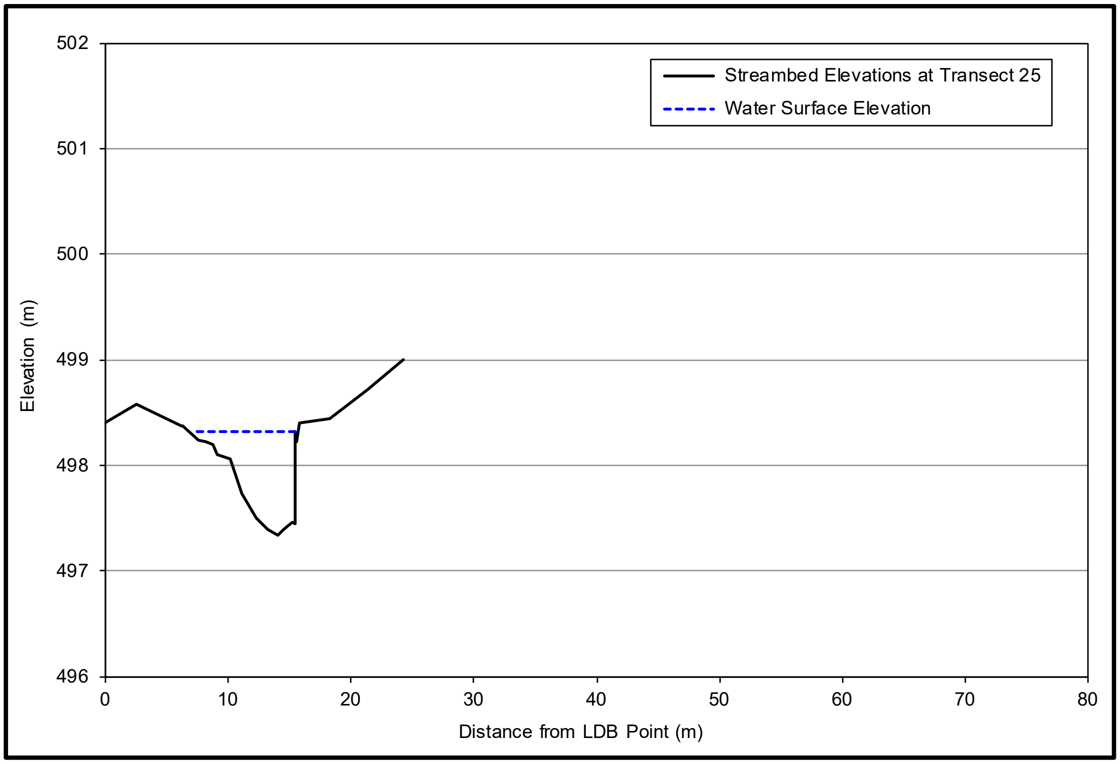


Figure C25: Patterson Lake Outlet Channel, Transect 25 Cross-Section

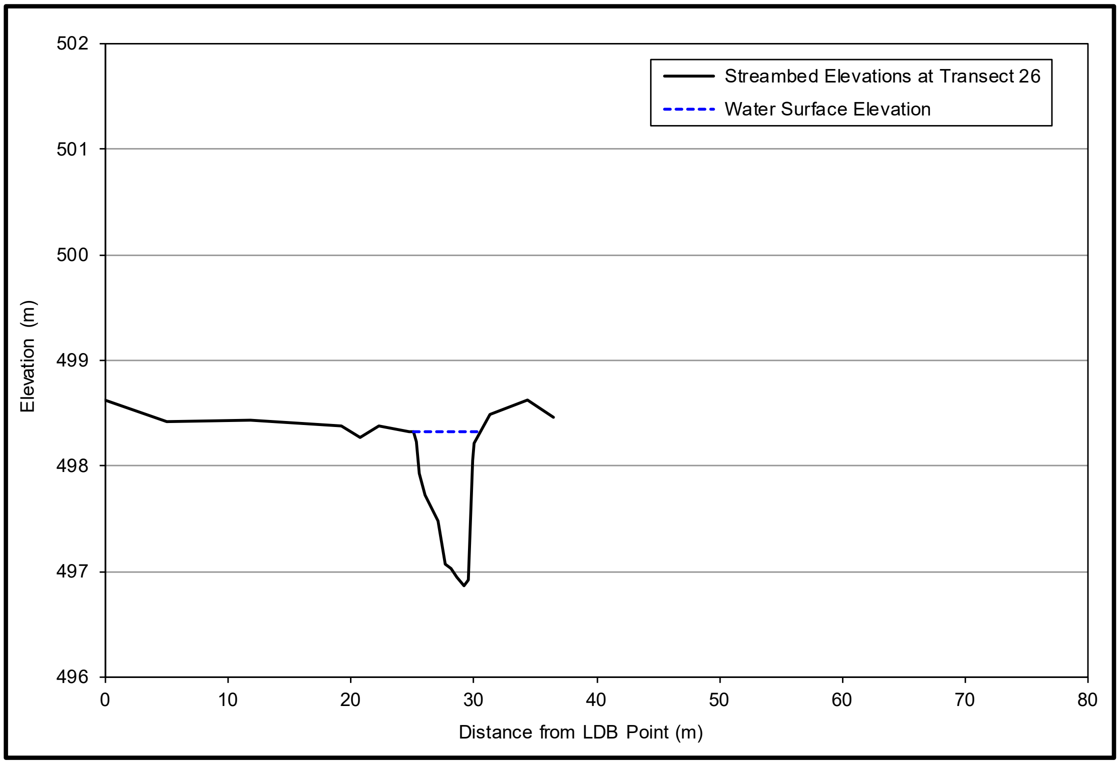


Figure C26: Patterson Lake Outlet Channel, Transect 26 Cross-Section

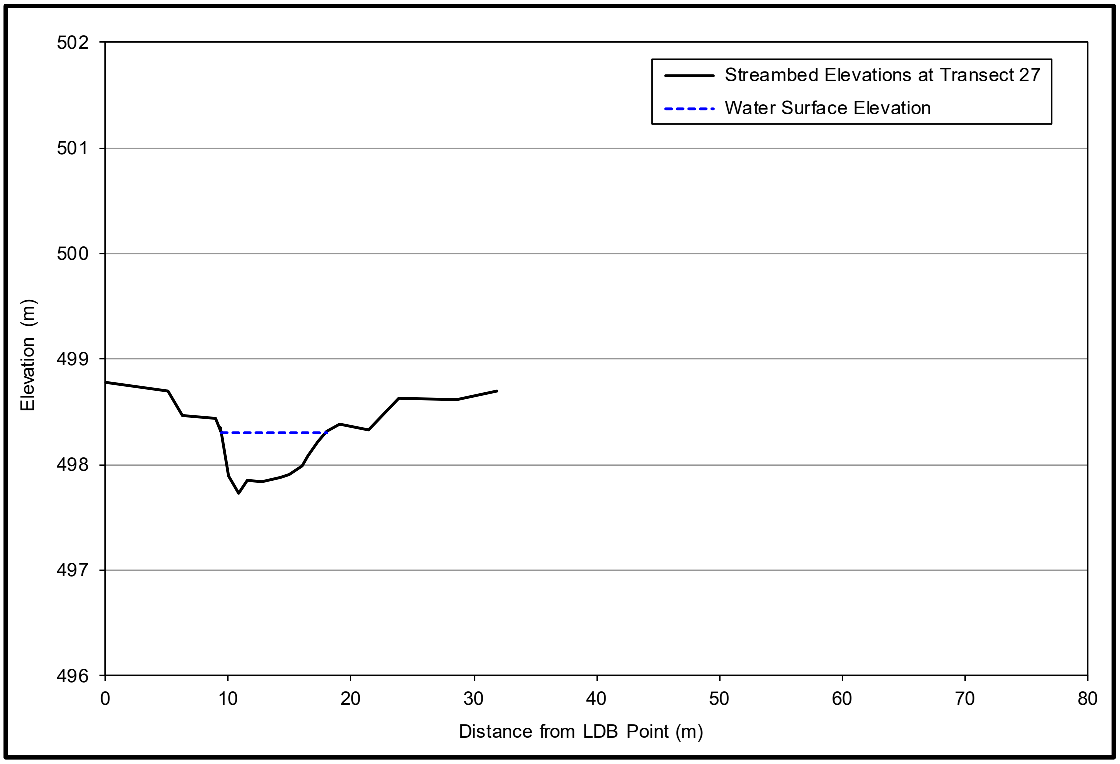


Figure C27: Patterson Lake Outlet Channel, Transect 27 Cross-Section

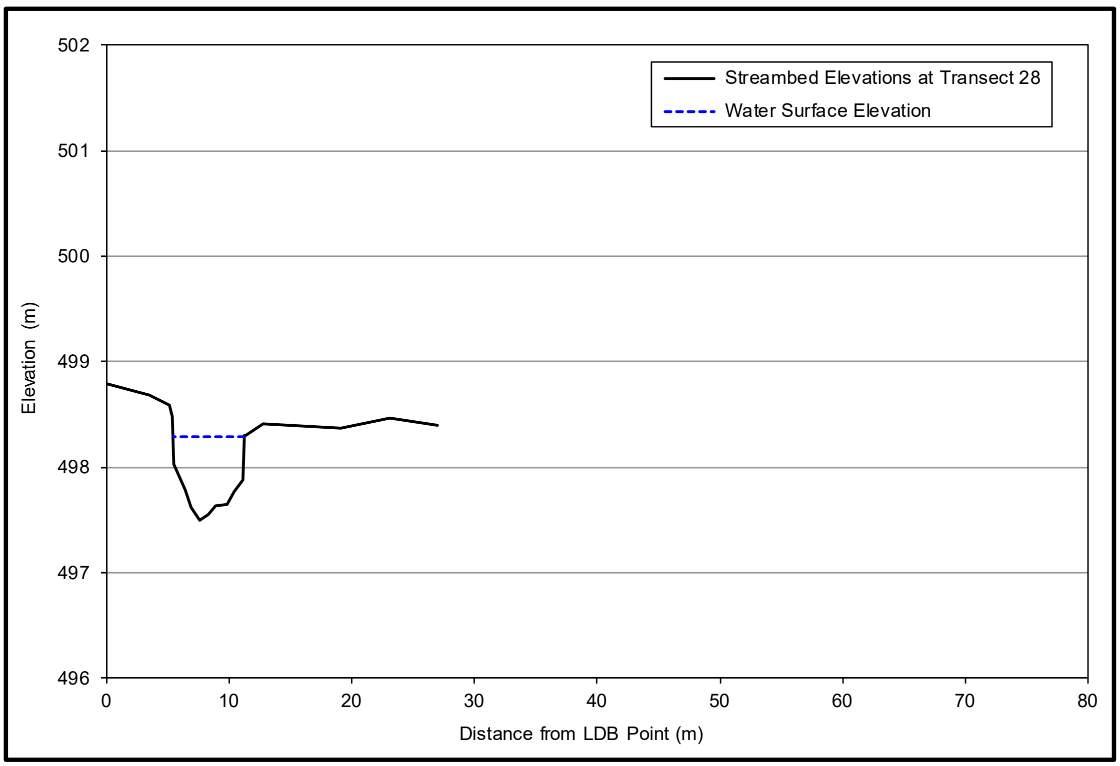


Figure C28: Patterson Lake Outlet Channel, Transect 28 Cross-Section

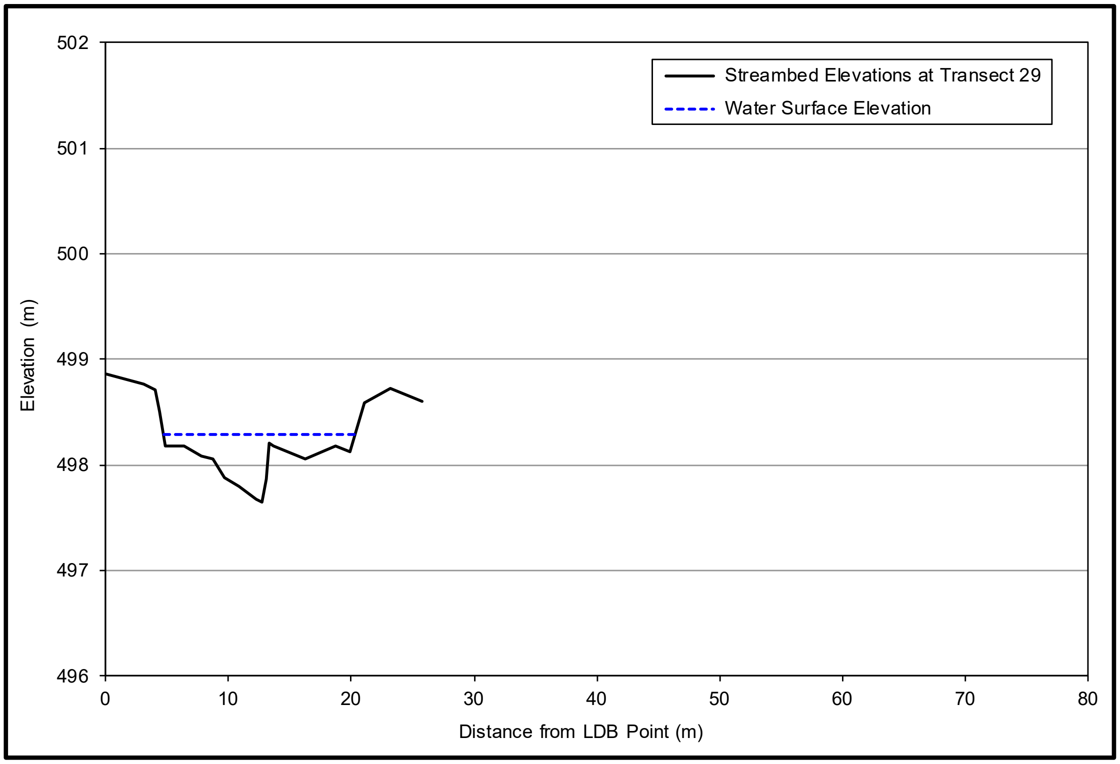


Figure C29: Patterson Lake Outlet Channel, Transect 29 Cross-Section

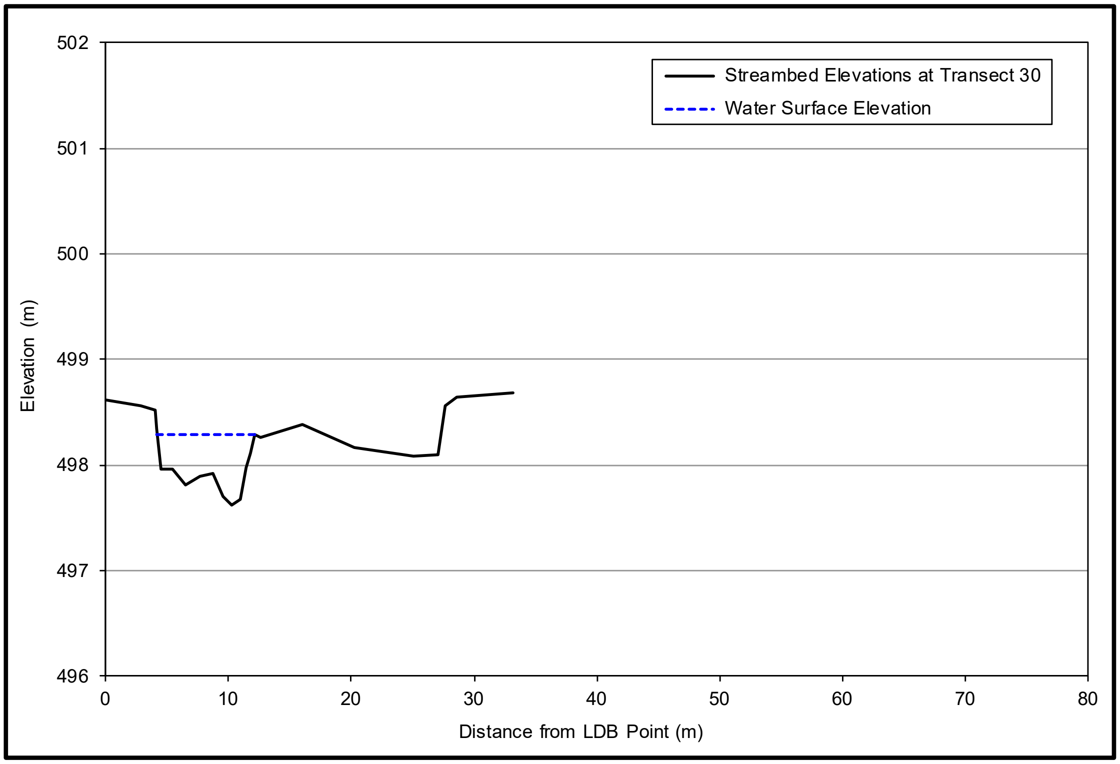


Figure C30: Patterson Lake Outlet Channel, Transect 30 Cross-Section

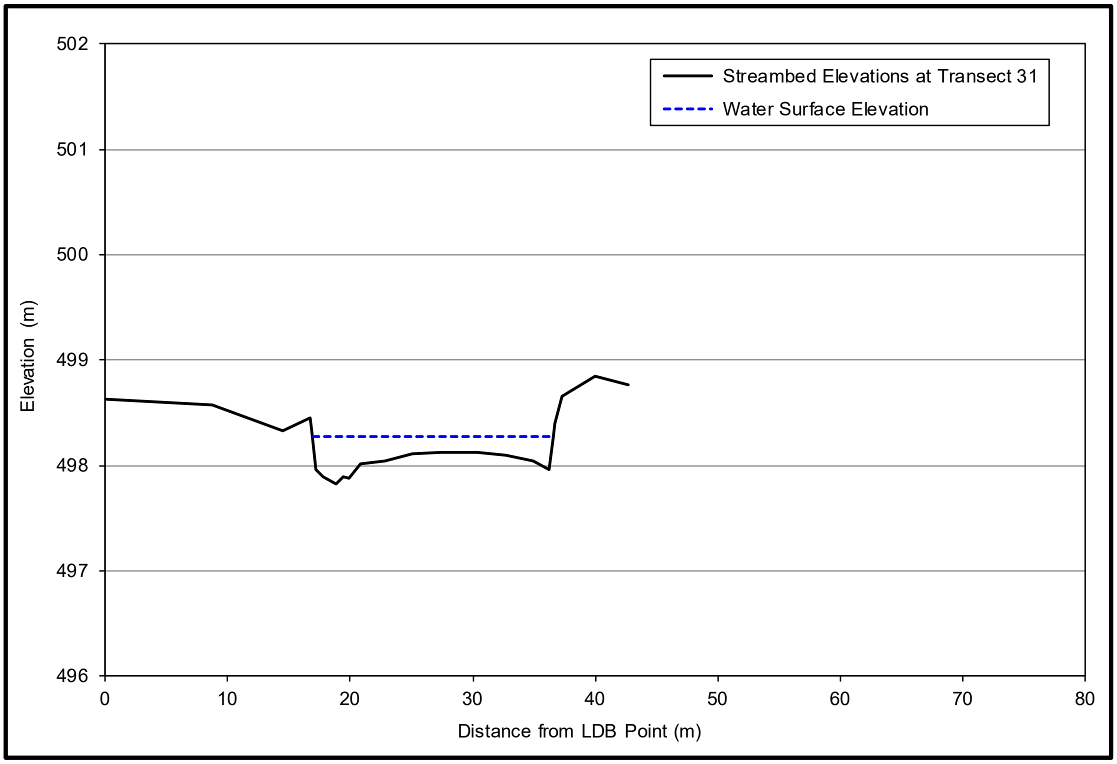


Figure C31: Patterson Lake Outlet Channel, Transect 31 Cross-Section

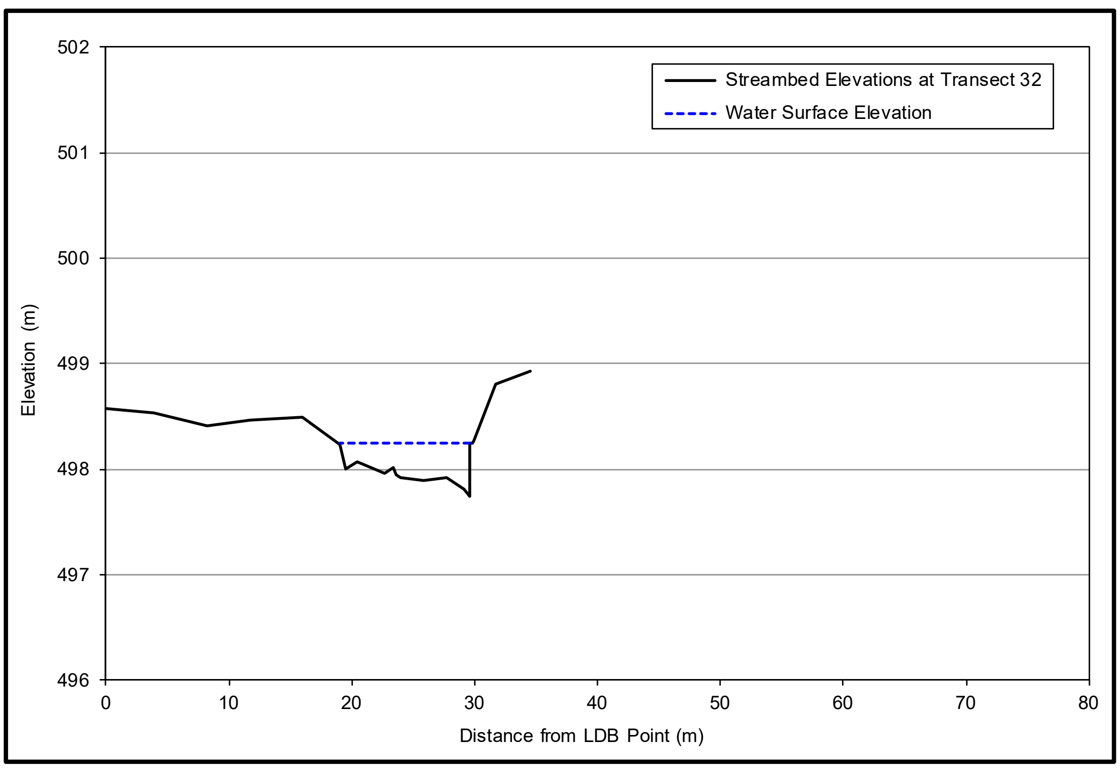


Figure C32: Patterson Lake Outlet Channel, Transect 32 Cross-Section

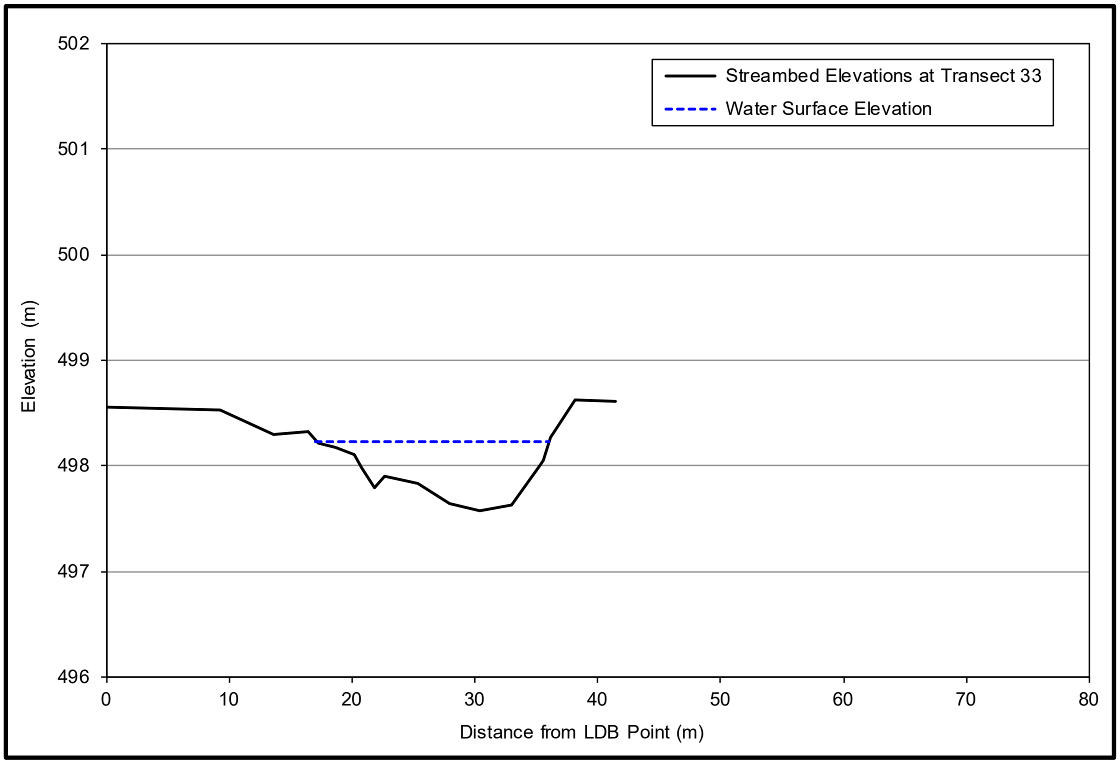


Figure C33: Patterson Lake Outlet Channel, Transect 33 Cross-Section

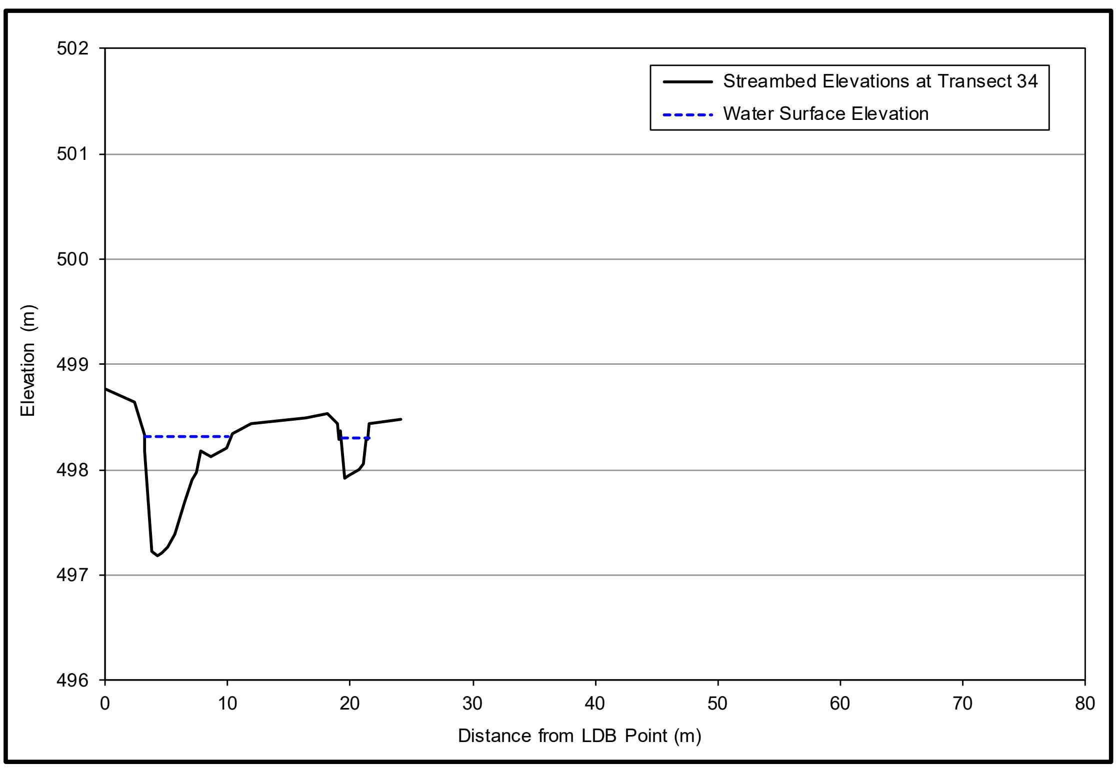
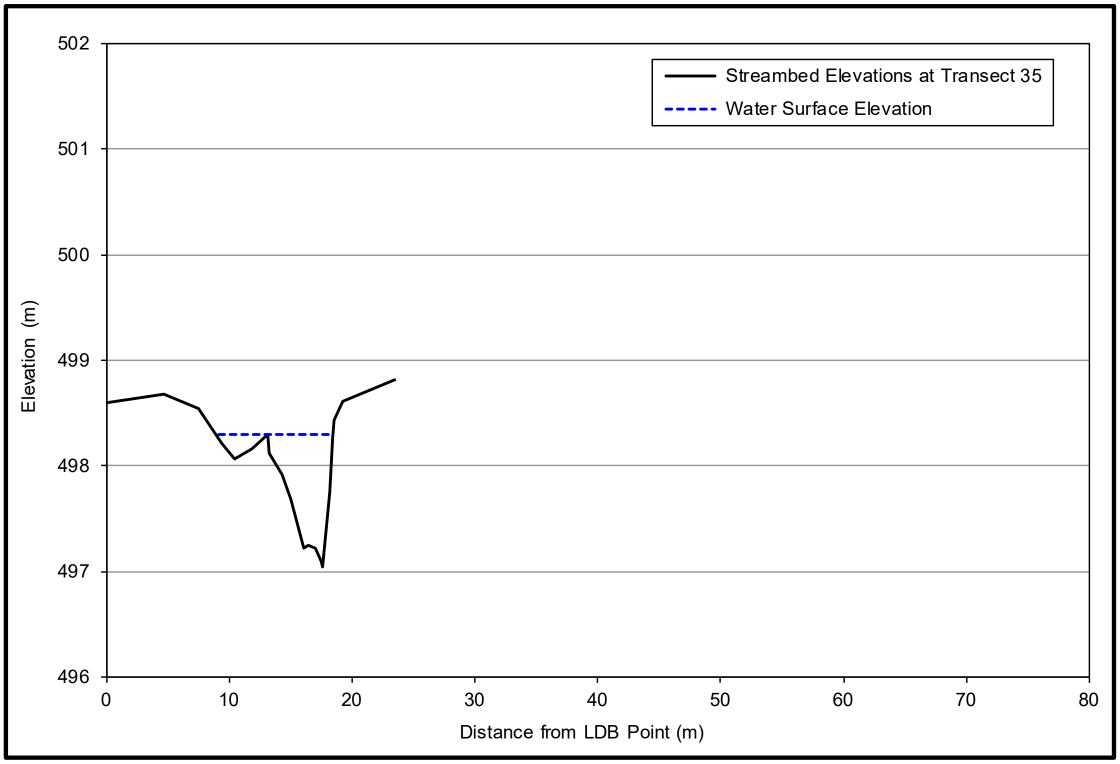


Figure C34: Patterson Lake Outlet Channel, Transect 34 Cross-Section



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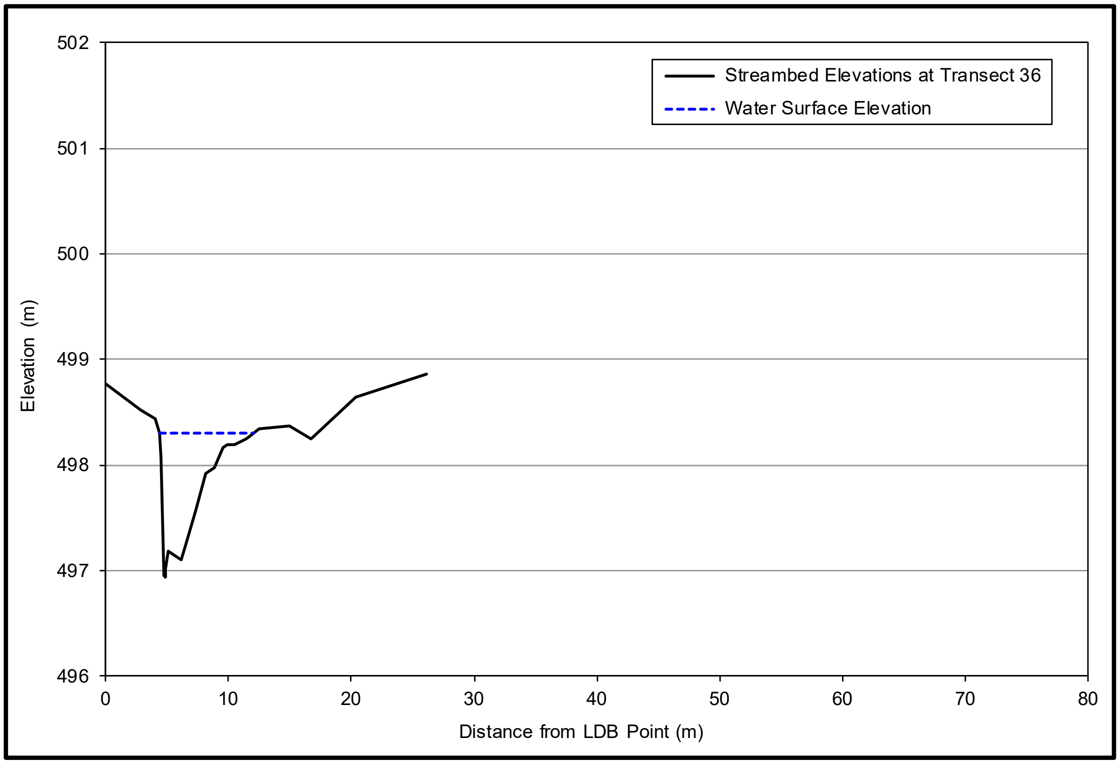


Figure C36: Patterson Lake Outlet Channel, Transect 36 Cross-Section

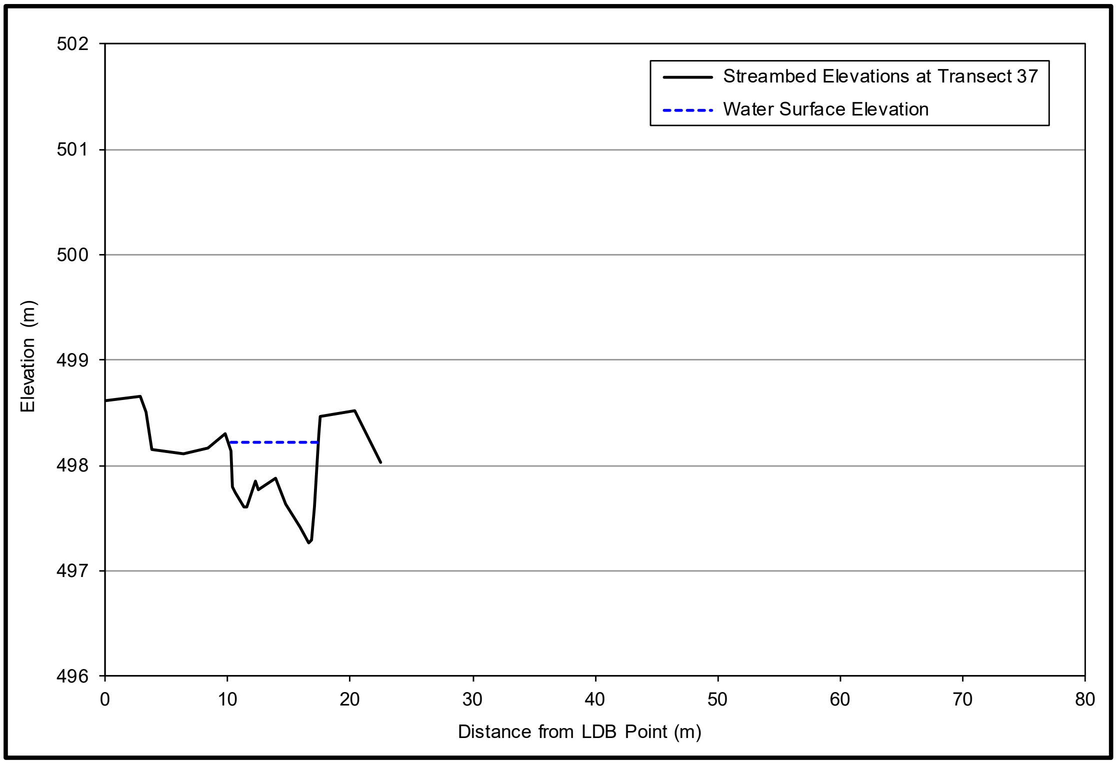


Figure C37: Patterson Lake Outlet Channel, Transect 37 Cross-Section

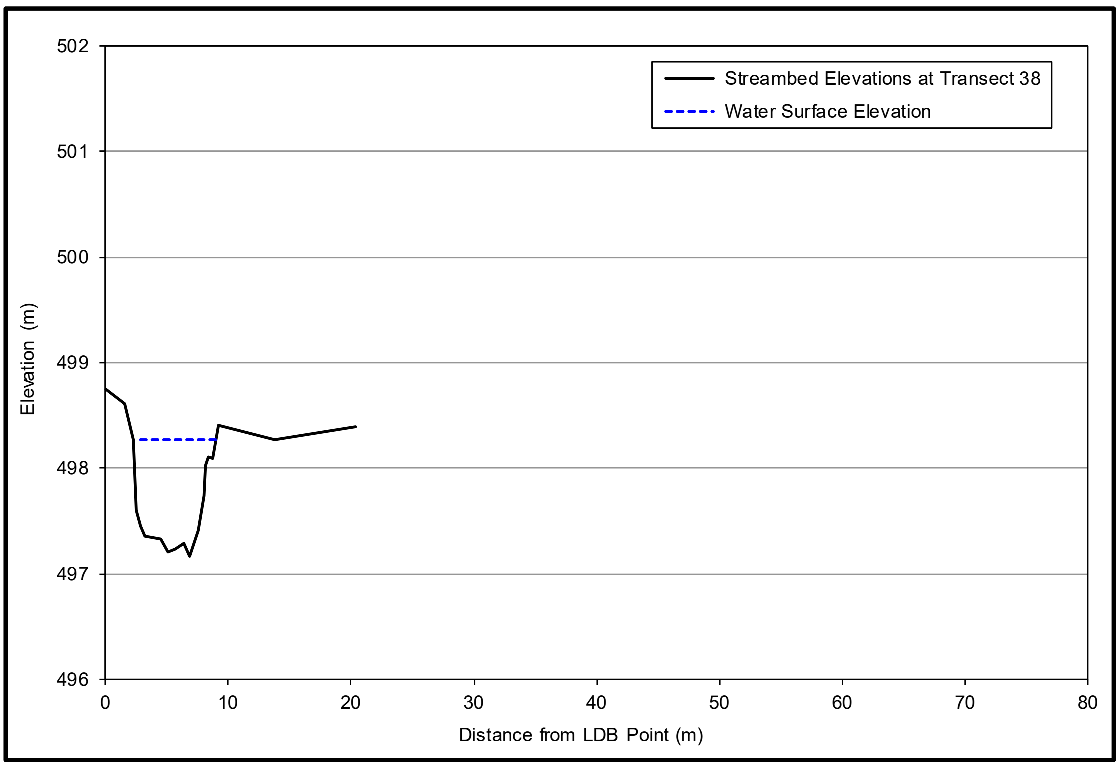


Figure C38: Patterson Lake Outlet Channel, Transect 38 Cross-Section

Rook I Project

Environmental Impact Statement

Annex IV.4: Patterson Lake Currents Assessment Report

PATTERSON LAKE CURRENTS ASSESSMENT REPORT
FOR THE ROOK I PROJECT

Prepared for:

NexGen Energy Ltd.

Prepared by:

WSP Canada Inc.

May 2023

Executive Summary

The assessment of potential adverse effects on surface water quantity and quality from industrial water intakes and outfalls is a provincial and federal requirement and is often a concern expressed by Indigenous Peoples and the public. To address these concerns and requirements, two dispersion modelling studies (Golder 2019, 2020) were conducted for the proposed Rook I Project to evaluate whether the releases from submerged outfalls would meet the requirements of the provincial Surface Water Quality Objectives (WSA 2015). Subsequent to the initiation of this study, the location of the treated sewage outfall was moved from Patterson Lake South Arm to Patterson Lake North Arm – West Basin. The revised location of the treated sewage outfall is approximately 400 m to the southwest of the treated effluent diffuser. A wide range of lake current speeds and directions based on available wind speed and direction data measured at the Rook I Meteorological Station were assumed in the dispersion modelling studies.

The two dispersion studies identified uncertainty owing to a lack of measured lake current data to verify the assumed lake current speeds and directions in the specific areas of the proposed intakes and outfalls in Patterson Lake. To help address this uncertainty, this baseline study was conducted in 2020 and through the winter of 2020-2021 to spring 2021 to provide measured site-specific lake currents data. This baseline study was also completed to improve the general understanding of Patterson Lake currents near the anticipated locations of the submerged infrastructure and to supplement the hydrology baseline study.

In this study, lake current speeds and directions were measured through the installation of acoustic Doppler current profilers (ADCPs) on the lake bed at proposed intake and outfall locations during the open-water season from July 2020 to September 2020. The ADCPs provided detailed high-frequency measurements of Patterson Lake currents from near the lake bed to the near the water surface. The ADCPs were installed and near-surface drogues (*note: drogues are floating “sails” or similar designs that are designed to drift below the water surface, and are fit with Global Positioning System [GPS] devices to track their positions*) were deployed for short periods from three lake currents station locations, one in each of the three basins:

1) Patterson Lake North Arm – East Basin (east of the narrows) near the proposed north fresh water intake location;
2) Patterson Lake North Arm – West Basin (west of the narrows) near the proposed treated effluent diffuser location; and
3) Patterson Lake South Arm – approximately 800 m west of the proposed treated sewage outfall, and at the proposed domestic fresh water intake provided in the 2019 site layout (Wood 2019)[1].

Short-term lake current speeds and directions were measured by releasing drogues fitted with GPS devices into the water from the proposed intake and outfall locations and monitoring their travel paths over a period of one to six hours. Two types of drogues designed for inland waters were used and provided data on near-surface lake current movements in the three Patterson Lake basins and on dispersion characteristics.

[1] Subsequent to the initiation of this study, the proposed location of the treated sewage outfall was moved from Patterson Lake South Arm to in Patterson Lake - North Arm – West Basin. The revised location of the treated sewage outfall is approximately 400 m to the southwest of the treated effluent diffuser.

The lake currents assessment met the baseline study objectives as it provided a better understanding of site-specific conditions at proposed locations of submerged infrastructure during both open-water conditions and ice-covered conditions. Measured current speeds were influenced by wind and local factors such as the orientation of the waterbody, steepness and height of surrounding shorelines, and bathymetry.

Since the collection of this data, the location of the proposed treated sewage outfall has moved to Patterson Lake North Arm – West Basin and the proposed domestic fresh water intake has been combined with the north fresh water intake (i.e., Patterson Lake North Arm – East Basin).

If referencing this report, please use for the following citation:

WSP (WSP Canada Inc.). 2023. Patterson Lake Currents Assessment Report for the Rook I Project. Prepared for NexGen Energy Ltd.

Table of Contents

TABLES

FIGURES

APPENDICES

Abbreviations and Units of Measures

Acronym Abbreviations	Definition
ADCP	acoustic Doppler current profiler
GPS	Global Positioning System
MS	mainstem
NexGen	NexGen Energy Ltd.
PL-North-Intake	proposed north fresh water intake in Patterson Lake North Arm – East Basin
PL-North-Outfall	proposed treated effluent diffuser in Patterson Lake North Arm – West Basin
PL-South	proposed south fresh water intake and treated sewage outfall location in Patterson Lake South Arm[2]
Project	Rook I Project
PVC	polyvinyl chloride
TLU	traditional land use
UTM	Universal Transverse Mercator

Units	Definition
%	percent
°C	degrees Celsius
°	degree
h	hour
km	kilometre
km^2	square kilometre
km/h	kilometres per hour
m	metre
m/s	metres per second
m^2/s	square metres per second
MHz	megahertz
min	minute
mm	millimetre

[2] Subsequent to the initiation of this study, the location of the treated sewage outfall was moved from Patterson Lake South Arm to Patterson Lake North Arm – West Basin. The revised location of the treated sewage outfall is approximately 400 m to the southwest of the treated effluent diffuser. Additionally, the fresh water intake in Patterson Lake South Arm was eliminated from the Project.

1.0 INTRODUCTION

The Rook I Project (Project) is a proposed new uranium mining and milling operation that is 100% owned by NexGen Energy Ltd. (NexGen). The Project would be located in northwestern Saskatchewan, approximately 40 km east of the Saskatchewan-Alberta border, 130 km north of the town of La Loche, and 640 km northwest of the city of Saskatoon (Figure 1). The Project would reside within Treaty 8 territory and within the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, and along the upper Clearwater River system (Figure 2). Access to the Project would be from an existing road off Highway 955. The Project would include underground and surface facilities to support the extraction and processing of uranium ore from the Arrow deposit, a land-based, basement-hosted, high-grade uranium deposit.

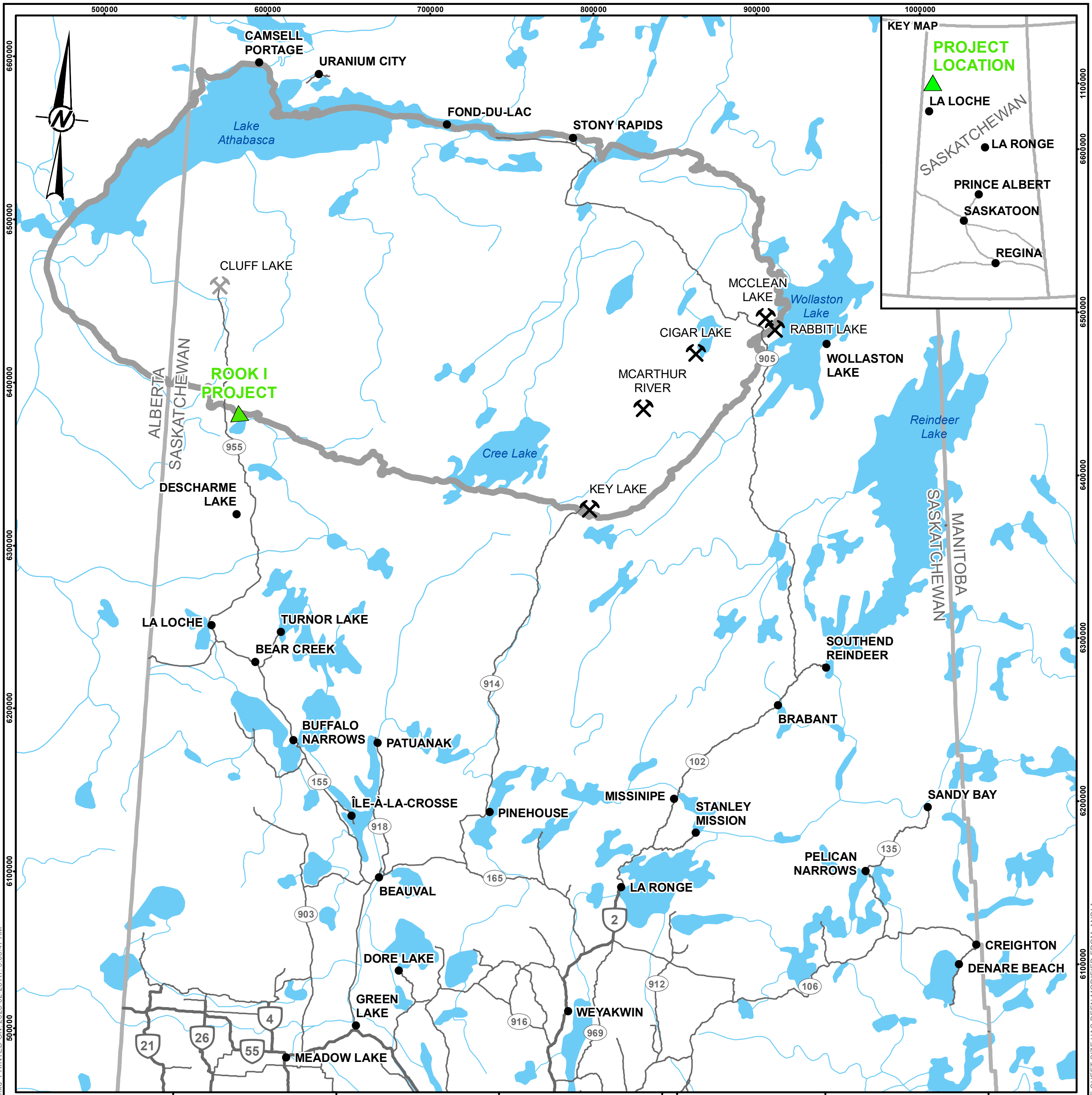
The characterization of Patterson Lake currents represents a component of a comprehensive baseline program that documents the natural and socio-economic environments in the anticipated area of the Project. The hydrology baseline program, of which the Patterson Lake currents assessment is a part, was undertaken to provide context from which Project environmental hydrological effects could be assessed in the Environmental Impact Statement.

Since exploration at the Project commenced in 2013, NexGen has engaged regularly and established relationships local First Nation and Métis Groups (collectively referred to as Indigenous Groups) and northern communities, specifically those closest and with greatest access to the proposed Project. NexGen respects the rights of Indigenous Peoples and the unique relationship Indigenous Peoples have with the environment, and recognizes the importance of full and open discussion with interested or potentially affected Indigenous communities regarding the development, operation, and decommissioning of the proposed Project. Engagement activities to date, as well as future planned engagement activities, reflect the value NexGen places on meaningful engagement with Indigenous Groups and northern communities who could be potentially affected by the proposed Project. Engagement mechanisms have included, but are not limited to: meetings with leadership, workshops and community information sessions, Project site tours, establishing Joint Working Groups to support the gathering and incorporation of Indigenous Knowledge throughout the Environmental Assessment process, and providing funding for Traditional Land Use (TLU) Studies[3] to understand how the proposed Project may interact with the Indigenous communities' traditional use of the anticipated area of the Project.

Feedback received during engagement activities was documented for contribution to the EA for the Project; examples of feedback received include discussion of concerns, interests, potential adverse effects, mitigation, and design alternatives. Many baseline studies were initiated in advance of formal engagement on the EA for the Project; however, engagement during the execution of baseline studies has helped inform the understanding of baseline conditions and confirmed components of the natural and socio-economic environments that required study. A summary of feedback related to the hydrology baseline program is presented in Appendix A of the Hydrology Baseline Road Map (Annex IV).

[3] Traditional Land Use (TLU) Studies include all land use studies developed by the Project's affected Indigenous Groups, including Traditional Land Use and Occupancy studies, Traditional Knowledge and Use studies, and Indigenous Rights and Knowledge studies, henceforth referred collectively as TLU Studies.

Potential adverse effects on surface water quantity and quality from industrial water intakes and outfalls require assessment prior to construction installation and are often a concern expressed by the public including Indigenous Peoples. Two dispersion modelling studies were conducted (Golder 2019, 2020) for the proposed Project to evaluate whether the releases from submerged outfalls would meet the requirements of the provincial Surface Water Quality Objectives (WSA 2015). A wide range of lake current speeds and directions were assumed in the dispersion modelling studies and were based on available wind speed and direction data measured at the Rook I Meteorological Station. The dispersion studies identified uncertainty in lake currents because measured current data were not available to verify the assumed lake current speeds and directions in the specific areas of the proposed intakes and outfalls in Patterson Lake. This baseline study was conducted from July 2020 to September 2020 and late October 2020 to June 2021 to provide measured-site specific lake currents data. This baseline study was also completed to improve overall understanding of Patterson Lake currents near the anticipated locations of the submerged infrastructure.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- ATHABASCA BASIN BOUNDARY
- PROJECT LOCATION

0 100 200

1:3,500,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

LOCATION OF THE ROOK I PROJECT, SASKATCHEWAN

CONSULTANT

wsp

YYYY-MM-DD	2023-02-28
DESIGNED	SS
PREPARED	NO/AK
REVIEWED	JMC
APPROVED	MM

PROJECT NO.	PHASE	REV.	FIGURE
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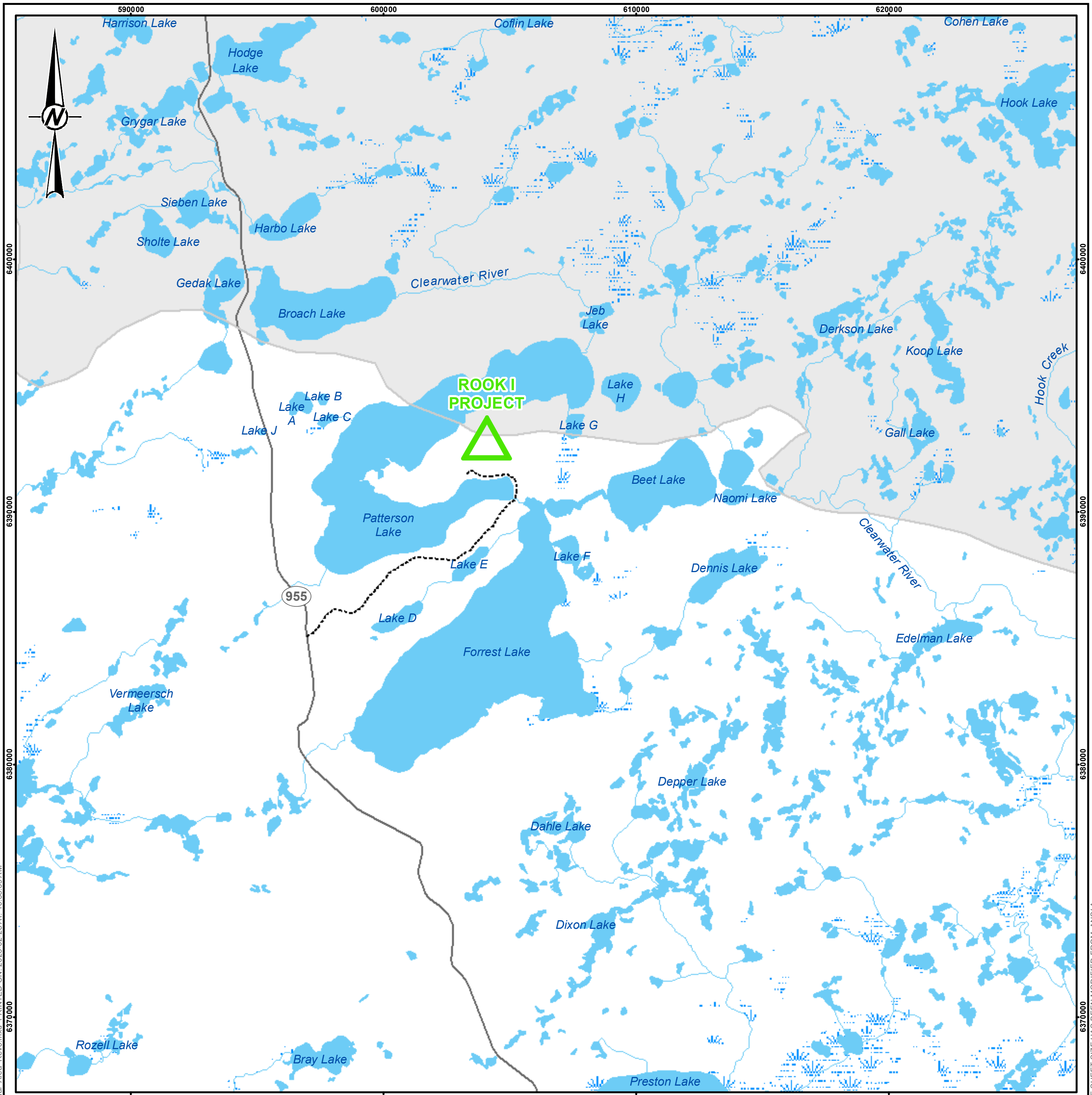

LEGEND

- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- WETLAND
- ATHABASCA BASIN
- PROJECT LOCATION
- EXISTING ACCESS ROAD

0 5,000 10,000

1:225,000 METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

REGIONAL AREA OF THE ROOK I PROJECT

CONSULTANT

wsp

YYYY-MM-DD	2023-02-28
DESIGNED	JMC
PREPARED	NO/AK
REVIEWED	JMC
APPROVED	MM

PROJECT NO.	PHASE	REV.	FIGURE
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2.0 STUDY OBJECTIVES

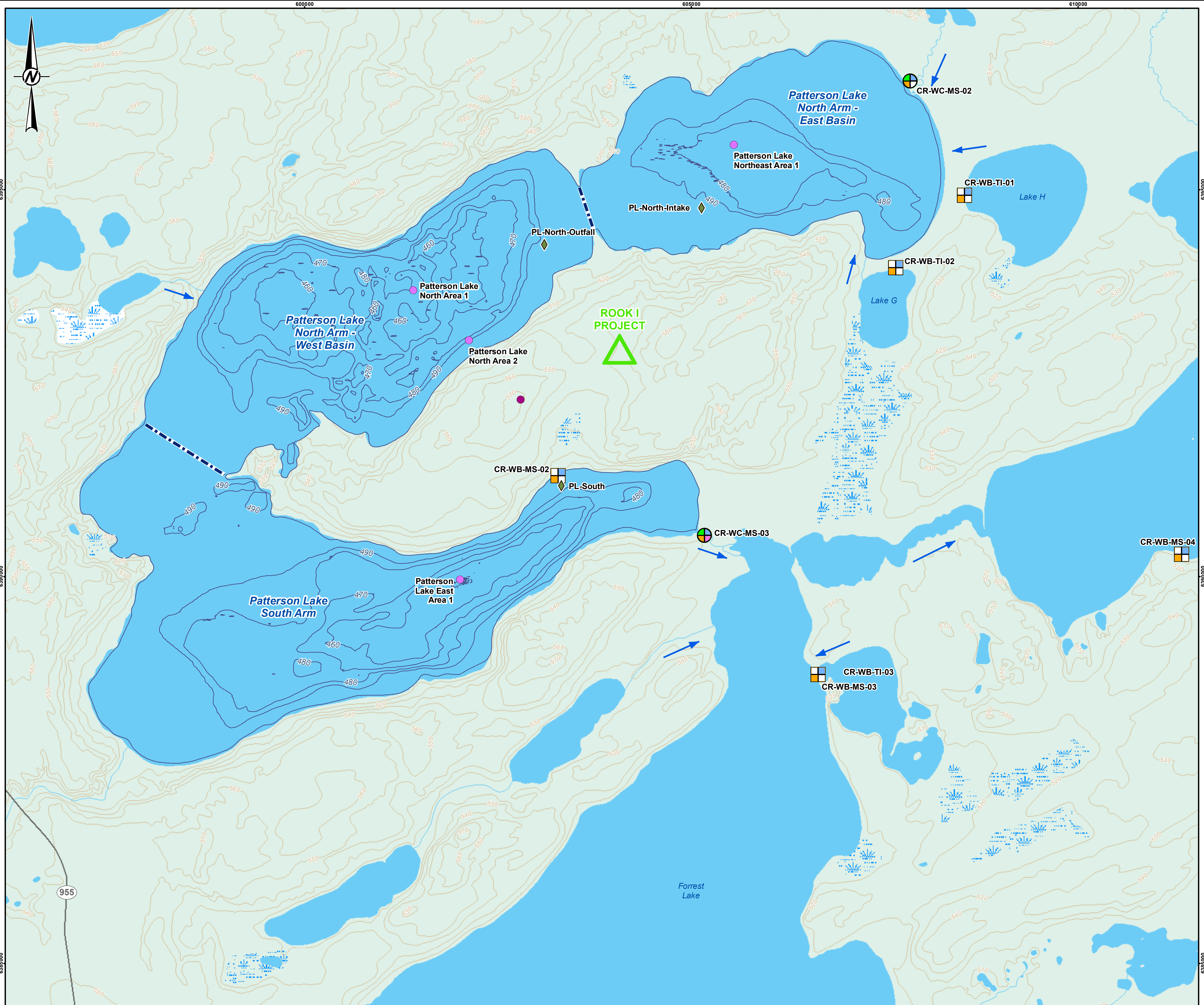
The Patterson Lake currents assessment was completed to supplement the hydrology baseline study and provide supporting information for both the conceptual design of a treated effluent diffuser and the modelling completed for the surface water quality effects assessment. This study was focused on Patterson Lake due to its proximity to the Project and importance as both a potential source of fresh water and as the proposed immediate receiving environment for treated effluent discharge.

The objective of the Patterson Lake currents assessment was to improve understanding of physical conditions, particularly lake currents, in Patterson Lake. Prior to this study, lake currents were estimated from wind speeds. This study was designed using different instruments to collect complementary measurements of lake currents. Stationary acoustic Doppler current profilers (ADCPs) are electronic instruments that were used in Patterson Lake to regularly measure lake currents at different depths over a long period of time (i.e., July 2020 to September 2020 and late October 2020 to June 2021). Underwater sails called drogues were used to measure lake currents at the surface over a shorter period (i.e., days), starting at a specific location and travelling in different directions depending on lake circulation currents. The combination of the measured lake current data from the different instruments provided detailed information on site-specific lake circulation patterns at the proposed locations of the north fresh water intake and treated effluent diffuser (using stationary ADCPs) and beyond the mixing zone (using drogues). The use of different instruments was intended to provide independent measurements to build confidence in the observations.

3.0 STUDY AREAS

The Patterson Lake currents assessment targeted Patterson Lake, which is located within the local study area defined for the hydrology program, and is the waterbody expected to be most influenced by proposed Project activities. Patterson Lake is divided into a North Arm and South Arm and is oriented approximately southwest to northeast (Figure 3). The North Arm is further separated into the West Basin and East Basin by a narrow and shallow sand bar. The Patterson Lake inflow is at the east end of the North Arm – East Basin and the outflow is at the east end of the South Arm.

The anticipated locations of proposed intakes and outfalls for the proposed Project in Patterson Lake at the time the study was designed and executed are shown in Figure 3. Since the collection of this data, the location of the proposed treated sewage outfall has moved to Patterson Lake North Arm – West Basin and the proposed domestic fresh water intake has been combined with the north fresh water intake (i.e., Patterson Lake North Arm – East Basin).



LEGEND

- PROJECT LOCATION
- BATHYMETRY CONTOUR ELEVATION (METRES)
- ELEVATION CONTOUR (10m INTERVAL)
- FLOW DIRECTION
- LAKE BASIN DIVISION
- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- WETLAND
- WOODED AREA
- AQUATIC BASELINE MONITORING POINT (CANNORTH 2019)
- LAKE CURRENTS ADCP LOCATIONS
- ROOK I METEOROLOGICAL STATION

WATERBODY HYDROMETRIC STATIONS

- DISCHARGE
- SURVEYED BENCHMARK (GEODETIC DATUM)
- TOTAL SUSPENDED SOLIDS AND BEDLOAD
- WATER SURFACE ELEVATION

WATERCOURSE HYDROMETRIC STATIONS

- DISCHARGE
- SURVEYED BENCHMARK (GEODETIC DATUM)
- TOTAL SUSPENDED SOLIDS AND BEDLOAD
- WATER SURFACE ELEVATION

0 1,000 2,000
1:50,000 METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. BATHYMETRY CONTOURS DERIVED FROM DATA COLLECTED BY NEXGEN, 2016.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT
NexGen Energy Ltd.

PROJECT
ROOK I PROJECT

TITLE
PATTERSON LAKE CURRENT MEASUREMENT LOCATIONS

CONSULTANT
wsp

YYYY-MM-DD	2023-02-28
DESIGNED	JH
PREPARED	NO
REVIEWED	JMC
APPROVED	MM

PROJECT NO.	PHASE	REV.	FIGURE
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4.0 METHODS

This section outlines existing information, approach, equipment, and methods used to conduct the Patterson Lake currents assessment.

4.1 Review of Existing Information

No previous lake currents studies have been conducted for Patterson Lake. Existing information used in this report includes the following data and reports:

- baseline Patterson Lake basin temperature profiles measured by CanNorth (2020);
- meteorological data from the Rook I Meteorological Station (Golder 2018);
- predicted lake current speeds and directions for Patterson Lake – North Arm contained within the conceptual diffuser design report (Golder 2019);
- predicted lake current speeds and directions included in the downstream user impact study for the treated sewage outfall for the Project (Golder 2020); and
- bathymetric mapping of Patterson Lake collected by NexGen using a Real-Time Kinematic (RTK) GPS and depth sounder.

4.2 Approach

Characterization of Patterson Lake currents was based on field data collected during the summer and fall open-water periods between July 2020 and October 2020 and May 2021 to June and July 2021, with supplementary data from other baseline studies. To obtain data representing ice-covered conditions, the ADCPs were redeployed over the winter from November 2020 to May 2021.

The following tasks were undertaken to meet the study objectives, and detailed methods are provided in Sections 4.2.1 to 4.2.3.2:

- Existing information as described in Section 4.1 was reviewed. Relevant supplementary data for this study that have been collected as part of other baseline monitoring activities include:
  - meteorological data, including wind speed and wind direction at the Rook I Meteorological Station for the open-water period in 2020 and spring 2021, was reviewed and compared with lake current patterns (see Section 4.2.1); and
  - Patterson Lake water temperature data were reviewed as these data provide information characterizing lake limnology and temperature is one of the main factors determining the density of either fresh water or treated effluent discharge and the mixing characteristics of treated effluent discharge into a lake (Section 4.2.2).

- Lake current profiles were monitored during the open-water period in 2020, ice-covered period in the winter of 2020 to 2021, and open-water period in spring 2021 using ADCPs at the following three monitoring locations (near the anticipated locations of the submerged infrastructure) (Section 4.2.3 and Figure 3):
  - proposed north fresh water intake in Patterson Lake North Arm – East Basin (PL-North-Intake);
  - proposed treated effluent diffuser in Patterson Lake North Arm – West Basin (PL-North-Outfall); and
  - proposed south fresh water intake and treated sewage outfall location in Patterson Lake South Arm (PL-South). It is noted that a fresh water intake and treated sewage outfall are no longer proposed for the South Arm of Patterson Lake.
- Drogues were released for periods of four to eight hours at the ADCP deployment locations to monitor near-surface lake circulation patterns near these locations. Drogues are floating "sails" or similar designs that are designed to drift below the water surface and are fitted with GPS devices to record their movements in detail (Section 4.2.4).

4.2.1 Meteorological Observations

The Rook I Meteorological Station was originally installed in 2015 and was moved to its current location in fall 2018 (Golder 2018). The station is currently located on a hill in a relatively open area near the exploration camp (Figure 3; UTM NAD83 Zone 12602795 E, 6392291 N). The meteorological parameters used in this study were wind speed and wind direction, which were measured with an RM Young anemometer installed at a height of 10 m above ground, with a 5 second sampling frequency and hourly averaging interval. Meteorological data were quality checked following the data collection period. Wind speed and direction patterns and statistics from the open water observation period are provided in Section 5.1.

4.2.2 Patterson Lake Water Temperature

Lake water temperature was measured by the ADCPs representing conditions near the lake bed, as well as at two hydrometric stations representing near-surface water temperatures, respectively. Water temperatures were recorded by level loggers from the two hydrometric stations: The Clearwater River below Patterson Lake CR-WC-MS-03 located near the lake outlet; and Patterson Lake CR-WB-MS-02 located near the camp in the Patterson Lake South Arm (Figure 3).

Water temperature profiles were recorded in Patterson Lake's North Arm (i.e., West and East basins) and South Arm as part of aquatic and surface water quality baseline studies completed for the Project (CanNorth 2020).

Lake water temperature profiles and near-surface temperature data provide context for the lake thermal stratification at the time of the lake currents measurements. Water temperature profile data indicate the depth of the thermocline and the strength of the stratification that can affect lake circulation, as well as the mixing characteristics of the treated effluent discharge in the lake.

4.2.3 Patterson Lake Currents Observations

The configuration of the ADCPs, along with deployment details for each of the three Patterson Lake monitoring locations, is described in the following subsections. The ADCPs were deployed over a period of months from July to September 2020 to collect data that represented open water conditions.

4.2.3.1 *Acoustic Doppler Current Profiler Deployment Details*

The ADCPs were mounted on the lake bed using purpose-built frames. The ADCPs measure current speed and direction in multiple layers throughout the water column; the layers are referred to as cells, with the lowest cell numbers being closest to the lake bed. Water velocity is measured using a physical principle called the "Doppler Effect", which measures the change in sound signal frequency reflected off particles in the water passing by the ADCP. Each of the ADCPs has three beams that transmit a short sound signal up into the water column. When the signals reflect off the particles in the water such as sediment, zooplankton, or air bubbles, the returning echo is recorded and the ADCP measures the difference in frequency between transmitted and received sound signals (Nortek 2018). When the water is not moving, there is no change in frequency between transmitted and received sound signals and the velocity calculated from each of the three beams is zero.

Each ADCP used in the study had slightly different configuration and sampling parameters designed to capture the most accurate velocity measurements for a certain range of water depths. The three beams of the ADCPs all faced upward and outward at fixed angles of about 35° to 45° from vertical. There is a fixed distance immediately above the ADCP that cannot collect data (this fixed distance is called a blanking distance). Details of the ADCP instrumentation and deployment parameters are provided in Table 1.

The ADCPs were deployed in open-water conditions for the first deployment and were redeployed in under-ice conditions for the second deployment. The second ADCP deployment was also separated into two periods for analysis: under ice before ice break-up and the spring 2021 open-water period after ice break-up. The timing of freeze-up and thaw of the Patterson Lake ice cover varied in different Patterson Lake basins in the winter of 2020-2021. To provide a consistent dataset, the winter ice-covered monitoring period and spring 2021 open-water periods were clearly defined to avoid time periods with partial ice cover. The timing was confirmed based on field observations from staff on site, from satellite imagery available for specific dates (Sentinelhub 2022), and through review of the ADCP multicell data and diagnostics data.

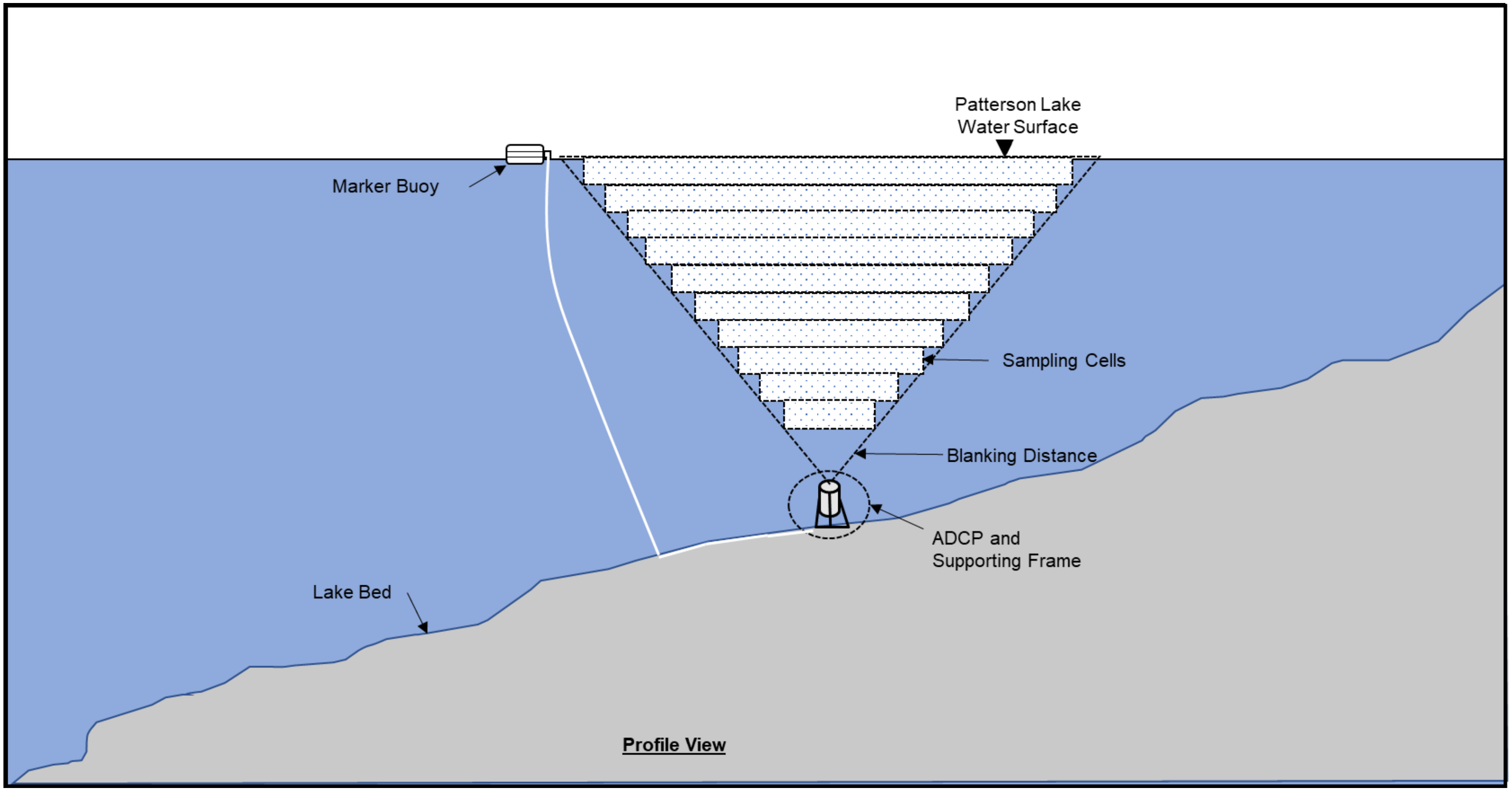
Freeze-up on Patterson Lake North Arm – East Basin occurred between 15 October 2020 when the lake was fully open (i.e., no ice cover), to 25 October 2020 when a complete ice cover had formed. Due to the early freeze-up, the installation of the ADCP at this location was postponed to 6 January 2021. On 29 October 2020, both Patterson Lake North Arm – West Basin and Patterson Lake South Arm still had open-water, and ADCPs were reinstalled on this date. Based on satellite imagery, a partial ice cover was forming in some areas by 30 October 2020, and complete ice cover was in place by 7 November 2020.

Ice break-up on Patterson Lake occurred between 21 May 2021 (based on satellite imagery, open-water was observed in various locations around the edge of the ice cover) and 26 May 2021 (only minimal ice cover remained in the southwest corner of the lake and far from the ADCP locations). Certain ADCP parameters were altered prior to the under-ice deployment, mainly to account for the lower velocity conditions that would occur once the ice cover was in place. To obtain more accurate results at low velocities, the cell size was increased (e.g., from 1.0 m to 2.0 m at PL-North-Outfall) and the sampling time was increased when possible (e.g., from 10 minutes to 15 minutes).

The main constraints on data collection during the longer winter deployments included reduced battery life in cooler water and total available instrument memory. Therefore, the interval between samples was increased, and the number of cells where data were collected were reduced to conserve the memory and battery power.

The typical deployment configuration is depicted on the sketch provided in Figure 4. Photos are included in Section 4.2.3.1.1 through Section 4.2.3.1.3.

Figure 4: Typical Acoustic Doppler Current Profiler Deployment Sketch



ADCP = acoustic Doppler current profiler.

Table 1: Acoustic Doppler Current Profiler Instrumentation and Deployment Details

Proposed Location	Station ID	Easting[(a)] (m)	Northing[(a)] (m)	Water Depth at the ADCP (m)	ADCP Type	Season	Cell Size (m)	Number of Cells Recording Data	Sampling Interval	Blanking Distance[(b)] (m)	Standard deviation (m/s) [(d,e)]	Dates Installed
North Arm – East Basin[(c)]	PL-North-Intake	605053	6394821	3.0	Nortek Aquadopp 1,000 MHz	2020 open-water	0.25	7	10 minutes sampling every 30 minutes	0.4	0.023	9 July 2020 to 23 September 2020
						Ice-covered and spring 2021 open-water	0.4	4	15 minutes sampling every 60 minutes	0.4	0.017	6 January 2021 to 9 June 2021 [(f)]
North Arm-West Basin	PL-North-Outfall	603024	6394347	11.0	Nortek Aquadopp 600 MHz	2020 open-water	1.0	10	10 minutes sampling every 20 minutes	0.5	0.020	9 July 2020 to 23 September 2020
						Ice-covered and spring 2021 open-water	2.0	5	15 minutes sampling every 60 minutes	0.5	0.010	29 October 2020 to 9 June 2021
South Arm [(c)]	PL-South	603245	6391230	3.5	Sontek Argonaut XR 3,000 MHz	2020 open-water	0.4	9	10 minutes sampling every 30 minutes	0.2	0.013	8 July 2020 to 23 August 2020 [(g)]
						Ice-covered and spring 2021 open-water	0.5	7	10 minutes sampling every 60 minutes	0.2	0.012	29 October 2020 to 13 June 2021

a) All coordinates referenced are in UTM Zone 12 and North American Datum 1983 (NAD83).
b) Blanking distance is the region closest to the transducers that minimizes interference during attenuation of the sound waves; the minimum blanking distance is the distance sound travels during attenuation (Nortek 2018).
c) The Patterson Lake South outfall was proposed to be located about 800 m east of the originally proposed camp drinking water intake location at a water depth of 3.0 m and it is 50 m from the north shoreline. This outfall is no longer part of the proposed Project.
d) The precision of horizontal measurements is set in the deployment process and it increases by using larger cell sizes and collecting a larger sample.
e)The Sontek measures accuracy directly using the standard deviation, which is based on a formula $\sigma = 20 / (\sqrt{N} * (\sqrt{CS}))$ where N = number of samples in seconds and CS = cell size in metres (Sontek 2007).
f) Data recorded for the ice-covered period and spring 2021 open-water conditions was not useable due to an installation error. The angle of placement was 28° from level, which exceeded quality control standards (QARTOD 2019).
g)The PL-South ADCP was reinstalled on 23 August 2020; however, battery issues resulted in a data gap from 23 August to 23 September 2020.
ADCP = acoustic Doppler current profiler.

4.2.3.1.1 Patterson Lake North Fresh Water Intake Location

The ADCP at PL-North-Intake was deployed to collect information on ambient lake currents near the anticipated location of the proposed north fresh water intake. The originally proposed deployment location was near shore in the Patterson Lake North Arm – East Basin (Wood 2019). However, that location was determined to be too shallow (i.e., less than 1.5 m) for reliable deployment of the ADCP. A more suitable location for the deployment was identified approximately 800 m northeast of the originally proposed location as shown in the Figure 3 which includes bathymetry data.

A Nortek Aquadopp 1,000 MHz ADCP was deployed from 9 July 2020 to 23 September 2020 and redeployed from 6 January 2021 to 9 June 2021 at PL-North-Intake (Figure 5, Table 1). The ADCP was deployed approximately 600 m from shore at a water depth of 3.0 m, with the top of the ADCP at approximately 1.0 m from the lake bed. At the deployment location, the lake bed is flat. To the west and south, the lake bed slope is gradual with depth decreasing towards shore. To the east and north, the lake bed slope increases where there is a drop-off.

Figure 5: Nortek Aquadopp Acoustic Doppler Current Profiler and Mounting Frame Deployed at Patterson Lake North Intake

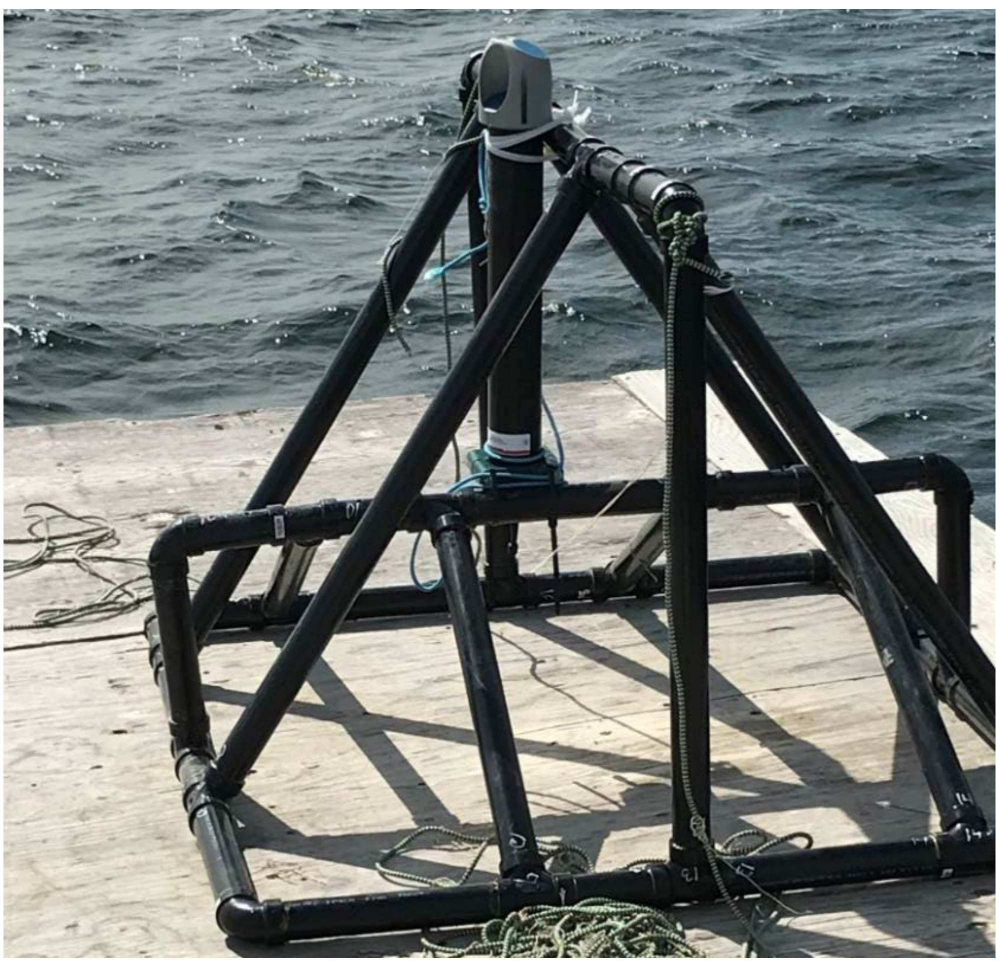
4.2.3.1.2 Patterson Lake Treated Effluent Diffuser Location

Lake currents monitoring at station PL-North-Outfall was initiated on 8 July 2020. PL-North-Outfall provided information on ambient lake currents near the anticipated location of the treated effluent diffuser. The proposed point for deployment was located offshore in the Patterson Lake North Arm – West Basin, based on the preferred location of the treated effluent diffuser (Golder 2019). The proposed deployment location was west of the narrows that separates the East and West basins of the North Arm and had a water depth of 10.0 m (Figure 3).

The ADCP was located approximately 50 m east of the proposed diffuser location on a small shelf that had a total water depth of 11.0 m, with the top of the ADCP at approximately 1.0 m from the lake bed. To the west, the depth increases rapidly, and to the east and south, the depth rapidly decreases by several metres then gradually decreases thereafter.

The ADCP at station PL-North-Outfall was deployed on 8 July 2020, checked, and redeployed at the same location on 9 July 2020. For the ice-covered period, the ADCP was redeployed on 29 October 2020 and retrieved 9 June 2021. Figure 6 shows the ADCP mounted on the frame; deployment details are provided in Table 1.

Figure 6: Nortek Aquadopp Acoustic Doppler Current Profiler and Mounting Frame Deployed at Patterson Lake North Outfall



4.2.3.1.3 Patterson Lake South Location

Lake currents monitoring at station PL-South was initiated to provide information on ambient lake currents near the anticipated locations of the south fresh water intake and the treated sewage outfall. The proposed point for deployment was located near shore in the Patterson Lake South Arm based on the downstream use and impact study for the sewage discharge (Golder 2020).

The proposed location was confirmed in the field to be suitable based on water depth similar to the proposed outfall location and low gradient slope of the lake bed. The ADCP at station PL-South was deployed on 8 July 2020. For the ice-covered and spring periods, the ADCP was redeployed on 29 October 2020 and retrieved 13 June 2021. The ADCP was installed on the lake bed at a depth of 3.5 m, with the top of the ADCP at approximately 0.5 m from the lake bed. The ADCP prepared for deployment is shown in Figure 7.

Figure 7: Sontek Argonaut-XR Acoustic Doppler Current Profiler and Mounting Frame Deployed at Patterson Lake South

4.2.3.2 *Acoustic Doppler Current Profiler Data Analysis*

Acoustic Doppler current profiler data were reviewed for quality, representative cells were chosen for each location, and current speeds were classified into current speed and direction categories to show the current patterns in a visible way. Data were reviewed for completeness and quality according to standard methods as outlined by the manufacturers and industry (NOAA 2000; QARTOD 2019). The review is summarized as follows:

- The ADCP data showed PL-North-Outfall and PL-South had sufficiently low tilt and roll values when installed, though data for PL-North-Outfall was corrected for a vertical angle of 5.5° (i.e., instrument was tilted 5.5°).
- PL-North-Intake ADCP had tilt values that were at the maximum value suggested by the manufacturer (i.e., greater than 30°) from November 2020 to January 2021 (i.e., ice-covered period); as such, the data collected during that period was not useable.
- For the open-water period, data for all three ADCPs had stable water depth, and there were only small shifts in compass direction between two short deployments for the two Nortek sensors.
- The ADCP data for all three ADCPs had sufficiently high signal-to-noise ratios to provide strong acoustic signal for the required signal range of water depth at each instrument.
- For the ice-covered period, the PL-North-Outfall and PL-South ADCP transducers were clear of obstructions. However, due to interference from ice, about 38% of the ADCP data at PL-North-Outfall and 33% at PL-South were screened out.
- Specific cells chosen to represent the near-lake-bed, mid-profile, and near-surface depths for the 2020 open-water period were as follows:
  - PL-North-Intake (cell 1 for near-lake-bed, cell 3 for mid-profile, and cell 5 for near-surface).
  - PL-North-Outfall (cell 1 for near-lake-bed, cell 4 for mid-profile, and cell 7 for near-surface).
  - PL-South (cell 2 for near-lake-bed, cell 4 for mid-profile, and cell 7 for near-surface).
- Specific cells chosen to represent the near-lake-bed, mid-profile, and near-surface depths for the ice-covered and spring 2021 open-water periods were as follows:
  - PL-North-Outfall (cell 2 for mid-profile and cell 3 for near-surface).
  - PL-South (cell 2 for near-lake-bed, cell 3 for mid-profile, and cell 4 for near-surface).
- Current data were classified according to speed categories and direction as follows:
  - Magnitude of current speeds for each ADCP dataset were ranked and plotted against percent frequency of exceedance calculated as the rank (with the highest current speed having the highest rank) divided by sample size plus 1.
  - In general, current speed that exceeds 0.1 m/s is considered high speed for a lake environment while speed < 0.005 m/s is classified as near-zero or calm.

4.2.4 Drogue Releases

Drogues are passive devices designed to float below the water surface and move with the ambient lake currents. Drogues provide a method of tracking near-surface lake circulation patterns over a short period of time. GPS devices were attached to each drogue to track their movement over a period of one to six hours. A photo showing how the drogues moved at Patterson Lake South Location is provided in Figure 8.

Figure 8: View Facing North of Acoustic Doppler Current Profiler Location at Patterson Lake South Arm on 13 June 2021

Photo taken facing north. Note the arrow is pointing to retrieval buoy. The three flags mark the positions of the drogues that were deployed at the same location, which are discussed in Section 4.2.4.

For this study, a set of drogues were released at each ADCP location during the field visits in July 2020, August 2020, September 2020, and June 2021. One set was released on 29 October 2020 to provide additional results using the sail drogue type at PL-South. Details of the drogue releases are provided in Table 2.

Two types of drogues were used in the study: polyvinyl chloride (PVC) and sail. The PVC-type drogues are designed for shallow water and extend to a depth of about 0.3 m. These drogues are made of PVC pipe connected in a cross-configuration that floats on the water surface, with a larger diameter central pipe with a screw-in cap that holds the GPS (Figure 9). The “sail-type” drogues are a longer design of about 2 m in length with nylon “sails” attached in a cross-configuration with aluminum cross-bars about 1 m in length at the top and bottom, with a float at the surface, and a weight attached at the base (Figure 10). The sail drogues are better designed for deeper water deployment as they will run aground sooner than the PVC type. Three drogues of each type were released during all field visits except the August 2020 field visit, where one PVC drogue was damaged and, consequently, only two PVC drogues were released at PL-North-Intake and PL-South.

Table 2: Drogue Release Details

Station ID	Date	Time Released	Time Picked up	Number of Drogues	Type of Drogue	Notes
PL-North-Intake	9 July 2020	12:15	17:54	3	PVC type	Light winds. All three GPS lost reception at times
	19 August 2020	12:30	16:42	2	PVC type	High westerly winds
	24 August 2020	09:04 and 10:23	14:56	2	PVC type	Moderate wind. One drogue deployed later after a lost one was found
	23 September 2020	11:00	16:05	3	PVC type	Moderate southeast winds shifting to southwest and wind speeds increasing
	9 June 2021	10:52	15:18	3	Sail type	Moderate east-southeast winds
PL-North-Outfall	9 July 2020	09:30	18:09	3 (2 complete)[a]	Sail type	Light winds. One GPS lost reception
	19 August 2020	11:48	18:35	3 (2 complete)[a]	Sail type	High westerly winds. One drogue GPS lost signal. Drogues ran ashore at about 17:00 [b]
	24 August 2020	08:35	14:40	3	Sail type	Moderate wind
	23 September 2020	10:05	16:40	3 (2 complete)[a]	Sail type	Moderate southeast winds shifting to southwest and wind speeds increasing. One GPS lost reception
	9 June 2021	09:08	16:40	3	Sail type	Moderate east-southeast winds. Drogues ran aground at about 15:00
PL-South	8 July 2020	11:30	17:53	3 (2 complete)[a]	Sail type	Light northerly winds. One GPS lost reception at times
	23 August 2020	10:11	16:52	2	PVC type	Light southerly winds
	26 September 2020	08:03	13:35	3	PVC type	Light west or southwest wind increasing to moderate in the afternoon
	29 October 2020	10:45	15:12	3	Sail type	Moderate northwest wind
	13 June 2021	08:44	10:27	3	Sail type	Light northwest wind

a) Although three drogues were released, there were issues with one of the drogues tipping over or being submerged such that the drogue's GPS track did not provide useful data.

b) Drogues were often retrieved after they had drifted ashore; data that showed the drogues slowing down near shore were removed from the analysis.

PVC = polyvinyl chloride.

Figure 9: View of a Polyvinyl Chloride Drogue Retrieved after Deployment

Figure 10: View of a Sail Drogue after Release

The GPS tracks, travel time, distance, and speeds were calculated for each drogue deployment. Dispersion coefficient(s) for the model were estimated from the movements of the individual drogues by determining the variance of the drogues about their centroid path (List et al. 1990). The method outlined below was used to estimate dispersion rates near the ADCP locations in the 2020 field program. Dispersion rates were only estimated when there was coincident data for three drogues.

The variance of the drogue positions in the X and Y directions are calculated by:

$$\sigma_{xi}^2 = \frac{\sum_j \left(X_{ij} - \bar{X}_i\right)^2}{N-1} \qquad \text{Equation 1}$$

$$\sigma_{yi}^2 = \frac{\sum_j \left(Y_{ij} - \bar{Y}_i\right)^2}{N-1} \qquad \text{Equation 2}$$

Where:
- X_{ij} X position of Drogue j at time i (m),
- Y_{ij} Y position of Drogue j at time i (m),
- σ_{xi} variance in X direction at time i (m²),
- σ_{yi} variance in Y direction at time i (m²),
- $\bar{X}_i$ mean X position of drogues at time i (m),
- $\bar{Y}_i$ mean Y position of drogues at time i (m), and
- N number of drogues.

The direction independent variation in location can be estimated as:

$$\sigma_i^2 = \frac{\sigma_{xi}^2+\sigma_{yi}^2}{2} \qquad \text{Equation 3}$$

The dispersion coefficient (K) can then be estimated by:

$$K_i = \frac{1}{2}\frac{\partial\sigma_i^2}{\partial t} \cong \frac{1}{2}\frac{\Delta\sigma_i^2}{\Delta t} \qquad \text{Equation 4}$$

5.0 RESULTS

The results of the 2020 and 2021 Patterson Lake currents assessment for wind speed and direction, water temperature, and currents are presented in Sections 5.1 to 5.3.

5.1 Meteorological Observations

Local weather conditions between July and September 2020 were windier, wetter, and slightly cooler (Table 3) than long-term regional averages for the months of July to September; there was cumulatively 297 mm of rainfall during the study months which is much higher than the long-term average of 223 mm for July to September based on European Re-Analysis Interim (ERAI) model data to 2019 (Annex IV.2). Cooler air temperatures influence water temperature (Section 5.2) and higher precipitation increases surface water inflows and outflows at Patterson Lake. Wind conditions have the most direct influence on lake currents and details are provided in this section.

In contrast, during the ice-covered period (i.e., December 2020 to May 2021) and the 2021 open-water period (i.e., June and July), the air temperature was slightly warmer than the long-term average. In terms of total precipitation, the ice-covered period received almost double the amount of precipitation as the long-term average (160 mm actual versus 89 mm for the long-term average), while the 2021 open-water period was significantly drier than the long-term average.

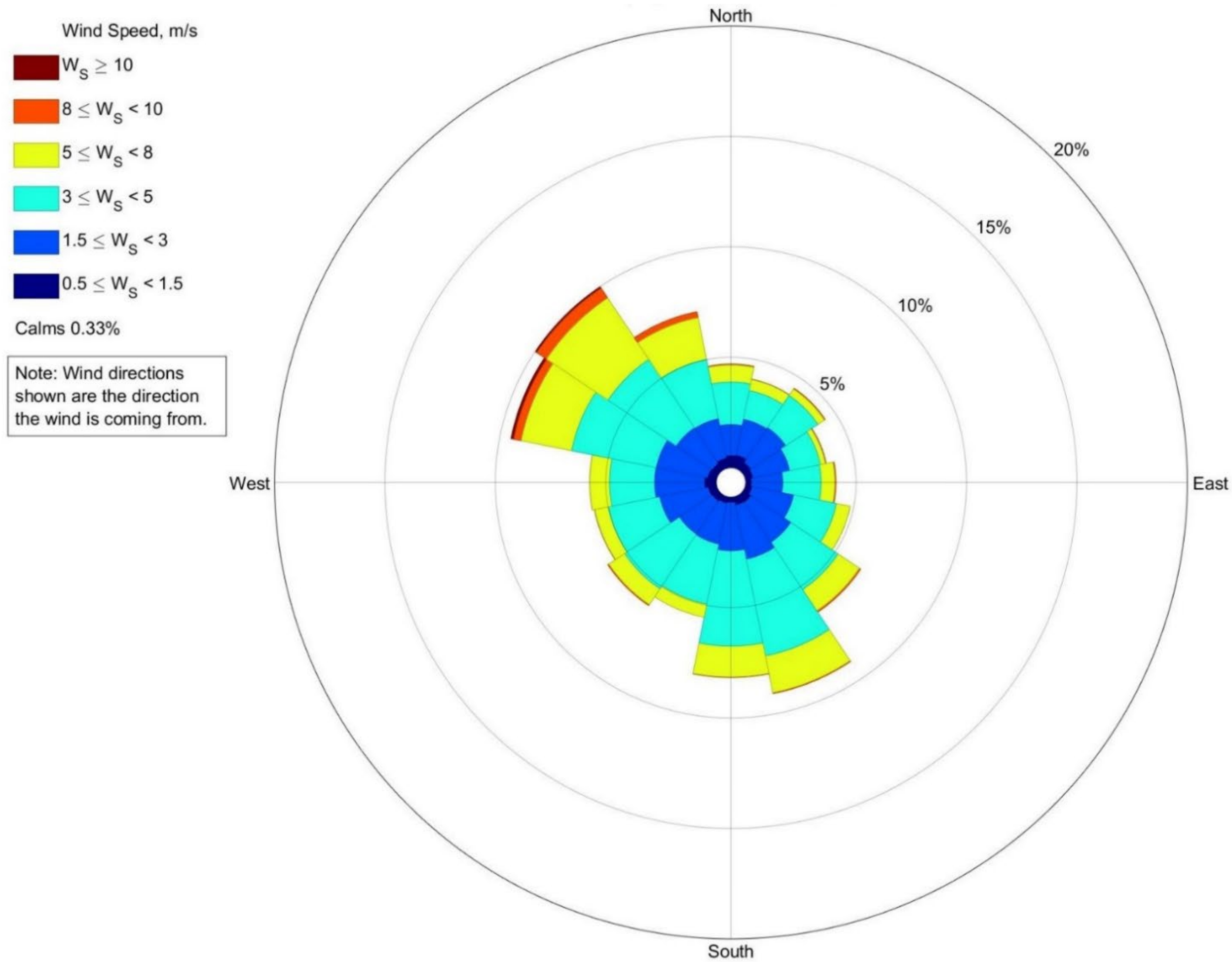
Table 3: Summary of Air Temperature and Total Precipitation During Study

Month	Median Air Temperature (°C)			Total Precipitation (mm)		
	2020	2021	ERAI (1979 to 2019)	2020	2021	ERAI (1979 to 2019)
January	-17.9	-13.6	-19.5	7.8	25.6	23.1
February	-15.4	-22.2	-16.5	15.2	25.3	16.9
March	-13.5	-7.6	-9.0	18.8	72.9	24.4
April	-3.9	-1.8	0.4	13.1	18.8	31.3
May	6.5	6.4	8.5	74.8	18.2	42.4
June	13.7	17.2	14.2	124.5	55.0	74.9
July	16.6	17.9	16.7	133.6	32.2	93.3
August	14.8	15.5	14.8	126.3	41.5	75.0
September	7.9	10.9	8.6	37.0	56.6	56.5
October	-2.1	3.5	1.0	57.9	11.2	41.3
November	-11.0	-6.8	-9.3	36.4	39.8	28.4
December	-12.6	n/d[(a)]	-17.2	36.4	n/d[(a)]	24.5
Annual	-1.4	1.4	-0.5	681.9	397.2	531.9

Note: Shaded cells indicate period where current data was collected.
a) data not available for December 2021 at time of report preparation.
ERAI = European Re-Analysis Interim; n/d = no data.

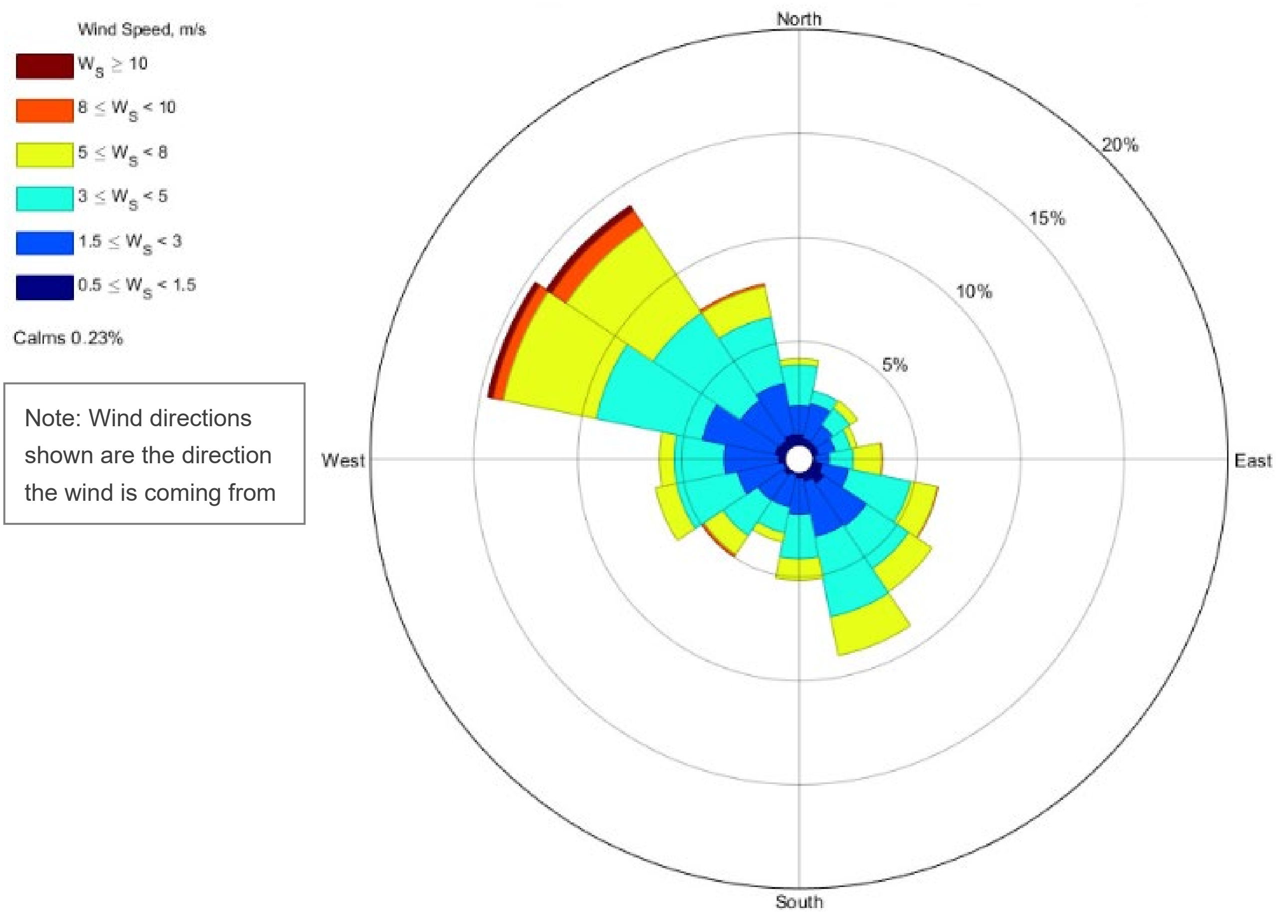
Wind speed and direction data were analyzed for the open-water period from May to October for a six-year period from 2016 to 2021. Prevailing winds were from the northwest and west-northwest directions, followed by south-southeast and south directions (Figure 11). Higher-speed winds exceeding 5 m/s occurred 25% of the time and were most frequently from the west-northwest to north-northwest directions (Golder 2019). Detailed summaries of measured wind speed and direction frequencies are provided in Appendix A (Table 1-3, Table 1-2, and Table 1-3).

Figure 11: Rook I Meteorological Station Wind Rose for the Open-Water Period, May 2016 to October 2021



The wind conditions during the Patterson Lake currents monitoring studies completed between July 2020 and September 2020 were compared with the six-year open-water period wind record, collected between May 2016 and October 2021, to verify if the measured field values were representative. The prevailing wind directions were similar to the six-year open-water period dataset, with west-northwest and northwest winds being the most frequent, followed by south-southeast winds, though south winds were relatively infrequent in summer and fall 2020 (Figure 12). The average hourly wind speed of 3.9 m/s in the July to September 2020 observation period was slightly higher than the 3.7 m/s wind speed over the six-year period.

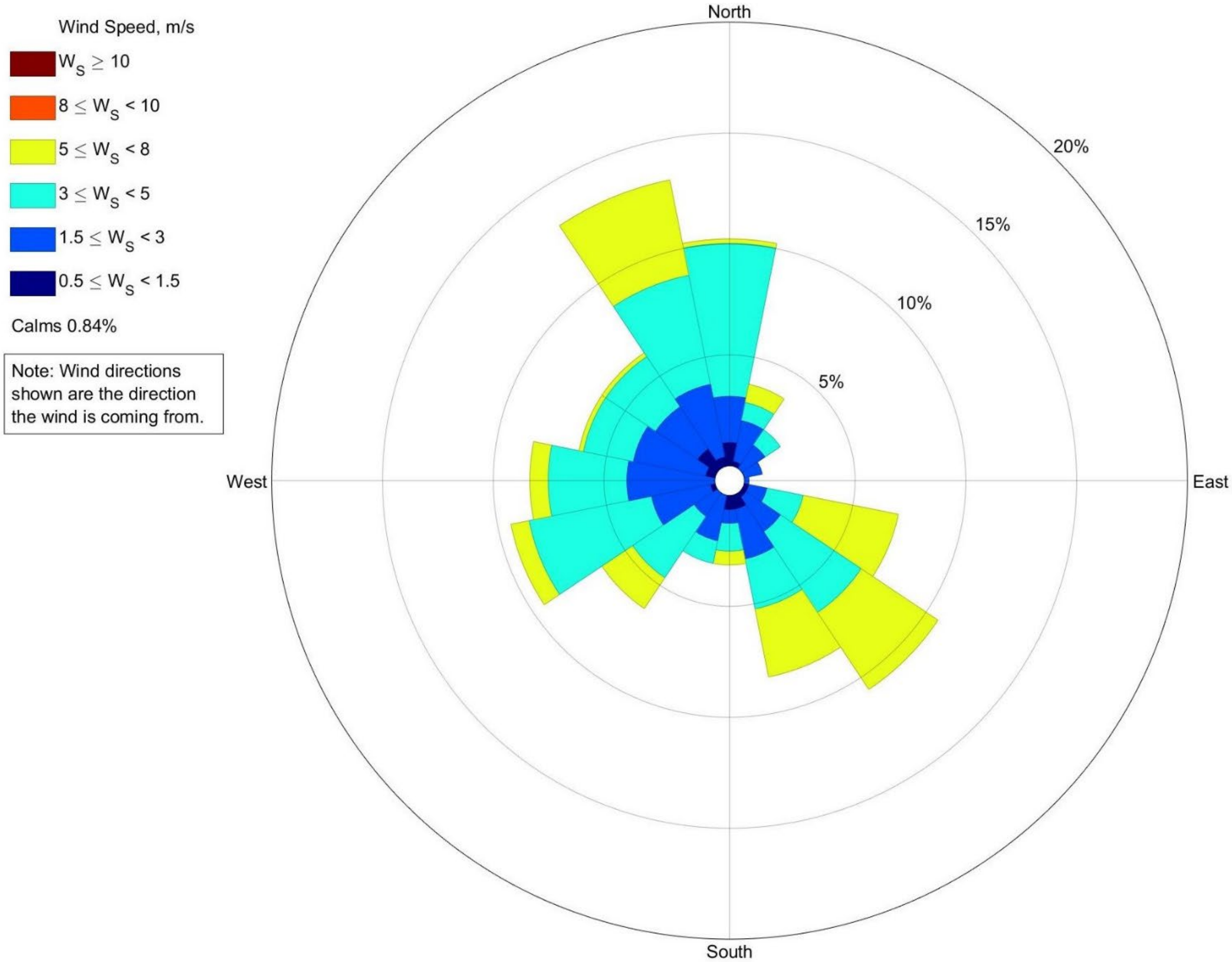
Figure 12: Frequency of Wind Direction and Speed, 1 July 2020 to 30 September 2020



Moderately high wind speeds between 5 m/s and 8 m/s (18 km/h and 29 km/h) were 5% more frequent than usual during the monitoring period (i.e., 22.5% compared to 17.5%). Lower wind speeds below 3.0 m/s were 1.0% less frequent in 2020 compared to the six-year average. High wind speeds exceeding 5 m/s occurred 25% of the time (i.e., 5% more frequently than the six-year record). The highest wind speeds (i.e., exceeding 10 m/s) in the observation period were three times more frequent than the six-year open-water period; however, these high wind speeds made up only 0.6% of the record.

Wind conditions for a short period from ice break-up around 25 May 2021 to 13 June 2021 are shown in Figure 13. In spring 2021, the most frequent wind directions were north-northwest, southeast, and north, and west-northwest and northwest winds were much less frequent than the six-year open-water period record. The wind speed classes recorded in spring 2021 were similar to the six-year record except that wind speeds between 3 m/s and 5 m/s were 2.5% more frequent, 5 m/s to 8 m/s was 1% less frequent, and there were no winds exceeding 8 m/s.

Figure 13: Frequency of Wind Direction and Speed, 25 May 2021 to 13 June 2021

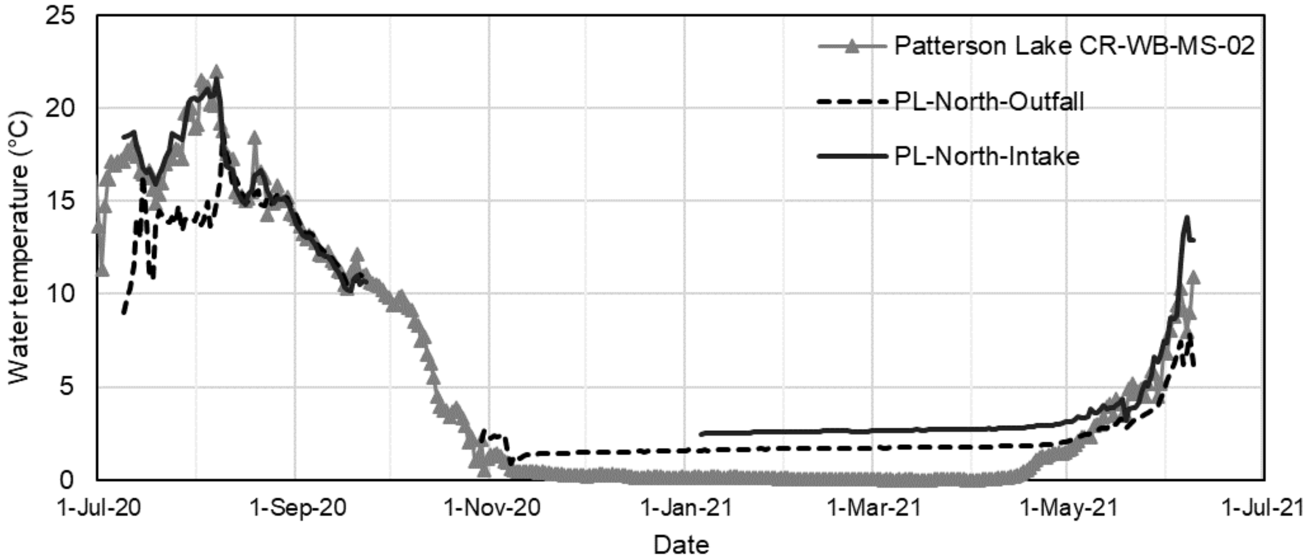


5.2 Patterson Lake Water Temperatures

Water temperature is one of the main factors determining water density, and results from water temperatures measured at the ADCP locations as well as at profiles in the water column during different seasons are provided in this section. Nearly a full year of ambient Patterson Lake water temperatures monitored during this study are provided in Figure 14. Data at PL-North-Outfall and PL-North-Intake were measured at the ADCPs which were mounted about 1 m above the lake bed in these locations. Data at CR-WB-MS-02 was measured in PL-South at the hydrometric station in shallow water near shore.

The ADCP installed at PL-North-Outfall had lower temperatures than the other locations until early August 2020 and had similar temperatures thereafter. PL-North-Outfall ADCP was below or within the thermocline in the North Arm – West Basin until 9 August 2020.

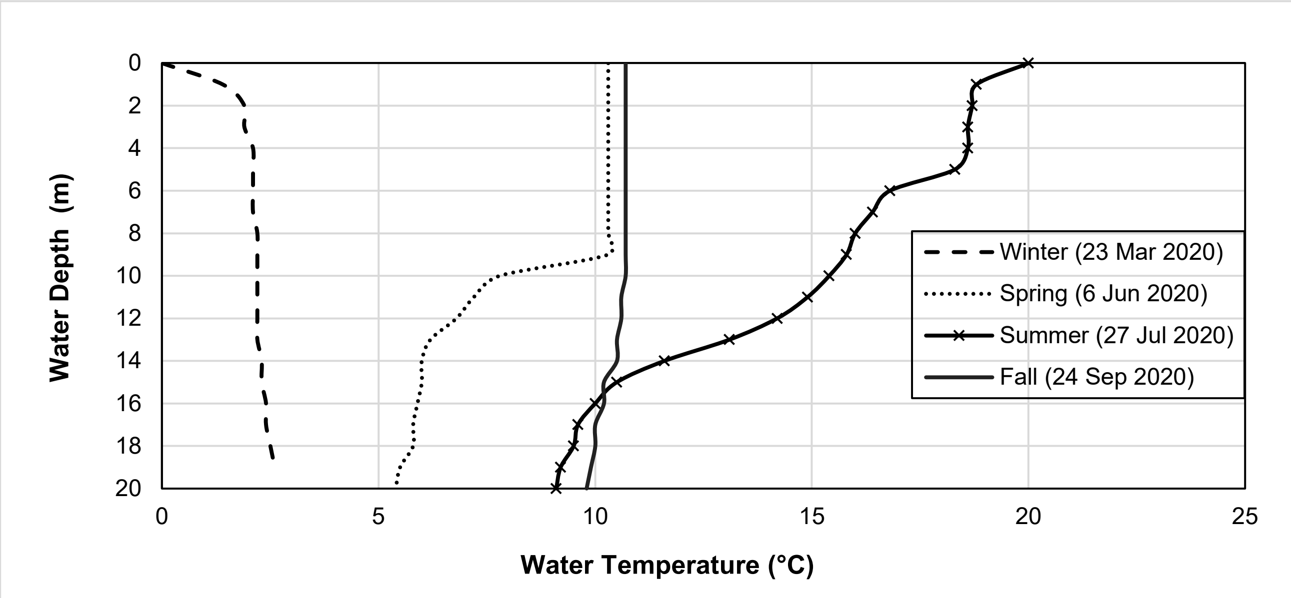
Figure 14: Patterson Lake Water Temperatures during Lake Currents Measurement Period



In the baseline dataset, water temperature profiles ranged from near 0°C in winter to above 20°C in mid-summer. Results of the baseline surveys for 2020 are shown in Figure 15, Figure 16, and Figure 17. Thermal lake stratification, indicated by decreases in water temperature with depth, was evident during the spring, summer, and fall field visits. During the spring 2020 field visit, the thermocline started at a water depth of about 9 m to 10 m in the North Arm in both East and West basins, and was at a depth of about 5 m in the South Arm. During the summer 2020 field visit, the top of the thermocline was at an approximate depth of between 5 m and 7 m for all three locations. During the fall 2020 field visit, the top of the thermocline was at depths of about 15 m and 17 m in the North Arm – West Basin and South Arm, respectively. However, the North Arm – East Basin was nearly isothermal (i.e., not clearly stratified).

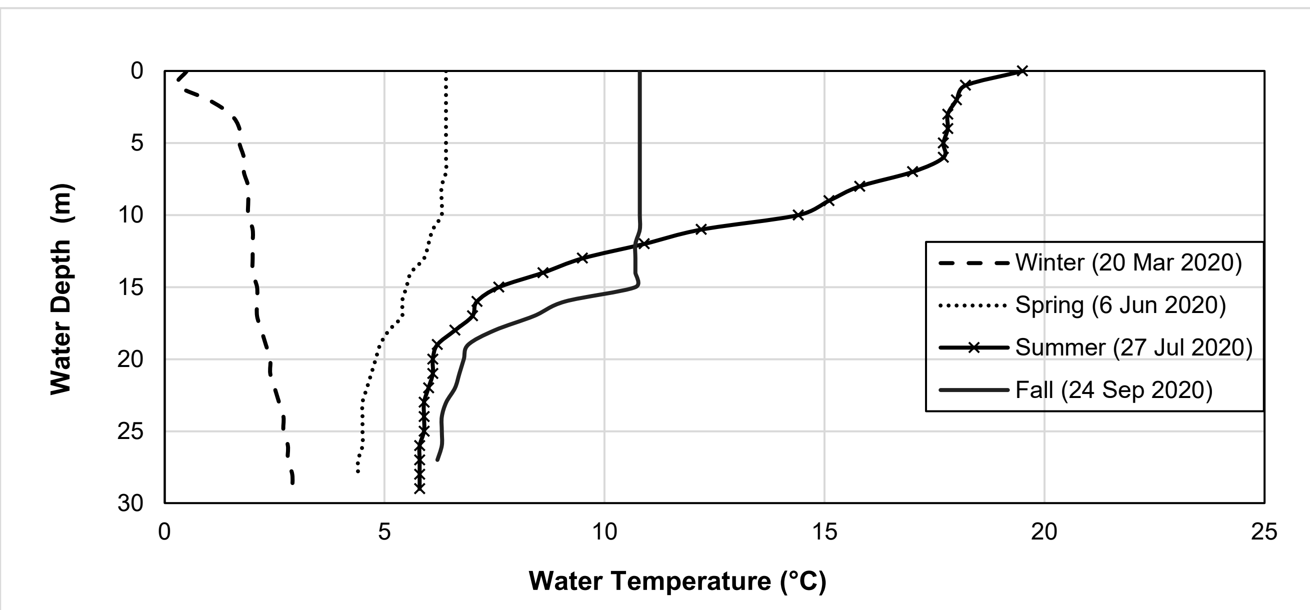
Winter water temperatures were all close to 0°C near the ice-covered surface, increasing to approximately 3°C at depth.

Figure 15: Patterson Lake North Arm – East Basin Water Quarterly Temperature Profiles



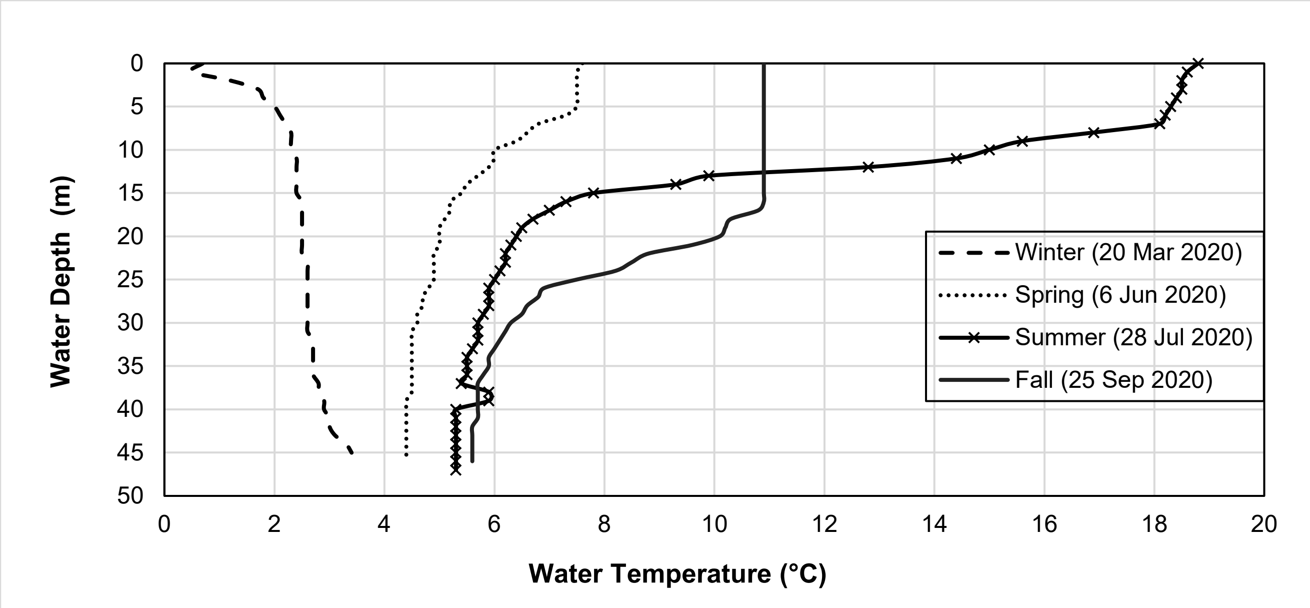
Source: CanNorth 2020.

Figure 16: Patterson Lake North Arm – West Basin Quarterly Water Temperature Profiles



Source: CanNorth 2020.

Figure 17: Patterson Lake South Arm Quarterly Water Temperature Profiles



Source: CanNorth 2020.

5.3 Patterson Lake Currents Observations

The ADCP and drogue results for the PL-North-Intake, PL-North-Outfall, and PL-South locations are presented in Sections 5.3.1 to 5.3.4.

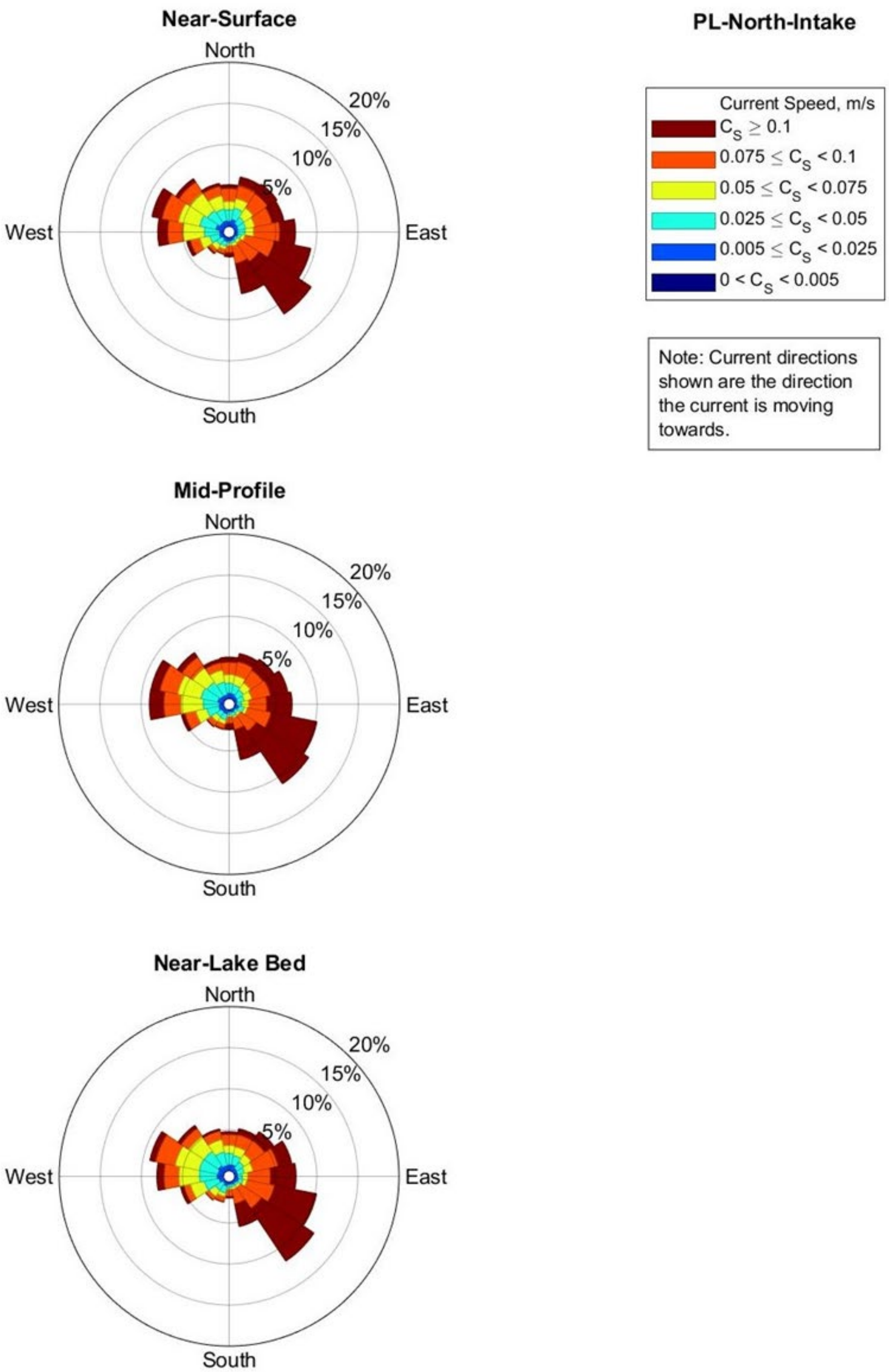
5.3.1 Patterson Lake North Fresh Water Intake Location

The speed and direction frequencies of Patterson Lake currents at PL-North-Intake location for the period of 9 July 2020 to 23 September 2020 are shown in Figure 18 for open-water conditions. Tabular results from this analysis are provided in Appendix A (Table 2-1, Table 2-2 and Table 2-3).

For 2020 open-water conditions, near-surface current speeds and directions shown are from Cell 5 (Figure 4), which had an average measurement height of 2.75 m above the lake bed and approximately 0.25 m below the water surface. The mid-profile is represented by data collected from Cell 3, which had an average measurement height of 2.25 m above the lake bed and approximately 0.75 m below the water surface. The near-lake bed is represented by data collected from Cell 1, which had an average measurement height of 1.75 m above the lake bed and 1.25 m below the water surface.

As noted in Section 4.2.3.1, the data recorded for ice-covered and spring 2021 open-water conditions was rejected due to problems with installation through the ice in January 2021.

Figure 18: Frequency of Current Speed and Direction at the Patterson Lake North Fresh Water Intake Location – 2020 Open Water Conditions



Current Direction

Near-surface, mid-profile, and near-lake bed currents were all dominated by lake currents moving to the southeast and east-southeast. The next highest frequencies of current direction were west-northwest and west. In general, the dominant lake currents directions appear to be related to the dominant wind directions for the same period, which are from west-northwest and northwest. Lake currents were alongshore (i.e., flowing in a direction perpendicular to shore, in this case the Patterson Lake North Arm – East Basin is oriented in a west or west-southwest and east or east-northeast direction) between 26% to 28% of the monitoring period. The Patterson Lake North Arm – East Basin does not have steep or high topography on most sides, which may be the reason the dominant wind direction aligns with the dominant lake current direction in this basin.

Current Speed

The cumulative frequency curve for current speeds is shown in Figure 19. Results are similar throughout the profile with slightly higher current speeds occurring mid-profile. Median current speeds were 0.079 m/s near-lake bed, 0.083 m/s at mid-profile, and 0.081 m/s at the near-surface. A comparison of current speeds statistics for the three ADCP locations is provided in Table 4.

Figure 19: Cumulative Frequency Curve for Lake Current Speeds at Patterson Lake North Fresh Water Intake

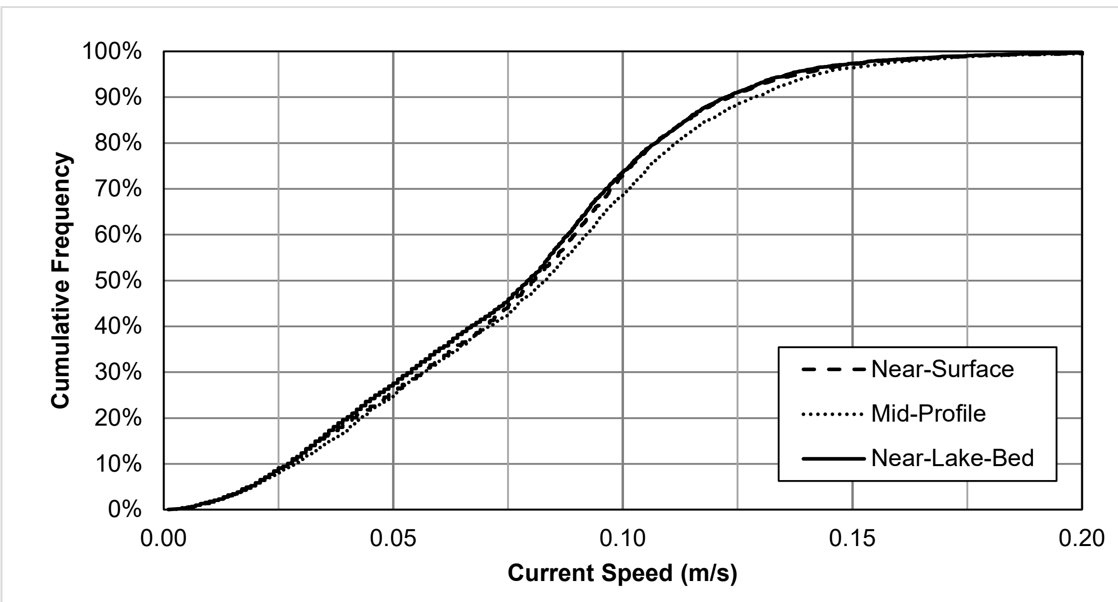


Table 4: Acoustic Doppler Current Profiler Lake Currents Speed Statistics

Statistic	Measured Lake Current Speeds (m/s)								
	PL-North-Intake			PL-North-Outfall			PL-South		
	Near-Lake Bed	Mid-Profile	Near-Surface	Near-Lake Bed	Mid-Profile	Near-Surface	Near-Lake Bed	Mid-Profile	Near-Surface
Open-Water Conditions (8-9 July 2020 to 23 September 2020)									
Maximum	0.250	0.302	0.252	0.186	0.192	0.208	0.164	0.168	0.183
75th Percentile	0.102	0.106	0.102	0.068	0.053	0.052	0.032	0.034	0.063
Mean	0.077	0.081	0.078	0.052	0.042	0.041	0.025	0.026	0.045
Median	0.079	0.083	0.081	0.049	0.039	0.039	0.021	0.021	0.040
25th Percentile	0.047	0.050	0.049	0.033	0.028	0.028	0.013	0.013	0.022
Minimum(a)	0.001	0.001	0.001	0	0.001	0	0	0	0
Ice-covered Conditions(b) (6 November 2020 to 21 May 2021)									
Maximum	n/d(c)	n/d(c)	n/d(c)	n/d(d)	0.040	0.040	0.025	0.025	0.025
75th Percentile					0.023	0.019	0.016	0.016	0.016
Mean					0.017	0.014	0.012	0.011	0.012
Median					0.016	0.013	0.011	0.011	0.011
25th Percentile					0.010	0.009	0.007	0.007	0.007
Minimum(a)					0	0	0	0	0
Spring Open-Water Conditions(b) (25 May 2021 to 9-13 June 2021)									
Maximum	n/d(c)	n/d(c)	n/d(c)	n/d(d)	0.062	0.063	0.060	0.060	0.060
75th Percentile					0.034	0.031	0.030	0.030	0.031
Mean					0.025	0.022	0.022	0.021	0.023
Median					0.022	0.019	0.019	0.018	0.019
25th Percentile					0.013	0.009	0.011	0.011	0.012
Minimum(a)					0.001	0	0.001	0	0.001

Note: Statistics are based on all available data at 20-minute intervals for PL-North-Intake and PL-North-Outfall, and at 30-minute intervals for PL-South.
a) The acoustic Doppler current profiler had a horizontal velocity accuracy of 0.022 m/s or less however they record data to the nearest 0.001 m/s.
b) Data greater than the 95th percentile of the raw dataset were removed in quality control for the ice-covered and spring 2021 open-water conditions.
c) The data recorded for ice-covered and spring 2021 open-water conditions were rejected due to a placement error. The angle of placement was 28° from level which exceeded quality control standards (QARTOD 2019).
d) Near-lake-bed data were rejected due to interference.

n/d = no data

5.3.2 Patterson Lake Treated Effluent Diffuser Location

Patterson Lake currents at the PL-North-Outfall ADCP location for open-water conditions for the period from 9 July 2020 to 23 September 2020, ice-covered conditions for the period from 6 November 2020 to 21 May 2021, and for spring 2021 open-water conditions for the period from 25 May 2021 to 9 June 2021 are shown in Figure 20. Tabular results from this analysis are provided in Appendix A (Tables 3-1 through 3-7).

For the 2020 open-water monitoring period, near-surface current speeds and directions shown in Figure 21 are from Cell 7, which had an average measurement height of 9.6 m above the lake bed (i.e., 1.4 m below the water surface). The mid-profile is represented by data collected from Cell 4, which had an average measurement height of 6.6 m above the lake bed (i.e., 4.4 m below the water surface). The near-lake-bed is represented by data collected from Cell 1, which had an average measurement height of 6.6 m above the lake bed.

For ice-covered and spring 2021 open-water conditions, near-surface current speeds and directions shown are from Cell 3, which had an average measurement height of 6.5 m above the lake bed (i.e., 4.5 m below the water surface). The mid-profile is represented by data collected from Cell 2, which had an average measurement height of 4.5 m above the lake bed (i.e., 6.5 m below the water surface).

Current Direction

The Patterson Lake North Arm – West Basin is oriented southwest–northeast and it has relatively steep and high topography that may influence local wind directions. The PL-North-Outfall ADCP location was exposed to a maximum wind fetch of about 5 km in the North Arm – West Basin from the southwest.

At PL-North-Outfall during the 2020 open-water period, lake currents throughout the profile were predominantly onshore between east-southeast and south-southwest 41% to 43% of the time, and less frequently alongshore (i.e., moving southwest through west and northeast through east) 27% to 29% of the time and offshore 28% to 30%.

The high frequency of onshore current directions may be related to the 4% to 5% more frequent west-northwest and northwest winds during the 2020 lake currents observation period compared to the five-year open-water period (Section 5.1).

For ice-covered conditions, lake currents near the surface were predominantly onshore between east southeast and south-southwest 29% of the time, alongshore (i.e., moving southwest through west and northeast through east) 22% of the time, offshore 11% of the time, and near-zero or screened out 38% of the time (possibly due to interference from ice). Mid-profile lake currents were onshore 40% of the time, alongshore 32% of the time, offshore 21% of the time, and near-zero or screened out in the quality control process 7.4% of the time.

For spring 2021 open-water conditions, lake currents near the surface were predominantly onshore between east southeast and south-southwest 49% of the time, offshore 24% of the time, alongshore 23% of the time, and screened out 4.8% of the time. Mid-profile lake currents were predominantly onshore 42% of the time, alongshore 35% of the time, offshore 20% of the time and screened out 3.5% of the time. There were no zero or near-zero flows in this open-water record. During the spring 2021 lake currents observation period, winds were nearly 8% more frequent from northwest and north directions than the six-year open-water period (Appendix A, Table 1-1 and Table 1-3).

Current Speed

A comparison of current speeds statistics for PL-North-Outfall during the 2020 open-water period, 2020 to 2021 ice-covered period, and spring 2021 open-water period at the various monitoring depths is provided in Table 4.

The cumulative frequency curve for current speeds is shown in Figure 21. Results show current speeds were similar throughout the profile at this location and the higher speeds occurred more frequently in south or northeast directions. The slightly higher speeds near the lake bed may be related to the ADCP location being near the edge of a drop-off (Figure 3). Median current speeds were between 0.041 m/s at the near-surface to 0.043 m/s near the lake bed. A comparison of current speeds statistics for the three ADCP locations is provided in Table 4.

For ice-covered conditions (6 November 2020 to 21 May 2021), the median lake current speeds were 0.016 m/s for mid-profile (mean of 0.017 m/s) and 0.013 m/s for the near-surface (mean of 0.014 m/s) (Table 4). Current speeds never exceeded 0.05 m/s.

For spring 2021 open-water conditions (25 May 2021 to 9 June 2021), the median lake current speeds were 0.024 m/s for mid-profile and 0.026 m/s for the near-surface (Figure 20). No current speed exceeded 0.075 m/s for the 2021 spring monitoring period.

Figure 20: Frequency of Current Speed and Direction at Patterson Lake North Outfall – a) 2020 Open-Water Conditions, b) Ice-Covered Conditions, and c) Spring 2021 Open-Water Conditions

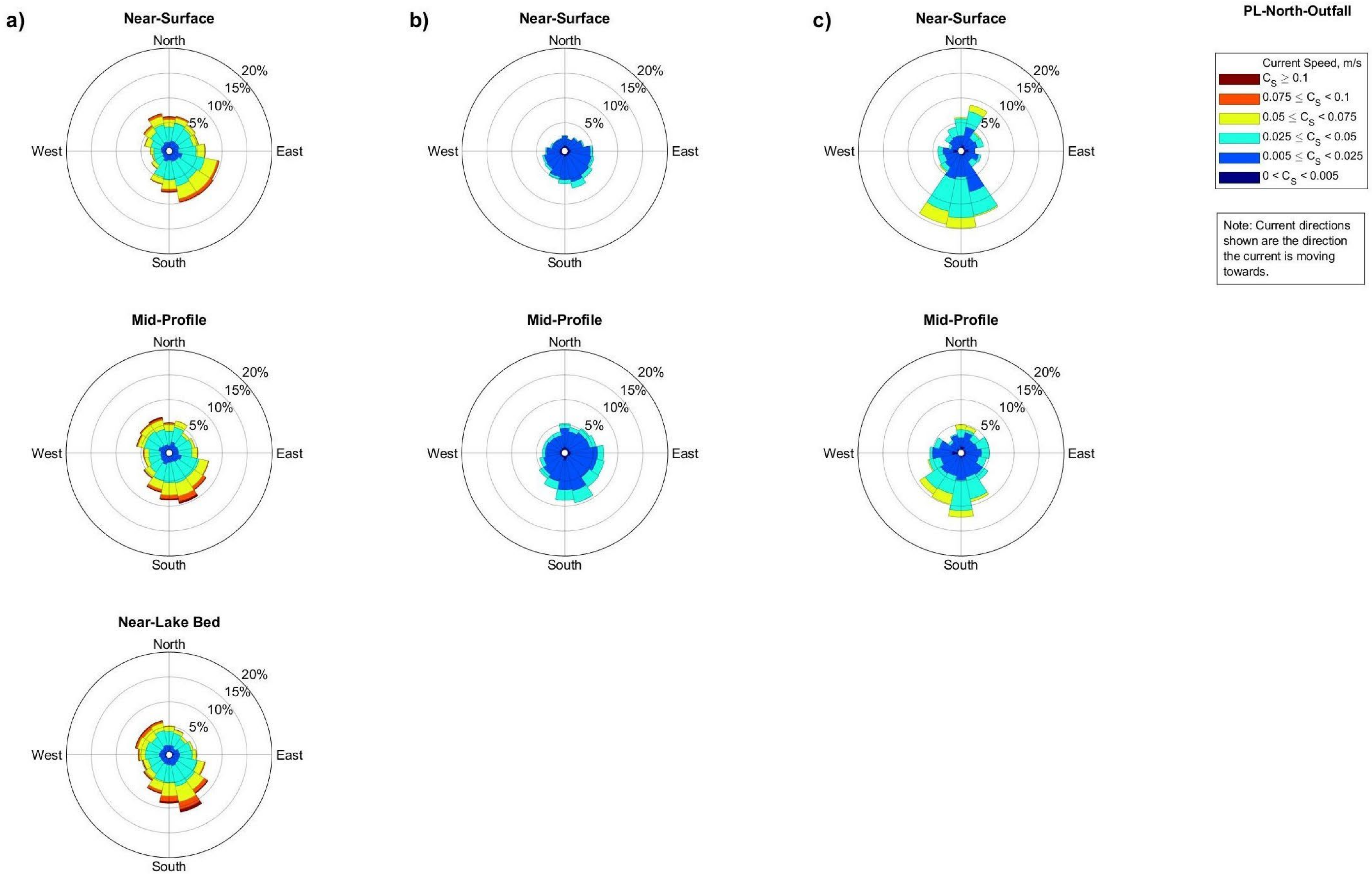
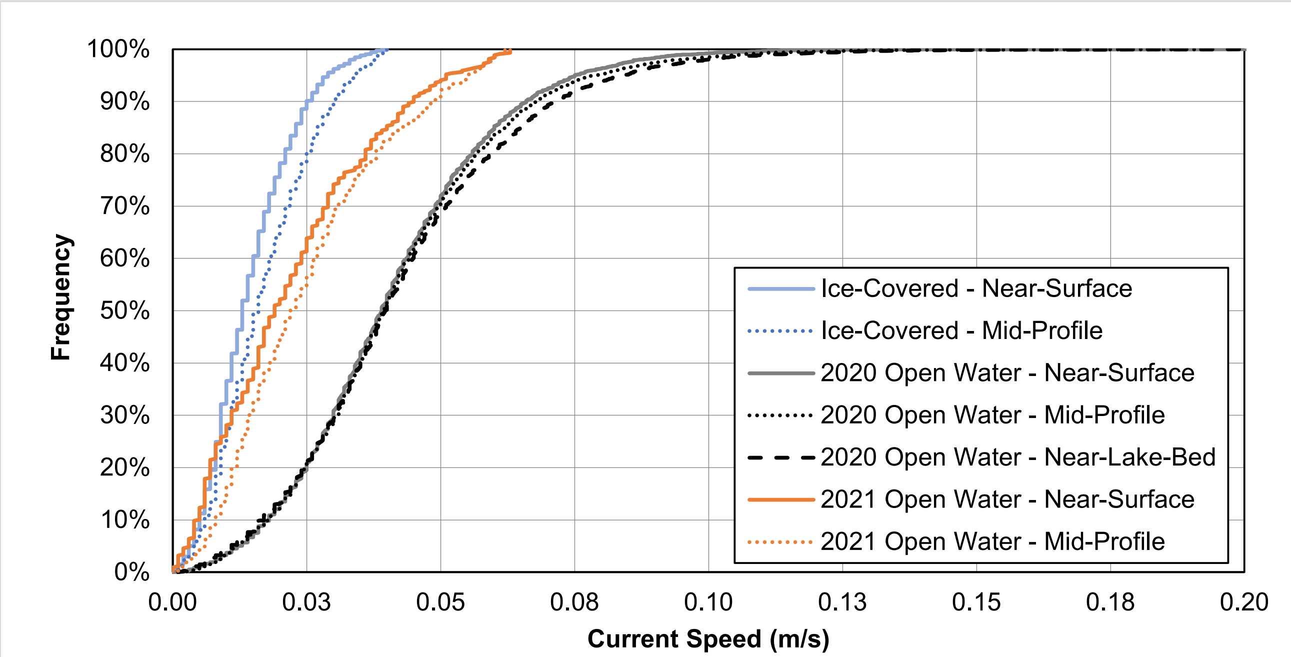


Figure 21: Cumulative Frequency Curve for Patterson Lake North Outfall Current Speeds



5.3.3 Patterson Lake South Fresh Water Intake Location

Patterson Lake currents at PL-South for the period from 8 July 2020 to 23 August 2020 for open-water conditions, for the period from 7 November 2020 to 21 May 2021 for the ice-covered conditions, and for the period from 25 May 2021 to 13 June 2021 during spring 2021 open-water conditions are shown in Figure 22. Tabular results from this analysis are provided in Appendix A (Tables 4-1 through 4-9).

For 2020 open-water conditions, current speeds and directions shown in Figure 22 are from Cell 6, which had an average measurement height of 2.9 m above the lake bed (i.e., 0.6 m below the water surface); this cell represented the near-surface lake currents at this location. The mid-profile is represented by data collected from Cell 4, which had an average measurement height of 2.1 m above the lake bed (i.e., 1.4 m below the water surface). The near-lake bed currents are represented by data collected from Cell 2, which had an average measurement height of 1.3 m above the lake bed (i.e., 2.2 m below the water surface).

For ice-covered and spring 2021 open-water conditions, current speeds and directions shown are from Cell 4, which had an average measurement height of 2.2 m above the lake bed (i.e., 1.3 m below the water surface); this cell represents the near-surface lake currents at this location. The mid-profile is represented by data collected from Cell 3, which had an average measurement height of 1.7 m above the lake bed (i.e., 1.8 m below the water surface). The near-lake-bed currents are represented by data collected from Cell 2, which had an average measurement height of 1.2 m above the lake bed (i.e., 2.3 m below the water surface).

Current Direction

Patterson Lake South Arm is oriented in a southwest to west-southwest and east-northeast to east direction. The PL-South ADCP location is about 100 m from the north shore and is exposed to a maximum wind fetch of about 5 km from the west-southwest, which corresponds with the dominant current directions.

For 2020 open-water conditions at PL-South, dominant current directions were bimodal, predominantly alongshore in the same orientation as the waterbody (i.e., SW to WSW or ENE to E) 40% to 41% of the time at all depths in the profile. The frequency of onshore currents (i.e., between W and NE in a clockwise direction) was 31% to 36%. The frequency of offshore currents (i.e., ESE to SSW) was 23% to 27%.

For ice-covered conditions, dominant current directions were predominantly onshore 40% (for the near-surface) to 51% (for the mid-profile) of the time. The frequency of offshore currents was between 12% (for the near-surface) and 24% (for the near-lake-bed). The frequency of alongshore currents was 15% (for the near surface) to between 24% and 25% (for the mid-profile and near-lake-bed, respectively). Ice-covered condition lake currents were near-zero or screened out between 4.6% to 4.9% (for the near-lake-bed and mid-profile, respectively) and 33.3% (for the near-surface).

For spring 2021 open-water conditions, dominant current directions were again predominantly onshore 42% to 44% of the time at all depths in the profile. The frequency of alongshore currents was 39% to 41%. The frequency of offshore currents was 12% to 15%. Lake currents were near-zero or screened out between 3.0% and 4.5% of the spring 2021 monitoring period.

Current Speed

The cumulative frequency curve for current speeds is shown in Figure 23. Results show current speeds were relatively homogeneous throughout the water profile. Median current speeds ranged from 0.018 m/s to 0.024 m/s for all three depths during both open-water periods. Current speeds at this location (Figure 23) were much lower than at the shallower PL-North Intake location (Figure 19), and somewhat lower at PL-North Outfall (Figure 21). A comparison of current speed statistics for the three ADCP locations is provided in Table 4.

For ice-covered conditions (i.e., November 2020 to May 2021), the median lake current speed was 0.016 m/s for mid-profile and 0.013 m/s for the near-surface (Figure 23). There were no current speeds above 0.05 m/s.

For spring 2021 open-water conditions (25 May 2021 to 13 June 2021), the median lake current speed was 0.018 m/s for mid-profile and 0.019 m/s for near-surface and near-lake-bed (Figure 23). There was no current speed higher than 0.075 m/s for this spring monitoring period.

Figure 22: Frequency of Current Speeds and Directions at the Patterson Lake South Acoustic Doppler Current Profiler – a) 2020 Open-Water Conditions, b) Ice-Covered Conditions, and c) Spring 2021 Open-Water Conditions

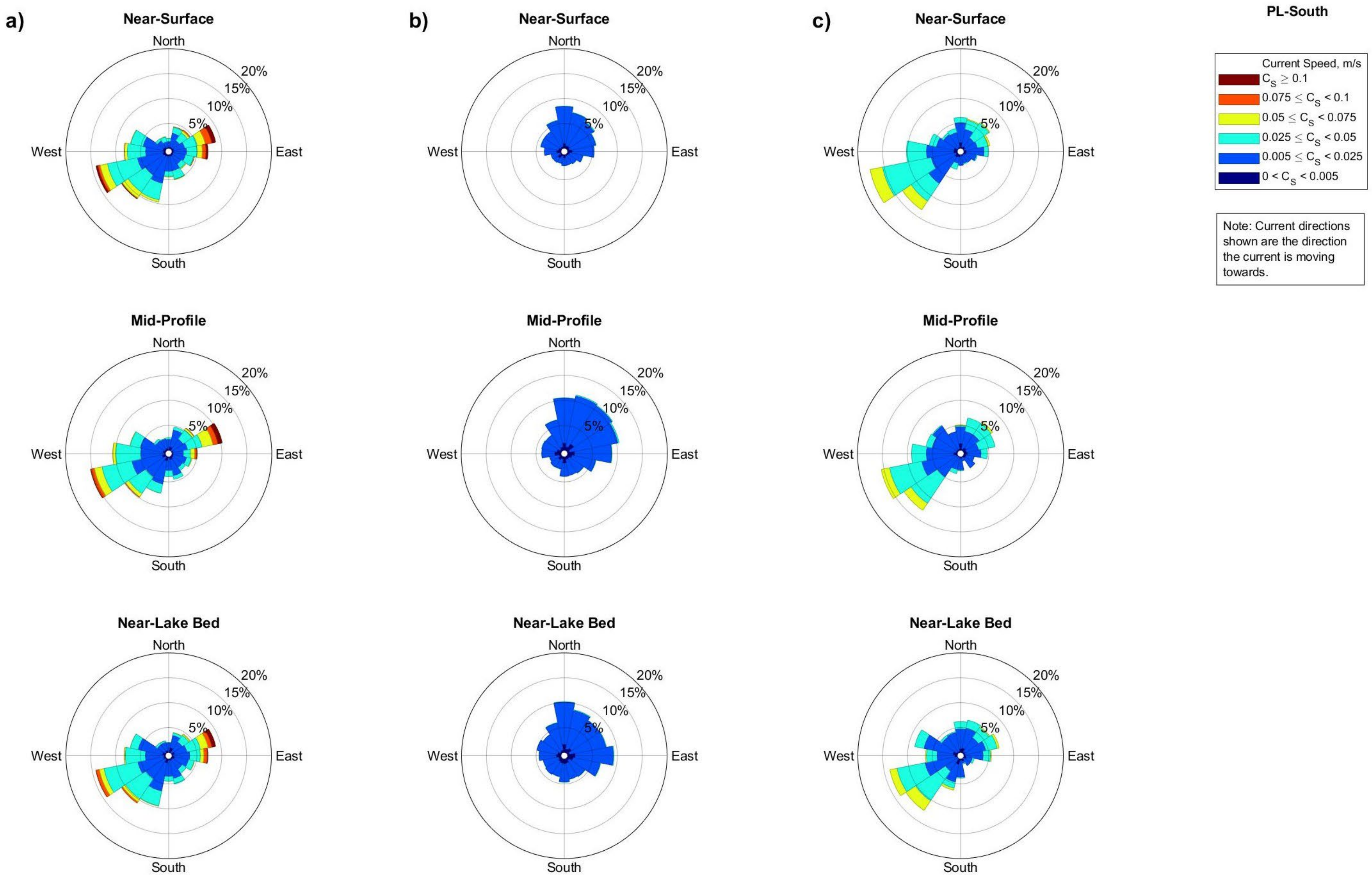
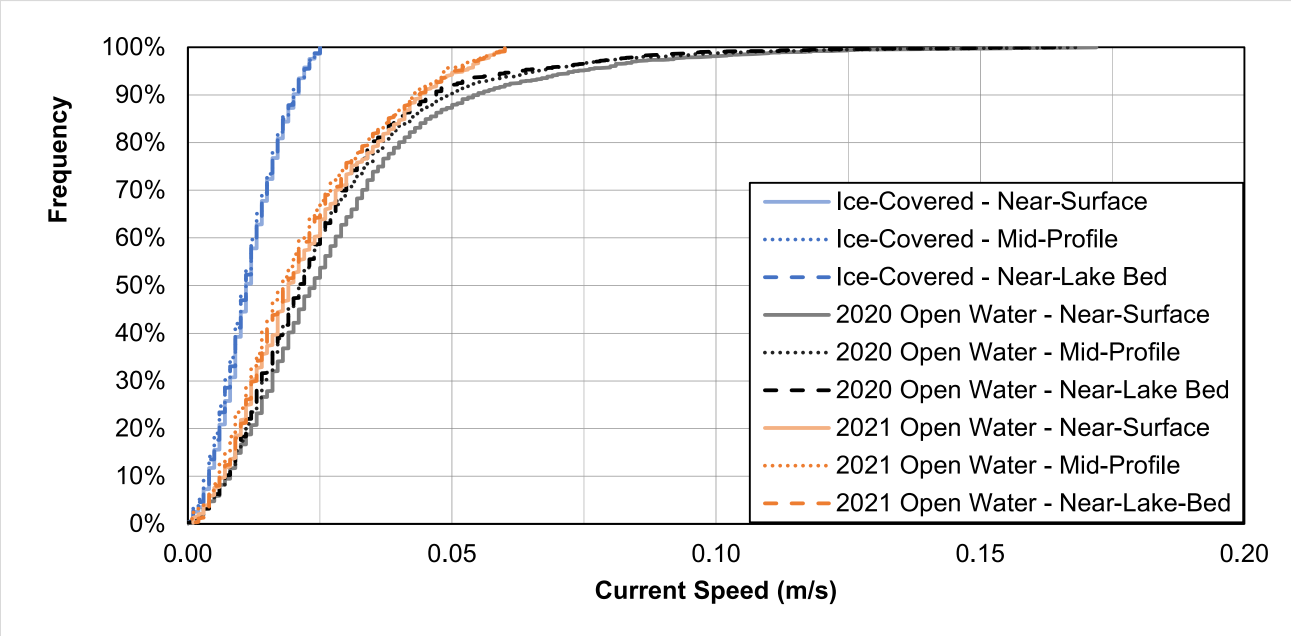


Figure 23: Cumulative Frequency Curve for Patterson Lake South

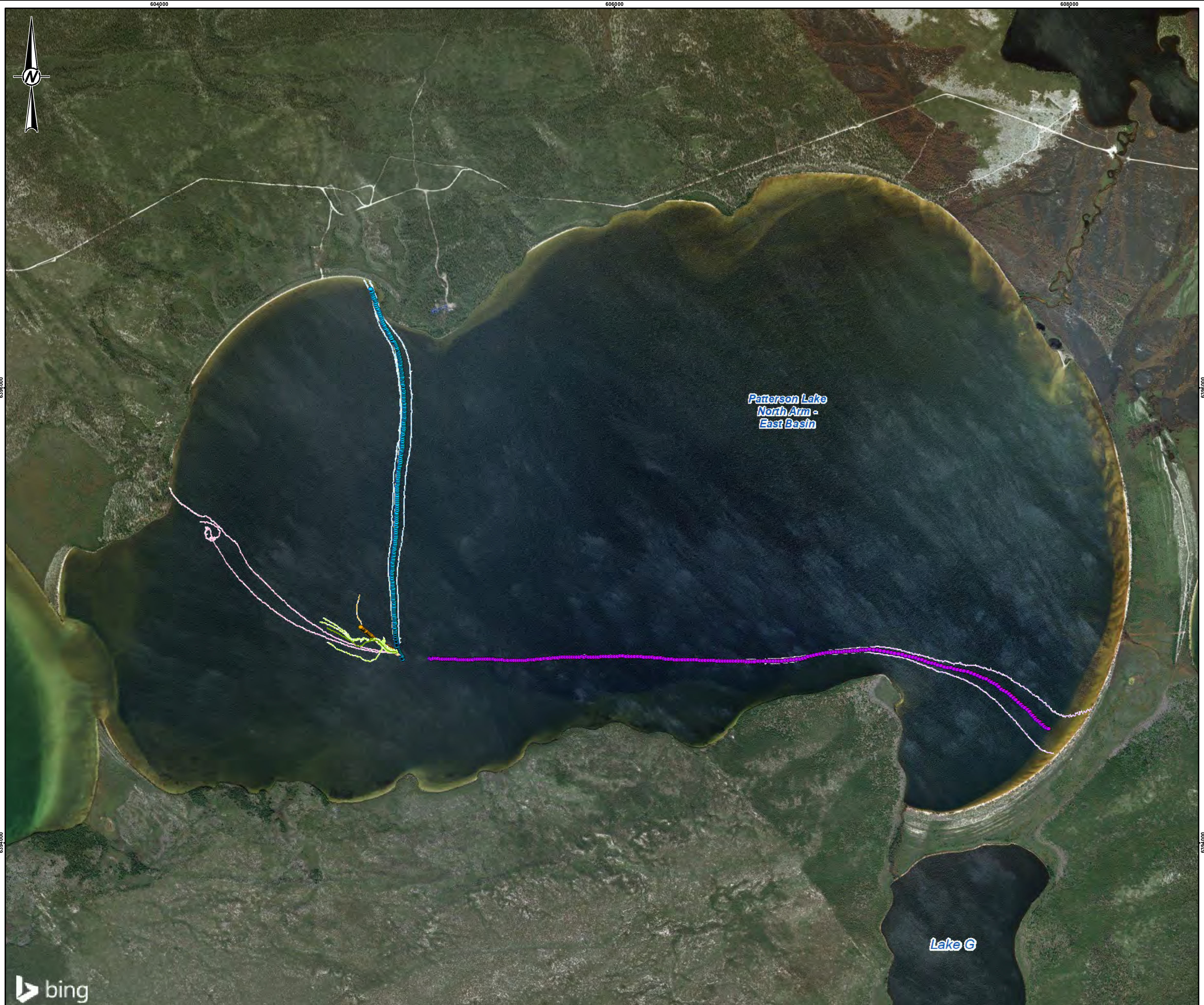


5.3.4 Drogue Paths and Results

The GPS tracks, travel time, distance, and speeds were calculated for each of the drogues deployed in Patterson Lake for the 2020 and 2021 field programs. The average and individual drogue paths are provided in Figure 24, Figure 25, and Figure 26, and a summary of the drogue results is provided in Table 5. The drogues were released from the three ADCP locations during a wide range of wind conditions. In general, the drogues travelled downwind and tended to have lower current speeds corresponding with lower wind conditions and higher current speeds corresponding with higher wind conditions.

The average speed of the drogues during the 2020 open-water period ranged between 0.069 m/s on 9 July 2020 and 0.192 m/s on 19 August 2020 at PL-North-Intake, from 0.024 m/s on 19 August 2022 to 0.050 m/s on 23 September 2020 at PL-North-Outfall, and from 0.029 m/s on 23 August 2020 to 0.084 m/s on 26 September 2020 at PL-South.

The average speed of the drogues during the spring 2021 open-water period ranged between 0.020 m/s at PL North-Intake and 0.046 m/s at PL-North-Outfall on 9 May 2021, and the average drogue speed was 0.038 m/s at PL-South on 13 May 2021.



LEGEND

- AVERAGE DROGUE PATH JULY 09, 2020
- ACTUAL DROGUE PATH LINE JULY 09, 2020
- AVERAGE DROGUE PATH AUGUST 19, 2020
- ACTUAL DROGUE PATH LINE AUGUST 19, 2020
- ACTUAL DROGUE PATH LINE AUGUST 24, 2020
- AVERAGE DROGUE PATH SEPTEMBER 23, 2020
- ACTUAL DROGUE PATH LINE SEPTEMBER 23, 2020
- AVERAGE DROGUE PATH JUNE 09, 2021
- ACTUAL DROGUE PATH LINE JUNE 09, 2021

0 500 1,000
1:17,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM BING MAPS FOR ARCGIS PUBLISHED BY MICROSOFT CORPORATION, REDMOND, WA, MAY 2009.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT
NexGen Energy Ltd.

PROJECT
ROOK I PROJECT

TITLE
PATTERSON LAKE AVERAGE AND ACTUAL DROGUE PATHS FROM THE PATTERSON LAKE NORTH INTAKE (MULTIPLE DATES)

CONSULTANT
wsp

YYYY-MM-DD	2023-02-22
DESIGNED	JH
PREPARED	NO
REVIEWED	RP
APPROVED	GVA

PROJECT NO.	PHASE	REV.	FIGURE
21451886	3000	0	24

PATH: I:\CLIENTS\NexGen\21451886\Mapping\Products\Hydrology\Fig24_21451886-3000_PattersonLake-Average-Actual-DroguePaths_From-PL-North-Intake_Rev0.mxd PRINTED ON: 2023-02-22 AT: 2:50:30 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25mm

LEGEND

- AVERAGE DROGUE PATH JULY 09, 2020
- ACTUAL DROGUE PATH LINE JULY 09, 2020
- AVERAGE DROGUE PATH AUGUST 19, 2020
- ACTUAL DROGUE PATH LINE AUGUST 19, 2020
- AVERAGE DROGUE PATH AUGUST 24, 2020
- ACTUAL DROGUE PATH LINE AUGUST 24, 2020
- AVERAGE DROGUE PATH SEPTEMBER 23, 2020
- ACTUAL DROGUE PATH LINE SEPTEMBER 23, 2020
- AVERAGE DROGUE PATH JUNE 09, 2021
- ACTUAL DROGUE PATH LINE JUNE 09, 2021

0 400 800

1:15,000 METRES

REFERENCE(S)
1. IMAGERY OBTAINED FROM BING MAPS FOR ARCGIS PUBLISHED BY MICROSOFT CORPORATION, REDMOND, WA, MAY 2009.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT
NexGen Energy Ltd.

PROJECT
ROOK I PROJECT

TITLE
PATTERSON LAKE AVERAGE AND ACTUAL DROGUE PATHS FROM THE PATTERSON LAKE NORTH OUTFALL (MULTIPLE DATES)

CONSULTANT
wsp

YYYY-MM-DD	2023-02-22
DESIGNED	JH
PREPARED	NO
REVIEWED	RP
APPROVED	GVA

PROJECT NO.	PHASE	REV.	FIGURE
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25mm

LEGEND

- AVERAGE DROGUE PATH JULY 08, 2020
- ACTUAL DROGUE PATH LINE JULY 08, 2020
- AVERAGE DROGUE PATH AUGUST 23, 2020
- ACTUAL DROGUE PATH AUGUST 23, 2020
- AVERAGE DROGUE PATH SEPTEMBER 26, 2020
- ACTUAL DROGUE PATH LINE SEPTEMBER 26, 2020
- AVERAGE DROGUE PATH OCTOBER 29, 2020
- ACTUAL DROGUE PATH LINE OCTOBER 29, 2020
- AVERAGE DROGUE PATH JUNE 13, 2021
- ACTUAL DROGUE PATH LINE JUNE 13, 2021

0 250 500

1:10,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM BING MAPS FOR ARCGIS PUBLISHED BY MICROSOFT CORPORATION, REDMOND, WA, MAY 2009.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

PATTERSON LAKE AVERAGE AND ACTUAL DROGUE PATHS FROM THE PATTERSON LAKE SOUTH INTAKE (MULTIPLE DATES)

CONSULTANT

wsp

YYYY-MM-DD	2023-02-22
DESIGNED	JH
PREPARED	NO
REVIEWED	RP
APPROVED	GVA

PROJECT NO.	PHASE	REV.	FIGURE
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

Table 5: Summary of Drogue Deployment Results

Station ID	Date	Time of Release	Duration[a] (h, min)	Mean Distance travelled (m)	Mean Drogue Speed (m/s)	Drogue Travelled	Mean Wind Direction and Speed [b]	Estimated Dispersion Rate (m^2/s)	Drogues Deployed	Near-Surface ADCP Directions and Speed (m/s) [d]
PL-North-Intake	9 Jul 2020	12:15	49 min	202	0.069	NW	NNW, 1.3 m/s	Not available[c]	2 PVC drogues	W, 0.057
	19 Aug 2020	12:30 – 16:42	4 h 12 min	2,735	0.192	E, SE	WNW, 4.4 m/s	Not available[c]	2 PVC drogues	SE, 0.084
	24 Aug 2020	09:04 – 10:00	4 h 36 min	1,107	0.098	WNW	SE, 3.8 m/s	Not available[c]	2 PVC Drogues released an hour apart	N to NE, 0.086
	23 Sep 2020	11:04	4 h 4 min	1,634	0.111	N, then NW	SSE, 4.8 m/s	10.2	3 PVC drogues	NNW shifting to SSE, 0.102 [e]
	9 June 2021	10:52	4 h 15 min	325	0.020	NW	ESE, 2.8-6.9 m/s	16.5	3 sail drogues	No data
PL-North-Outfall	9 Jul 2020	09:30	2 h 1 min	253	0.035	SSW	NNW, 1.2 m/s	13.7	3 sail drogues	SE, 0.050
	19 Aug 2020	11:48	5 h 12 min	546	0.029	NE, then N	W, 4.0 m/s	Not available[c]	2 sail drogues. Separated into two paths based on change in direction	Variable, 0.042
		17:00	1 h 36 min	136	0.024	SE	W, 4.3 m/s			Variable, 0.032
	24 Aug 2020	10:20	4 h 19 min	768	0.035	WNW	SE, 4.0 m/s	6.48	3 sail drogues	Variable, 0.036
	23 Sep 2020	10:15	6 h 23 min	1,161	0.050	N, then NW, then W	SSE, 4.7 m/s	Not available[c]	2 sail drogues (GPS issue)	N, 0.056 [e]
	9 June 2021	9:08	5 h 53 min	978	0.046	N, then NW, then W	ESE, 2.8-6.9 m/s	11.0	3 sail drogues	N to ENE, 0.026
PL-South	8 Jul 2020	11-11:30	1 h 10 min	60	0.014	S	N, 5.0 m/s	16.6	3 PVC drogues	SSE shifting to N, 0.016
	23 Aug 2020	10:11	5 h 4 min	533	0.029	SW	NNE, 1.5 m/s	Not available[c]	2 PVC drogues	no concurrent data [f]
	26 Sep 2020	08:02	4 h 43 min	1,435	0.084	E	WNW, 3.8 m/s	169	3 PVC drogues	no concurrent data [f]
	29 Oct 2020	10:45	4 h 27 min	676	0.042	SE	NW, 5.3 m/s	87.5	3 sail drogues	no concurrent data [f]
	13 June 2021	08:44	1 h 43 min	225	0.038	ENE	SW, 3.3-5.0 m/s	0.29	3 sail drogues	WNW shifting to NNE, 0.019

a) Duration included in this table indicates time from release to the end of the edited drogue GPS track datasets. The datasets were edited to remove periods when GPS signals were lost or when the drogues started to drag on the lake bed or reached shore.
b) Wind data are from the Rook I Meteorological Stations during the drogue deployment hours; wind directions indicate direction that the wind is coming from per World Meteorological Organization standards (WMO 2018).
c) Data from three or more drogues are required to estimate dispersion rate.
d) Average ADCP current speed and direction are provided for the same time periods that the drogues were deployed. Current directions are the direction towards which the currents are moving per industry standard convention (NOAA 2000; QARTOD 2019).
e) On these dates, ADCP data collection only partially overlapped the drogue deployment time periods and thus results represent only one or two ADCP samples.
f) On these dates, ADCP data collection did not overlap with the drogue deployment time periods and no direct comparison could be made.

PVC = polyvinyl chloride; NW = northwest, NNW = north-northwest, N = north, NNE = north-northeast, NE = northeast, E = east, SE = southeast, SSE = south- southeast, S = south, SSW = south-southwest, SW = southwest, W = west, WNW = west-northwest; n/d = no data.

5.3.5 Comparison of Concurrent Drogue and Acoustic Doppler Current Profiler Results

A comparison of current speed and direction data collected during 2020 drogue deployments with concurrent near-surface stationary ADCP measurements is presented in Table 6. The results were only compared when the drogues were within 100 m of the ADCP (i.e., not the entire deployment period per Table 6), as the ADCP measurements were stationary, whereas the drogues travelled across the lake surface over a period of hours. The focus was on comparing the near-surface ADCP results with the drogue results to provide additional confidence when these results agreed (Table 6).

Mean drogue speed (i.e., the average path speed of two or three drogues moving at the same time) was usually lower than what was measured at the ADCPs, as the different drogues did not take identical paths. In general, when the drogues had higher (i.e., faster) average speeds, the ADCP lake current speeds were also higher, as observed at PL-North-Intake on 24 August 2020. The lowest drogue speeds were observed when the current direction was actively shifting (e.g., at PL-North-Outfall on 24 August 2020), or if winds were light or from offshore (e.g., at PL-South on 8 July 2020).

Current directions of the mean drogue direction and near-surface ADCP current direction were generally aligned.

Table 6: Concurrent Drogue and Acoustic Doppler Current Profiler Results

Station ID	Date	Concurrent Deployment Time	Mean Drogue Speed first 100 m (m/s) [(a)]	Near-Surface ADCP Speed (m/s)	Mean Drogue Direction	Near-Surface ADCP Current Direction
PL-North-Intake	9 Jul 2020	12:15–12:41	0.069	0.087	NW	W
	24 Aug 2020	09:04–09:20	0.100	0.076	W	NW to NE
	23 Sep 2020	11:04–11:32	0.058	0.102	NW	Variable NNW shifting to SSE
PL-North-Outfall	9 Jul 2020	10:20	0.046	0.055	SW	ENE shifting to SE
	19 Aug 2020	11:48–12:46	0.029	0.035	NE	N to NE, SW
	24 Aug 2020	08:39–10:05	0.019	0.037	W	Variable
	9 Jun 2021	**09:08-15:00**	**0.076**	**0.026**	**N then NW**	**N to ENE**
PL-South	8 Jul 2020	11:00–13:34	0.013	0.014	S and SE	SSE shifting to N
	13 Jun 2021	**08:44–10:27**	**0.029**	**0.019**	**NE then ENE**	**WNW shifting to NNE**

Note: **Bold text** indicates the Near-Surface ADCP observation for which comparison to drogue data is more appropriate.
a) observations were compared for the period when the drogues were within 100 m of the ADCP.
ADCP = acoustic Doppler current profiler; NW = northwest, NNW = north-northwest, N = north, NNE = north-northeast, NE = northeast, E = east, SE = southeast, SSE = south- southeast, S = south, SSW = south-southwest, SW = southwest, W = west, WNW = west-northwest.

6.0 SUMMARY

Lake current patterns were monitored at three locations in Patterson Lake between July 2020 and June 2021 to improve understanding of lake currents near the anticipated locations of the Rook I Project submerged north fresh water intake, treated sewage outfall, and treated effluent diffuser. Both open-water and under-ice conditions were monitored.

The dominant lake current directions varied at each acoustic Doppler current profiler (ADCP) location and were influenced by wind and local factors such as the orientation of the waterbody, steepness and height of surrounding shorelines, and bathymetry. The observation period from July 2020 to September 2020 had slightly windier conditions than those during the six-year open-water period wind record though average hourly wind speeds were similar. Prevailing wind directions were similar for the 2020 observation period (Figure 12) and 5-year open water period (Figure 11), with west-northwest and northwest being the most frequent, followed by south-southeast.

In spring 2021, the most frequent wind directions were north-northwest, southeast, and north, and west-northwest and northwest winds were much less frequent than the six-year open-water period record. The wind speed classes recorded in spring 2021 were similar to the six-year record except that moderate wind speeds between 3 m/s and 5 m/s were 2.5% more frequent, higher wind speeds from 5 m/s to 8 m/s were 1% less frequent, and there were no winds exceeding 8 m/s.

Key findings for the Patterson Lake North Intake location (i.e., PL-North-Intake) for 2020 open-water conditions only were as follows:

- The range of observed current speeds was 0.001 m/s to 0.252 m/s.
- Median current speed ranged from 0.079 m/s near-lake-bed to 0.083 m/s at mid-profile.
- Average current speed was 0.081 m/s in the mid-profile.
- Dominant current directions at this location (i.e., southeast and east-southeast, followed by west-northwest and west) were aligned with wind directions monitored at the Rook I Meteorological Station.
- The higher current speeds and agreement with wind direction results may be due to the East Basin being more exposed to regional wind as the topography is relatively flat compared to other basins of Patterson Lake.

Key findings for the Patterson Lake North Outfall (i.e., PL-North-Outfall) location were as follows:

- The range of observed current speeds observed during the 2020 open-water period in the mid-profile was 0.001 m/s to 0.192 m/s.
- Median current speed ranged from 0.041 m/s at near-surface and mid-profile to 0.043 m/s near the lake bed.
- Average current speed was 0.042 m/s in the mid-profile, which is less than the assumed average current speed of 0.055 m/s used in the conceptual diffuser design (based on wind speed) (Golder 2019) .

- Lake currents throughout the profile were predominantly onshore between east-southeast and south-southwest 41% to 43% of the time, and less frequently alongshore (i.e., moving southwest through west and northeast through east) 27% to 29% of the time and offshore 28% to 30%. Local wind speed and direction may be affected by the topography around the Patterson Lake North Arm – West Basin, which may have an influence on current speeds.
- The high frequency of onshore current directions at PL-North-Outfall may be related to the 4% to 5% more frequent west-northwest and northwest winds during the 2020 lake current observation period compared to the six-year open-water period. However, it is not certain if onshore lake currents are normally more frequent than alongshore currents during the open-water period.
- Lake bathymetry near the ADCP location may also be an important factor affecting current directions and speeds in the water column, particularly near the lake bed. The slope of the lake bed is relatively steep, with a drop-off just north and northwest of the ADCP location (Figure 24), and the drogue paths appeared to follow the edge of the drop-off.
- Lake currents during the under-ice period were significantly lower than during the open-water periods due to the lack of wind stress on the surface. The median lake current speed was 0.016 m/s for mid-profile and 0.013 m/s for the near-surface, and no current speeds exceeded 0.05 m/s. The lake current speeds were less than 0.005 m/s about 5.5% of the time for mid-profile and 5.0% of the time for near-surface, and calm for 0.2% of the time near-surface to 0.4% (mid-profile). Due to interference with ice, about 38% of the near-surface ADCP data needed to be screened out.
- The median lake current speed was 0.024 m/s for mid-profile and 0.026 m/s for near-surface during the early spring of 2021. These current speeds are less than for the 2020 open-water period; this may be due to the lower wind speeds during the 2021 spring open-water period.

For the Patterson Lake South Location (PL-South), key findings were as follows:

- The range of measured current speeds in the mid-profile was from zero to 0.168 m/s.
- For the 2020 open-water monitoring period, median current speeds were 0.400 m/s at the near-surface, 0.021 m/s in mid-profile and near-lake bed.
- Lake currents during the under-ice period were much less than during the open-water periods due to the lack of wind stress on the surface. The median lake current speed was 0.016 m/s for mid-profile and 0.013 m/s for the near-surface, and there were no current speeds above 0.05 m/s. The lake current speeds were less than 0.005 m/s 13.0% of the time for near-lake bed, 13.5% of the time for the mid-profile, and 7.9% of the time for near-surface. Lake currents were calm for 0.3% of the time near-surface, and 0.5% for the mid-profile and near-lake bed.
- For the 2020 open water period, the near-surface, mid-profile, and near-lake bed current directions were bimodal, predominantly alongshore in the same orientation as the Patterson Lake – South Arm occurring 40% to 41% of the time. Currents were onshore between 31% and 36% of the time and offshore the remaining time.
- For ice-covered conditions, dominant current directions were predominantly onshore (40% of the time for the near-surface and 51% of the time for the mid-profile).

- For spring 2021 open-water conditions, dominant current directions were again predominantly onshore 42% to 44% of the time at all depths in the profile. The frequency of alongshore currents was 39% to 41%. The frequency of offshore currents was 12% to 15%.

Although the general direction of flow through Patterson Lake is from the North Arm – East Basin, through the narrows to North Arm – West Basin, and out through the South Arm, this overall flow may not have influenced lake currents during the open-water period in 2020 or early spring 2021, nor did it appear to influence lake current directions during the ice-covered period.

7.0 CLOSING

WSP is pleased to submit this report to NexGen in support of the environmental assessment for the Rook I Project. For details on the limitations and use of information presented in this report, please refer to the Study Limitations section following this page. If you have any questions or require additional details related to this study, please contact the undersigned.

WSP Canada Inc.

Prepared by:

PROFESSIONAL ENGINEER
R.W. PHILLIPS
MEMBER 22672
23 05 26
YR. MN. DAY
SASKATCHEWAN

Ross Phillips, M.Sc., P.Eng.
Principal Water Resource Engineer

Reviewed by:

Gerard Van Arkel, M.Eng.
Associate, Senior Water Resources Specialist

JH/RP/GVA/rd

Association of Professional Engineers & Geoscientists of Saskatchewan
CERTIFICATE OF AUTHORIZATION
WSP Canada Inc.
Number **C0868**
Permission to Consult held by:

Discipline	Sk. Reg. No.	Signature
Wat. Resources	22672	

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The report is of a summary nature and is not intended to stand alone without reference to the instructions given to WSP by the Client, communications between WSP and the Client, and to any other reports prepared by WSP for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be to the foregoing and to the entirety of the report. WSP cannot be responsible for use of portions of the report without reference to the entire report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client and were prepared for the specific purpose set out herein. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, is the responsibility of such third parties. WSP accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

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APPENDIX A

Wind Rose and Lake Currents Rose Statistics

Table 1-1: Wind Speed and Direction Frequency at Rook I Meteorological Station for the Open Water Period from May 2016 to October 2021

Direction	Direction Interval (°)	Average Direction (°)	Wind Speed, WS (m/s)						
			0.5≤WS<1.5	1.5≤WS<3	3≤WS<5	5≤WS<8	8≤WS<10	WS≥10	TOTAL
N	[348.75 , 11.25]	0	0.5%	1.4%	1.9%	0.8%	0.0%	0.0%	4.7%
NNE	[11.25 , 33.75]	22.5	0.6%	1.7%	1.3%	0.5%	0.0%	0.0%	4.1%
NE	[33.75 , 56.25]	45	0.4%	1.9%	1.8%	0.4%	0.0%	0.0%	4.5%
ENE	[56.25 , 78.75]	67.5	0.3%	1.7%	1.4%	0.2%	0.0%	0.0%	3.7%
E	[78.75 , 101.25]	90	0.2%	1.4%	1.7%	0.6%	0.0%	0.0%	4.1%
ESE	[101.25 , 123.75]	112.5	0.3%	1.9%	2.0%	0.6%	0.0%	0.0%	4.8%
SE	[123.75 , 146.25]	135	0.4%	2.2%	2.6%	1.2%	0.1%	0.0%	6.4%
SSE	[146.25 , 168.75]	157.5	0.4%	2.5%	4.5%	1.7%	0.0%	0.0%	9.1%
S	[168.75 , 191.25]	180	0.2%	2.2%	4.3%	1.4%	0.0%	0.0%	8.2%
SSW	[191.25 , 213.75]	202.5	0.3%	1.9%	2.8%	0.6%	0.0%	0.0%	5.6%
SW	[213.75 , 236.25]	225	0.3%	1.8%	3.0%	0.9%	0.1%	0.0%	6.0%
WSW	[236.25 , 258.75]	247.5	0.4%	2.2%	2.4%	0.6%	0.0%	0.0%	5.6%
W	[258.75 , 281.25]	270	0.5%	2.3%	2.0%	0.9%	0.0%	0.0%	5.7%
WNW	[281.25 , 303.75]	292.5	0.4%	2.4%	3.9%	2.3%	0.4%	0.1%	9.5%
NW	[303.75 , 326.25]	315	0.3%	2.0%	3.7%	3.4%	0.5%	0.1%	10.0%
NNW	[326.25 , 348.75]	337.5	0.4%	1.8%	2.7%	1.9%	0.3%	0.0%	7.2%
Total	[0 , 360]	TOTAL	6.0%	31.3%	42.1%	18.0%	1.6%	0.2%	99.2%
Other	No Direction	Wind Speed = 0							0.3%
Missing Data	-	-							0.5%

N = north; S = south; E = east; W = west.

Table 1-2: Wind Speed and Direction Frequency at Rook I Meteorological Station for July to September 2020

Direction	Direction Interval (°)	Average Direction (°)	Wind Speed, W_S (m/s)						
			$0.5 \le W_S < 1.5$	$1.5 \le W_S < 3$	$3 \le W_S < 5$	$5 \le W_S < 8$	$8 \le W_S < 10$	$W_S \ge 10$	TOTAL
N	[348.75 , 11.25]	0	0.5%	1.4%	1.9%	0.3%	0.0%	0.0%	4.2%
NNE	[11.25 , 33.75]	22.5	0.3%	1.7%	0.6%	0.0%	0.0%	0.0%	2.7%
NE	[33.75 , 56.25]	45	0.3%	1.0%	1.0%	0.5%	0.0%	0.0%	2.7%
ENE	[56.25 , 78.75]	67.5	0.3%	0.8%	0.8%	0.3%	0.0%	0.0%	2.2%
E	[78.75 , 101.25]	90	0.1%	0.7%	1.2%	1.4%	0.0%	0.0%	3.4%
ESE	[101.25 , 123.75]	112.5	0.5%	1.3%	3.0%	1.3%	0.0%	0.0%	6.2%
SE	[123.75 , 146.25]	135	0.7%	2.5%	2.4%	1.4%	0.0%	0.0%	7.0%
SSE	[146.25 , 168.75]	157.5	0.4%	2.7%	3.9%	1.9%	0.0%	0.0%	9.0%
S	[168.75 , 191.25]	180	0.2%	1.8%	2.1%	1.0%	0.0%	0.0%	5.2%
SSW	[191.25 , 213.75]	202.5	0.1%	1.6%	1.3%	0.5%	0.0%	0.0%	3.4%
SW	[213.75 , 236.25]	225	0.2%	1.5%	2.0%	1.1%	0.1%	0.0%	5.0%
WSW	[236.25 , 258.75]	247.5	0.1%	2.3%	3.0%	1.0%	0.0%	0.0%	6.4%
W	[258.75 , 281.25]	270	0.3%	2.6%	2.4%	0.7%	0.0%	0.0%	6.1%
WNW	[281.25 , 303.75]	292.5	0.5%	3.6%	5.2%	4.6%	0.5%	0.3%	14.6%
NW	[303.75 , 326.25]	315	0.4%	2.3%	5.1%	5.0%	0.9%	0.3%	14.0%
NNW	[326.25 , 348.75]	337.5	0.5%	2.5%	3.3%	1.5%	0.1%	0.0%	7.9%
Total	[0 , 360]	TOTAL	5.4%	30.3%	39.3%	22.5%	1.7%	0.6%	99.8%
Other	No Direction	Wind Speed < 0.5							0.2%
Missing Data	-	-							0.0%

N = north; S = south; E = east; W = west.

Table 1-3: Wind Speed and Direction Frequency at Rook I Meteorological Station for 25 May to 13 June 2021

Direction	Direction Interval (°)	Average Direction (°)	Wind Speed, W_S (m/s)						
			$0.5 \le W_S < 1.5$	$1.5 \le W_S < 3$	$3 \le W_S < 5$	$5 \le W_S < 8$	$8 \le W_S < 10$	$W_S \ge 10$	TOTAL
N	[348.75 , 11.25]	0	1.0%	2.1%	6.9%	0.2%	0.0%	0.0%	10.2%
NNE	[11.25 , 33.75]	22.5	0.2%	1.9%	0.8%	0.8%	0.0%	0.0%	3.8%
NE	[33.75 , 56.25]	45	0.0%	1.3%	0.8%	0.0%	0.0%	0.0%	2.1%
ENE	[56.25 , 78.75]	67.5	0.0%	0.8%	0.0%	0.0%	0.0%	0.0%	0.8%
E	[78.75 , 101.25]	90	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.2%
ESE	[101.25 , 123.75]	112.5	0.2%	0.8%	1.7%	4.4%	0.0%	0.0%	7.1%
SE	[123.75 , 146.25]	135	0.2%	1.9%	4.4%	4.2%	0.0%	0.0%	10.6%
SSE	[146.25 , 168.75]	157.5	0.6%	2.3%	2.3%	3.1%	0.0%	0.0%	8.4%
S	[168.75 , 191.25]	180	0.6%	0.6%	1.3%	0.6%	0.0%	0.0%	3.1%
SSW	[191.25 , 213.75]	202.5	0.0%	2.1%	1.0%	0.0%	0.0%	0.0%	3.1%
SW	[213.75 , 236.25]	225	0.0%	1.3%	3.3%	1.7%	0.0%	0.0%	6.3%
WSW	[236.25 , 258.75]	247.5	0.2%	2.7%	5.6%	0.8%	0.0%	0.0%	9.4%
W	[258.75 , 281.25]	270	0.0%	4.0%	3.5%	0.8%	0.0%	0.0%	8.4%
WNW	[281.25 , 303.75]	292.5	0.4%	3.3%	2.3%	0.2%	0.0%	0.0%	6.3%
NW	[303.75 , 326.25]	315	1.0%	2.3%	2.7%	0.2%	0.0%	0.0%	6.3%
NNW	[326.25 , 348.75]	337.5	0.4%	3.3%	5.0%	4.4%	0.0%	0.0%	13.2%
Total	[0 , 360]	TOTAL	5.0%	30.9%	41.8%	21.5%	0.0%	0.0%	99.2%
Other	No Direction	Wind Speed = 0							0.8%
Missing Data	-	-							0.0%

N = north; S = south; E = east; W = west.

Table 2-1: 2020 Open Water Period Lake Current Speed and Direction Frequency at PL-North-Intake (Near-Surface)

Current Direction	Direction Interval (°)	Average Direction (°)	Current Speed, C_S (m/s)						
			$0<C_S<0.005$	$0.005 \le C_S<0.025$	$0.025 \le C_S<0.05$	$0.05 \le C_S<0.075$	$0.075 \le C_S<0.1$	$C_S \ge 0.1$	TOTAL
N	[348.75 , 11.25]	0	0.0%	0.6%	1.4%	1.0%	1.6%	0.5%	5.1%
NNE	[11.25 , 33.75]	22.5	0.1%	0.8%	1.4%	1.2%	1.6%	1.0%	6.2%
NE	[33.75 , 56.25]	45	0.0%	0.5%	1.0%	1.3%	2.1%	1.4%	6.3%
ENE	[56.25 , 78.75]	67.5	0.0%	0.4%	1.0%	1.1%	2.1%	1.5%	6.1%
E	[78.75 , 101.25]	90	0.0%	0.3%	0.9%	1.0%	3.2%	2.0%	7.4%
ESE	[101.25 , 123.75]	112.5	0.1%	0.4%	0.4%	0.5%	3.6%	4.6%	9.5%
SE	[123.75 , 146.25]	135	0.0%	0.2%	0.3%	0.4%	2.7%	7.7%	11.3%
SSE	[146.25 , 168.75]	157.5	0.0%	0.3%	0.3%	0.4%	2.1%	3.8%	7.0%
S	[168.75 , 191.25]	180	0.0%	0.4%	0.2%	0.3%	0.9%	0.5%	2.4%
SSW	[191.25 , 213.75]	202.5	0.0%	0.5%	0.6%	0.4%	0.5%	0.1%	2.1%
SW	[213.75 , 236.25]	225	0.0%	0.3%	0.9%	0.7%	0.5%	0.2%	2.5%
WSW	[236.25 , 258.75]	247.5	0.1%	0.5%	1.2%	1.2%	1.2%	0.5%	4.6%
W	[258.75 , 281.25]	270	0.0%	0.5%	1.8%	2.6%	1.9%	1.2%	8.0%
WNW	[281.25 , 303.75]	292.5	0.0%	1.0%	2.0%	2.6%	2.0%	1.3%	8.9%
NW	[303.75 , 326.25]	315	0.0%	0.6%	1.8%	2.6%	1.5%	0.5%	7.2%
NNW	[326.25 , 348.75]	337.5	0.0%	0.7%	1.5%	1.6%	1.2%	0.4%	5.4%
Total	[0 , 360]	TOTAL	0.3%	8.1%	16.7%	18.9%	28.8%	27.1%	100.0%
Other	No Direction	Current Speed = 0							0.0%
Missing Data	-	-							0.0%

N = north; S = south; E = east; W = west.

Table 2-2: 2020 Open Water Period Lake Current Speed and Direction Frequency at PL-North-Intake (Mid-Profile)

Current Direction	Direction Interval (°)	Average Direction (°)	Current Speed, C_S (m/s)						
			$0<C_S<0.005$	$0.005 \le C_S<0.025$	$0.025 \le C_S<0.05$	$0.05 \le C_S<0.075$	$0.075 \le C_S<0.1$	$C_S \ge 0.1$	TOTAL
N	[348.75 , 11.25]	0	0.0%	0.6%	1.2%	1.0%	1.5%	0.7%	5.0%
NNE	[11.25 , 33.75]	22.5	0.1%	0.5%	1.1%	1.1%	1.7%	1.0%	5.6%
NE	[33.75 , 56.25]	45	0.0%	0.4%	1.0%	1.0%	1.8%	1.6%	5.9%
ENE	[56.25 , 78.75]	67.5	0.0%	0.4%	0.8%	0.9%	2.3%	2.2%	6.6%
E	[78.75 , 101.25]	90	0.0%	0.2%	0.6%	0.9%	2.2%	3.1%	7.0%
ESE	[101.25 , 123.75]	112.5	0.1%	0.4%	0.7%	0.4%	2.9%	5.7%	10.2%
SE	[123.75 , 146.25]	135	0.0%	0.2%	0.4%	0.3%	2.3%	7.7%	11.0%
SSE	[146.25 , 168.75]	157.5	0.0%	0.3%	0.5%	0.2%	1.4%	3.8%	6.2%
S	[168.75 , 191.25]	180	0.0%	0.3%	0.3%	0.2%	0.8%	0.8%	2.4%
SSW	[191.25 , 213.75]	202.5	0.1%	0.5%	0.8%	0.5%	0.6%	0.1%	2.5%
SW	[213.75 , 236.25]	225	0.0%	0.4%	0.7%	0.7%	0.6%	0.1%	2.6%
WSW	[236.25 , 258.75]	247.5	0.0%	0.6%	1.5%	1.4%	1.3%	0.5%	5.3%
W	[258.75 , 281.25]	270	0.0%	0.5%	1.9%	2.7%	2.0%	1.8%	9.0%
WNW	[281.25 , 303.75]	292.5	0.0%	0.7%	2.1%	2.9%	2.2%	1.1%	9.0%
NW	[303.75 , 326.25]	315	0.0%	0.5%	2.0%	2.1%	1.6%	0.7%	6.9%
NNW	[326.25 , 348.75]	337.5	0.0%	0.5%	1.6%	1.5%	0.9%	0.4%	4.9%
Total	[0 , 360]	TOTAL	0.4%	7.1%	17.1%	17.8%	26.2%	31.4%	100.0%
Other	No Direction	Current Speed = 0							0.0%
Missing Data	-	-							0.0%

N = north; S = south; E = east; W = west.

Table 2-3: 2020 Open Water Period Lake Current Speed and Direction Frequency at PL-North-Intake (Near Lake Bed)

Current Direction	Direction Interval (°)	Average Direction (°)	Current Speed, C_S (m/s)						
			$0<C_S<0.005$	$0.005\leq C_S<0.025$	$0.025\leq C_S<0.05$	$0.05\leq C_S<0.075$	$0.075\leq C_S<0.1$	$C_S\geq 0.1$	TOTAL
N	[348.75 , 11.25]	0	0.0%	0.7%	1.4%	1.0%	1.3%	0.4%	4.8%
NNE	[11.25 , 33.75]	22.5	0.1%	0.7%	1.2%	1.1%	1.5%	0.8%	5.3%
NE	[33.75 , 56.25]	45	0.0%	0.5%	1.0%	1.1%	2.0%	1.4%	5.9%
ENE	[56.25 , 78.75]	67.5	0.0%	0.3%	0.9%	1.1%	3.1%	1.7%	7.1%
E	[78.75 , 101.25]	90	0.0%	0.3%	0.6%	0.7%	2.7%	3.1%	7.5%
ESE	[101.25 , 123.75]	112.5	0.0%	0.5%	0.6%	0.5%	3.4%	5.2%	10.2%
SE	[123.75 , 146.25]	135	0.0%	0.3%	0.3%	0.3%	3.1%	7.7%	11.7%
SSE	[146.25 , 168.75]	157.5	0.0%	0.3%	0.3%	0.3%	1.8%	2.9%	5.6%
S	[168.75 , 191.25]	180	0.0%	0.2%	0.4%	0.2%	0.9%	0.2%	2.0%
SSW	[191.25 , 213.75]	202.5	0.1%	0.5%	0.9%	0.4%	0.6%	0.1%	2.5%
SW	[213.75 , 236.25]	225	0.0%	0.3%	1.0%	0.9%	0.5%	0.1%	2.8%
WSW	[236.25 , 258.75]	247.5	0.0%	0.5%	1.8%	1.7%	0.8%	0.5%	5.4%
W	[258.75 , 281.25]	270	0.0%	0.8%	2.2%	2.5%	1.8%	0.9%	8.1%
WNW	[281.25 , 303.75]	292.5	0.0%	0.6%	2.3%	3.0%	2.4%	0.8%	9.2%
NW	[303.75 , 326.25]	315	0.0%	0.9%	2.1%	2.2%	1.1%	0.5%	6.8%
NNW	[326.25 , 348.75]	337.5	0.1%	0.6%	1.7%	1.5%	1.1%	0.3%	5.2%
Total	[0 , 360]	TOTAL	0.4%	8.1%	18.6%	18.4%	28.1%	26.5%	100.0%
Other	No Direction	Current Speed = 0							0.0%
Missing Data	-	-							0.0%

N = north; S = south; E = east; W = west.

Table 3-1: 2020 Open Water Period Lake Current Speed and Direction Frequency at PL-North-Outfall (Near-Surface)

Current Direction	Direction Interval (°)	Average Direction (°)	Current Speed, C_S (m/s)						
			$0<C_S<0.005$	$0.005\leq C_S<0.025$	$0.025\leq C_S<0.05$	$0.05\leq C_S<0.075$	$0.075\leq C_S<0.1$	$C_S\geq 0.1$	TOTAL
N	[348.75 , 11.25]	0	0.0%	1.0%	3.1%	1.5%	0.5%	0.1%	6.3%
NNE	[11.25 , 33.75]	22.5	0.1%	1.3%	3.7%	1.0%	0.3%	0.1%	6.4%
NE	[33.75 , 56.25]	45	0.0%	1.3%	3.3%	1.0%	0.1%	0.0%	5.7%
ENE	[56.25 , 78.75]	67.5	0.1%	1.3%	2.8%	1.0%	0.1%	0.0%	5.3%
E	[78.75 , 101.25]	90	0.0%	1.1%	3.6%	1.7%	0.1%	0.0%	6.6%
ESE	[101.25 , 123.75]	112.5	0.1%	1.9%	4.6%	2.5%	0.4%	0.1%	9.6%
SE	[123.75 , 146.25]	135	0.0%	1.6%	4.5%	3.1%	0.7%	0.1%	9.9%
SSE	[146.25 , 168.75]	157.5	0.1%	1.4%	5.0%	2.6%	0.6%	0.1%	9.8%
S	[168.75 , 191.25]	180	0.1%	1.1%	4.0%	1.8%	0.4%	0.2%	7.6%
SSW	[191.25 , 213.75]	202.5	0.1%	1.3%	3.3%	1.3%	0.1%	0.0%	6.1%
SW	[213.75 , 236.25]	225	0.0%	1.0%	1.8%	0.7%	0.1%	0.0%	3.6%
WSW	[236.25 , 258.75]	247.5	0.0%	0.7%	1.8%	0.2%	0.1%	0.0%	2.9%
W	[258.75 , 281.25]	270	0.0%	0.8%	1.6%	0.7%	0.1%	0.0%	3.1%
WNW	[281.25 , 303.75]	292.5	0.1%	0.9%	2.1%	1.2%	0.1%	0.0%	4.4%
NW	[303.75 , 326.25]	315	0.0%	0.9%	2.9%	1.4%	0.3%	0.0%	5.5%
NNW	[326.25 , 348.75]	337.5	0.0%	1.1%	3.5%	1.7%	0.5%	0.1%	7.0%
Total	[0 , 360]	TOTAL	0.8%	18.6%	51.6%	23.6%	4.4%	0.8%	99.9%
Other	No Direction	Current Speed = 0							0.1%
Missing Data	-	-							0.0%

N = north; S = south; E = east; W = west.

Table 3-2: 2020 Open Water Period Lake Current Speed and Direction Frequency at PL-North-Outfall (Mid-Profile)

Current Direction	Direction Interval (°)	Average Direction (°)	Current Speed, C_S (m/s)						
			$0<C_S<0.005$	$0.005\leq C_S<0.025$	$0.025\leq C_S<0.05$	$0.05\leq C_S<0.075$	$0.075\leq C_S<0.1$	$C_S\geq 0.1$	TOTAL
N	[348.75 , 11.25]	0	0.0%	0.7%	2.9%	1.4%	0.2%	0.1%	5.4%
NNE	[11.25 , 33.75]	22.5	0.1%	1.5%	3.0%	1.3%	0.1%	0.0%	5.9%
NE	[33.75 , 56.25]	45	0.0%	1.1%	2.5%	0.6%	0.0%	0.0%	4.2%
ENE	[56.25 , 78.75]	67.5	0.0%	1.2%	2.9%	0.5%	0.0%	0.0%	4.6%
E	[78.75 , 101.25]	90	0.0%	1.1%	2.7%	1.1%	0.1%	0.0%	5.1%
ESE	[101.25 , 123.75]	112.5	0.1%	1.7%	3.6%	1.8%	0.1%	0.0%	7.4%
SE	[123.75 , 146.25]	135	0.0%	1.4%	3.9%	2.1%	0.7%	0.1%	8.2%
SSE	[146.25 , 168.75]	157.5	0.0%	1.2%	4.3%	2.7%	1.1%	0.4%	9.6%
S	[168.75 , 191.25]	180	0.0%	1.2%	4.1%	2.5%	0.7%	0.2%	8.8%
SSW	[191.25 , 213.75]	202.5	0.1%	1.6%	3.3%	1.7%	0.5%	0.1%	7.4%
SW	[213.75 , 236.25]	225	0.0%	1.2%	2.7%	1.2%	0.1%	0.1%	5.5%
WSW	[236.25 , 258.75]	247.5	0.0%	1.1%	2.5%	0.7%	0.1%	0.0%	4.4%
W	[258.75 , 281.25]	270	0.0%	1.0%	2.4%	0.9%	0.2%	0.0%	4.5%
WNW	[281.25 , 303.75]	292.5	0.1%	1.4%	2.9%	1.3%	0.2%	0.1%	6.0%
NW	[303.75 , 326.25]	315	0.0%	1.1%	3.4%	1.6%	0.2%	0.1%	6.3%
NNW	[326.25 , 348.75]	337.5	0.1%	0.9%	3.2%	1.9%	0.3%	0.3%	6.6%
Total	[0 , 360]	TOTAL	0.7%	19.3%	50.3%	23.5%	4.7%	1.6%	100.0%
Other	No Direction	Current Speed = 0							0.0%
Missing Data	-	-							0.0%

N = north; S = south; E = east; W = west.

Table 3-3: 2020 Open Water Period Lake Current Speed and Direction Frequency at PL-North-Outfall (Near Lake Bed)

Current Direction	Direction Interval (°)	Average Direction (°)	Current Speed, C_S (m/s)						
			$0<C_S<0.005$	$0.005\leq C_S<0.025$	$0.025\leq C_S<0.05$	$0.05\leq C_S<0.075$	$0.075\leq C_S<0.1$	$C_S\geq 0.1$	TOTAL
N	[348.75 , 11.25]	0	0.1%	1.1%	2.8%	1.0%	0.1%	0.0%	5.2%
NNE	[11.25 , 33.75]	22.5	0.0%	1.2%	2.6%	0.7%	0.1%	0.0%	4.5%
NE	[33.75 , 56.25]	45	0.0%	0.8%	2.4%	0.5%	0.0%	0.0%	3.7%
ENE	[56.25 , 78.75]	67.5	0.1%	1.2%	2.5%	0.4%	0.0%	0.0%	4.3%
E	[78.75 , 101.25]	90	0.2%	1.3%	2.5%	0.8%	0.0%	0.0%	4.8%
ESE	[101.25 , 123.75]	112.5	0.1%	1.3%	3.8%	1.4%	0.2%	0.0%	6.7%
SE	[123.75 , 146.25]	135	0.0%	1.4%	4.1%	2.2%	0.8%	0.2%	8.7%
SSE	[146.25 , 168.75]	157.5	0.1%	1.5%	4.2%	3.2%	1.5%	0.6%	11.1%
S	[168.75 , 191.25]	180	0.1%	1.2%	3.6%	2.7%	1.1%	0.3%	9.1%
SSW	[191.25 , 213.75]	202.5	0.0%	1.2%	3.5%	1.9%	0.5%	0.1%	7.3%
SW	[213.75 , 236.25]	225	0.0%	1.0%	2.8%	1.3%	0.2%	0.1%	5.5%
WSW	[236.25 , 258.75]	247.5	0.1%	1.0%	2.5%	1.0%	0.1%	0.1%	4.8%
W	[258.75 , 281.25]	270	0.1%	1.2%	2.8%	1.2%	0.2%	0.0%	5.5%
WNW	[281.25 , 303.75]	292.5	0.1%	1.1%	2.9%	1.7%	0.4%	0.1%	6.2%
NW	[303.75 , 326.25]	315	0.1%	1.0%	2.5%	1.9%	0.6%	0.2%	6.2%
NNW	[326.25 , 348.75]	337.5	0.0%	1.3%	3.0%	1.5%	0.4%	0.1%	6.3%
Total	[0 , 360]	TOTAL	1.1%	18.7%	48.5%	23.5%	6.2%	2.0%	100.0%
Other	No Direction	Current Speed = 0							0.0%
Missing Data	-	-							0.0%

N = north; S = south; E = east; W = west.

Table 3-4: Ice-Covered Period Lake Current Speed and Direction Frequency at PL-North-Outfall (Near-Surface)

Current Direction	Direction Interval (°)	Average Direction (°)	Current Speed, C_S (m/s)						
			$0<C_S<0.005$	$0.005\le C_S<0.025$	$0.025\le C_S<0.05$	$0.05\le C_S<0.075$	$0.075\le C_S<0.1$	$C_S\ge 0.1$	TOTAL
N	[348.75 , 11.25]	0	0.4%	1.9%	0.1%	0.0%	0.0%	0.0%	2.5%
NNE	[11.25 , 33.75]	22.5	0.4%	1.4%	0.1%	0.0%	0.0%	0.0%	1.8%
NE	[33.75 , 56.25]	45	0.2%	2.2%	0.2%	0.0%	0.0%	0.0%	2.6%
ENE	[56.25 , 78.75]	67.5	0.2%	2.8%	0.3%	0.0%	0.0%	0.0%	3.3%
E	[78.75 , 101.25]	90	0.5%	4.0%	0.5%	0.0%	0.0%	0.0%	4.9%
ESE	[101.25 , 123.75]	112.5	0.3%	4.4%	0.6%	0.0%	0.0%	0.0%	5.3%
SE	[123.75 , 146.25]	135	0.3%	4.8%	0.9%	0.0%	0.0%	0.0%	6.0%
SSE	[146.25 , 168.75]	157.5	0.3%	5.4%	1.3%	0.0%	0.0%	0.0%	6.9%
S	[168.75 , 191.25]	180	0.4%	4.7%	0.8%	0.0%	0.0%	0.0%	5.9%
SSW	[191.25 , 213.75]	202.5	0.2%	4.3%	0.6%	0.0%	0.0%	0.0%	5.2%
SW	[213.75 , 236.25]	225	0.3%	3.4%	0.5%	0.0%	0.0%	0.0%	4.2%
WSW	[236.25 , 258.75]	247.5	0.4%	3.1%	0.4%	0.0%	0.0%	0.0%	3.9%
W	[258.75 , 281.25]	270	0.3%	2.6%	0.2%	0.0%	0.0%	0.0%	3.2%
WNW	[281.25 , 303.75]	292.5	0.3%	1.7%	0.3%	0.0%	0.0%	0.0%	2.3%
NW	[303.75 , 326.25]	315	0.1%	1.7%	0.1%	0.0%	0.0%	0.0%	2.0%
NNW	[326.25 , 348.75]	337.5	0.2%	1.6%	0.2%	0.0%	0.0%	0.0%	2.0%
Total	[0 , 360]	TOTAL	4.8%	50.0%	7.1%	0.0%	0.0%	0.0%	61.9%
Other	No Direction	Current Speed = 0							0.2%
Missing Data	-	-							37.9%

N = north; S = south; E = east; W = west.

Table 3-5: Ice-Covered Period Lake Current Speed and Direction Frequency at PL-North-Outfall (Mid-Profile)

Current Direction	Direction Interval (°)	Average Direction (°)	Current Speed, C_S (m/s)						
			$0<C_S<0.005$	$0.005 \le C_S<0.025$	$0.025 \le C_S<0.05$	$0.05 \le C_S<0.075$	$0.075 \le C_S<0.1$	$C_S \ge 0.1$	TOTAL
N	[348.75 , 11.25]	0	0.5%	3.8%	0.9%	0.0%	0.0%	0.0%	5.2%
NNE	[11.25 , 33.75]	22.5	0.3%	3.3%	0.9%	0.0%	0.0%	0.0%	4.6%
NE	[33.75 , 56.25]	45	0.2%	4.0%	1.1%	0.0%	0.0%	0.0%	5.3%
ENE	[56.25 , 78.75]	67.5	0.3%	4.1%	1.3%	0.0%	0.0%	0.0%	5.7%
E	[78.75 , 101.25]	90	0.5%	5.4%	1.3%	0.0%	0.0%	0.0%	7.1%
ESE	[101.25 , 123.75]	112.5	0.4%	5.4%	1.6%	0.0%	0.0%	0.0%	7.4%
SE	[123.75 , 146.25]	135	0.2%	5.0%	2.3%	0.0%	0.0%	0.0%	7.5%
SSE	[146.25 , 168.75]	157.5	0.3%	6.7%	2.5%	0.0%	0.0%	0.0%	9.5%
S	[168.75 , 191.25]	180	0.7%	6.0%	2.1%	0.0%	0.0%	0.0%	8.8%
SSW	[191.25 , 213.75]	202.5	0.2%	4.9%	1.6%	0.0%	0.0%	0.0%	6.7%
SW	[213.75 , 236.25]	225	0.2%	4.2%	1.0%	0.0%	0.0%	0.0%	5.5%
WSW	[236.25 , 258.75]	247.5	0.2%	3.4%	0.8%	0.0%	0.0%	0.0%	4.4%
W	[258.75 , 281.25]	270	0.2%	3.0%	0.6%	0.0%	0.0%	0.0%	3.8%
WNW	[281.25 , 303.75]	292.5	0.4%	2.8%	0.5%	0.0%	0.0%	0.0%	3.7%
NW	[303.75 , 326.25]	315	0.1%	2.8%	0.7%	0.0%	0.0%	0.0%	3.6%
NNW	[326.25 , 348.75]	337.5	0.3%	2.5%	0.8%	0.0%	0.0%	0.0%	3.6%
Total	[0 , 360]	TOTAL	5.1%	67.4%	20.1%	0.0%	0.0%	0.0%	92.6%
Other	No Direction	Current Speed = 0							0.4%
Missing Data	-	-							7.0%

N = north; S = south; E = east; W = west.

Table 3-6: Spring 2021 Open Water Period Lake Current Speed and Direction Frequency at PL-North-Outfall (Near-Surface)

Current Direction	Direction Interval (°)	Average Direction (°)	Current Speed, C_S (m/s)						
			$0<C_S<0.005$	$0.005\leq C_S<0.025$	$0.025\leq C_S<0.05$	$0.05\leq C_S<0.075$	$0.075\leq C_S<0.1$	$C_S\geq 0.1$	TOTAL
N	[348.75 , 11.25]	0	0.0%	2.4%	3.4%	0.3%	0.0%	0.0%	6.1%
NNE	[11.25 , 33.75]	22.5	0.5%	3.7%	3.2%	1.3%	0.0%	0.0%	8.8%
NE	[33.75 , 56.25]	45	0.3%	2.1%	1.3%	0.3%	0.0%	0.0%	4.0%
ENE	[56.25 , 78.75]	67.5	0.0%	2.7%	1.3%	0.0%	0.0%	0.0%	4.0%
E	[78.75 , 101.25]	90	0.8%	1.3%	0.0%	0.0%	0.0%	0.0%	2.1%
ESE	[101.25 , 123.75]	112.5	0.3%	2.7%	0.5%	0.0%	0.0%	0.0%	3.4%
SE	[123.75 , 146.25]	135	0.3%	1.6%	1.3%	0.0%	0.0%	0.0%	3.2%
SSE	[146.25 , 168.75]	157.5	0.3%	7.4%	4.8%	0.3%	0.0%	0.0%	12.7%
S	[168.75 , 191.25]	180	0.0%	4.5%	8.2%	2.1%	0.0%	0.0%	14.9%
SSW	[191.25 , 213.75]	202.5	0.0%	5.0%	6.6%	2.7%	0.0%	0.0%	14.3%
SW	[213.75 , 236.25]	225	0.0%	3.2%	1.1%	0.3%	0.0%	0.0%	4.5%
WSW	[236.25 , 258.75]	247.5	0.0%	2.7%	1.3%	0.0%	0.0%	0.0%	4.0%
W	[258.75 , 281.25]	270	0.8%	2.1%	1.1%	0.0%	0.0%	0.0%	4.0%
WNW	[281.25 , 303.75]	292.5	0.0%	1.3%	0.5%	0.0%	0.0%	0.0%	1.9%
NW	[303.75 , 326.25]	315	0.0%	2.1%	1.1%	0.0%	0.0%	0.0%	3.2%
NNW	[326.25 , 348.75]	337.5	0.0%	2.4%	1.9%	0.0%	0.0%	0.0%	4.2%
Total	[0 , 360]	TOTAL	3.2%	47.2%	37.7%	7.2%	0.0%	0.0%	95.2%
Other	No Direction	Current Speed = 0							0.0%
Missing Data	-	-							4.8%

N = north; S = south; E = east; W = west.

Table 3-7: Spring 2021 Open Water Period Lake Current Speed and Direction Frequency at PL-North-Outfall (Mid-Profile)

Current Direction	Direction Interval (°)	Average Direction (°)	Current Speed, C_S (m/s)						
			$0<C_S<0.005$	$0.005 \le C_S<0.025$	$0.025 \le C_S<0.05$	$0.05 \le C_S<0.075$	$0.075 \le C_S<0.1$	$C_S \ge 0.1$	TOTAL
N	[348.75 , 11.25]	0	0.5%	1.9%	1.6%	1.1%	0.0%	0.0%	5.0%
NNE	[11.25 , 33.75]	22.5	0.5%	2.9%	0.5%	0.8%	0.0%	0.0%	4.8%
NE	[33.75 , 56.25]	45	0.0%	2.4%	1.3%	0.0%	0.0%	0.0%	3.7%
ENE	[56.25 , 78.75]	67.5	0.3%	2.4%	2.4%	0.0%	0.0%	0.0%	5.0%
E	[78.75 , 101.25]	90	0.3%	3.2%	1.6%	0.0%	0.0%	0.0%	5.0%
ESE	[101.25 , 123.75]	112.5	0.3%	2.7%	1.6%	0.0%	0.0%	0.0%	4.5%
SE	[123.75 , 146.25]	135	0.3%	4.2%	1.3%	0.0%	0.0%	0.0%	5.8%
SSE	[146.25 , 168.75]	157.5	0.0%	4.2%	4.5%	0.5%	0.0%	0.0%	9.3%
S	[168.75 , 191.25]	180	0.3%	4.5%	6.1%	1.3%	0.0%	0.0%	12.2%
SSW	[191.25 , 213.75]	202.5	0.0%	4.0%	3.7%	2.1%	0.0%	0.0%	9.8%
SW	[213.75 , 236.25]	225	0.0%	4.2%	3.7%	1.3%	0.0%	0.0%	9.3%
WSW	[236.25 , 258.75]	247.5	0.0%	3.4%	2.4%	0.3%	0.0%	0.0%	6.1%
W	[258.75 , 281.25]	270	1.1%	4.0%	0.5%	0.0%	0.0%	0.0%	5.6%
WNW	[281.25 , 303.75]	292.5	0.0%	3.7%	1.1%	0.0%	0.0%	0.0%	4.8%
NW	[303.75 , 326.25]	315	0.3%	1.6%	0.5%	0.0%	0.0%	0.0%	2.4%
NNW	[326.25 , 348.75]	337.5	0.0%	2.9%	0.3%	0.0%	0.0%	0.0%	3.2%
Total	[0 , 360]	TOTAL	3.7%	52.3%	33.2%	7.4%	0.0%	0.0%	96.6%
Other	No Direction	Current Speed = 0							0.0%
Missing Data	-	-							3.5%

N = north; S = south; E = east; W = west.

Table 4-1: 2020 Open Water Period Lake Current Speed and Direction Frequency at PL-South (Near-Surface)

Current Direction	Direction Interval (°)	Average Direction (°)	Current Speed, C_S (m/s)						
			$0<C_S<0.005$	$0.005\leq C_S<0.025$	$0.025\leq C_S<0.05$	$0.05\leq C_S<0.075$	$0.075\leq C_S<0.1$	$C_S\geq 0.1$	TOTAL
N	[348.75 , 11.25]	0	0.2%	1.1%	0.7%	0.0%	0.0%	0.0%	2.0%
NNE	[11.25 , 33.75]	22.5	0.2%	2.8%	1.2%	0.0%	0.0%	0.0%	4.4%
NE	[33.75 , 56.25]	45	0.1%	1.8%	2.0%	0.5%	0.2%	0.0%	4.5%
ENE	[56.25 , 78.75]	67.5	0.3%	2.3%	2.6%	1.6%	1.3%	0.8%	8.9%
E	[78.75 , 101.25]	90	0.3%	2.6%	2.1%	1.0%	0.7%	0.4%	7.2%
ESE	[101.25 , 123.75]	112.5	0.2%	2.5%	1.7%	0.1%	0.0%	0.0%	4.6%
SE	[123.75 , 146.25]	135	0.3%	2.0%	1.1%	0.2%	0.0%	0.0%	3.6%
SSE	[146.25 , 168.75]	157.5	0.2%	3.0%	1.8%	0.1%	0.0%	0.0%	5.1%
S	[168.75 , 191.25]	180	0.3%	3.0%	1.0%	0.1%	0.0%	0.0%	4.5%
SSW	[191.25 , 213.75]	202.5	0.3%	5.5%	3.4%	0.5%	0.0%	0.0%	9.7%
SW	[213.75 , 236.25]	225	0.4%	4.5%	4.2%	1.4%	0.1%	0.1%	10.8%
WSW	[236.25 , 258.75]	247.5	0.5%	5.2%	6.1%	1.5%	0.5%	0.4%	14.2%
W	[258.75 , 281.25]	270	0.3%	3.6%	3.7%	0.5%	0.1%	0.0%	8.3%
WNW	[281.25 , 303.75]	292.5	0.5%	4.1%	2.5%	0.1%	0.0%	0.0%	7.2%
NW	[303.75 , 326.25]	315	0.4%	1.6%	0.5%	0.0%	0.0%	0.0%	2.5%
NNW	[326.25 , 348.75]	337.5	0.1%	1.2%	1.0%	0.1%	0.0%	0.0%	2.4%
Total	[0 , 360]	TOTAL	4.5%	46.9%	35.7%	7.9%	3.0%	1.9%	99.9%
Other	No Direction	Current Speed = 0							0.1%
Missing Data	-	-							0.0%

N = north; S = south; E = east; W = west.

Table 4-2: 2020 Open Water Period Lake Current Speed and Direction Frequency at PL-South (Mid-Profile)

Current Direction	Direction Interval (°)	Average Direction (°)	Current Speed, C_S (m/s)						
			$0<C_S<0.005$	$0.005\leq C_S<0.025$	$0.025\leq C_S<0.05$	$0.05\leq C_S<0.075$	$0.075\leq C_S<0.1$	$C_S\geq 0.1$	TOTAL
N	[348.75 , 11.25]	0	0.0%	2.1%	0.4%	0.0%	0.0%	0.0%	2.5%
NNE	[11.25 , 33.75]	22.5	0.6%	3.5%	0.6%	0.0%	0.0%	0.0%	4.8%
NE	[33.75 , 56.25]	45	0.0%	2.7%	2.2%	0.4%	0.0%	0.1%	5.5%
ENE	[56.25 , 78.75]	67.5	0.2%	3.0%	3.0%	2.2%	1.0%	0.9%	10.3%
E	[78.75 , 101.25]	90	0.0%	2.3%	1.4%	0.9%	0.4%	0.1%	5.0%
ESE	[101.25 , 123.75]	112.5	0.2%	2.7%	1.0%	0.1%	0.0%	0.0%	4.1%
SE	[123.75 , 146.25]	135	0.3%	2.4%	0.8%	0.0%	0.0%	0.0%	3.4%
SSE	[146.25 , 168.75]	157.5	0.5%	3.3%	0.8%	0.0%	0.0%	0.0%	4.6%
S	[168.75 , 191.25]	180	0.1%	2.5%	1.2%	0.0%	0.0%	0.0%	3.9%
SSW	[191.25 , 213.75]	202.5	0.8%	4.7%	1.9%	0.0%	0.0%	0.0%	7.4%
SW	[213.75 , 236.25]	225	0.1%	4.7%	4.1%	0.8%	0.1%	0.0%	9.9%
WSW	[236.25 , 258.75]	247.5	0.6%	6.2%	6.1%	1.5%	0.7%	0.1%	15.3%
W	[258.75 , 281.25]	270	0.1%	4.7%	5.0%	0.6%	0.0%	0.0%	10.5%
WNW	[281.25 , 303.75]	292.5	0.5%	4.6%	2.1%	0.1%	0.0%	0.0%	7.3%
NW	[303.75 , 326.25]	315	0.2%	2.2%	0.5%	0.0%	0.0%	0.0%	2.9%
NNW	[326.25 , 348.75]	337.5	0.4%	1.9%	0.2%	0.0%	0.0%	0.0%	2.5%
Total	[0 , 360]	TOTAL	4.8%	53.5%	31.3%	6.7%	2.3%	1.2%	99.8%
Other	No Direction	Current Speed = 0							0.2%
Missing Data	-	-							0.0%

N = north; S = south; E = east; W = west.

Table 4-3: 2020 Open Water Period Lake Current Speed and Direction Frequency at PL-South (Near-Lake Bed)

Current Direction	Direction Interval (°)	Average Direction (°)	Current Speed, C_S (m/s)						
			$0<C_S<0.005$	$0.005\leq C_S<0.025$	$0.025\leq C_S<0.05$	$0.05\leq C_S<0.075$	$0.075\leq C_S<0.1$	$C_S\geq 0.1$	TOTAL
N	[348.75 , 11.25]	0	0.0%	1.9%	0.2%	0.0%	0.0%	0.0%	2.0%
NNE	[11.25 , 33.75]	22.5	0.9%	2.5%	0.5%	0.1%	0.0%	0.0%	4.1%
NE	[33.75 , 56.25]	45	0.0%	2.5%	1.6%	0.3%	0.0%	0.0%	4.5%
ENE	[56.25 , 78.75]	67.5	0.5%	2.5%	2.8%	1.6%	0.8%	0.8%	8.9%
E	[78.75 , 101.25]	90	0.0%	3.5%	2.1%	0.7%	0.7%	0.1%	7.2%
ESE	[101.25 , 123.75]	112.5	0.5%	2.9%	1.2%	0.1%	0.0%	0.0%	4.6%
SE	[123.75 , 146.25]	135	0.2%	2.4%	1.0%	0.0%	0.0%	0.0%	3.6%
SSE	[146.25 , 168.75]	157.5	0.3%	3.7%	1.2%	0.0%	0.0%	0.0%	5.1%
S	[168.75 , 191.25]	180	0.2%	3.3%	1.0%	0.0%	0.0%	0.0%	4.5%
SSW	[191.25 , 213.75]	202.5	0.8%	5.8%	3.0%	0.1%	0.0%	0.0%	9.7%
SW	[213.75 , 236.25]	225	0.1%	4.7%	5.0%	0.7%	0.3%	0.0%	10.8%
WSW	[236.25 , 258.75]	247.5	0.4%	5.3%	6.9%	1.0%	0.7%	0.0%	14.3%
W	[258.75 , 281.25]	270	0.2%	3.8%	4.0%	0.2%	0.0%	0.0%	8.3%
WNW	[281.25 , 303.75]	292.5	0.6%	5.0%	1.6%	0.0%	0.0%	0.0%	7.2%
NW	[303.75 , 326.25]	315	0.1%	1.9%	0.5%	0.0%	0.0%	0.0%	2.5%
NNW	[326.25 , 348.75]	337.5	0.4%	1.7%	0.3%	0.0%	0.0%	0.0%	2.4%
Total	[0 , 360]	TOTAL	5.2%	53.2%	33.1%	4.8%	2.5%	1.0%	99.7%
Other	No Direction	Current Speed = 0							0.3%
Missing Data	-	-							0.0%

N = north; S = south; E = east; W = west.

Table 4-6: Ice-Covered Period Lake Current Speed and Direction Frequency at PL-South (Near-Surface)

Direction	Direction Interval (°)	Average Direction (°)	Current Speed, C_S (m/s)						
			0<Cs<0.005	0.005≤Cs< 0.025	0.025≤Cs<0.05	0.05≤Cs<0.075	0.075≤Cs<0.1	Cs≥0.1	TOTAL
N	[348.75 , 11.25]	0	0.9%	7.5%	0.1%	0.0%	0.0%	0.0%	8.5%
NNE	[11.25 , 33.75]	22.5	0.5%	6.7%	0.1%	0.0%	0.0%	0.0%	7.4%
NE	[33.75 , 56.25]	45	0.6%	5.9%	0.2%	0.0%	0.0%	0.0%	6.7%
ENE	[56.25 , 78.75]	67.5	0.3%	5.4%	0.1%	0.0%	0.0%	0.0%	5.8%
E	[78.75 , 101.25]	90	0.8%	4.5%	0.0%	0.0%	0.0%	0.0%	5.3%
ESE	[101.25 , 123.75]	112.5	0.4%	2.7%	0.0%	0.0%	0.0%	0.0%	3.2%
SE	[123.75 , 146.25]	135	0.3%	2.0%	0.0%	0.0%	0.0%	0.0%	2.3%
SSE	[146.25 , 168.75]	157.5	0.2%	1.9%	0.0%	0.0%	0.0%	0.0%	2.1%
S	[168.75 , 191.25]	180	0.5%	1.6%	0.0%	0.0%	0.0%	0.0%	2.2%
SSW	[191.25 , 213.75]	202.5	0.2%	1.5%	0.0%	0.0%	0.0%	0.0%	1.8%
SW	[213.75 , 236.25]	225	0.9%	1.1%	0.0%	0.0%	0.0%	0.0%	2.0%
WSW	[236.25 , 258.75]	247.5	0.2%	1.9%	0.0%	0.0%	0.0%	0.0%	2.1%
W	[258.75 , 281.25]	270	0.8%	2.6%	0.0%	0.0%	0.0%	0.0%	3.3%
WNW	[281.25 , 303.75]	292.5	0.5%	3.6%	0.1%	0.0%	0.0%	0.0%	4.2%
NW	[303.75 , 326.25]	315	0.3%	3.9%	0.0%	0.0%	0.0%	0.0%	4.2%
NNW	[326.25 , 348.75]	337.5	0.3%	5.3%	0.1%	0.0%	0.0%	0.0%	5.8%
Total	[0 , 360]	TOTAL	7.6%	58.3%	0.9%	0.0%	0.0%	0.0%	66.8%
Other	No Direction	Current Speed = 0							0.3%
Missing Data	-	-							32.9%

N = north; S = south; E = east; W = west.

Table 4-5: Ice-Covered Period Lake Current Speed and Direction Frequency at PL-South (Mid-Profile)

Direction	Direction Interval (°)	Average Direction (°)	Current Speed, C_S (m/s)						
			0<Cs<0.005	0.005≤Cs< 0.025	0.025≤Cs<0.05	0.05≤Cs<0.075	0.075≤Cs<0.1	Cs≥0.1	TOTAL
N	[348.75 , 11.25]	0	1.4%	9.1%	0.1%	0.0%	0.0%	0.0%	10.5%
NNE	[11.25 , 33.75]	22.5	0.7%	10.4%	0.2%	0.0%	0.0%	0.0%	11.3%
NE	[33.75 , 56.25]	45	1.6%	9.2%	0.2%	0.0%	0.0%	0.0%	11.0%
ENE	[56.25 , 78.75]	67.5	0.4%	9.8%	0.3%	0.0%	0.0%	0.0%	10.5%
E	[78.75 , 101.25]	90	1.3%	7.4%	0.1%	0.0%	0.0%	0.0%	8.9%
ESE	[101.25 , 123.75]	112.5	0.9%	4.9%	0.1%	0.0%	0.0%	0.0%	5.8%
SE	[123.75 , 146.25]	135	0.5%	3.5%	0.0%	0.0%	0.0%	0.0%	4.0%
SSE	[146.25 , 168.75]	157.5	0.5%	3.3%	0.0%	0.0%	0.0%	0.0%	3.8%
S	[168.75 , 191.25]	180	1.2%	2.7%	0.0%	0.0%	0.0%	0.0%	3.9%
SSW	[191.25 , 213.75]	202.5	0.4%	2.1%	0.0%	0.0%	0.0%	0.0%	2.5%
SW	[213.75 , 236.25]	225	0.8%	1.8%	0.0%	0.0%	0.0%	0.0%	2.6%
WSW	[236.25 , 258.75]	247.5	0.3%	2.0%	0.0%	0.0%	0.0%	0.0%	2.3%
W	[258.75 , 281.25]	270	1.2%	2.7%	0.0%	0.0%	0.0%	0.0%	3.9%
WNW	[281.25 , 303.75]	292.5	0.8%	3.1%	0.1%	0.0%	0.0%	0.0%	4.0%
NW	[303.75 , 326.25]	315	0.3%	3.5%	0.0%	0.0%	0.0%	0.0%	3.8%
NNW	[326.25 , 348.75]	337.5	0.7%	5.5%	0.1%	0.0%	0.0%	0.0%	6.3%
Total	[0 , 360]	TOTAL	13.0%	80.9%	1.3%	0.0%	0.0%	0.0%	95.1%
Other	No Direction	Current Speed = 0							0.5%
Missing Data	-	-							4.3%

N = north; S = south; E = east; W = west.

Table 4-4: Ice-Covered Period Lake Current Speed and Direction Frequency at PL-South (Near-Lake Bed)

Direction	Direction Interval (°)	Average Direction (°)	Current Speed, C_S (m/s)						
			0<Cs<0.005	0.005≤Cs< 0.025	0.025≤Cs<0.05	0.05≤Cs<0.075	0.075≤Cs<0.1	Cs≥0.1	TOTAL
N	[348.75 , 11.25]	0	1.6%	8.5%	0.1%	0.0%	0.0%	0.0%	10.2%
NNE	[11.25 , 33.75]	22.5	0.7%	7.9%	0.2%	0.0%	0.0%	0.0%	8.8%
NE	[33.75 , 56.25]	45	1.0%	6.8%	0.0%	0.0%	0.0%	0.0%	7.9%
ENE	[56.25 , 78.75]	67.5	0.4%	7.5%	0.1%	0.0%	0.0%	0.0%	8.0%
E	[78.75 , 101.25]	90	1.5%	7.7%	0.2%	0.0%	0.0%	0.0%	9.3%
ESE	[101.25 , 123.75]	112.5	1.1%	5.6%	0.1%	0.0%	0.0%	0.0%	6.8%
SE	[123.75 , 146.25]	135	0.4%	3.9%	0.1%	0.0%	0.0%	0.0%	4.4%
SSE	[146.25 , 168.75]	157.5	0.8%	3.3%	0.1%	0.0%	0.0%	0.0%	4.2%
S	[168.75 , 191.25]	180	0.9%	3.8%	0.0%	0.0%	0.0%	0.0%	4.7%
SSW	[191.25 , 213.75]	202.5	0.8%	2.8%	0.0%	0.0%	0.0%	0.0%	3.7%
SW	[213.75 , 236.25]	225	0.7%	3.2%	0.0%	0.0%	0.0%	0.0%	3.9%
WSW	[236.25 , 258.75]	247.5	0.5%	3.2%	0.0%	0.0%	0.0%	0.0%	3.7%
W	[258.75 , 281.25]	270	0.9%	3.5%	0.0%	0.0%	0.0%	0.0%	4.4%
WNW	[281.25 , 303.75]	292.5	0.7%	4.3%	0.0%	0.0%	0.0%	0.0%	4.9%
NW	[303.75 , 326.25]	315	0.3%	4.2%	0.0%	0.0%	0.0%	0.0%	4.5%
NNW	[326.25 , 348.75]	337.5	0.4%	5.6%	0.1%	0.0%	0.0%	0.0%	6.1%
Total	[0 , 360]	TOTAL	12.5%	81.7%	1.2%	0.0%	0.0%	0.0%	95.4%
Other	No Direction	Current Speed = 0							0.5%
Missing Data	-	-							4.2%

N = north; S = south; E = east; W = west.

Table 4-7: Spring 2021 Open Water Period Lake Current Speed and Direction Frequency at PL-South (Near-Surface)

Direction	Direction Interval (°)	Average Direction (°)	Current Speed, C_S (m/s)						
			0≤Cs<0.005	0.005≤Cs< 0.025	0.025≤Cs<0.05	0.05≤Cs<0.075	0.075≤Cs<0.1	Cs≥0.1	TOTAL
N	[348.75 , 11.25]	0	1.1%	4.0%	1.1%	0.0%	0.0%	0.0%	6.2%
NNE	[11.25 , 33.75]	22.5	0.2%	3.6%	1.9%	0.2%	0.0%	0.0%	6.0%
NE	[33.75 , 56.25]	45	0.4%	2.1%	3.6%	0.2%	0.0%	0.0%	6.4%
ENE	[56.25 , 78.75]	67.5	0.0%	2.8%	2.1%	0.4%	0.0%	0.0%	5.3%
E	[78.75 , 101.25]	90	0.4%	3.6%	0.9%	0.0%	0.0%	0.0%	4.9%
ESE	[101.25 , 123.75]	112.5	0.4%	2.1%	0.2%	0.0%	0.0%	0.0%	2.8%
SE	[123.75 , 146.25]	135	0.0%	1.9%	0.0%	0.0%	0.0%	0.0%	1.9%
SSE	[146.25 , 168.75]	157.5	0.2%	1.5%	0.2%	0.0%	0.0%	0.0%	1.9%
S	[168.75 , 191.25]	180	0.0%	2.1%	0.0%	0.0%	0.0%	0.0%	2.1%
SSW	[191.25 , 213.75]	202.5	0.4%	1.3%	1.3%	0.0%	0.0%	0.0%	3.0%
SW	[213.75 , 236.25]	225	0.6%	6.4%	4.3%	2.1%	0.0%	0.0%	13.4%
WSW	[236.25 , 258.75]	247.5	0.2%	5.1%	10.0%	2.6%	0.0%	0.0%	17.9%
W	[258.75 , 281.25]	270	0.6%	5.5%	4.0%	0.0%	0.0%	0.0%	10.2%
WNW	[281.25 , 303.75]	292.5	0.6%	3.6%	1.5%	0.0%	0.0%	0.0%	5.7%
NW	[303.75 , 326.25]	315	0.0%	3.4%	0.4%	0.0%	0.0%	0.0%	3.8%
NNW	[326.25 , 348.75]	337.5	0.2%	3.0%	0.9%	0.0%	0.0%	0.0%	4.0%
Total	[0 , 360]	TOTAL	5.5%	52.1%	32.3%	5.5%	0.0%	0.0%	95.5%
Other	No Direction	Current Speed = 0							0.0%
Missing Data	-	-							4.5%

N = north; S = south; E = east; W = west.

Table 4-8: Spring 2021 Open Water Period Lake Current Speed and Direction Frequency at PL-South (Mid-Profile)

Direction	Direction Interval (°)	Average Direction (°)	Current Speed, C_S (m/s)						
			0≤Cs<0.005	0.005≤Cs< 0.025	0.025≤Cs<0.05	0.05≤Cs<0.075	0.075≤Cs<0.1	Cs≥0.1	TOTAL
N	[348.75 , 11.25]	0	1.3%	3.4%	0.2%	0.2%	0.0%	0.0%	5.1%
NNE	[11.25 , 33.75]	22.5	0.2%	3.6%	2.8%	0.0%	0.0%	0.0%	6.6%
NE	[33.75 , 56.25]	45	0.6%	3.2%	2.8%	0.4%	0.0%	0.0%	7.0%
ENE	[56.25 , 78.75]	67.5	0.4%	2.6%	3.4%	0.0%	0.0%	0.0%	6.4%
E	[78.75 , 101.25]	90	0.6%	2.8%	1.3%	0.0%	0.0%	0.0%	4.7%
ESE	[101.25 , 123.75]	112.5	0.4%	1.7%	0.0%	0.0%	0.0%	0.0%	2.1%
SE	[123.75 , 146.25]	135	0.4%	2.3%	0.0%	0.0%	0.0%	0.0%	2.8%
SSE	[146.25 , 168.75]	157.5	0.0%	0.9%	0.0%	0.0%	0.0%	0.0%	0.9%
S	[168.75 , 191.25]	180	0.2%	2.3%	0.2%	0.0%	0.0%	0.0%	2.8%
SSW	[191.25 , 213.75]	202.5	0.0%	2.6%	0.9%	0.0%	0.0%	0.0%	3.4%
SW	[213.75 , 236.25]	225	0.0%	4.9%	6.4%	1.7%	0.0%	0.0%	13.0%
WSW	[236.25 , 258.75]	247.5	0.2%	7.0%	6.6%	1.7%	0.0%	0.0%	15.5%
W	[258.75 , 281.25]	270	0.6%	5.5%	3.0%	0.0%	0.0%	0.0%	9.1%
WNW	[281.25 , 303.75]	292.5	0.2%	4.9%	1.3%	0.0%	0.0%	0.0%	6.4%
NW	[303.75 , 326.25]	315	0.2%	5.7%	0.2%	0.0%	0.0%	0.0%	6.2%
NNW	[326.25 , 348.75]	337.5	0.2%	3.6%	0.0%	0.0%	0.0%	0.0%	3.8%
Total	[0 , 360]	TOTAL	5.7%	57.0%	28.9%	4.0%	0.0%	0.0%	95.7%
Other	No Direction	Current Speed = 0							0.9%
Missing Data	-	-							3.4%

N = north; S = south; E = east; W = west.

Table 4-9: Spring 2021 Open Water Period Lake Current Speed and Direction Frequency at PL-South (Near-Lake Bed)

Direction	Direction Interval (°)	Average Direction (°)	Current Speed, C_S (m/s)						
			0≤Cs<0.005	0.005≤Cs< 0.025	0.025≤Cs<0.05	0.05≤Cs<0.075	0.075≤Cs<0.1	Cs≥0.1	TOTAL
N	[348.75 , 11.25]	0	0.6%	4.0%	1.5%	0.0%	0.0%	0.0%	6.2%
NNE	[11.25 , 33.75]	22.5	0.9%	4.0%	1.7%	0.0%	0.0%	0.0%	6.6%
NE	[33.75 , 56.25]	45	0.2%	3.4%	2.6%	0.2%	0.0%	0.0%	6.4%
ENE	[56.25 , 78.75]	67.5	0.2%	4.3%	2.3%	0.4%	0.0%	0.0%	7.2%
E	[78.75 , 101.25]	90	0.2%	3.6%	1.5%	0.2%	0.0%	0.0%	5.5%
ESE	[101.25 , 123.75]	112.5	0.4%	1.3%	0.4%	0.0%	0.0%	0.0%	2.1%
SE	[123.75 , 146.25]	135	0.0%	1.7%	0.0%	0.0%	0.0%	0.0%	1.7%
SSE	[146.25 , 168.75]	157.5	0.4%	0.4%	0.2%	0.0%	0.0%	0.0%	1.1%
S	[168.75 , 191.25]	180	0.2%	3.4%	0.2%	0.0%	0.0%	0.0%	3.8%
SSW	[191.25 , 213.75]	202.5	1.1%	3.6%	1.3%	0.4%	0.0%	0.0%	6.4%
SW	[213.75 , 236.25]	225	0.0%	3.0%	7.2%	2.3%	0.0%	0.0%	12.6%
WSW	[236.25 , 258.75]	247.5	0.0%	6.6%	5.7%	1.5%	0.0%	0.0%	13.8%
W	[258.75 , 281.25]	270	0.4%	3.6%	2.1%	0.2%	0.0%	0.0%	6.4%
WNW	[281.25 , 303.75]	292.5	0.9%	6.0%	1.9%	0.0%	0.0%	0.0%	8.7%
NW	[303.75 , 326.25]	315	0.2%	3.6%	0.4%	0.0%	0.0%	0.0%	4.3%
NNW	[326.25 , 348.75]	337.5	0.2%	3.8%	0.2%	0.0%	0.0%	0.0%	4.3%
Total	[0 , 360]	TOTAL	6.0%	56.4%	29.4%	5.3%	0.0%	0.0%	97.0%
Other	No Direction	Current Speed = 0							0.0%
Missing Data	-	-							3.0%

N = north; S = south; E = east; W = west.

Rook I Project

Environmental Impact Statement

Annex IV.5: Forrest Lake Mixing Study Report

GOLDER
MEMBER OF WSP

FORREST LAKE MIXING STUDY REPORT FOR THE ROOK I PROJECT

Prepared for:

NexGen Energy Ltd.

Prepared by:

Golder Associates Ltd.

March 2022

Executive Summary

The Forrest Lake mixing study was completed as part of the hydrology program to establish baseline conditions to support an Environmental Assessment (EA) for the Rook I Project (Project). The mixing study was conducted from 30 September 2018 to 3 October 2018 and evaluated the extent that water from the Clearwater River flowing from the Patterson Lake outlet mixes within Forrest Lake, which is the nearest downstream lake. The objectives of the Forrest Lake mixing study were to:

- determine the dominant flow path from Patterson Lake and the degree of mixing within the Forrest Lake – North Basin; and
- determine if and how the lake water in the North Basin and South Basin of Forrest Lake mix.

The main component of the mixing study involved the use of a harmless fluorescent rhodamine dye to trace the flow of water into and through Forrest Lake. The dye was released into the water at the access road bridge downstream of Patterson Lake, and the plume was traced visually and with YSI-brand sonde (i.e., water quality sensor) probes. The probes were initially deployed at the two Clearwater River stream channels that enter Forrest Lake from Patterson Lake and were redeployed at the Forrest Lake outlet the next day. Plume delineation was completed over four days using visual tracing and probes.

Complementary physical measurements and observations were collected to provide additional context for the plume mapping:

- Wind speed and direction data were downloaded from the Rook I Meteorological Station to characterize local meteorological conditions.
- Forrest Lake inflows and outflows were monitored during the study.
- Forrest Lake physical properties (i.e., water surface elevation, volume, area) were calculated from bathymetric maps.
- Forrest Lake water temperatures were monitored in a profile from the lake surface to lake bed in the North Basin during the study.
- Drogues (i.e., floating “sails” or similar designs that are fitted with GPS and drift below the water surface) were released in the North Basin at the same time as the dye was released to provide data on lake current speeds and directions during the field study.

The baseline mixing study achieved the objective of determining the dominant flow paths from Patterson Lake through Forrest Lake and the degree of mixing within Forrest Lake. The study results indicated the flow path from Patterson Lake to the Forrest Lake – North Basin is clearly defined. Once in the North Basin, the plume spread in two directions. One plume flowed north along the northern shore of Forrest Lake before reaching the Forrest Lake outlet. The second plume flowed south and along the west shore of the North Basin before turning to the northeast and crossing the North Basin toward the Forrest Lake outlet. The North Basin was shown to become well mixed, but there was limited mixing between the North and South basins.

If referencing this report, please use for the following citation:

Golder (Golder Associates Ltd.). 2022. Forrest Lake Mixing Study Report for the Rook I Project. Prepared for NexGen Energy Ltd.

Table of Contents

TABLES

FIGURES

APPENDICES

Abbreviations and Units of Measures

Acronym	Definition
EA	Environmental Assessment
EIS	Environmental Impact Statement
GPS	Global Positioning System
HEC-RAS	Hydrologic Engineering Center River Analysis System
NexGen	NexGen Energy Ltd.
Project	Rook I Project
TLU	Traditional Land Use

Unit/Symbol	Definition
%	percent
ºC	degrees Celsius
µg/L	micrograms per litre
ha	hectare
kg	kilogram
km	kilometre
km/h	kilometres per hour
km^2	square kilometre
L	litre
m	metre
m^3/s	cubic metres per second
masl	metres above sea level
mm	millimetre
Mm^3	million cubic metres
m/s	metres per second

1.0 INTRODUCTION

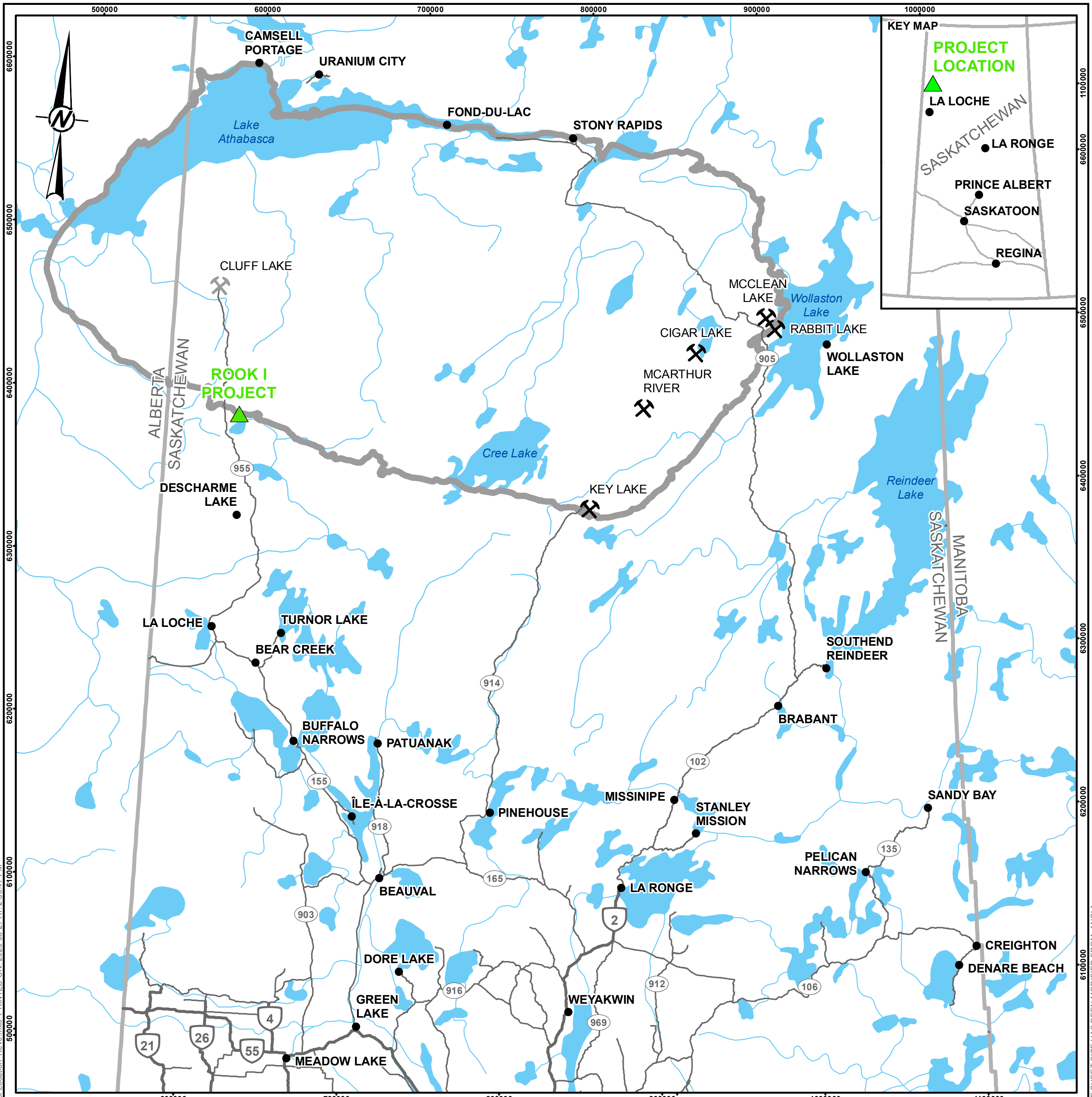
The Rook I Project (Project) is a proposed new uranium mining and milling operation that is 100% owned by NexGen Energy Ltd. (NexGen). The Project would be located in northwestern Saskatchewan, approximately 40 km east of the Saskatchewan-Alberta border, 130 km north of the town of La Loche, and 640 km northwest of the city of Saskatoon (Figure 1). The Project would reside within Treaty 8 territory and within the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, and along the upper Clearwater River system (Figure 2). Access to the Project would be from an existing road off Highway 955. The Project would include underground and surface facilities to support the extraction and processing of uranium ore from the Arrow deposit, a land-based, basement-hosted, high-grade uranium deposit.

The Forrest Lake mixing study report represents a component of a comprehensive baseline program that documents the natural and socio-economic environments in the anticipated area of the Project. The hydrology baseline program, of which the Forrest Lake mixing study is a part, was undertaken to provide context from which Project environmental hydrological effects could be assessed in the Environmental Impact Statement (EIS).

Since exploration at the Project commenced in 2013, NexGen has engaged regularly and established relationships with local First Nation and Métis Groups (collectively referred to as Indigenous Groups) and northern communities, specifically those closest and with greatest access to the proposed Project. NexGen respects the rights of Indigenous Peoples and the unique relationship Indigenous Peoples have with the environment, and recognizes the importance of full and open discussion with interested or potentially affected Indigenous communities regarding the development, operation, and decommissioning of the proposed Project. Engagement activities to date, as well as future planned engagement activities, reflect the value NexGen places on meaningful engagement with Indigenous and northern communities who could be potentially affected by the proposed Project. Engagement mechanisms have included, but are not limited to: meetings with leadership, workshops and community information sessions, Project site tours, establishing Joint Working Groups to support the gathering and incorporation of Indigenous and Local Knowledge throughout the Environmental Assessment (EA) process, and providing funding for Traditional Land Use (TLU) Studies[1] to understand how the proposed Project may interact with the Indigenous communities' traditional use of the anticipated area of the Project.

Feedback received during engagement activities was documented for contribution to the EIS for the Project; examples of feedback received include discussion of concerns, interests, potential adverse effects, mitigation, and design alternatives. Many baseline studies were initiated in advance of formal engagement on the EA for the Project; however, engagement during the execution of baseline studies has helped inform the understanding of baseline conditions and confirmed components of the natural and socio-economic environments that required study. A summary of feedback related to the hydrology baseline program is presented in Appendix A of the Hydrology Baseline Road Map (Annex IV).

[1] Traditional Land Use (TLU) Studies include all land use studies developed by the Project's affected Indigenous Groups, including Traditional Land Use and Occupancy studies, Traditional Knowledge and Use studies, and Indigenous Rights and Knowledge studies, henceforth referred collectively as TLU Studies.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- ATHABASCA BASIN BOUNDARY
- PROJECT LOCATION

0 100 200

1:3,500,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

LOCATION OF THE ROOK I PROJECT, SASKATCHEWAN

CONSULTANT

GOLDER

YYYY-MM-DD	2020-03-27
DESIGNED	SS
PREPARED	NO/AK
REVIEWED	JMC
APPROVED	MM

PROJECT NO.	PHASE	REV.	FIGURE
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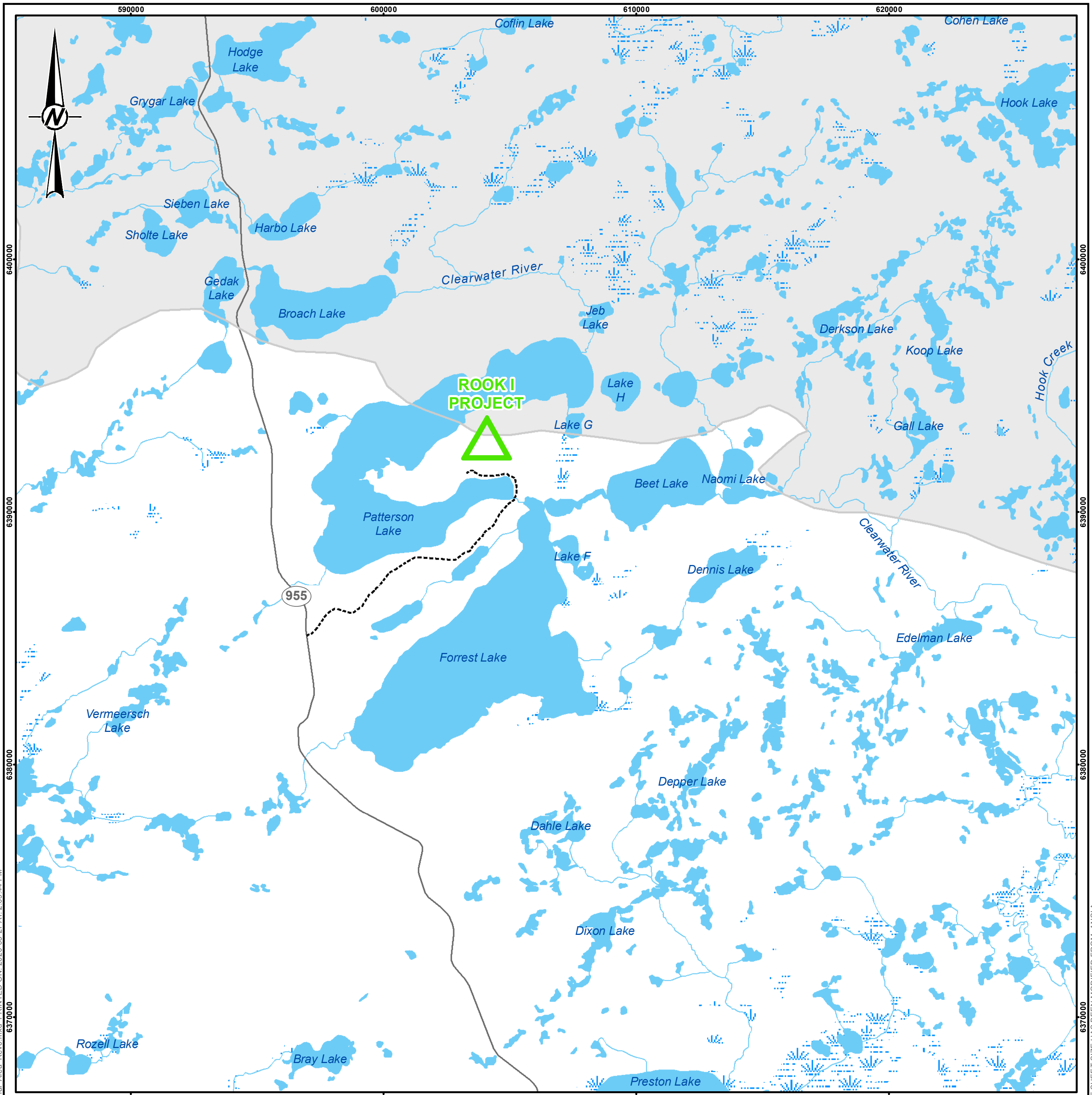

LEGEND

SECONDARY HIGHWAY
WATERCOURSE
WATERBODY
WETLAND
ATHABASCA BASIN
PROJECT LOCATION
EXISTING ACCESS ROAD

0 5,000 10,000
1:225,000 METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT
NexGen Energy Ltd.

PROJECT
ROOK I PROJECT

TITLE
REGIONAL AREA OF THE ROOK I PROJECT

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-27
DESIGNED	JMC
PREPARED	NO/AK
REVIEWED	JMC
APPROVED	MM

PROJECT NO.	PHASE	REV.	FIGURE
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25mm
0

2.0 STUDY OBJECTIVES

Forrest Lake is composed of two basins: the Forrest Lake – North Basin and the Forrest Lake – South Basin. The two basins are separated by a large sand bar. Water flows from Patterson Lake into the western side of the North Basin and out of the eastern side of the North Basin, both via the Clearwater River. Given the potential for short circuiting of the inflow and outflow located at the northern extent of the North Basin, the degree to which inflows mix with the South Basin is uncertain. This study was undertaken to gain a better understanding of the surface water mixing occurring within Forrest Lake and to provide sufficient information to assess potential Project effects in the EA process.

The objective of the mixing study was to establish the extent that water from the Patterson Lake outlet mixes within the downstream Forrest Lake. Specific objectives of the study were to:

- determine the dominant flow path from Patterson Lake through Forrest Lake;
- determine the degree of mixing within the North Basin; and
- determine the degree of mixing between the North and South basins.

3.0 STUDY AREAS

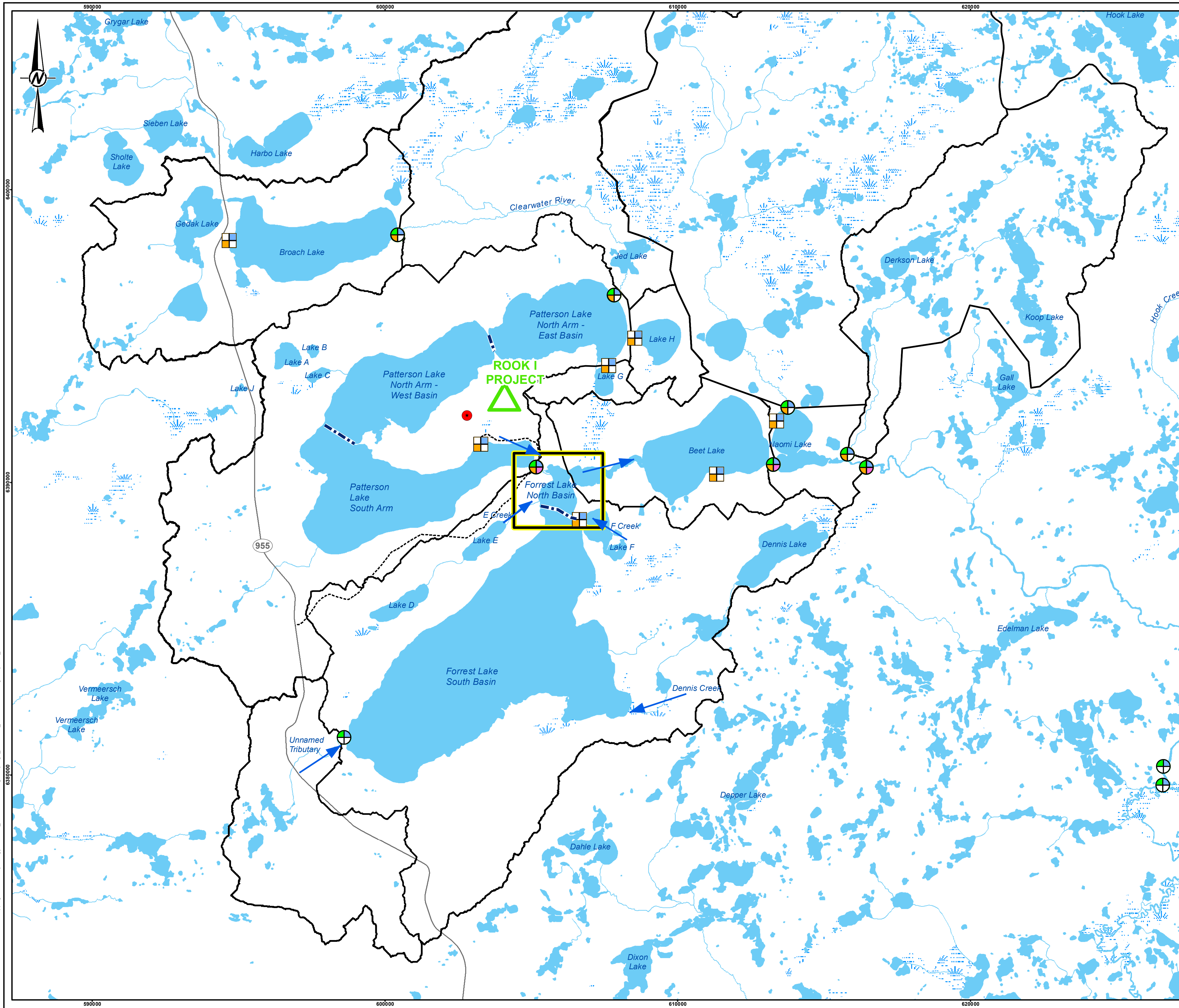
The Forrest Lake mixing study area (Figure 3) is contained within the local study area for the hydrological baseline program. An aerial view of where the Clearwater River flows into the North Basin is shown in Figure 4. The Forrest Lake outflow into Beet Lake is shown in Figure 5. The North Basin is separated from the South Basin by a sand bar. Water depths over the sand bar are typically less than 1 m.

Outflow from Patterson Lake is conveyed to Forrest Lake by a section of the Clearwater River, which for the purposes of this study is divided into an upstream and downstream length: the Upper Reach and Lower Reach. The Clearwater River Upper Reach is 580 m long and varies from 0.5 to 1.5 m deep. At the downstream end of the Upper Reach, the Clearwater River mainstem divides into two channels that constitute the Lower Reach: the Lower Reach North Channel, which is 170 m long; and the Lower Reach South Channel, which is 300 m long. The outlets where each channel flows into the North Basin are shown in Figure 4.

The South Basin is larger than the North Basin. By volume, the South Basin comprises approximately 99.9% of the total, with the North Basin accounting for 0.1%. By area, the South Basin accounts for 97.5% of the total while the North Basin accounts for 2.5% based baseline digital bathymetry data (Annex V.1 Aquatic Environment Baseline).

The drainage area contributing to Patterson Lake is 264 km^2 and a total of 445 km^2 drains into Forrest Lake. In addition to inflows from the Clearwater River, Forrest Lake receives inflows from four other tributaries: E Creek, F Creek, Dennis Creek, and an unnamed tributary at the southwest corner of Forrest Lake (Figure 3). The E Creek flows into the west side of the North Basin and drains an area of 15 km^2. The F Creek drains an area of 13 km^2 into the east side of Forrest Lake just south of the sand bar, which separates the Forrest Lake North and South basins. The unnamed tributary flows into the southwest corner of Forrest Lake, which is gauged by a continuous hydrometric monitoring instrumentation at station CR-WC-TI-01 (Figure 3), and drains an area of 35 km^2. Dennis Creek flows into the east side of Forrest Lake and drains an area of 10.4 km^2 including Dennis Lake, which lies at the headwaters of Dennis Creek.

The study was completed over a three-day period from 30 September 2018 to 2 October 2018.



LEGEND

- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- WATERSHED
- WETLAND
- EXISTING ACCESS ROAD
- PROJECT LOCATION
- METEOROLOGICAL STATION

WATERBODY HYDROMETRIC STATIONS

- DISCHARGE
- SURVEYED BENCHMARK (GEODETIC DATUM)
- TOTAL SUSPENDED SOLIDS AND BEDLOAD
- WATER SURFACE ELEVATION

WATERCOURSE HYDROMETRIC STATIONS

- DISCHARGE
- SURVEYED BENCHMARK (GEODETIC DATUM)
- TOTAL SUSPENDED SOLIDS AND BEDLOAD
- WATER SURFACE ELEVATION
- FORREST LAKE MIXING STUDY AREA

0 3,000 6,000

1:130,000 METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. WATERSHEDS DELINEATED BY GOLDER USING GREENKENUE SOFTWARE BASED ON CANADIAN DIGITAL ELEVATION DATA AND NATIONAL HYDROGRAPHIC NETWORK WATERCOURSES.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

FORREST LAKE MIXING STUDY AREA

CONSULTANT

GOLDER

YYYY-MM-DD	2022-01-26
DESIGNED	RP
PREPARED	LMS/NO
REVIEWED	RWP
APPROVED	GVA

PROJECT NO.	PHASE	REV.	FIGURE
19114981	7000	0	3

Figure 4: Aerial View of the Clearwater River Where It Flows into the Forrest Lake – North Basin

Note: Direction of flow is toward camera. View is from a helicopter facing southwest, 2 October 2018.

Figure 5: Aerial View of the Forrest Lake Outlet with the Beet Lake Channel in the Distance

Note: Direction of flow is away from the camera. View is from helicopter over Forrest Lake North Basin facing east,, 4 August 2018.

4.0 METHODS

The Forrest Lake mixing study included both a field program to collection information as well as a desktop analysis and interpretation of the collected field data.

4.1 Review of Existing Information

No previous studies exist related to this assessment. Local meteorological data collected from 2015 to 2018 from the Rook I Meteorological Station (Figure 3) were reviewed and used for high-level field planning.

4.2 Approach

4.2.1 Field Data Collection

The field component of the mixing study was completed by releasing benign (EC 2003) fluorescent rhodamine[2] dye and monitoring its movement in the environment. The dye was released into the Clearwater River at the access road bridge (Figure 6) near the Patterson Lake outlet and the extent of the plume in Forrest Lake was mapped. Tracer concentrations at the Clearwater River inflow channels into Forrest Lake and at the Forrest Lake outlet were measured and complementary physical measurements were also collected to provide additional context for the plume mapping.

A plan view of the study area centred on the North Basin is presented in Figure 6. Photographs that provide context for other measurements are included as Appendix A.

The mixing study involved the following environmental data and observations:

- local meteorological conditions;
- Forrest Lake inflows and outflows;
- Forrest Lake physical properties (e.g., water surface elevation, volume, area);
- Forrest Lake temperature;
- drogue (i.e., floating "sails" or similar designs that drift below the water surface and are fitted with GPS devices to record their movements in detail) releases; and
- rhodamine dye release:
  - YSI-brand sonde (i.e., water quality sensor) probes.
  - visual plume tracing.

An Argonaut XR acoustic doppler current profiler was also deployed but did not collect data due to instrument failure; other methods of obtaining information on lake current patterns such as dye tracing provided sufficient information to complete this study.

[2] Rhodamine is a harmless dye that is often used in tracing water flows and is the tracer preferred in guidance published by Environment Canada (2003)

4.2.1.1 Local Meteorological Conditions

Local meteorological conditions are important to interpreting mixing study data: Wind and ice may affect plume dispersion and air temperature, ice conditions, and wave action can all influence the behaviour of the plume. Meteorological data was used to understand how wind acting on Forrest Lake may have induced currents or waves. Local meteorological conditions are monitored by the Rook I Meteorological Station, which is located near the existing exploration camp (Universal Transverse Mercator 12V 602795E 6392291N) (Figure 3). The meteorological station has been operating since installation in 2015. Hourly wind speed and direction data for the mixing study period (i.e., 30 September 2018 to 2 October 2018) were downloaded and used as representative of conditions in the study area. Anecdotal qualitative observations of wind speed and direction at the North Basin corroborated the quantitative observations made at the meteorological station.

4.2.1.2 Forrest Lake Inflow and Outflow

Inflows and outflows were monitored to calculate rates of mass loading of dye tracers during the study. Instantaneous velocity and depth were measured to calculate discharge upstream and downstream of Forrest Lake at the Clearwater River below Patterson Lake hydrometric station and the Clearwater River below the Beet Lake hydrometric station. A Sontek-brand FlowTracker acoustic doppler velocimeter was used to measure discharge. Manual discharge measurements were conducted according to the Water Survey of Canada standard described by Terzi et al. (1994). Velocity and depth measurements used for discharge calculations were collected using the FlowTracker and a top-setting wading rod. A Sontek-brand M9 acoustic doppler current profiler was used to measure discharge at the Clearwater River below Beet Lake. Discharge was also monitored continuously during the study period at the nearby hydrometric stations (i.e., Clearwater River below Patterson Lake and Clearwater River below Beet Lake) as a function of continuous water level measurements.

4.2.1.3 Forrest Lake Physical Properties

Water level was measured to understand the volume of water available for plume mixing and dispersion. During the mixing study, a levelling survey was conducted to measure the surface water elevation of Forrest Lake relative to a local benchmark, CR-WB-MS-03-BM1. Optical level surveys were supplemented by reading local staff gauges concurrent with the optical level survey and surveying the top of the staff gauge relative to the primary benchmark. Stage-storage-area relationships developed from bathymetric data collected in June 2019 (Annex V.3, Naomi Lake Bathymetry Report) were used to estimate the volume and area of the North and South basins at the water surface elevation observed on 30 September 2018.

4.2.1.4 Forrest Lake Temperature Profile

Temperature was used to monitor ice conditions and thermal stratification which can influence currents and the behaviour of the plume. Temperature sensors were deployed to measure temperature from the water surface to near the lakebed at a buoy in the middle of the North Basin. The central thermistor string consisted of Solinst Levelogger Edge temperature and pressure sensors at 0.3 m depth intervals established in the middle of the North Basin (Figure 6) from 30 September 2018 to 1 October 2018.

LEGEND

PROJECT FEATURES

EXISTING ACCESS ROAD

1981 DEPTH MEASUREMENT POINT (APPROXIMATE)

1981 BATHYMETRIC CONTOUR (APPROXIMATE)

1981 INTERPOLATED BATHYMETRIC CONTOUR (1 M INTERVAL)

FLOW DIRECTION

0 200 400

1:10,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, DATED: 2015.
2. HISTORIC BATHYMETRY DIGITIZED FROM 1981 MAP OBTAINED FROM GOEVERNMENT OF SASKATCHEWAN.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

PROJECT

ROOK I PROJECT

TITLE

FORREST LAKE – NORTH BASIN

CONSULTANT

GOLDER

YYYY-MM-DD	2020-03-20
DESIGNED	RP
PREPARED	LMS/NO
REVIEWED	RWP
APPROVED	GVA

PROJECT NO.	PHASE	REV.	FIGURE
19114981	7000	0	6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

PATH: I:\CLIENTS\NexGen\19114981\Mapping\Products\Hydrology\Baseline_ForrestLakeMixingStudy\Fig6_19114981_ForrestLake_NorthBasin_Rev0.mxd

4.2.1.5 Drogues

Drogues are passive devices designed to float below the water surface and move with the ambient current. Drogues provide a method of tracking near-surface dispersion over a short period of time. The drogues used in the mixing study floated just below the water surface within the rhodamine plume to measure the speed and direction of currents in the North Basin. Three drogues were released near the mouth of the Clearwater River Lower Reach, North and South channels, where there was sufficient depth for the drogues to float freely. The drogues were deployed within the water column (from surface to 1 m or 2 m depth) to document lake currents near the surface with less effect from wind. The drogues consisted of a central axial tube with four rectangular panels extending out from the axial tube at right angles to one another. Each of the drogues was equipped with an internal Global Positioning System (GPS) to record the path of movement. The GPS units were encased in a waterproof container within the drogue float.

During the second release, sustained aggressive wave action and the onset of ice resulted in lost seal and entry of water into one drogue float which prevented retrieval of data from one of the GPS units. The proximity upon retrieval of the drogue without data to the other drogues with data suggests a similar path was travelled by all three drogues released. A similar release location and retrieval location for all drogues means that it is unlikely that the data not retrieved would have been substantially different than the data retrieved, and sufficient data were collected from the other drogues to complete the study.

4.2.1.6 Rhodamine Dye Tracer

A tracer is a conservative substance that can move with the fluid. Rhodamine WT was used as a dye tracer for the study. Rhodamine WT is a fluorescent dye that is the preferred added tracer for plume delineation studies (EC 2003): It is not harmful to the environment, has a zero background level as it does not occur naturally, it can be readily measured in the field at low concentrations, and it mixes freely into receiving water. A dye slug was released at the access road bridge over the Clearwater River upstream of Forrest Lake and downstream of Patterson Lake (Figure 7). The slug consisted of 15 L of Rhodamine WT liquid dye (rhodamine dye concentration is 20% active ingredient), which was diluted in two five-gallon pails with 15 L of water from the Clearwater River. The total mass of dye released was 3 kg.

During the release, the dye was poured evenly across the channel to approximate full lateral mixing of the rhodamine slug. Observations of the rhodamine dye were a combination of visual observations of the presence or absence of the plume or concentration measurements using two YSI OMS600 sonde probes. The probes were calibrated on 29 September 2018 using a two-point (i.e., 0 µg/L and 100 µg/L) calibration per instructions in the instrument user manual. Following preliminary review of the rhodamine concentrations observed at the inflow into Forrest Lake, observed values were adjusted using a constant multiplier to calibrate total mass to approximately equal the initial slug release.

Figure 7: Dye Release from the Access Road Bridge, 30 September 2018 at 13:51

The chronological steps associated with observing rhodamine dye concentrations following the release are described below:

1) A GPS and boat were used to track the speed of the visible plume front as it advanced downstream toward Forrest Lake.

2) Two sonde probes, one stationed at the Lower Reach North Channel outlet and one stationed at the Lower Reach South Channel outlet, logged temperature and rhodamine concentration with the passing of the plume.

3) Once the plume reached Forrest Lake, a canoe equipped with a GPS was used for a period of approximately two hours to trace the outline of the visible plume as it advanced out into Forrest Lake.

4) Once the visible plume had passed the probe at the Lower Reach North Channel outlet, the probe was retrieved and used to map the advance of the plume into Forrest Lake based on a grid of points at the northwest corner of the North Basin.

5) Following the grid collection on 30 September 2018 at 18:30, one probe was moved to the middle of the North Basin (i.e., at the location of the thermistor string), where it was suspended from a floating platform, and the other probe was moved to the Forrest Lake outflow to observe rhodamine concentrations in the channel overnight.

6) On 1 October 2018, the probe that had been stationed in the middle of the North Basin overnight was used to map rhodamine concentrations with the objective of delineating the plume boundary.

7) Following the grid on 1 October 2018, both probes were re-established to collect data at the outlet of Forrest Lake.

8) On the morning of 2 October 2018, visual observations of the plume extent were made from a helicopter. A video was collected during the helicopter flight to document visual observations.

9) On 3 October 2018, the probes and all other instrumentation were retrieved, and observations ceased.

5.0 RESULTS

5.1 Local Meteorological Conditions

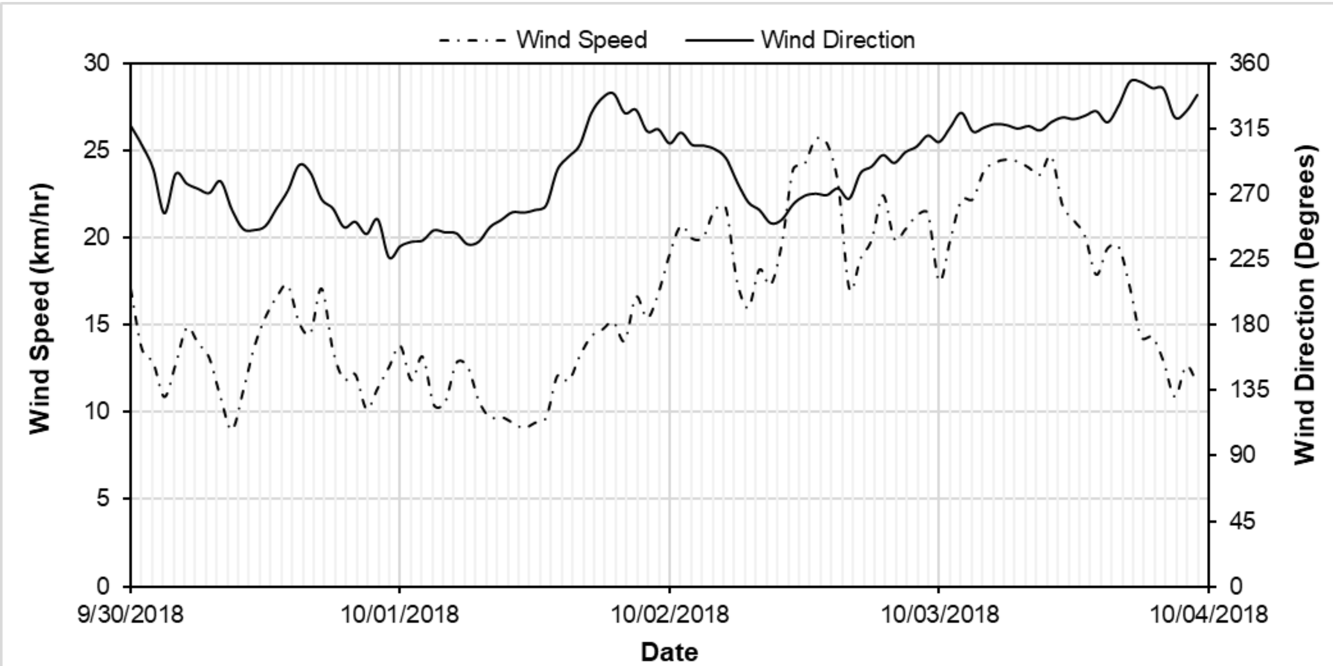
Local meteorological conditions monitored during the field investigation are summarized in Table 1 and Figure 8. No rainfall occurred during the study period; however, minimal precipitation in the form of snowfall was observed. Temperatures during the three day field study ranged from approximately -8°C to 3°C.

On 30 September 2018, conditions were generally overcast in the morning turning to clear around 12:00 and remained clear until sunset. At the time of the dye release on 30 September 2018 at 13:51, winds were from the west-northwest at roughly 15 km/h. Wind remained from the west-northwest with wind speeds generally decreasing until 1 October 2018 at 14:00. After 1 October 2018 at 14:00, the wind direction changed to north-northwest before returning to the west-northwest 1 October 2018 around 18:00. Wind speeds increased through 1 October 2018 and 2 October 2018, ultimately reaching a maximum average hourly wind speed of 25 km/h with gusts exceeding 45 km/h. Throughout the duration of the study, the wind was generally from the northwest.

Table 1: Summary of Local Meteorological Conditions during Forrest Lake Mixing Study, 30 September 2018 to 2 October 2018

Date	Precipitation (mm)			Temperature (°C)		
	Rainfall	Snowfall	Total Precipitation	Minimum	Average	Maximum
30 September 2018	0.0	0.1	0.1	-7.7	-1.7	2.5
1 October 2018	0.0	0.3	0.3	-2.6	-0.6	2.1
2 October 2018	0.0	2.2	2.2	-6.7	-4.2	-0.7
3 October 2018	0.0	1.6	1.6	-6.4	-5.0	-2.5

Figure 8: Local Hourly Wind Speed and Direction Monitored during the Forrest Lake Mixing Study



5.2 Forrest Lake Inflow and Outflow

Forrest Lake inflow and outflow were measured at the hydrometric monitoring stations shown in Figure 3. Discharge at the Clearwater River downstream of Patterson Lake (CR-MS-WC-03) on 29 September 2018 at 17:50 was measured to be 0.98 m^3/s. Discharge at the Clearwater River downstream of Beet Lake (CR-MS-WC-04) on 1 October 2018 was measured to be 1.70 m^3/s. Outflow from Forrest Lake during the mixing study was estimated to be 1.60 m^3/s based on prorating observations made at the Clearwater River downstream of Beet Lake (CR-MS-WC-04). During the mixing study, the total inflows to Forrest Lake of 1.60 m^3/s were estimated to be composed of 0.98 m^3/s from the Clearwater River, as well as inflows of 0.62 m^3/s from other tributaries (i.e., E Creek, F Creek, Dennis Creek, and the unnamed tributary).

Continuous measurements of water level at both hydrometric monitoring stations indicate that discharge rate remained unchanged over the duration of the mixing study.

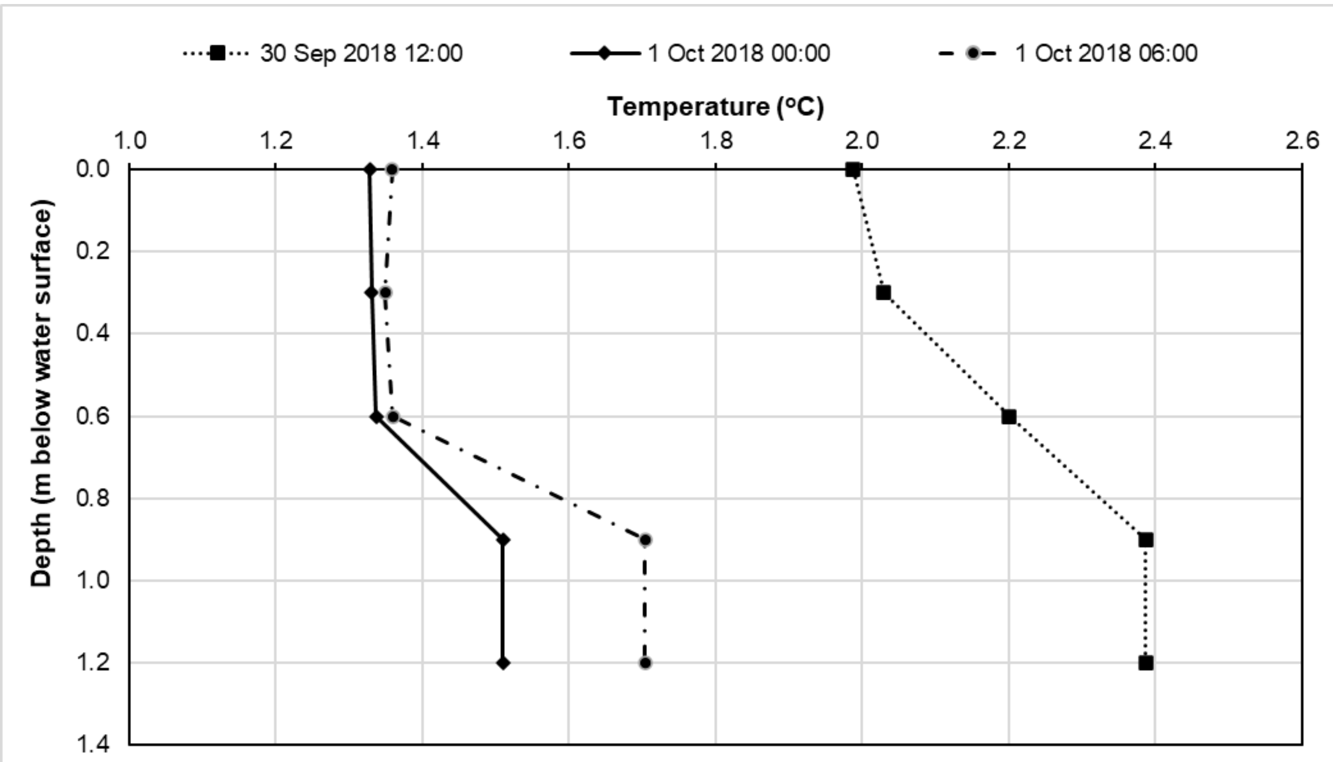
5.3 Forrest Lake Physical Properties

The water surface elevation of Patterson Lake was 498.51 metres above sea level (masl; surveyed on 30 September 2018) and the water surface elevation of Forrest Lake was 498.23 masl (surveyed on 1 October 2018). At an elevation of 498.23 masl, the volume of the North Basin was 0.55 Mm^3 and the surface area was 98 ha. Based on these dimensions, the average depth in the North Basin was estimated to be 0.6 m and the residence time was estimated to be approximately four days based on an average outflow of 1.60 m^3/s. At an elevation of 498.23 masl, the volume of the South Basin was estimated to be 1,202 Mm^3 and the surface area was estimated to be 379 ha.

5.4 Forrest Lake Temperature Profile

Forrest Lake temperature profiles in the North Basin were measured by the central thermistor string (Figure 6) at depth intervals of 0.3 m, and measurements from every six hours over the period of deployment are summarized in Figure 9. Water temperature decreased by about 0.6°C in the evening of 30 September 2018 and remained roughly the same temperature until the thermistor string was removed the morning of 1 October 2018. The thermistor string was removed at this time as the leveloggers being used to monitor temperature needed to be deployed elsewhere as part of the hydrometric monitoring program.

Figure 9: Temperature Profile in Forrest Lake – North Basin, 30 September 2018 and 1 October 2018



5.5 Drogues

A cluster of three drogues was released near the North Channel outlet on 30 September 2018 at 17:20 and retrieved at 18:43 on 30 September 2018. The details of each drogue trial, including the start and end time, are provided in Table 2. The drogues at the point of retrieval on 30 September 2018 are shown in Figure 10. The same cluster of three drogues was released near the South Channel outlet on 1 October 2018 at 13:39. The drogues released on 1 October 2018 were retrieved at 10:30 3 October 2018 after becoming encased in ice as shown in Figure 11. The GPS tracks were used to calculate the travel time, distance, and speeds associated with each drogue.

During the drogue release on 30 September 2018, winds blew steadily from the west (i.e., 263°) and averaged 4.3 m/s. During the drogue release on 1 October 2018, winds increased from 2.7 m/s at the time of release to 5.6 m/s (average of 4.3 m/s) when the drogues would have encountered the shore. As the wind speed increased during the second drogue release, the wind direction changed from west to northwest . The drogues released on 1 October 2018 were retrieved on 3 October 2018. However, according to the GPS data, the drogues had run aground on the east shore of Forrest Lake on 2 October 2018 at 3:20.

The Drogue 3 waterproof seal failed during the South Channel outlet release and the GPS was irreparably damaged after getting wet and freezing. As a result, no travel time or average velocity data were recorded for Drogue 3 during the Lower Reach South Channel outlet release. Drogue 3 was released at the same point and was recovered within 25 m of Drogue 1 and Drogue 2, suggesting that the path of all three drogues was similar and that the data lost from Drogue 3 would have been similar to the data collected by Drogue 1 and Drogue 2.

Table 2: Drogue Release Details

Parameter	Units	North Channel Outlet Release			South Channel Outlet Release		
		Drogue 1	Drogue 2	Drogue 3	Drogue 1	Drogue 2	Drogue 3
Start date/time	-	30 Sep 2018 17:20	30 Sep 2018 17:20	30 Sep 2018 17:20	1 Oct 2018 13:39	1 Oct 2018 13:39	1 Oct 2018 13:39
End date/time	-	30 Sep 2018 18:43	30 Sep 2018 18:43	30 Sep 2018 18:43	2 Oct 2018 3:20[a)]	2 Oct 2018 3:20[a)]	n/d
Average drogue direction	-	NW	NW	NW	SW	SW	SW
Average wind speed	m/s	4.30	4.30	4.30	4.30	4.30	n/d
Average wind direction	-	W	W	W	NW	NW	n/d
Distance	m	361	367	399	1,440	1,500	1,500
Release easting	m	605626	605626	605626	605691	605691	605691
Release northing	m	6390409	6390409	6390409	6390299	6390299	6390299
Retrieval easting	m	605843	605843	605843	606509	606509	606509
Retrieval northing	m	5390578	5390578	5390578	6389210	6389210	6389210
Travel time	s	4,980	4,980	4,980	49,300	49,300	n/d
Travel time	h	1.38	1.38	1.38	13.7	13.7	n/d
Average velocity	m/s	0.072	0.074	0.080	0.029	0.030	n/d
Release average velocity	m/s	0.075			0.030		

n/d = no data; NW = northwest; SW = southwest; W = west

Time is for last recorded movement of drogues prior to running aground rather than time of retrieval. Droques were retrieved on 3 October 2018, after they had run aground on the east shoreline and became encased in ice.

Figure 10: View of Drogues at Retrieval Point, 30 September 2018

Note: Drogues are floating in the North Basin with the northern shoreline of Forrest Lake visible on the right; view is from east facing west toward the outflow channels of the Clearwater River below Patterson Lake.

Figure 11: View of Drogues at Retrieval Point, 3 October 2018

Note: Drogues are encased in ice; view is from west facing east toward the east shoreline of Forrest Lake.

5.6 Rhodamine Dye Tracer Observations

The dye tracer slug was released downstream of Patterson Lake and upstream of Forrest Lake. The dye was transported to Forrest Lake by the Clearwater River and once in the North Basin, the plume spread in two directions. The visible plume emanating from the North Channel outlet flowed north towards and along the northern shore of Forrest Lake before reaching the Forrest Lake outlet. The visible plume emanating from the South Channel outlet flowed south and followed along the west shore of the North Basin approximately 1 km south to the mouth of E Creek. At this point, the plume flowed to the northeast and crossed the North Basin toward the Forrest Lake outlet. Outflow from Patterson Lake was observed to remain nearly completely isolated from the South Basin.

The rhodamine dye was released at the access road bridge on 30 September 2018 at 13:51 (Figure 7). As the plume advanced downstream, it was first concentrated on the outside of meander bends before full lateral mixing, which occurred before reaching Forrest Lake. Where the Clearwater River Lower Reach separates into the North Channel and South Channel, the dye was observed to flow first and more rapidly through the North Channel.

The visible plume arrived first at the North Channel outlet at 14:34, roughly 43 minutes after the initial release (i.e., 13:51). The plume front had passed the North Channel outlet completely by 17:00. The plume front arrived at the South Channel outlet at 15:05 and had passed completely by 18:00. Rhodamine concentrations observed at the North Channel outlet and South Channel outlet are shown in Figure 12. The elapsed time and associated average channel velocity are presented in Table 3.

Peak rhodamine concentrations could not be logged as the plume passed the North Channel and South Channel outlets because they were too far outside the calibration bounds. A Gaussian distribution was fitted to the observed concentration curves to estimate rhodamine concentrations during the periods of missing data. An estimated mass of 1.77 kg (or 59% of released mass) passed through the North Channel outlet and 1.17 kg (or 39% of released mass) through the South Channel outlet (total mass of 2.94 kg or 98% of released mass). Measurement of 98% of the mass released is considered satisfactory and 2% error does not influence confidence in the interpretation of results. The remaining 2% that was not measured may have been caught in slack or recirculating currents in the Clearwater River or adsorbed to vegetation.

The temperature observed during the transit of the dye tracer through the North Channel outlet and the South Channel outlet is shown in Figure 13. Temperature averaged 6.1°C in the North Channel outlet and 6.0°C in the South Channel outlet.

The velocity in the Clearwater River Upper Reach mainstem and Lower Reach North Channel were consistent (0.29 m/s and 0.28 m/s, respectively), with the velocity in the Lower Reach South Channel being notably smaller at 0.14 m/s. The division of flow observed in the field between the two channels is supported by preliminary one-dimensional hydraulic modelling of the reach using HEC-RAS (USACE 2018), which is standard software for the modelling of open channel hydraulics developed by the United States Army Corps of Engineers. According to the preliminary modelling, approximately 34% of the flow in the Upper Reach mainstem flows through the Lower Reach South Channel and 66% Lower Reach North Channel (Appendix 9A, Hydrological Modelling Summary Report), which agrees with the approximate proportions of measured dye mass in each channel.

Table 3: Summary of Plume Advance through Clearwater River below Patterson Lake, 30 September 2018

Location / Reach	Plume Arrival Time[(a)]	Time Since Release (minutes)	Incremental Elapsed Time (minutes)	Distance (m)	Velocity (m/s)
Access Road Bridge (release point)	13:51	0	0	0	n/a
Access Road to Channel Fork	14:24	33	33	569	0.29
Channel Fork to North Channel outlet	14:34	43	10	168	0.28
Channel Fork to South Channel outlet	15:05	84	41	341	0.14

a) The plume arrival time is at the downstream end of the reach.
n/a = not applicable.

Figure 12: Concentration of Rhodamine Observed in Outflow from the Clearwater River into the Forrest Lake – North Basin via the North Channel and South Channel

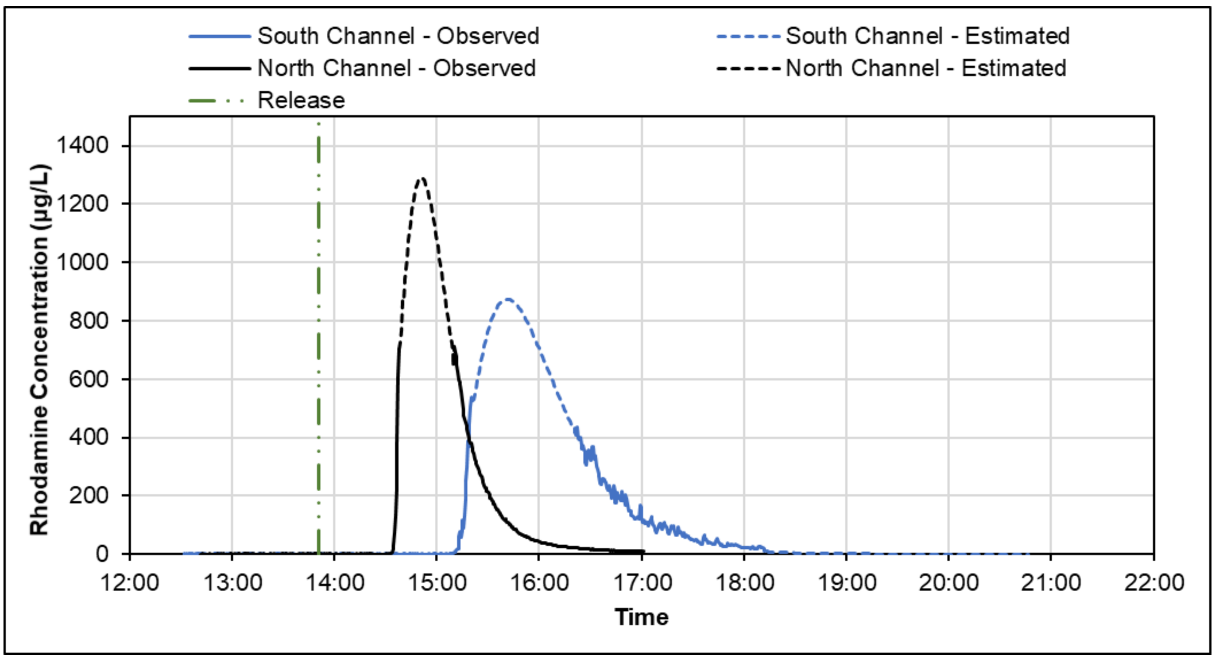
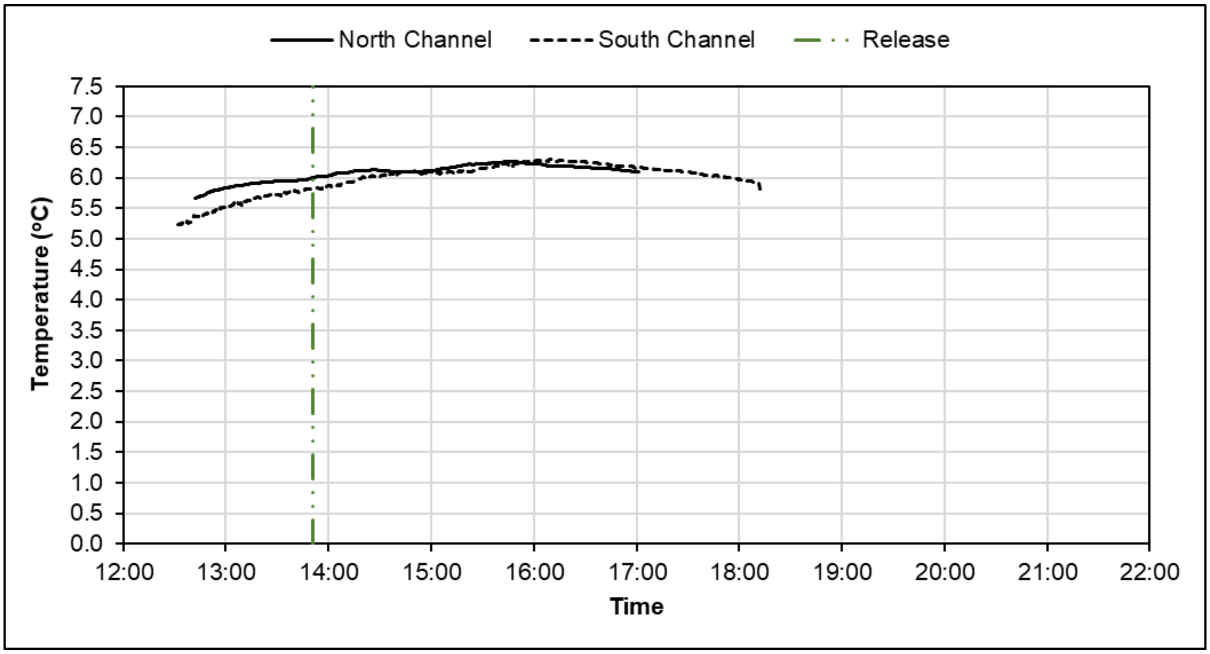
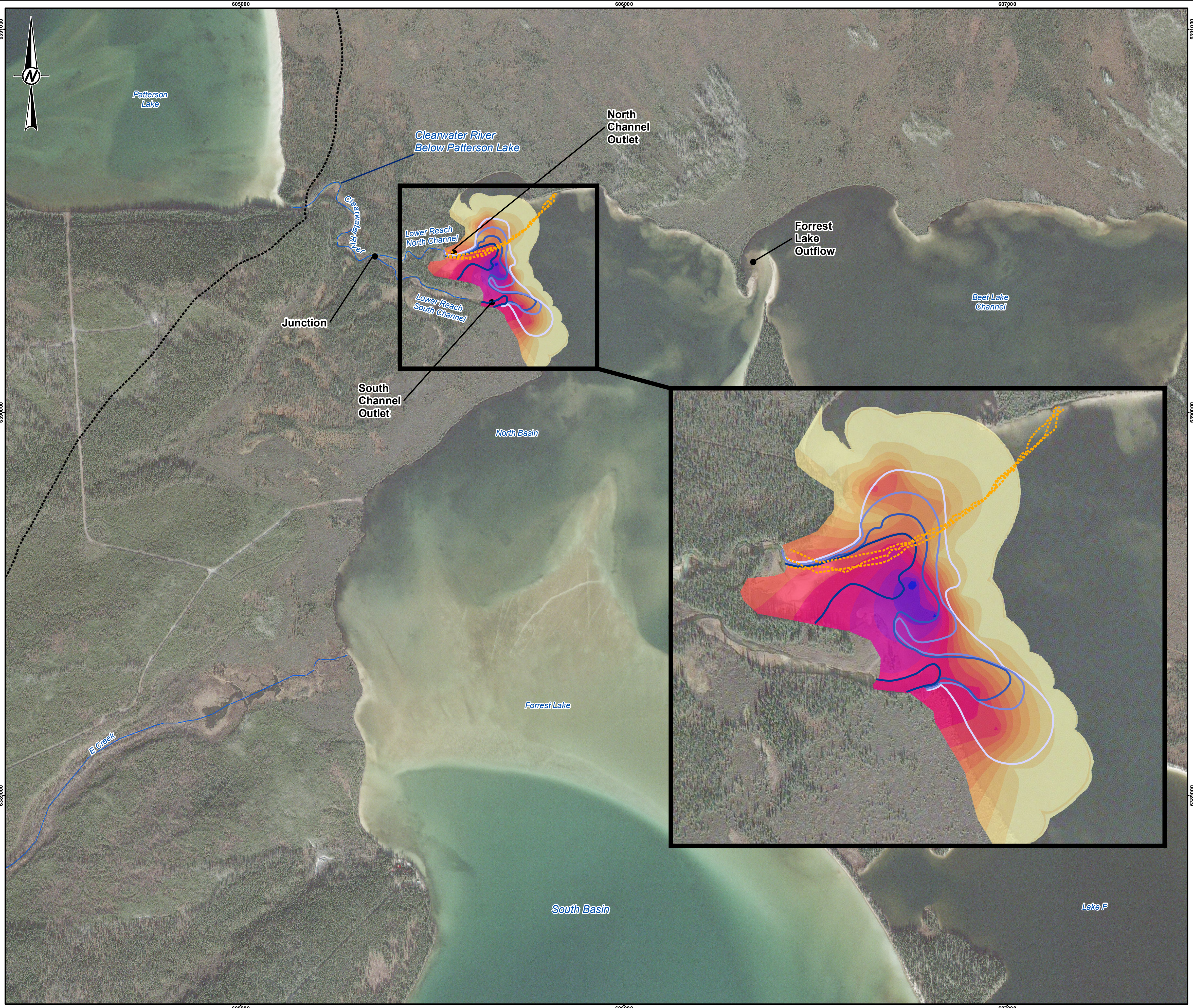


Figure 13: Observed Temperature of Outflow from the Clearwater River into the Forrest Lake – North Basin via the North Channel and South Channel



The observations of the plume advance into the North Basin on 30 September 2018 are shown in Figure 14. The emergence of two distinct flow paths, one emanating from the North Channel outlet and one emanating from the South Channel outlet, are visible in Figure 14 based on the visual plume outlines traced by canoe with GPS and on the plume boundaries from interpolated concentration measurements. Also visible in Figure 14 is the development of a high concentration pocket situated approximately 50 m from the west shore between the two developing flow paths. The drogue paths for the release on 30 September 2018 further validate the direction of the currents from the outflow of the North Channel outlet.



LEGEND

PROJECT FEATURES

EXISTING ACCESS ROAD

DROGUE PATH

VISUAL PLUME OUTLINES

15:09-15:38

15:38-15:59

15:59-16:28

16:28-16:57

PLUME BOUNDARIES INTERPOLATED FROM CONCENTRATION MEASUREMENTS (µg/L)[1]

1-50
50-100
100-150
150-200
200-250
250-300
300-350
350-400
400-450
450-500
500-550
550-600
600-650
650-700

0 200 400

1:10,000 METRES

NOTE(S)

1. CONCENTRATION MEASUREMENTS COLLECTED ON SEPTEMBER 30, 2018 BETWEEN 17:23 AND 17:48.

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, DATED: 2015.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

PROJECT

ROOK I PROJECT

TITLE

FORREST LAKE MIXING STUDY - SEPTEMBER 30, 2018 OBSERVATIONS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-03-20
DESIGNED	RP
PREPARED	LMS/NO
REVIEWED	RWP
APPROVED	GVA

PROJECT NO.	PHASE	REV.	FIGURE
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The rhodamine concentrations observed at the Forrest Lake outlet are shown in Figure 15, while the observed water temperatures at the Forrest Lake outlet are shown in Figure 16. The initial plume front was visually observed to arrive at the Forrest Lake outlet on 1 October 2018 at 10:30. The sonde probe at the outlet of Forrest Lake failed to log rhodamine concentrations on 1 October 2018 between 01:28 and 13:01. The probe began to successfully log beginning at 13:01 and continued to log until its eventual retrieval on 3 October 2018 at 09:14. The observed peak was 15.6 µg/L at 13:03; however, actual rhodamine concentrations at the Forrest Lake outlet were expected to have peaked sometime between 10:30 and 13:01 when the probe was not logging. This means that there is some uncertainty in the timing and magnitude of the peak concentrations at the Forrest Lake outlet but the gap does not have a meaningful impact on the interpretation of the results. Rhodamine concentrations declined from the observed peak through the afternoon and evening of 1 October 2018.

Between 10:58 and 13:03 on 1 October 2018, rhodamine concentrations and the plume extent in the North Basin were mapped using one of the probes. The observed plume extent, shown in Figure 17, was focused on the west shore and north shore of the North Basin. Flow to the south along the west shore was validated by observation of aquatic vegetation bending with a long shore current in a southerly direction. The plume went to the east at the mouth of E Creek along the sand sill that separates the North Basin from the South Basin. The plume did not pass over the sand sill into the South Basin, suggesting that exchange flows between the two basins are limited.

The drogue paths for the release on 1 October 2018 are shown in Figure 17. The drogue paths on 1 October are likely to have been heavily influenced by wind conditions at surface that may not have influenced the water column as a whole. The path does not appear to reflect the path travelled by the plume itself.

One key observation on 1 October 2018 was that a substantial portion of the plume remained just offshore between the North Channel outlet and South Channel outlet. This extended residence time was likely the result of a circulating current or eddy generated between the two flow paths.

Rhodamine concentrations at the Forrest Lake outlet began to increase again on 2 October 2018 at 0:00 (Figure 15) and continued to increase to a peak at 14.7 µg/L on 2 October 2018 at 12:00 before decreasing. On 2 October 2018 around 19:00, the rhodamine concentration observed at the outlet appeared to have stabilized at around 3 µg/L until the probe was removed the morning of 3 October 2018. This indicated a high degree of mixing occurring in the North Basin. The degree of mixing in the North Basin likely increased during the afternoon of 2 October 2018 in response to wind and wave action. However, since the measured concentrations at the outlet of Forrest Lake showed considerable variation over the first two days of the study, including two peaks, it is expected that the time required for the North Basin to become well mixed is approximately two days based on the water level and wind conditions at the time of the survey.

An aerial survey was completed the morning of 2 October 2018 at 10:30, and the observed plume extent is shown in Figure 18. Video footage and photographs collected during the aerial survey indicated a more uniformly distributed but not completely mixed coverage of the North Basin by the plume. A key observation, visible in Figure 19 and Figure 20, was that the boundary of the plume roughly coincided with the sand sill that separates the North and South basins. The plume was not observed to cross over the sand sill into the South Basin. Light conditions were poor during the helicopter flight, and it was difficult to see the dye clearly except over the sand sill where the white sand backdrop accentuated the plume boundary.

Over the period that the sonde probes were deployed at the Forrest Lake outlet, diurnal temperature fluctuations were visible but the general trend beginning on 1 October 2018 was downward (i.e., cooler), with temperatures eventually reaching approximately 0°C by the time the probes were retrieved.

The mass of dye that was observed to leave Forrest Lake was 1.67 kg. At the end of the study on the morning of 3 October 2018, there would have been 1.30 kg remaining in the North Basin if the area of the visible plume observed on 2 October 2018 in the North Basin (86 ha) was fully mixed with a rhodamine concentration of 3 µg/L equal to that observed at the outlet. This accounts for approximately 2.97 kg of dye, which is within 1% of the amount released (3.00 kg) at the access road bridge below Patterson Lake. This recovery is higher than the 98% calculated at the inflow to the lake but reflects relatively low analytical variability considering the measurement errors inherent in the volumes, flows and concentrations required to close the mass balance. Overall, the mass balance suggests the study was well constrained and provided sufficient information for understanding circulation and mixing patterns in the North Basin and the limited connection to the South Basin.

Figure 15: Rhodamine Dye Concentration Observed in Outflow from Forrest Lake

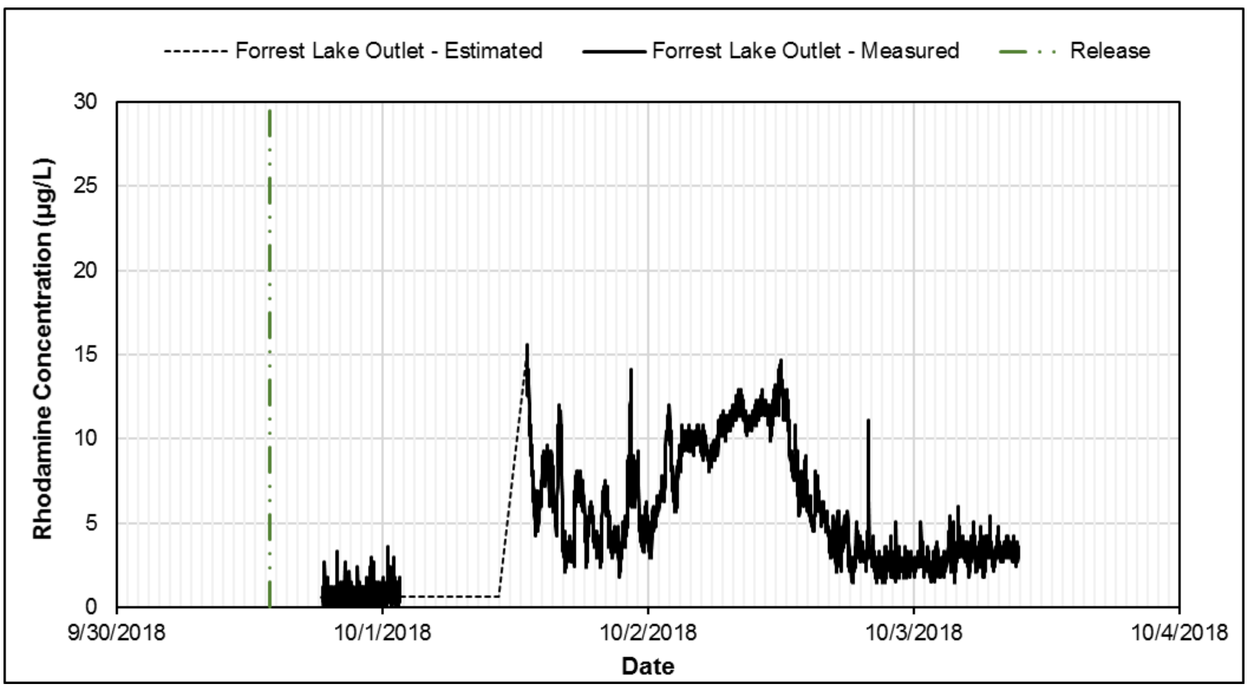
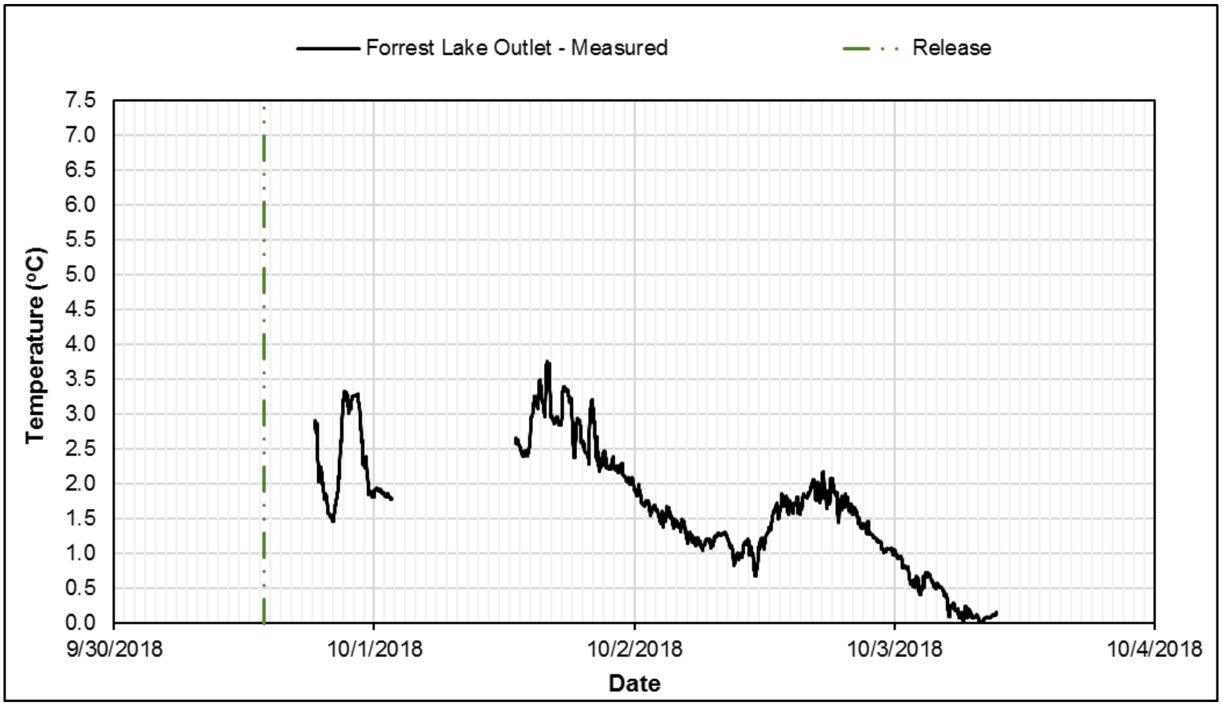


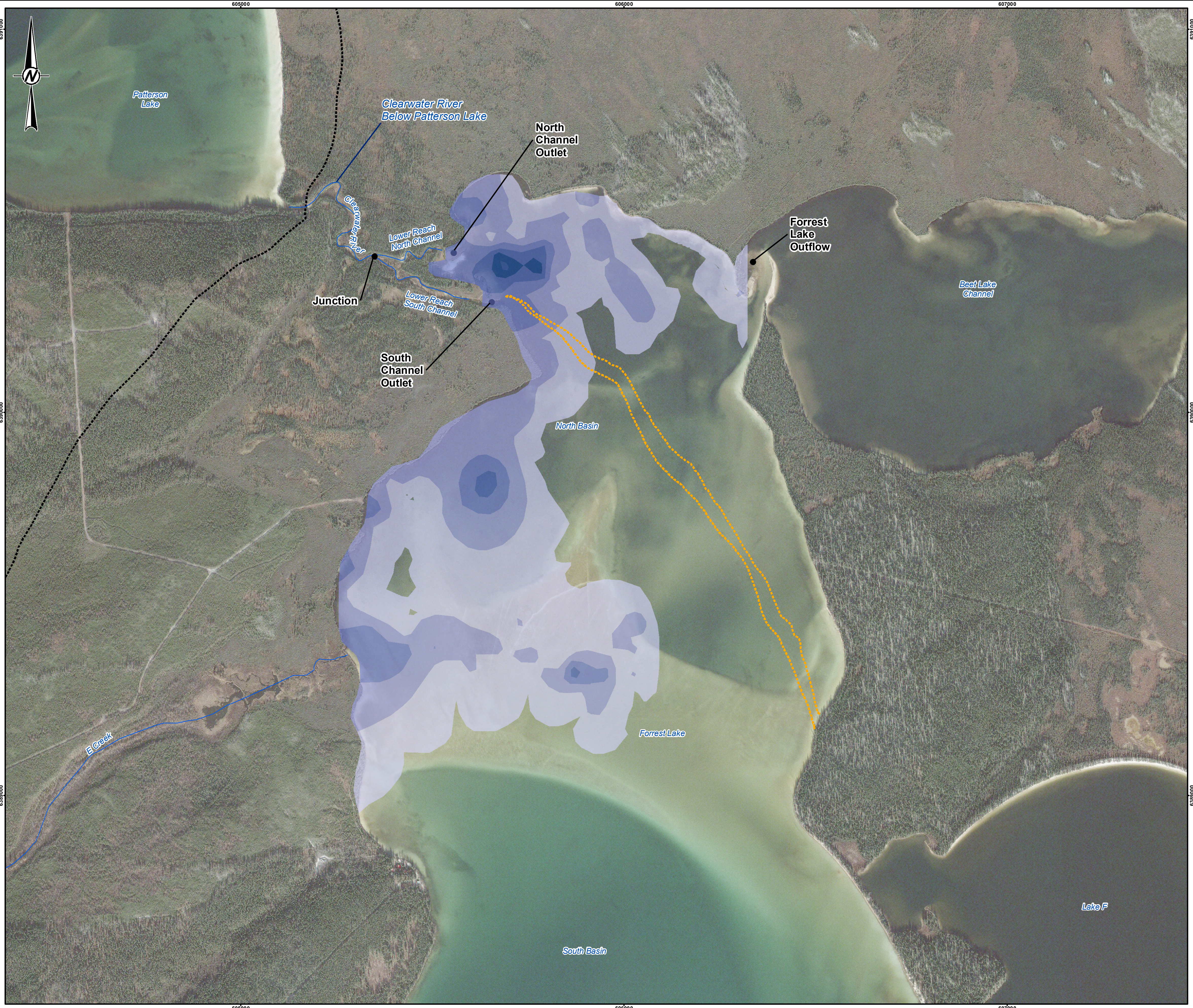
Figure 16: Water Temperature Observed in Outflow from Forrest Lake



The dye tracer observations discussed here are specific to the physical, hydrological, and meteorological conditions that existed during the study. However, the key finding that Patterson Lake outflow was nearly completely isolated from the South Basin is not anticipated to be highly sensitive to changes in wind or changes in water level.

During the study, wind speed and direction varied. On 30 September 2018 and 1 October 2018 wind speeds were low and remained less generally less than 15 km/hr. Wind speeds increased through 2 October 2018, ultimately reaching a maximum average hourly wind speed of 25 km/h with gusts exceeding 45 km/h. Throughout the duration of the study, the wind was generally from the northwest. Winds of 25 km/h are anticipated to represent routine windy conditions in the vicinity of Rook I. Sustained winds from the northwest of 25 km/hr (approximately 7 m/s) did not result in flow over the sand sill to the south. Winds from any other direction would not be expected to increase likelihood of flow over the sand sill to the south. Wind speeds greater than 25km/hr are likely to occur for a period but winds sustained over a period of days are not likely

Water levels in Forrest Lake are expected to range 0.7 m in a typical year with the annual maximum approximately 0.5 m higher than the water level observed during the field study. The sill would be more of a barrier in low water levels due to shallow water depth. Even at maximum water levels, the water depth above the sill would be relatively shallow with depths of approximately 1.0 m to 1.1 m. As a result, seasonal increase to water level is not expected result in a meaningful change to the lack of connectivity between the North Basin and South Basin observed during this field study.



LEGEND

PROJECT FEATURES

EXISTING ACCESS ROAD

DROGUE PATH

PLUME BOUNDARIES INTERPOLATED FROM CONCENTRATION MEASUREMENTS (µg/L)[1]

- 1-25
- 25-50
- 50-75
- 75-100
- 125-150
- 100-125

0 200 400

1:10,000 METRES

NOTE(S)

1. CONCENTRATION MEASUREMENTS COLLECTED ON OCTOBER 1, 2018 BETWEEN 10:58 AND 13:03.

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, DATED: 2015.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

PROJECT

ROOK I PROJECT

TITLE

FORREST LAKE MIXING STUDY - OCTOBER 1, 2018 OBSERVATIONS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-03-20
DESIGNED	RP
PREPARED	LMS/NO
REVIEWED	RWP
APPROVED	GVA

PROJECT NO.	PHASE	REV.	FIGURE
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

LEGEND

PROJECT FEATURES

EXISTING ACCESS ROAD

VISUAL PLUME BASED ON HELICOPTER RECONNAISSANCE

0 200 400

1:10,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, DATED: 2015.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

PROJECT

ROOK I PROJECT

TITLE

FORREST LAKE MIXING STUDY - OCTOBER 2, 2018 OBSERVATIONS

CONSULTANT

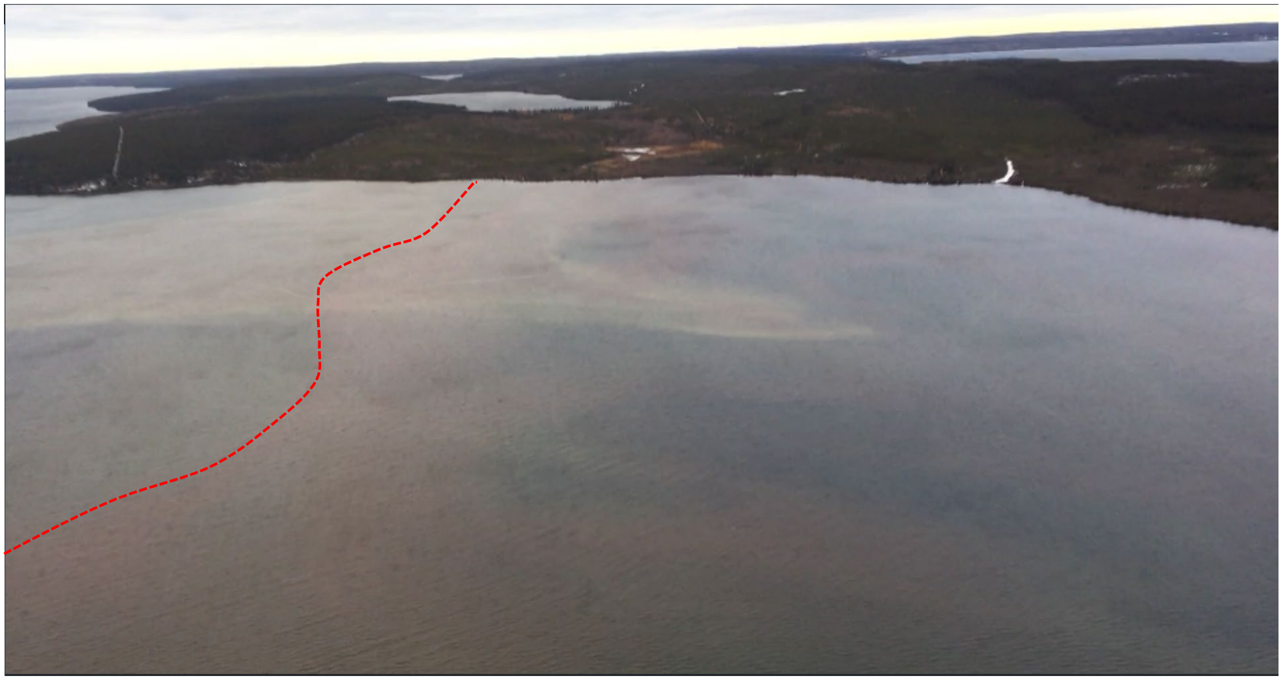
GOLDER

YYYY-MM-DD	2020-03-20
DESIGNED	RP
PREPARED	LMS/NO
REVIEWED	RWP
APPROVED	GVA

PROJECT NO.	PHASE	REV.	FIGURE
19114981	7000	0	**18**

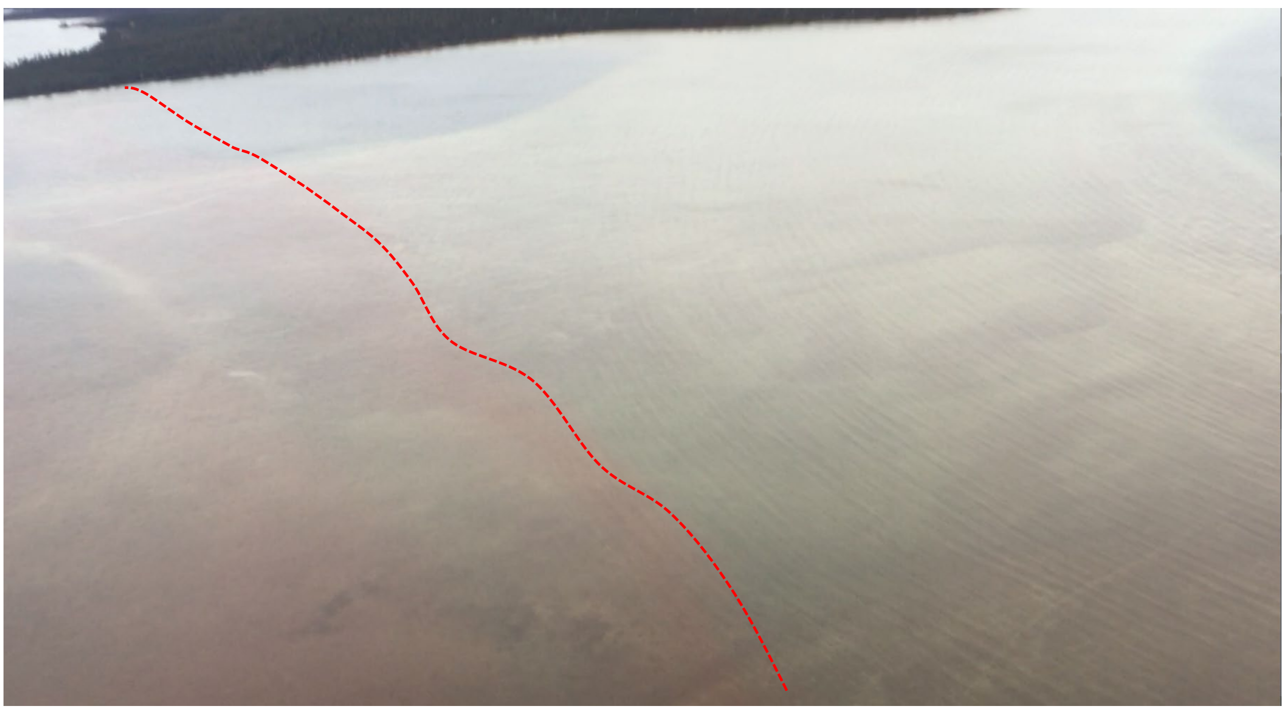
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Figure 19: Aerial View from East Showing the Maximum Observed Plume Extent, 2 October 2018



Note: Plume extent is indicated by red dashed line; helicopter view from the east facing west-southwest.

Figure 20: Aerial View from West Showing the Maximum Observed Plume Extent, 2 October 2018



Note: Plume extent is indicated by red dashed line; helicopter view from the west facing east.

6.0 SUMMARY

The 2018 Forrest Lake mixing study was completed to evaluate the extent that water from the Clearwater River flowing from the Patterson Lake outlet mixes within Forrest Lake. A visual overview of the 2018 Forrest Lake mixing study is provided in Figure 21.

The study was conducted primarily with a rhodamine dye tracer that was observed visually and by logging concentration measurements from YSI sonde probes. To provide additional context to the plume mapping, complementary physical measurements were collected from the Rook I Meteorological Station and drogues that followed surficial lake currents.

Dye tracer observations indicated that most of the dye/flow from Patterson Lake to Forrest Lake was conveyed through the Lower Reach North Channel outlet. The plume front arrived at the North Channel outlet first and passed more rapidly than that observed at the South Channel outlet.

Once in the North Basin, the plume spread in two directions. The visible plume emanating from the North Channel outlet flowed north towards and along the northern shore of Forrest Lake before reaching the Forrest Lake outlet. The visible plume emanating from the South Channel outlet flowed south and followed along the west shore of the North Basin approximately 1 km south to the mouth of E Creek. At this point, the plume flowed to the northeast and crossed the North Basin toward the Forrest Lake outlet. A substantial portion of the plume remained just offshore between the North Channel outlet and South Channel outlet. This effect is likely the result of a circulating current or eddy generated between the two flow paths.

Based on measured conditions at the time of the study, the residence time of the North Basin was approximately four days, and it took two days for the basin to become fully mixed.

Outflow from Patterson Lake was observed to remain nearly completely isolated from the South Basin. Three lines of evidence confirmed this observation:

1) The plume was measured in real time from a boat and observed to end at the sand sill.

2) The plume was visually delineated from helicopter and seen to stop at the sill.

3) A mass balance confirmed to within 1% that the plume was entirely contained within the North Basin or flowed out of Forrest Lake after two days.

Consequently, the flow over the sand sill can be considered unidirectionally north, and flow from Patterson Lake can be thought of as unidirectionally to the east, with a small basin with a residence time of a few days that fully mixes these inflows.

LEGEND

PROJECT FEATURES

EXISTING ACCESS ROAD

PLUME DIRECTION

PATH A

PATH B

DEPOSITIONAL AREA WITH EXTENDED RESIDENCE TIME

0 200 400

1:10,000 METRES

REFERENCE(S)

1. IMAGERY OBTAINED FROM CLIENT, DATED: 2015.
2. HISTORIC BATHYMETRY DIGITIZED FROM 1981 MAP OBTAINED FROM GOEVERNMENT OF SASKATCHEWAN.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

PROJECT

ROOK I PROJECT

TITLE

FORREST LAKE MIXING STUDY – OVERVIEW

CONSULTANT

GOLDER

YYYY-MM-DD	2020-03-20
DESIGNED	RP
PREPARED	LMS/NO
REVIEWED	RWP
APPROVED	GVA

PROJECT NO.	PHASE	REV.	FIGURE
19114981	7000	0	21

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

PATH: \\CLIENTS\NexGen\19114981\Mapping\Products\Hydrology\Baseline_ForrestLakeMixingStudy\Fig21_19114981_ForrestLake_MixingStudyOverview_Rev0.mxd

CLOSING

Golder is pleased to submit this report to NexGen in support of the environmental assessment for the Rook I Project. For details on the limitations and use of information presented in this report, please refer to the Study Limitations section following this page. If you have any questions or require additional details related to this study, please contact the undersigned.

Golder Associates Ltd.

Prepared By:

Ross Phillips, M.Sc., P.Eng.
Senior Water Resources Engineer

Reviewed By:

Gerard Van Arkel, M.Eng.
Principal Water Resources Engineer

RP/GVA/pls

Association of Professional Engineers & Geoscientists of Saskatchewan
CERTIFICATE OF AUTHORIZATION
Golder Associates Ltd.
Number C0230
Permission to Consult held by:

Discipline	Sk. Reg. No.	Signature
Water Resources	22672	

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REFERENCES

ENV (Saskatchewan Ministry of the Environment). 1981. Bathymetry Map for Forrest Lake.

EC (Environment Canada). 2003. Revised Technical Guidance on How to Conduct Effluent Plume Delineation Studies. 42 p.

Terzi RA, Winkler T, Routledge B. 1994. Hydrometric Field and Related Manual, Water Survey of Canada. Environment Canada, Ottawa, ON.

USACE (United States Army Corps of Engineers). 2018. Hydrologic Engineering Center. 2018. HEC-RAS (5.0.6). Available at https://www.hec.usace.army.mil/software/hec-ras/

APPENDIX A

Photo Appendix

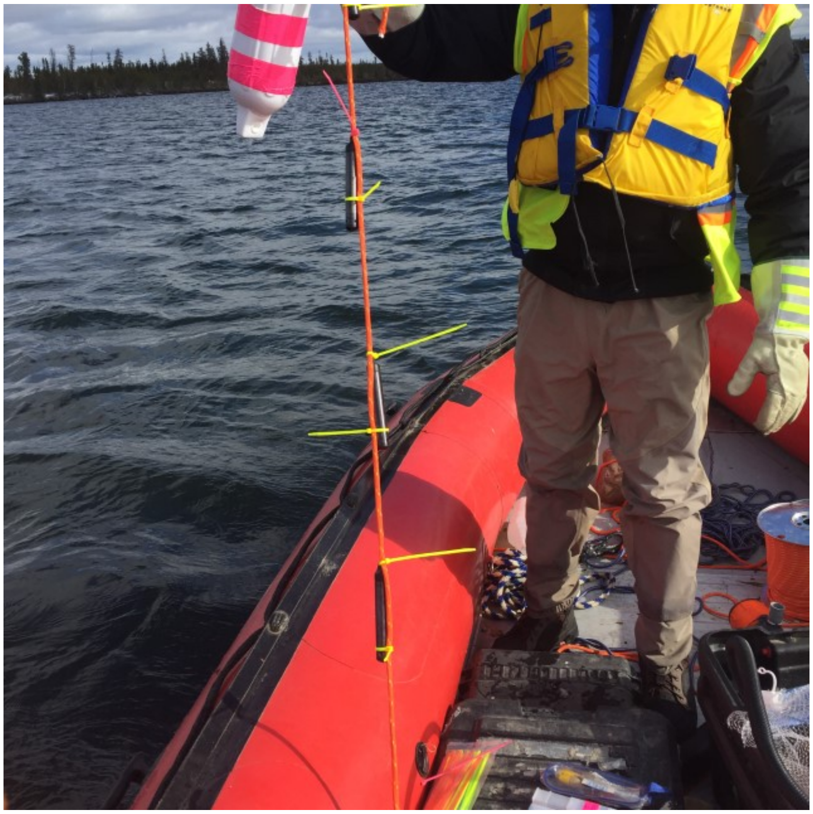

Photo 1: Thermistor String

Photo 2: Thermistor String prior to Deployment

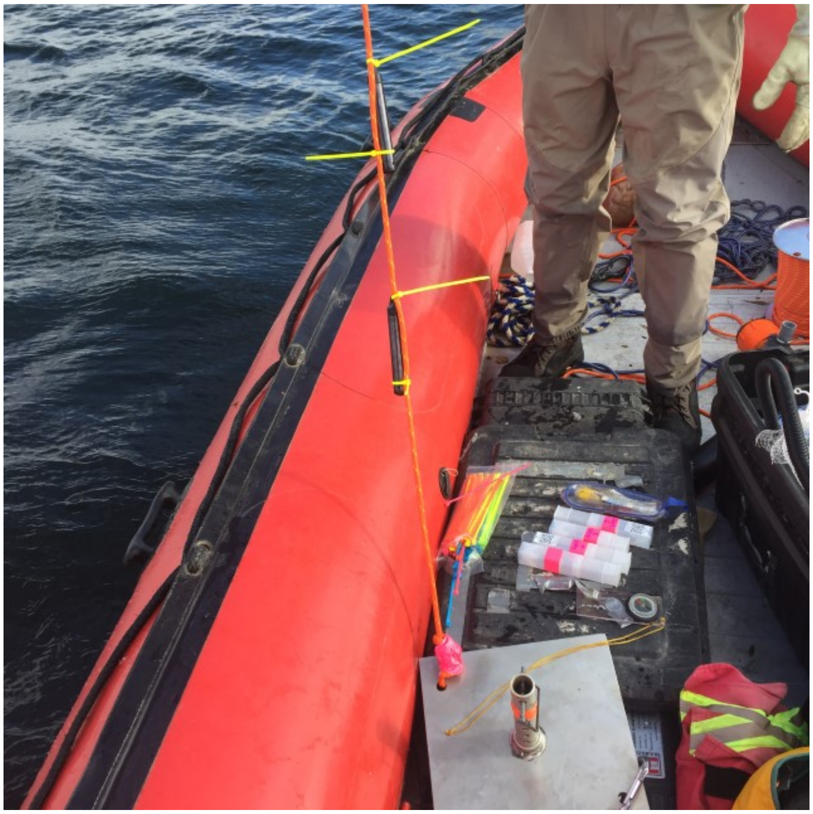

Photo 3: Thermistor String Base prior to Deployment

Photo 4: YSI Probe Installed at South Channel Outlet. View is facing North on 30 September 2018.

Photo 5: Clearwater River above the Access Bridge prior to Dye Release. The view is from the Access Road Bridge facing Upstream (West) on 30 September 2018.

Photo 6: Clearwater River below the Access Bridge prior to Dye Release. The view is from the Access Road Bridge facing Downstream (East) on 30 September 2018.

Photo 7: Water Pail used for Dilution

Photo 8: View of the Clearwater River at the Point of Release. View is from the North Bank facing South on 30 September 2018; 13:54.

Photo 9: View of the Clearwater River at the Point of Release. View is from the North Bank facing South on 30 September 2018; 13:54.

Photo 10: View of the Clearwater River at (Latitude: 57º38"41.38'; Longitude: 109º14'10.20") the Point of Release. View is from the Center facing downstream on 30 September 2018; 14:02.

Photo 11: View of the Clearwater River at (Latitude: 57°38'41.32"; Longitude: 109°14'9.93") facing downstream on 30 September 2018; 14:02.

Photo 12: View of the Clearwater River at (Latitude: 57°37'40.64"; Longitude: 109°14'9.02") facing downstream on 30 September 2018; 14:03.

Photo 13: View of the Clearwater River at (Latitude: 57°38'39.72; Longitude: 109°14'9.66") facing downstream on 30 September 2018; 14:05.

Photo 14: View of the Clearwater River at (Latitude: 57°38'38.91"; Longitude: 109°14'12.15") facing downstream on 30 September 2018; 14:09.

Photo 15: View of the Clearwater River at (Latitude: No Data; Longitude: No Data) facing downstream on 30 September 2018; 14:12.

Photo 16: View of the Clearwater River at (Latitude: 57°38'37.57"; Longitude: 109°14'9.30") facing downstream on 30 September 2018; 14:15.

Photo 17: View of the Clearwater River at (Latitude: 57°38'37.58"; Longitude: 109°14'9.27") facing downstream on 30 September 2018; 14:15.

Photo 18: View of the Clearwater River at (Latitude: 57°38'37.37"; Longitude: 109°14'8.12") facing downstream on 30 September 2018; at 14:17.

Photo 19: View of the Clearwater River at (Latitude: 57°38'37.70"; Longitude: 109°14'6.50") facing downstream on 30 September 2018; 14:19.

Photo 20: View of the Clearwater River at (Latitude: 57°38'37.62"; Longitude: 109°14'5.04") facing downstream on 30 September 2018; 14:20.

Photo 21: View of the Clearwater River at (Latitude: 57°38'37.21"; Longitude: 109°14'2.57") facing downstream on 30 September 2018; 14:22.

Photo 22: View of the Clearwater River at (Latitude: 57°38'37.15"; Longitude: 109°14'2.51") facing downstream on 30 September 2018; 14:23.

Photo 23: View of the Clearwater River at (Latitude: 57°38'37.14"; Longitude: 109°14'2.40") facing downstream on 30 September 2018; 14:23.

Photo 24: View of the Clearwater River at (Latitude: 57°38'37.36"; Longitude: 109°14'1.58") facing downstream on 30 September 2018.

Photo 25: View of the Clearwater River at (Latitude: 57°38'37.37"; Longitude: 109°14'1.55") facing downstream on 30 September 2018; 14:24.

Photo 26: View of the Clearwater River at (Latitude: 57°38'37.33"; Longitude: 109°13'58.92") facing downstream on 30 September 2018; 14:28.

Photo 27: View of the Clearwater River at (Latitude: 57°38'37.37"; Longitude: 109°13'58.94") facing downstream on 30 September 2018; 14:28.

Photo 28: View of the Clearwater River at (Latitude: 57°38'37.33; Longitude: 109°13'58.92") facing downstream on 30 September 2018; 14:28.

Photo 29: View of the Clearwater River at (Latitude: 57°38'37.37; Longitude: 109°13'58.94") facing downstream on 30 September 2018; 14:28.

Photo 30: View of the Clearwater River at (Latitude: 57°38'37.94; Longitude: 109°13'58.31") facing downstream on 30 September 2018; 14:23.

Photo 31: View of the Clearwater River at (Latitude: No Data; Longitude: No Data) facing downstream on 30 September 2018; 14:31.

Photo 32: View of the Clearwater River at (Latitude: 57°38"38.14; Longitude: 109°13'56") facing downstream on 30 September 2018; 14:32.

Photo 33: View of the Clearwater River at the North Channel Outlet at (Latitude: 57°38'37.44"; Longitude: 109°13'54.85") facing Upstream on 30 September 2018.

Photo 34: View of the Clearwater River near the South Channel Outlet at the Location of the Plume Front facing Upstream (West) on 30 September 2018; 14:50.

Photo 35: View of the Clearwater River near the South Channel Outlet at the Location of the Plume Front facing Downstream (East) on 30 September 2018; 14:50.

Photo 36: View of the Clearwater River Outflow from the South Channel Outlet (Latitude: 57°38'32.80"; Longitude: 109°13'47.08") facing North on 30 September 2018; 15:02.

Photo 37: View of the Clearwater River Outflow from the South Channel Outlet (Latitude: 57°38'32.80"; Longitude: 109°13'47.08") facing North on 30 September 2018; 15:03.

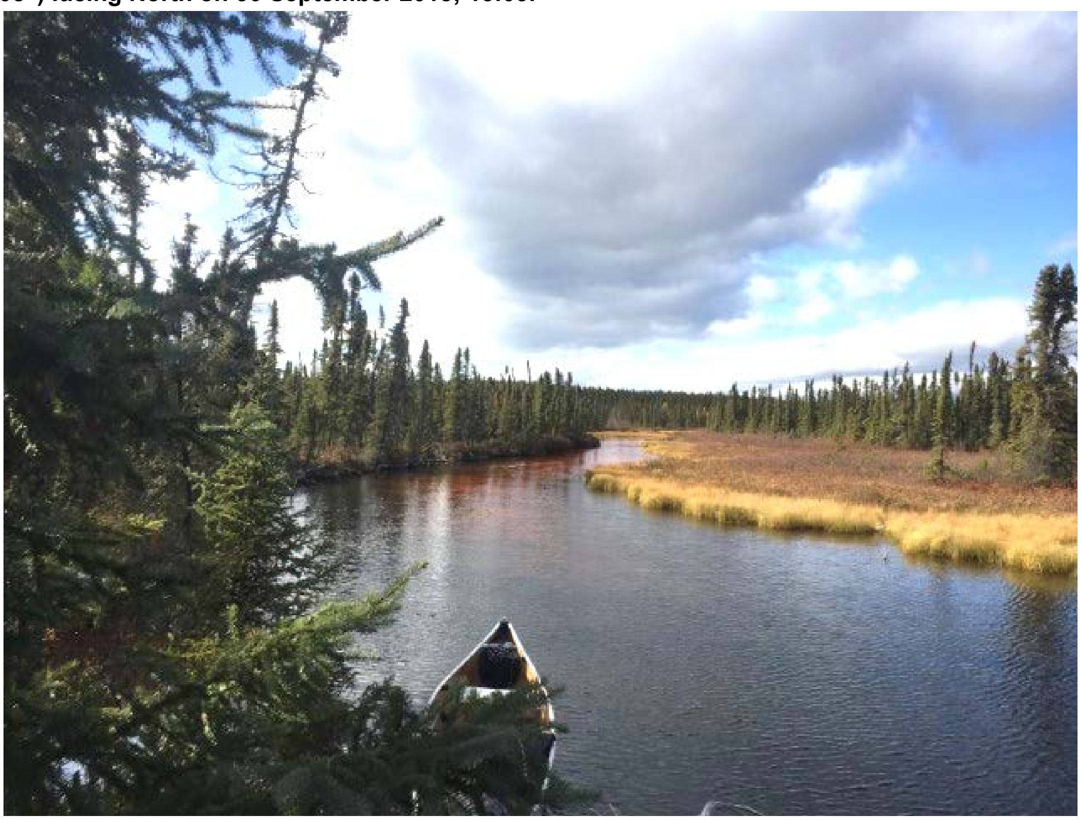

Photo 38: View of the Clearwater River South Channel from the South Channel Outlet (Latitude: 57°38'32.80"; Longitude: 109°13'47.08") facing Upstream (West) on 30 September 2018; 15:03.

Photo 39: View of the Clearwater River South Channel from the South Channel Outlet (Latitude: 57°38'32.80"; Longitude: 109°13'47.08") facing Upstream (West) on 30 September 2018; 15:04.

Photo 40: View of the Clearwater River Outflow from the South Channel Outlet (Latitude: 57°38'32.80"; Longitude: 109°13'47.08") facing North on 30 September 2018; 15:04.

Photo 41: View of the Clearwater River Outflow from the South Channel Outlet (Latitude: 57°38'32.80"; Longitude: 109°13'47.08") facing North on 30 September 2018; 15:05. The Photograph Shows the Point of Plume Arrival at the South Channel Outlet.

Photo 42: View of the Clearwater River South Channel from the South Channel Outlet (Latitude: 57°38'32.80"; Longitude: 109°13'47.08") facing Upstream (West) on 30 September 2018; 15:08.

Photo 43: View of the Clearwater River Outflow from the South Channel Outlet (Latitude: 57°38'32.80"; Longitude: 109°13'47.08") facing North on 30 September 2018; 15:08.

Photo 44: View of the Clearwater River South Channel from the South Channel Outlet (Latitude: 57°38'32.80"; Longitude: 109°13'47.08") facing Downstream (East) on 30 September 2018; 15:09.

Photo 45: View of the Clearwater River South Channel from the South Channel Outlet (Latitude: 57°38'32.80"; Longitude: 109°13'47.08") facing Upstream (West) on 30 September 2018; 15:09.

Photo 46: Panoramic view of the Clearwater River North Channel Outlet (Latitude: 57°38'36.84"; Longitude: 109°13'54.22") facing South on 30 September 2018; 15:17.

Photo 47: View of Forrest Lake from the Mouth of the North Channel Outlet (Latitude: 57°38'36.84"; Longitude: 109°13'54.22") facing Upstream (West) on 30 September 2018; 15:17.

Photo 48: View of Forrest Lake from the Mouth of the North Channel Outlet (Latitude: 57°38'36.84"; Longitude: 109°13'54.22") facing Downstream (East) on 30 September 2018; 15:17.

Photo 49: Panoramic view of the Clearwater River North Channel Outlet (Latitude: 57°38'36.84"; Longitude: 109°13'54.22") facing South on 30 September 2018; at 15:37.

Photo 50: View of the Clearwater River at the North Channel Outlet at (Latitude: 57°38'37.44"; Longitude: 109°13'54.85") facing Upstream on 30 September 2018; 15:37.

Photo 51: View of the Clearwater River South Channel from the South Channel Outlet (Latitude: 57°38'32.80"; Longitude: 109°13'47.08") facing Downstream (East) on 30 September 2018; 15:55.

Photo 52: View of the Clearwater River South Channel from the South Channel Outlet (Latitude: 57°38'32.80"; Longitude: 109°13'47.08") facing Upstream (West) on 30 September 2018; 15:55.

Photo 53: View of the Clearwater River Outflow from the South Channel Outlet (Latitude: 57°38'32.80"; Longitude: 109°13'47.08") facing North on 30 September 2018; 16:55.

Photo 54: Drogues at Point of Retrieval facing Southwest on 30 September 2018; 18:43.

Photo 55: Drogues at Point of Retrieval facing Southwest on 3 October 2018; 10:34.

Photo 56: Drogues at Point of Retrieval (Latitude 57°37'57.08"; Longitude: 109°12'58.85") facing Northeast on 3 October 2018; 10:34.

Photo 57: Drogues at Point of Retrieval (Latitude 57°37'57.08"; Longitude: 109°12'58.85") facing Northeast on 3 October 2018; 10:35.

Photo 58: View of Forrest Lake from North facing South (Latitude: 57°38'55.84"; Longitude: 109°13'51.06") on 2 October 2018; 08:32.

Photo 59: View of Forrest Lake from North facing South-South-West (Latitude: 57°38'51.30"; Longitude: 109°13'49.63") on 2 October 2018; 08:32.

Photo 60: View of Forrest Lake facing South-South-West (Latitude: 57°38'34.65"; Longitude: 109°13'55.54") on 2 October 2018; 08:32.

Photo 61: View of YSI Deployed at Forrest Lake Outlet on 3 October 2018; 09:22.

Photo 62: View of Forrest Lake Outlet from the Outlet facing West on 3 October 2018; 09:48.

Photo 63: View of Forrest Lake Outlet from the Outlet facing North on 3 October 2018; 09:48.

Photo 64: View of Forrest Lake Outlet from the Outlet facing South on 3 October 2018; 09:48.

Photo 65: View of Forrest Lake Outlet from the Outlet (Latitude: 57°38'33.32"; Longitude: 109°13'4.84") facing North on 3 October 2018; 09:48.