



November 29, 2019

File: 3AM-IQA1626 (Nunavut Water Board)

Attention: Hon. Carolyn Bennett, M.D., P.C., M.P.
Minister of Crown-Indigenous Relations
Government of Canada
[via email: carolyn.bennett@parl.gc.ca]

Attention: Goump Djalogue
Senior Planner
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Attention: Jaida Ohokannoak
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Nunavut Impact Review Board
[via email: johokannoak@nirb.ca]

Reference: Report of Activities – Iqaluit 2019 Emergency Water Supply Project

Dear Minister Bennett, Mr. Djalogue and Ms. Ohokannoak:

In August 2019, the City of Iqaluit (the "City") received approval from the Nunavut Water Board to amend its Type A water licence 3AM-IQA1626 to allow supplementation of its drinking water supply by withdrawing water from the Apex River and Unnamed Lake in 2019.

This project was undertaken in response to an emergency, as declared by the Government of Nunavut Minister of Community and Government Services pursuant to Section 11(1) of the *Emergency Measures Act*. This declaration invoked the provisions of Section 152 of the *Nunavut Planning and Project Assessment Act* (NUPPAA) such that the review provisions of the Act did not apply, and further the Minister of Crown and Indigenous relations agreed that the review of the application could proceed without a public hearing, as allowed for under Sections 52(2)(c) and 55(5) of the *Nunavut Surface Waters and Rights Tribunals Act*. The emergency supplementation project was completed on October 1, 2019. A total of 462,394 cubic metres (m³) of water were withdrawn from Unnamed Lake, and 568,103 m³ were withdrawn from the Apex River and transferred to the Lake Geraldine water reservoir.

Section 152(2) of the NUPPAA requires:

152(2) As soon as practicable after undertaking a project referred to in subsection (1), the person or entity carrying it out must submit a written report to the Commission, the Board and the federal Minister describing

(a) All of the works or activities that have been undertaken or carried out in response to the emergency referred to in paragraphs (1)(a), (b) or (c), as the case may be; and

(b) Any further works or activities required after the end of that emergency to complete the project or maintain a work referred to in paragraph (a).

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The City is pleased to submit a report titled "Iqaluit 2019 Emergency Water Supply Project: Report of Activities" (Nunami Stantec 2019) in fulfillment of these requirements. It is further noted that no further works or activities are required to be completed or maintain the 2019 emergency water supply project.

Sincerely,



Matthew Hamp

Acting Chief Administrative Officer, City of Iqaluit

CC: Spencer Dewar – Crown Indigenous Relations Northern Affairs Canada
Derek Donald – Nunavut Water Board
Amy Elgersma – City of Iqaluit
Josip Deronja – City of Iqaluit (Colliers Project Leaders)
Erica Bonhomme – Nunami Stantec



**Final Report: Iqaluit 2019
Emergency Water Supply Project:
Report of Activities**

November 27, 2019

Prepared for:
City of Iqaluit
Iqaluit, Nunavut

Prepared by:
Nunami Stantec Limited

Project Number: 144902884

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Abbreviations

| | |
|-------------------------|-------------------------------|
| km..... | kilometre |
| m | metre |
| m ³ /s | cubic metres per second |
| mg/L | milligram per litre |
| City | City of Iqaluit |
| DFO..... | Fisheries and Oceans Canada |
| MAD | Mean annual discharge |
| masl..... | metres above sea level |
| UTM..... | Universal Transverse Mercator |
| WSC | Water Survey of Canada |

1 INTRODUCTION

1.1 Background

The City of Iqaluit (City) obtains and distributes potable water from Lake Geraldine, an engineered reservoir located approximately 1 kilometer (km) north of the City center. The reservoir is designed to provide water to a population of up to 8,300 (City of Iqaluit 2010). The reservoir is refilled annually during the open water season (spring to fall) by natural inflows from snowmelt and precipitation. Over winter, the City draws down the available water in the reservoir, as no inflows occur. In years when natural inflows or precipitation are low and the reservoir does not fill to full capacity or, when seasonal demand has been high, there is a potential for a shortage of drinking water available to the City over the winter. As the City's water demands have been increasing, up to 80% of the available water volume stored within the reservoir is used during winter months. Given the uncertainty in demand, the reservoir must be at full capacity at the onset of winter to reduce the risk of potential water shortages. In 2018, a water supplementation project was undertaken to fill the reservoir from an external source (Apex River) on an emergency basis, prior to the onset of winter 2018/2019 ("2018 Supplementation Project").

Owing to the success of the 2018 Supplementation Project, the City applied to the Nunavut Water Board to supplement the Lake Geraldine Reservoir from the Apex River during summer months on an annual basis until 2026 (the term of the licence). The application to amend the City's Type A water licence underwent screening by the Nunavut Impact Review Board and a public hearing by the Nunavut Water Board. An amended licence was sent to the Minister for approval in September 2019, and a decision is pending.

Due to low lake level elevations in Lake Geraldine in early summer 2019, it became evident that supplementation of the reservoir would be needed; however, due to the ongoing review of the City's application to amend its licence, there was no approval in place to permit supplementation from Apex River. Additionally, flows in the Apex River as of mid-July 2019 were low as well, below 30% mean annual discharge (MAD). On July 31, the Minister of Community and Government Services, Hon. Lorne Kusugak declared an emergency owing to the water shortage in Lake Geraldine and low water levels in the Apex River (Appendix A). The Minister's declaration triggered the City to apply to the Nunavut Water Board for an amendment to its licence to allow supplementation of the reservoir from the Apex River and "Unnamed Lake". The Nunavut Water Board reviewed the application and agreed that the situation constituted an emergency, and that it could consider the application without it undergoing assessment by the Nunavut Planning Commission and Nunavut Impact Review Board, as indicated in section 152(1)(b) of the *Nunavut Planning and Project Assessment Act (NUPPAA)*. On August 9, 2019, the Minister of Crown-Indigenous Relations, Hon. Carolyn Bennett consented to the Nunavut Water Board's consideration of the application on an emergency basis and approved the water licence amendment as recommended by the Nunavut Water Board.

1.2 Purpose of this Report

The application of section 152(1) of the NUPPAA to a project invokes section 152(2), which specifies:

152(2) As soon as practicable after undertaking a project referred to in subsection (1), the person or entity carrying it out must submit a written report to the Commission, the Board and the federal Minister describing

(a) all of the works or activities that have been undertaken or carried out in response to the emergency referred to in paragraph (1)(a), (b) or (c), as the case may be; and

(b) any further works or activities required after the end of that emergency to complete the project or maintain a work referred to in paragraph (a).

This report provides information required by this section and is intended to be used as a basis for the City's submission of a written report to the Nunavut Planning Commission, Nunavut Impact Review Board and Minister of Crown-Indigenous Relations in fulfillment of the requirements of section 152(2) of NUPPAA.

This report also presents results of monitoring undertaken pursuant to water licence 3AM-IQA1626 and Fisheries and Oceans Canada Letter of Advice 19-HCAA-00969.

2 PROJECT WORKS AND ACTIVITIES

The Iqaluit 2019 Emergency Water Supply Project was completed between August 10, 2019 and October 17, 2019. Works and activities completed include:

- Mobilization of equipment and infrastructure to Apex River and Unnamed Lake pumping sites
- Construction of an access trail from Road to Nowhere to Unnamed Lake
- Construction of semi-permanent pipeline from Apex River to Lake Geraldine
- Placement of flexible hoses from Unnamed Lake to Apex River
- Installation and operation of temporary pumps in Unnamed Lake and Apex River
- Conveyance of water from Unnamed Lake to Apex River and from Apex River to Lake Geraldine
- Supporting activities such as power supply, maintenance, refueling and monitoring
- Demobilization of equipment and infrastructure (except semi-permanent pipeline)

The location of works and activities is shown in Figure 2-1. An access trail was constructed using local borrow material to facilitate mobilization, operations, maintenance and demobilization activities at Unnamed Lake. Culverts were installed to maintain cross-drainage as required based on site observations.

Two medium-head, 58 Hp submersible pumps were installed in Unnamed Lake, and water was pumped approximately 1.2 km overland via flexible hoses for discharge into the Apex River at a location approximately 2.3 km upstream of the Apex River pumping site. Pumps were housed in a screened cage to meet the Fisheries and Oceans Canada (DFO) Freshwater Intake End-of-Pipe fish Screen Guidelines (Department of Fisheries and Oceans 1995). This additional water traveled downstream along with Apex River natural flow. Water was then pumped from three high-head 94 Hp submersible pumps in the Apex River and conveyed overland to Lake Geraldine. Pumping took place continuously between August 25, 2019 and October 1, 2019. All temporary infrastructure and equipment were demobilized in October 2019. The access trail and semi-permanent pipeline between the Apex River and Lake Geraldine have remained in place.

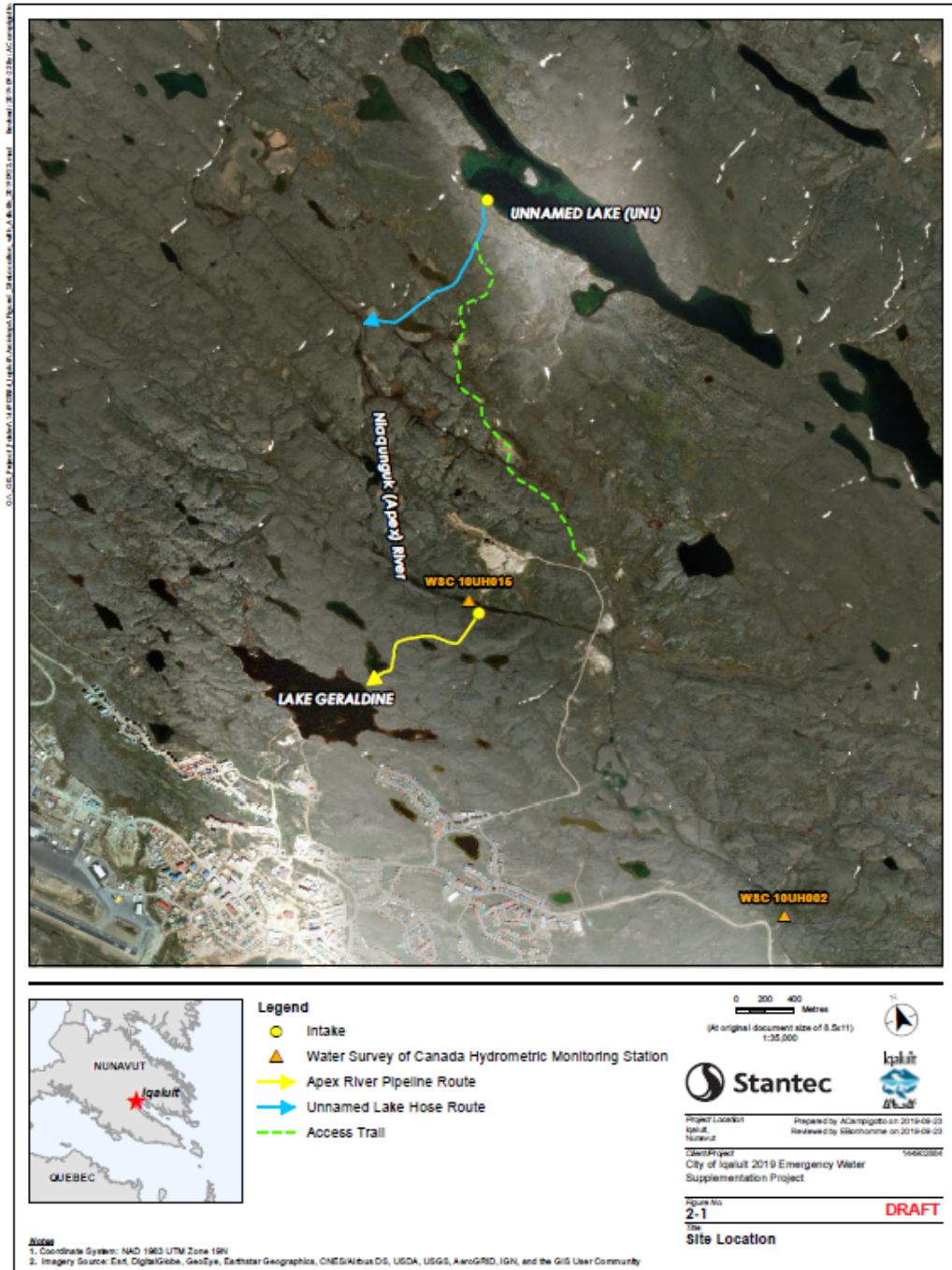
No activities associated with the Iqaluit 2019 Emergency Water Supply Project are needed to be maintained, as the authorized project is considered complete. For additional clarity, the semi-permanent pipeline from Apex River to Lake Geraldine is necessary to the activities within the scope of a separate project (Apex River Drinking Water Supply 2019-2026; water licence “amendment #4”; NIRB file 19UN013).

A total of 462,394 cubic meters (m³) were withdrawn from Unnamed Lake, as measured at SNP IQA-10. A total of 568,103 m³ were withdrawn from the Apex River, as measured at SNP UNL-01. Lake Geraldine was filled to within 0.064 m of spillway elevation at the suspension of pumping on October 1, 2019, reflecting a capacity deficit of 32,000 m³.

Prior to, during and after supplementation activities, Nunami Stantec Limited (Nunami Stantec) conducted daily monitoring in accordance with the Operational Monitoring Plan (Nunami Stantec Ltd. 2019b) (Appendix B).

PLACEHOLDER

Figure 2-1 Iqaluit 2019 Emergency Water Supplementation Project Site Overview



3 OPERATIONAL MONITORING PLAN

The Operational Monitoring Plan was designed to be implemented during water withdrawal activities to maintain compliance with Type A Water Licence 3AM-IQA1626 (Amendment No. 3) and with advice provided by Fisheries and Oceans Canada in a Letter of Advice 19-HCAA-00969.

The objective of monitoring activities was to observe hydrologic conditions in the Unnamed Lake, the Unnamed Lake outlet, and Apex River during pumping conditions and to inform changes in pumping rates that were required variably throughout the program.

The Operational Monitoring Plan for the 2019 Emergency Water Supplementation Project relied on Nunami Stantec established field monitoring locations and information supplied by the Water Survey of Canada (WSC) at established hydrometric monitoring locations, shown on Figure 3-1. The Operational Monitoring Plan provided further background details on the water licence requirements and rationale for the selection of chosen monitoring locations and sources (Nunami Stantec Ltd. 2019b).

The Operational Monitoring Plan provided a detailed description of monitoring locations, frequency, and parameters to be monitored throughout the program. A summary of monitoring locations and activities completed during the program is presented in Table 3-1. A photo log is provided in Appendix C.

Table 3-1 2019 Operational Monitoring Program Summary

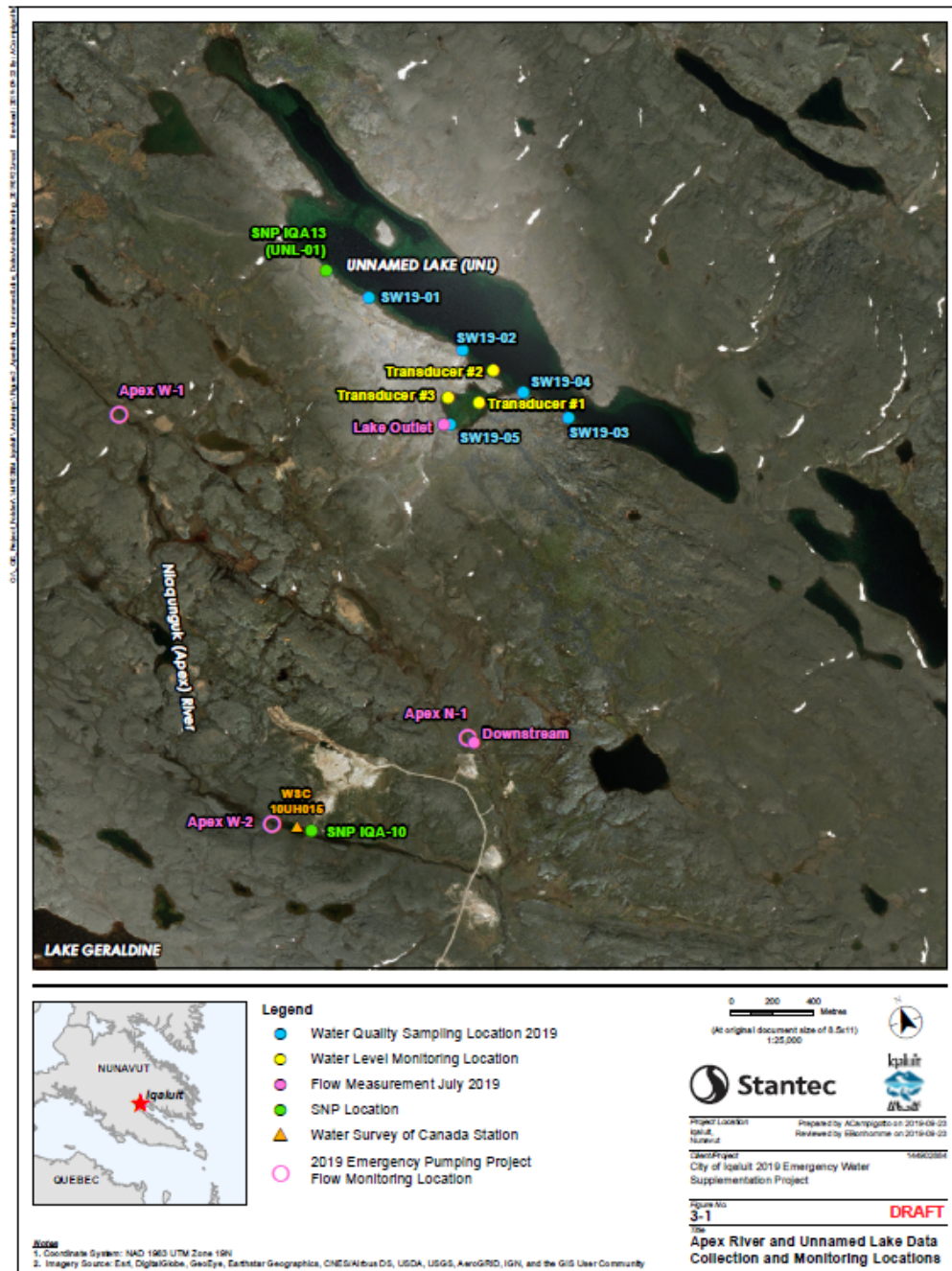
| Monitoring Location ID | Latitude | Longitude | Monitoring Parameter | Method | Data Source (Nunami Stantec, Contractor, or WSC Location) |
|------------------------|-------------|--------------|---|---|---|
| SNP UNL-01 | 63.783274 | -68.455219 | Water level Unnamed Lake | Staff Gauge Readings | Nunami Stantec |
| | 63.783274 | -68.455219 | Pumped Flow | Volumetric Flow Meter | Contractor |
| SNP IQA-10 | 63.760535 | -68.475915 | Pumped Flow | Volumetric Flow Meter | Contractor |
| Apex W-1 | 63.78050629 | -68.4793296 | Spot flow upstream of where discharge from Unnamed Lake (UNL) enters Apex River | Sontek Flowtracker Discharge Measurements | Nunami Stantec |
| | | | Temperature, Turbidity downstream of where discharge from UNL enters Apex River | Hana handheld Turbidity meter | Nunami Stantec |
| Apex W-2 | 63.7614205 | -68.47936781 | Water level Apex River immediately upstream of Apex pump site | Staff Gauge Readings | Nunami Stantec |
| | | | Spot flow immediately upstream of Apex pump site | Sontek Flowtracker Discharge Measurements | Nunami Stantec |

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| Monitoring Location ID | Latitude | Longitude | Monitoring Parameter | Method | Data Source (Nunami Stantec, Contractor, or WSC Location) |
|--|-----------------|------------------|--|---|--|
| Apex N-1 | 63.76196846 | -68.45829888 | Spot flow in Apex River tributary discharging from UNL | Sontek Flowtracker Discharge Measurements | Nunami Stantec |
| Transducers #1, #2, #3 | Various | Various | Water levels UNL | Solinst Data loggers | Nunami Stantec |
| "Apex River at Apex" (station ID: UH10UH002) | 63° 44' 09" | 68° 27' 05" | Water level and flow data for Apex River downstream of pump site | Access data online | WSC |
| "Apex River 1km Above Bridge to Nowhere" (station ID: 10UH015) | 63° 45' 41" | 68° 28' 37" | Water level immediately upstream of Apex pump site | Access data online | WSC |
| "Lake Geraldine Near Iqaluit" (station ID: 10UH013) | 63° 45' 23" | 68° 30' 15" | Water level in Lake Geraldine | Access data online | WSC |

Figure 3-1 Iqaluit 2019 Emergency Water Supplementation Project Monitoring Locations



4 METHODS

The intent of the daily monitoring program was to maintain compliance with the water licence, and to monitor, record, and analyze the effects of the 2019 Emergency Water Supplementation Project on the natural system. As described in the Operational Monitoring Plan (Appendix B) monitoring was developed to establish the parameters, frequency, methods, contingencies and communications to guide monitoring of water withdrawal activities approved in Emergency Amendment No. 3 and in DFO's Letter of Advice. An adaptive management approach was selected to provide a framework for decision-making based on field observations and data analysis.

The following sections describe the methods undertaken to collect data during the 2019 Emergency Water Supplementation Program.

4.1 Water Withdrawal Pumping Rates

Permitted extraction rates for the 2019 Emergency Water Supplementation Program were limited to 10% of the instantaneous flow at the withdrawal location when flows were above 30% of the Mean Annual Discharge (MAD) in the Apex River. The addition of supplemental flow to the river from Unnamed Lake maintain flows above than 30% MAD threshold for the duration of the project.

On a daily basis, Nunami Stantec:

- Noted the average daily flows recorded at WSC "Apex River at Apex" station 10UH002 (WSC Apex)
 - *downloaded and analyzed daily by Nunami Stantec – refer to Section 4.3*
- Recorded the daily average pump rates at SNP UNL-01 and at SNP IQA-10
 - *pump rates recorded by the contractor on an hourly basis and provided to Nunami Stantec on a daily basis; average pump rates were calculated by Nunami Stantec using the average pump rate for the daily period when pumps were operational.*
- Collected spot flow measurements at Apex W-1, at Apex W-2, and at Apex N-1
 - *conducted in the field once daily by Nunami Stantec field staff – refer to Section 4.3*

DFO guidelines for water withdrawals recommend that proponents can withdraw water from a waterbody at a rate up to 10% of the instantaneous flow as long as flows are above 30% of MAD. To calculate 30% MAD, Nunami Stantec used the available period of record for the WSC Apex from 1973 to 2017 (> 35-year record and excluding 0 values). Nunami Stantec calculated a MAD of 1.056 m³/s, which equates to a 30% MAD threshold of 0.316 m³/s. To scale flows measured at the WSC station to the pumping location, a factor of 0.73 was used, the same factor as was used in the 2018 Emergency Water Supplementation Program. A discussion of the scaling factors is included in Section 6.

In order to determine whether Apex River flows exceeded the 30% MAD threshold at any given time, Nunami Stantec scaled average daily flows from WSC Apex to the pumping location (SNP IQA-10). Flows were adjusted to represent 'natural' flows by accounting for flows pumped into (SNP UNL-01) and out of

(SNP IQA-10) the Apex River. The scaled flows were compared with Apex W-2 spot flow measurements for reference. This calculation was done on a daily basis and informed potential pumping rate adjustments. Two common scenarios throughout the program were:

- When natural flows in the Apex River were declining and nearing 30% MAD – the project team would adjust (reduce) pumping rates at SNP IQA-10 (pumping from Apex River to Lake Geraldine) compared to SNP UNL-01 (pumping from Unnamed Lake to Apex River)
- When natural flows in the Apex River increased after a rainfall event to above 30% MAD – the project team would calculate the available natural flow from the Apex River (10% of flow), add this to the pumping rate of SNP UNL-01 and attempt to set the pumping rate at SNP IQA-10 to this combined rate.

Spot flow measurements were conducted at Apex W-1 and were used to confirm the estimated natural flows calculated and to monitor the Apex River's natural response to rainfall events as it was upstream of any pumping activity.

Daily summaries were compiled and reported via Daily Environmental Monitoring Reports (Appendix D). Daily summaries included a compilation of measured and calculated flow and water level data, as well as commentary on visual observations, equipment maintenance and shutdowns, weather impacts, and recommended pump rate adjustments.

4.2 Water Levels in Unnamed Lake

STAFF GAUGES

Water level data was collected from Unnamed Lake using a staff gauge located near the intake of the pump (SNP UNL-01) and near the pump intakes at SNP IQA-10. Staff gauge readings were recorded daily during the pumping program by the contractor and Nunami Stantec staff and used to establish declining or increasing trends in water levels on a daily basis. Water levels reported from staff gauge readings have not been surveyed and therefore provide only relative water level information (i.e. how water levels changed from day to day). (Nunami Stantec Ltd. 2019c)

PRESSURE TRANSDUCERS

Data loggers were deployed in Unnamed Lake approximately 500m east of the pumping location. One data logger was deployed in approximately 3 m of water in the main portion of Unnamed Lake and required a boat to retrieve it (transducer 1). This transducer had previously been deployed in the fall of 2018. A second data logger was deployed in approximately 2.5 m of water in a small bay connecting Unnamed Lake to its discharge channel and also required a boat to retrieve it (transducer 2). This transducer had also been deployed in the fall of 2018 as a back-up to transducer 1 as field conditions through the winter were unknown. A third data logger was deployed in August 2019 in the small bay along the south shore of Unnamed Lake, near the shore in approximately 0.5 m of water. This logger was accessible from shore and was deployed to facilitate quick and safe access to a water level information through the pumping program.

Data were primarily corrected for atmospheric pressure using a barometric pressure transducer located on shore near the three data loggers. Barometric pressure reported at the Iqaluit Climate Station were used for data correction for a portion of time when it is believed that the on-site barologger readings were impacted by the extreme cold weather at the Site. This occurred prior to pumping activities (i.e. winter 2018/19) and the onsite barologger was used to correct data throughout the 2019 pumping program. Local benchmarks were established during November 2018 field work near the data logger locations using real time kinematic (RTK) survey equipment. Establishing known elevation benchmarks allowed for water surface level data to be converted into water surface elevation data. A local level survey of the benchmarks and water surface, using rod and level equipment, prior to and following each subsequent field visit and data logger download was completed. The local level surveys allowed for corrections in data logger movement to be accounted for. This was necessary as data loggers were retrieved from the lake bottom for each download and replaced in approximately the same location following the download.

4.3 Apex River Flow Measurements

SPOT FLOW MEASUREMENTS

Spot flow measurements were completed daily at three locations:

- Apex River upstream of Unnamed Lake discharge location (Apex W-1) – to determine Apex River flows upstream of the confluence of pumped water from Unnamed Lake and Apex River natural flows.
- Apex River upstream of Apex River pump intake location (Apex W-2) – to determine augmented Apex River flows upstream of the Apex River pump intake location.
- Unnamed Lake natural outflows (Apex N-1) – to determine the contribution of Unnamed Lake outflow to Apex River downstream of the Apex River pumping location and to establish potential impact on Apex River flows if the Unnamed Lake outflow is cut off during pumping activities.

Flow measurements were conducted by Nunami Stantec staff using Sontek Flowtracker equipment and following Environment Canada guidance (WSC 2015).

WATER SURVEY OF CANADA DATA

WSC data was obtained on a daily basis at each of the monitored stations: “Apex River at Apex” (station ID: 10UH002) and “Apex River 1 km Above Bridge to Nowhere” (station ID: 10UH015). Each day, the complete record of the previous day was analyzed. Station 10UH002 has a period of record 1973-present and reports water level and discharge in 5-min time increments. Station 10UH015 was installed July 2019 and currently reports water level in 5-min time increments.

Data was obtained from the WSC website, and while labeled as “real-time” there is a delay of several hours before data is posted, and data can be subject to future revisions following WSC QA/QC procedures.

ENVIRONMENT AND CLIMATE CHANGE CANADA DATA

In many instances throughout the monitoring of the 2019 Emergency Water Supplementation Program, it was useful to consult weather forecasts for the area to determine whether adjustments to pumping rates were expected to be required and to compare observed flow rates with reported precipitation amounts. Nunami Stantec used the weather forecast data provided by Environment and Climate Change Canada (ECCC) for Iqaluit Airport (Climate ID: 2402596) (Environment and Climate Change Canada [ECCC] 2019), which was subsequently confirmed using the historic data for the Iqaluit Climate station, provided by ECCC and operated by Meteorological Services Canada (Meteorological Services Canada [MSC] 2019). Data was obtained on an as-needed basis, based on field observations.

4.4 Lake Geraldine Water Level

Lake Geraldine water levels were monitored daily using WSC station “Lake Geraldine Near Iqaluit” (station ID: 10UH013). This station provided real-time water level data available in 10-min increments (period of record 2007-present). Nunami Stantec developed a stage-storage curve for Lake Geraldine based on 2008 bathymetry data (Nunami Stantec Ltd. 2019c). Reported WSC water levels were used with the stage-storage curve to confirm the volumes pumped to the reservoir and the remaining volume within the reservoir.

A recent bathymetry survey of Lake Geraldine was conducted by TetraTech in July 2019 to confirm previous analyses conducted by Nunami Stantec; the total volume estimates generated by Nunami Stantec (1,168,323 m³) (Nunami Stantec Ltd. 2019c) and Tetra Tech (1,205,600 m³) (Tetra Tech Canada Inc. 2019) on the day of the bathymetry survey were within 3.2%.

4.5 Unnamed Lake Water Quality

Field staff conducted surface water sampling in Unnamed Lake to demonstrate acceptable quality against Public Health Protection Northern Health water quality parameters. Sampling was done in accordance with Stantec Consulting Ltd. (Stantec)'s Standard Operating Procedures. Sample locations and the analyses performed for each sample are shown in Table 4-1 below. Results were previously reported in (Nunami Stantec Ltd. 2019a).

Table 4-1 Laboratory Analysis – Water Quality Sample Location Summary

| Location ID | Parameters Sampled | Date Sampled | Latitude | Longitude |
|-------------|--|--|-----------|-----------|
| SW19-01 | General Chemistry, benzene/ toluene/ ethylbenzene/ xylene (BTEX) and Petroleum Hydrocarbons (PHCs), Metals, and Microbiology | July 4, 2019 and September 12, 2019 (BTEX, PHC, and mercury) | 63.781474 | -68.45223 |
| SW19-02 | General Chemistry, BTEX and PHCs, Metals, and Microbiology | July 4, 2019 and September 12, 2019 (BTEX, PHC, and mercury) | 63.77787 | -68.44533 |
| SW19-03 | General Chemistry, BTEX and PHCs, Metals, and Microbiology | July 4, 2019 and September 12, 2019 (BTEX, PHC, and mercury) | 63.77353 | -68.43791 |
| SW19-04 | General Chemistry, BTEX and PHCs, Metals, and Microbiology | July 4, 2019 and September 12, 2019 (BTEX, PHC, and mercury) | 63.77522 | -68.44123 |
| SW19-05 | General Chemistry, BTEX and Petroleum Hydrocarbons, Metals, and Microbiology | July 4, 2019 and September 12, 2019 (BTEX, PHC, and mercury) | 63.77502 | -68.44905 |

In-situ turbidity results were collected by Nunami Stantec field staff at the following locations using a Hanna handheld turbidity meter:

Table 4-2 Operational Monitoring - Sample Location Summary

| Location ID | Location Description | Dates Sampled | Approximate Coordinates | |
|-------------|--|--------------------------------------|-------------------------|--------------|
| | | | Latitude | Longitude |
| Apex W-1 | in Apex River, upstream of pumping effects from Unnamed Lake | August 21, 2019 – September 12, 2019 | 63.78050629 | -68.4793296 |
| DSAD | in Apex River, downstream of the discharge from Unnamed lake | August 26, 2019 – September 11, 2019 | 63.779177 | -68.477376 |
| Apex W-2 | in Apex River, upstream of the Apex River intake to Lake Geraldine | August 21, 2019 – September 11, 2019 | 63.7614205 | -68.47936781 |
| Apex N-1 | in the outflow from Unnamed Lake, upstream of the Apex River | August 21, 2019 – September 11, 2019 | 63.76196846 | -68.45829888 |

5 RESULTS

Daily monitoring was conducted between August 21, 2019 and October 2, 2019. Monitoring results are presented below and further discussed below. Daily pumping summary reports were generated throughout the 2019 Emergency Water Supplementation Program and are provided in Appendix D.

5.1 Water Withdrawal Pumping Rates

Water withdrawal from the Unnamed Lake at SNP UNL-01 began on August 25, 2019, using two pumps directed through a single flow totalizer. Water withdrawal was continuous throughout the program with several exceptions for equipment maintenance. A single pump or both pumps were operated as required depending on when natural flows in the Apex River were adequate to supply SNP IQA-10 pumping demands with only a single pump providing supplementation. Water withdrawal at SNP IQA-10 began on August 25, 2019 using three pumps after it was confirmed through flow monitoring that water pumped from Unnamed Lake had reached SNP IQA-10. Pumping at SNP IQA-10 was also continuous throughout the program, with several brief shutdowns for equipment maintenance

Table 5-1 provides a summary of volumes and flows pumped at both SNP IQA-10 and SNP UNL-01 locations. Monthly quantities are also provided at the bottom of Table 5-1. The total volumetric withdrawal limit provided in the City's water license were set at 700,000 m³ for each pumping location and pumped volumes at both locations did not exceed this. Figure 5-1 and Figure 5-2 display the daily and cumulative pumped volumes respectively for both locations.

As the natural flow in the Apex River remained above 30% MAD for the majority of the pumping program there was nearly always some natural flow that could be withdrawn from the river. Additionally, precipitation events during the pumping program resulted in increased natural flow in the Apex River. This allowed for the majority of days to have a higher pumping rate at SNP IQA-10 compared to that at SNP UNL-01, as shown in Figure 5-1. The pumps and equipment used at Unnamed Lake (SNP UNL-01) did not allow for fine tuning of the pumping rate. The pump flow meter was considered precise, but the exact pumping rate had limited means of control.

Figure 5-2 illustrates that the cumulative water volume pumped from the Apex River was greater than the volume pumped from Unnamed Lake. This discrepancy is a result of natural flows in the Apex River remaining over 30% MAD for the majority of the pumping program.,

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Table 5-1 2019 Water Supplementation Pumped Flow and Volume Summary

| Date | Apex River Pump System | | | Unnamed Lake Pump System | | |
|-----------|--|---|--|--|---|--|
| | SNP IQA-10 Average Pumping Rate (m ³ /s) | SNP IQA-10 Daily Pumped Volume (m ³) | SNP IQA-10 Cumulative Pumped Volume (m ³) | SNP UNL-01 Average Pumping rate (m ³ /s) | SNP UNL-01 Daily Pumped Volume (m ³) | SNP UNL-01 Cumulative Pumped Volume (m ³) |
| 8/25/2019 | 0.134 | 4,167 | 4,167 | 0.196 | 10,830 | 10,830 |
| 8/26/2019 | 0.156 | 13,888 | 18,055 | 0.181 | 15,590 | 26,420 |
| 8/27/2019 | 0.150 | 11,791 | 29,846 | 0.181 | 15,638 ^b | 42,058 |
| 8/28/2019 | 0.145 | 12,677 | 42,523 | 0.181 | 15,638 ^b | 57,697 |
| 8/29/2019 | 0.145 | 12,698 | 55,221 | 0.181 | 15,638 ^b | 73,335 |
| 8/30/2019 | 0.143 | 12,502 | 67,723 | 0.169 | 14,605 ^b | 87,940 |
| 8/31/2019 | 0.148 | 10,809 | 78,532 | 0.150 | 12,995 | 100,935 |
| 9/1/2019 | 0.187 | 16,168 | 94,700 | 0.151 | 13,006 | 113,941 |
| 9/2/2019 | 0.189 | 16,287 | 110,987 | 0.148 | 12,722 | 126,663 |
| 9/3/2019 | 0.187 | 16,257 | 127,244 | 0.146 | 12,615 | 139,278 |
| 9/4/2019 | 0.188 | 16,235 | 143,479 | 0.147 | 12,661 | 151,939 |
| 9/5/2019 | 0.189 | 16,369 | 159,848 | 0.094 | 6,622 | 158,561 |
| 9/6/2019 | 0.187 | 16,198 | 176,046 | 0.145 | 11,863 | 170,424 |
| 9/7/2019 | 0.183 | 14,437 | 190,483 | 0.141 | 12,224 | 182,648 |
| 9/8/2019 | 0.186 | 18,198 | 208,681 | 0.1484 | 12,607 | 195,255 |
| 9/9/2019 | 0.186 | 16,113 | 224,794 | 0.1615 | 15,408 | 210,663 |
| 9/10/2019 | 0.185 | 16,002 | 240,796 | 0.146 | 9,841 | 220,504 |
| 9/11/2019 | 0.168 | 14,739 | 255,535 | 0.1414 | 15,233 | 235,737 |
| 9/12/2019 | 0.184 | 15,880 | 271,415 | 0.1412 | 12,517 | 248,254 |
| 9/13/2019 | 0.186 | 16,029 | 287,444 | 0.1218 | 10,537 | 258,791 |
| 9/14/2019 | 0.193 | 16,065 | 303,509 | 0.1163 | 10,049 | 268,840 |
| 9/15/2019 | 0.193 | 14,699 | 318,208 | 0.1214 | 7,538 | 276,378 |
| 9/16/2019 | 0.185 | 16,987 | 335,195 | 0.1317 | 14,474 | 290,852 |
| 9/17/2019 | 0.196 | 16,489 ^a | 351,284 | 0.169 | 14,711 | 305,563 |
| 9/18/2019 | 0.184 | 16,245 | 367,529 | 0.218 | 18,821 | 324,384 |
| 9/19/2019 | 0.186 | 15,996 | 384,865 | 0.185 | 16,832 | 341,216 |
| 9/20/2019 | 0.184 | 14,560 | 399,425 | 0.1325 | 8,001 | 349,217 |
| 9/21/2019 | 0.183 | 15,770 ^a | 415,195 | 0.115 | 9,998 | 359,215 |
| 9/22/2019 | 0.184 | 15,486 | 430,681 | 0.115 | 9,900 | 369,115 |
| 9/23/2019 | 0.188 | 16,282 | 446,963 | 0.115 | 9,909 | 379,024 |
| 9/24/2019 | 0.176 | 15,479 | 462,442 | 0.116 | 12,973 | 391,997 |
| 9/25/2019 | 0.182 | 15,758 | 478,187 | 0.116 | 7,018 | 399,015 |
| 9/26/2019 | 0.183 | 15,798 | 493,985 | 0.1155 | 10,008 | 409,023 |
| 9/27/2019 | 0.181 | 15,692 | 509,677 | 0.1269 | 11,282 | 420,305 |

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| Date | Apex River Pump System | | | Unnamed Lake Pump System | | |
|--------------------------------------|--|---|--|--|---|--|
| | SNP IQA-10 Average Pumping Rate (m ³ /s) | SNP IQA-10 Daily Pumped Volume (m ³) | SNP IQA-10 Cumulative Pumped Volume (m ³) | SNP UNL-01 Average Pumping rate (m ³ /s) | SNP UNL-01 Daily Pumped Volume (m ³) | SNP UNL-01 Cumulative Pumped Volume (m ³) |
| 9/28/2019 | 0.181 | 15,020 | 528,101 | 0.123 | 7,964 | 428,269 |
| 9/29/2019 | 0.181 | 15,988 | 540,685 | 0.146 | 12,665 | 440,934 |
| 9/30/2019 | 0.181 | 16,349 | 557,034 | 0.146 | 12,889 | 453,823 |
| 10/1/2019 | 0.181 | 10,207 ^a | 568,103 | 0.144 | 8,571 | 462,394 |
| August total (7 days) | - | 78,532 | - | - | 100,935 | - |
| September total (30 days) | - | 477,575 | - | - | 352,888 | - |
| October total (1 day) | - | 10, 207 | - | - | 8,571 | - |
| Total Volume Pumped | | 568,103 | | | 462,394 | |

Notes:

a – Minor errors were noted in the recorded daily pumped rates on these days (<1%). Cumulative volumes reported in this table reflect the actual pumped volumes.

b – Flow meter at Unnamed Lake malfunctioned on August 27th, a new flow meter was installed August 31st. Flows on previous days were assumed to be representative of flows for the days with missing records.

c – Due to minor reporting errors in daily pumped rates noted in (a) the sum of the daily and monthly pumped volumes differs slightly from the final flow totalizer reading for each pump location. The Total Volume Pumped shown is the final reading on each flow totalizer.

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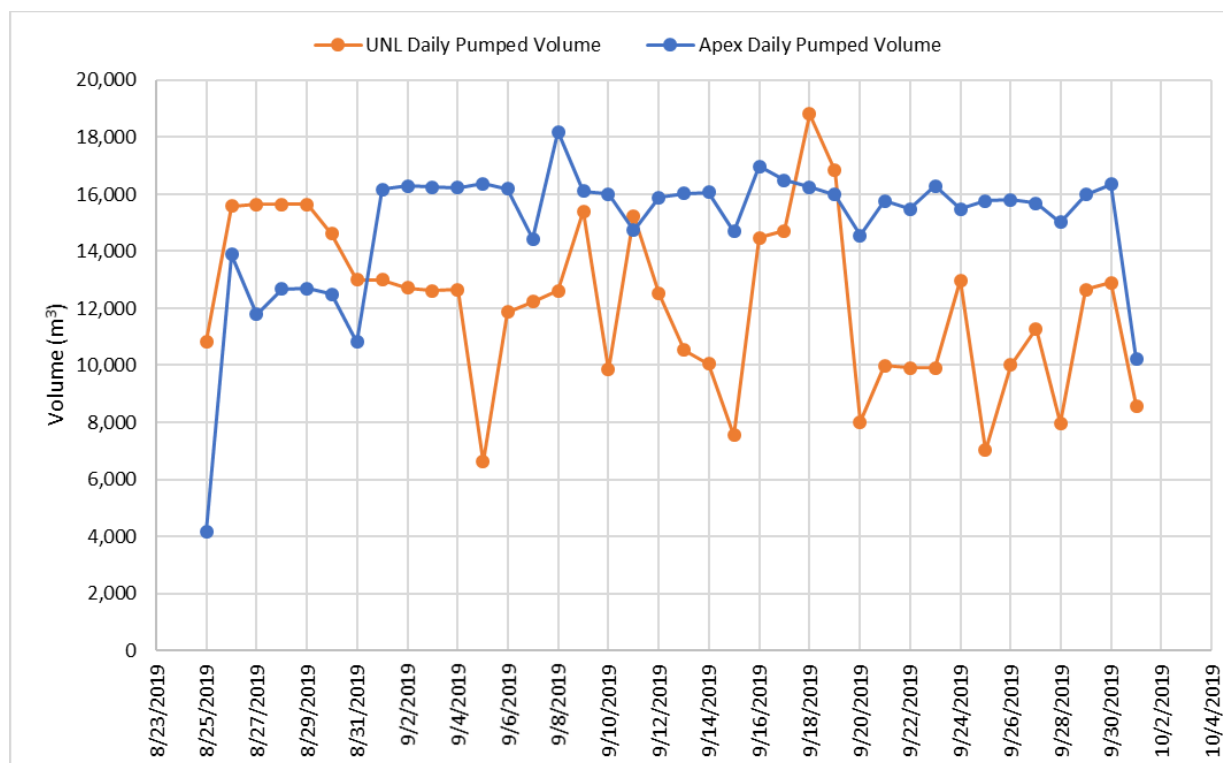


Figure 5-1 Daily Pumped Volumes – Unnamed Lake (UNL) and Apex River.

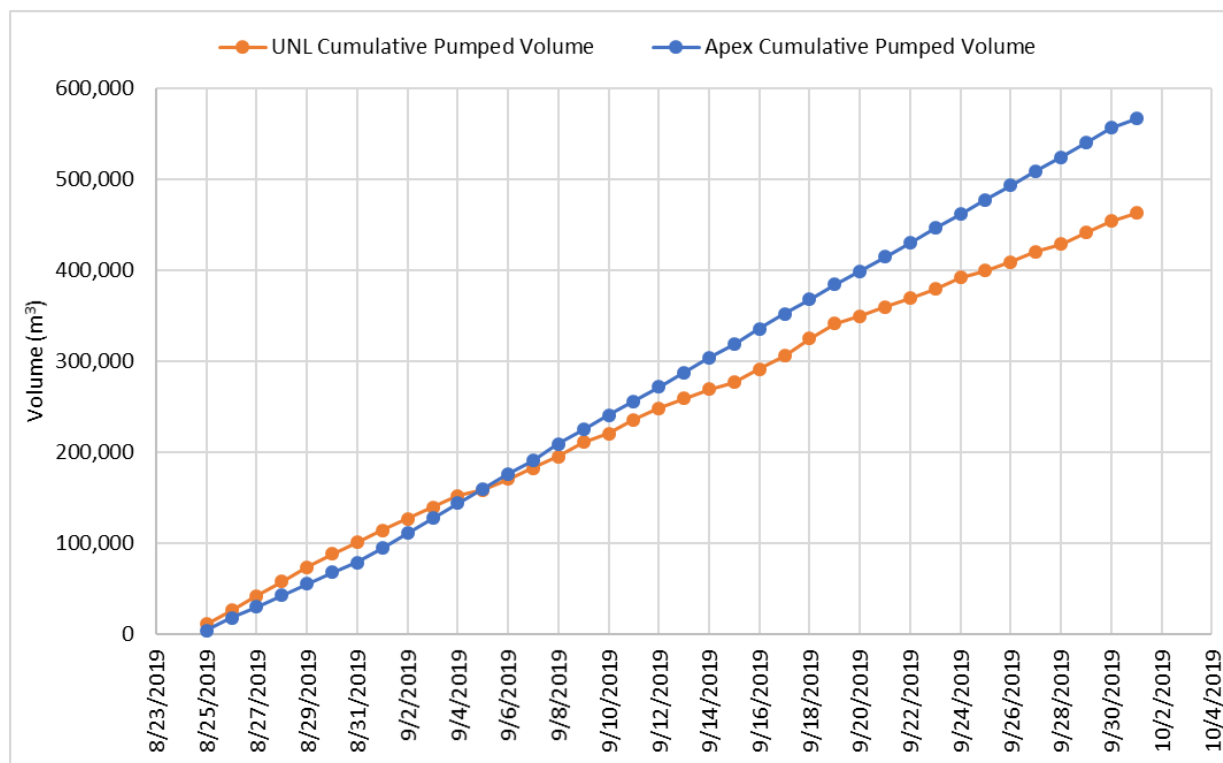


Figure 5-2 Cumulative Pumped Volumes – Unnamed Lake (UNL) and Apex River.

5.2 Water Levels

STAFF GAUGES

Water levels were recorded at Unnamed Lake near the pump intake and at the Apex River pumping site using a staff gauge. Manual staff gauge readings were recorded and reported in the Daily Summary Reports (Appendix D) and are summarized in Table 5-2 below. Water levels reported from staff gauge readings have not been surveyed and therefore provide only relative water level information (i.e. how water levels change from day to day).

Table 5-2 Staff Gauge Reading (Apex W-2, Unnamed Lake) Summary

| Date | Apex W-2 | Unnamed Lake |
|-----------|------------------|-----------------|
| | Water Level (m) | Water Level (m) |
| 8/20/2019 | 0.410 | 0.750 |
| 8/21/2019 | 0.408 | not measured |
| 8/22/2019 | 0.405 | not measured |
| 8/23/2019 | not measured | not measured |
| 8/24/2019 | 0.405 | 0.749 |
| 8/25/2019 | 0.405 (pre pump) | 0.740 |
| 8/26/2019 | not measured | 0.740 |
| 8/27/2019 | not measured | 0.700 |
| 8/28/2019 | not measured | 0.690 |
| 8/29/2019 | not measured | 0.670 |
| 8/30/2019 | not measured | 0.690 |
| 8/31/2019 | not measured | 0.680 |
| 9/1/2019 | not measured | 0.695 |
| 9/2/2019 | 0.550 | 0.720 |
| 9/3/2019 | 0.540 | 0.725 |
| 9/4/2019 | 0.535-0.540 | 0.720 |
| 9/5/2019 | 0.563 | 0.753 |
| 9/6/2019 | 0.540 | 0.750 |
| 9/7/2019 | 0.530 | 0.750 |
| 9/8/2019 | 0.515 | 0.740 |
| 9/9/2019 | 0.500 | 0.730 |
| 9/10/2019 | 0.495 | 0.725 |
| 9/11/2019 | 0.495 | 0.720 |
| 9/12/2019 | 0.495 | 0.720 |
| 9/13/2019 | 0.490 | 0.7150 |
| 9/14/2019 | 0.488 | 0.7110 |
| 9/15/2019 | 0.483 | 0.7000 |

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| Date | Apex W-2 | Unnamed Lake |
|--|-----------------|-----------------|
| | Water Level (m) | Water Level (m) |
| 9/16/2019 | 0.478 | 0.698 |
| 9/17/2019 | 0.470 | 0.695 |
| 9/18/2019 | 0.480 | 0.690 |
| 9/19/2019 | 0.480 | 0.696 |
| 9/20/2019 | not measured | not measured |
| 9/21/2019 | 0.500 | 0.775 |
| 9/22/2019 | 0.500 | 0.772 |
| 9/23/2019 | 0.495 | 0.769 |
| 9/24/2019 | 0.490 | 0.765 |
| 9/25/2019 | 0.485 | 0.765 |
| 9/26/2019 | 0.480 | 0.755 |
| 9/27/2019 | 0.485 | 0.775 |
| 9/28/2019 | 0.465 | 0.775 |
| 9/29/2019 | 0.475 | 0.770 |
| 9/30/2019 | 0.478 | 0.770 |
| 10/1/2019 | 0.475 | 0.760 |
| 10/2/2019 | 0.470 | 0.755 |
| Note: Not measured = field measurements not collected due to equipment issues or weather/safety concerns. | | |

PRESSURE TRANSDUCERS

Continuous water level data were collected using the three pressure transducers deployed in Unnamed Lake. Water level data was converted to water surface elevation using the locally established benchmarks as discussed in Section 4.2. Water surface elevation fluctuations correlated well between the three transducers - Figure 5-3 below shows the barometrically corrected water surface elevations for Transducers #3, and others are included in Appendix E.

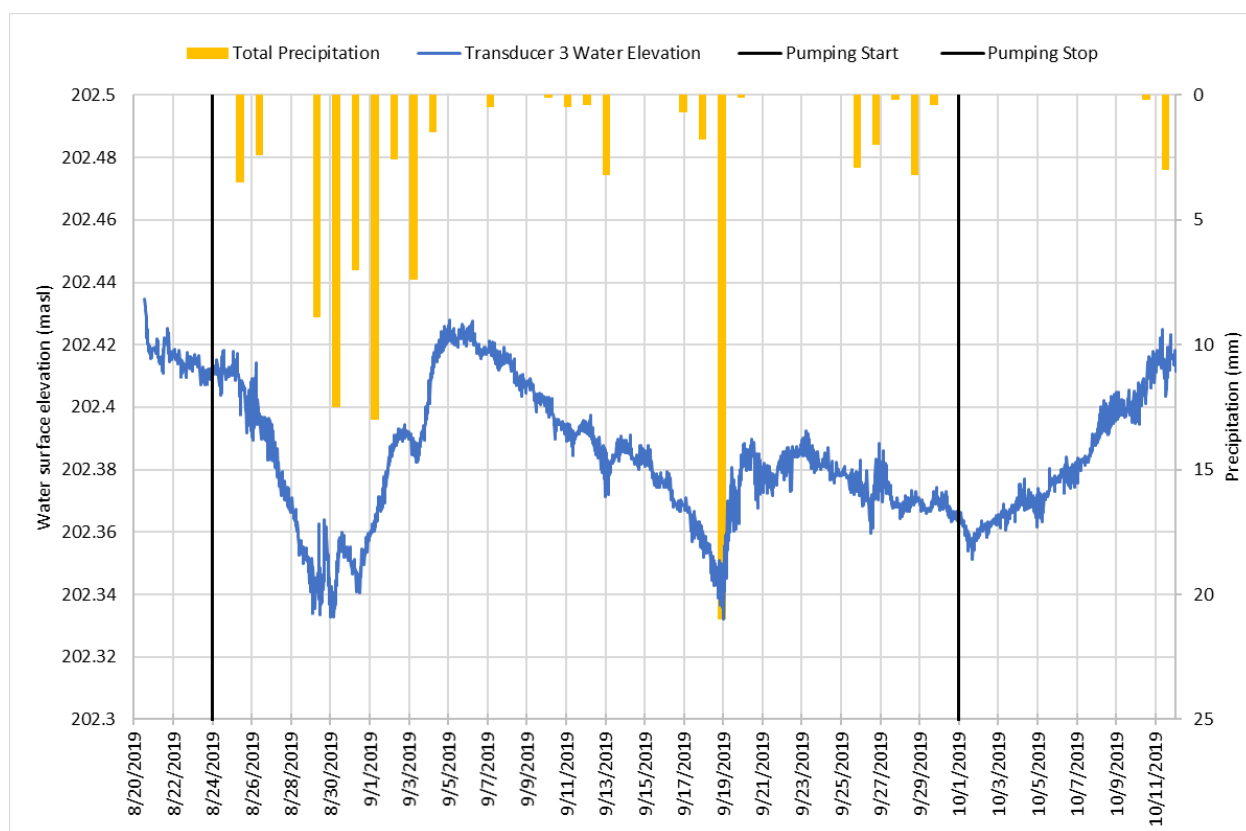


Figure 5-3 Unnamed Lake Transducer 3 Water Surface Elevations During Pumping

5.3 Apex River Flow Measurements

Flow measurements were collected and analyzed on a daily basis from both field measurements and from the WSC Apex station data reported online.

SPOT FLOW MEASUREMENTS

Field flow measurements were taken at three locations daily throughout the pumping program.

Table 5-3 provides a summary of these data below. Data reported as 'not measured' was due to equipment malfunctions (replacement Flow Tracker shipped between Sept. 2nd and 9th, 2019) or unsafe weather/site conditions. WSC flow data were solely relied on during days when no flow measurements were collected.

Table 5-3 Field Flow Measurement Summary

| Date | Apex N-1 | Apex W-1 | Apex W-2 |
|-----------|--------------------------|----------|----------|
| | Flow (m ³ /s) | | |
| 8/20/2019 | not measured | | |
| 8/21/2019 | 0.0241 | 0.0482 | 0.1016 |
| 8/22/2019 | 0.0208 | 0.0588 | 0.1179 |
| 8/23/2019 | not measured | | |

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| Date | Apex N-1 | Apex W-1 | Apex W-2 |
|-----------|--------------|-------------|--------------|
| | Flow (m³/s) | | |
| 8/24/2019 | 0.0242 | 0.0453 | 0.0925 |
| 8/25/2019 | not measured | | 0.2838 |
| 8/26/2019 | 0.0294 | 0.0922 | 0.3268 |
| 8/27/2019 | 0.0251 | 0.0903 | 0.2626 |
| 8/28/2019 | 0.0211 | 0.0604 | 0.3248 |
| 8/29/2019 | 0.0191 | 0.0696 | |
| 8/30/2019 | 0.0638 | 0.2682 | 0.8587 |
| 8/31/2019 | 0.0860 | 0.2841 | 0.5538 |
| 9/1/2019 | 0.1433 | 0.3478 | 0.8797 |
| 9/2/2019 | not measured | | |
| 9/3/2019 | not measured | | |
| 9/4/2019 | not measured | | |
| 9/5/2019 | not measured | | |
| 9/6/2019 | not measured | | |
| 9/7/2019 | not measured | | |
| 9/8/2019 | not measured | | |
| 9/9/2019 | not measured | | |
| 9/10/2019 | 0.0556 | No measured | 1.0478 |
| 9/11/2019 | not measured | 0.4246 | not measured |
| 9/12/2019 | 0.0541 | 0.4056 | 0.7679 |
| 9/13/2019 | 0.0597 | 0.4035 | 0.8737 |
| 9/14/2019 | 0.0550 | 0.3840 | 0.8623 |
| 9/15/2019 | 0.0434 | 0.3579 | 0.7131 |
| 9/16/2019 | 0.0425 | 0.3493 | 0.7303 |
| 9/17/2019 | 0.0322 | 0.3180 | 0.7688 |
| 9/18/2019 | 0.0348 | 0.3060 | 0.7355 |
| 9/19/2019 | not measured | | |
| 9/20/2019 | not measured | | |
| 9/21/2019 | 0.1238 | 0.5528 | 1.0077 |
| 9/22/2019 | 0.0865 | 0.4977 | 1.0702 |
| 9/23/2019 | 0.0552 | 0.4309 | 0.8849 |
| 9/24/2019 | 0.0564 | 0.3879 | 0.9847 |
| 9/25/2019 | 0.0533 | 0.3824 | 0.8432 |
| 9/26/2019 | 0.0470 | 0.3319 | 0.7775 |
| 9/27/2019 | 0.0585 | 0.3574 | 0.9127 |
| 9/28/2019 | 0.0559 | 0.3541 | 0.7117 |
| 9/29/2019 | not measured | 0.3121 | 0.7952 |

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| Date | Apex N-1 | Apex W-1 | Apex W-2 |
|------------|--------------------------|----------|--------------|
| | Flow (m ³ /s) | | |
| 9/30/2019 | not measured | | |
| 10/1/2019 | 0.0532 | 0.2994 | not measured |
| 10/2/2019* | 0.0408 | 0.2623 | 0.4860 |

* - Data from October 2 was collected after pumping operations had finished on October 1, 2019.

WATER SURVEY OF CANADA DATA

Apex River discharge data were collected and analyzed daily; data was downloaded from the WSC. Figure 5-4 below shows discharge data reported at WSC APEX from June 4 to October 2. This figure illustrates the low flows experienced in the Apex River throughout July and August that triggered the need for a supplementary source of water (i.e. Unnamed Lake) because flows were well below 30% MAD.

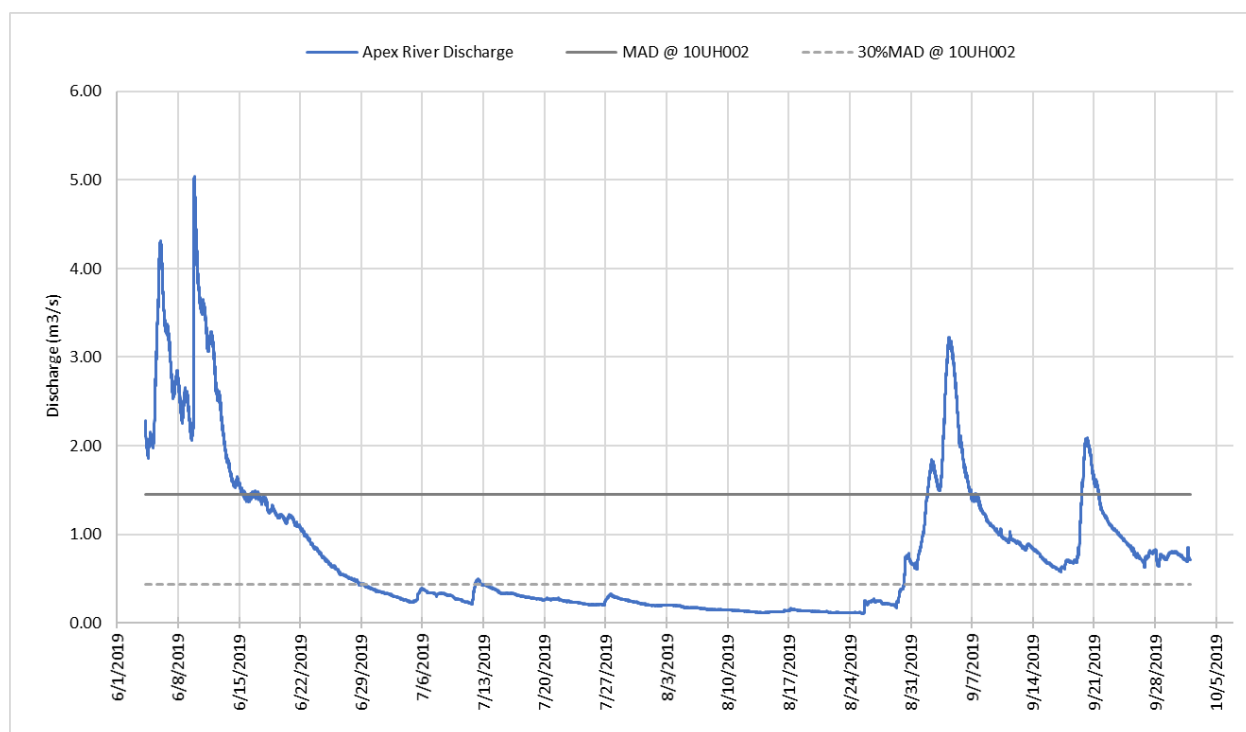


Figure 5-4 Apex River Discharge Data for WSC Station 10UH002

ENVIRONMENT AND CLIMATE CHANGE CANADA DATA

Forecasts from ECCC weather stations and forecasting tools were monitored on a daily and hourly basis to facilitate both field work planning and pumping operations. Daily precipitation values were compared with both Apex River flow data, Lake Geraldine and Unnamed Lake water level data to assess impacts of natural inputs on the pumping program. Figure 5-5 below shows the daily precipitation data reported through 2019 for Iqaluit.

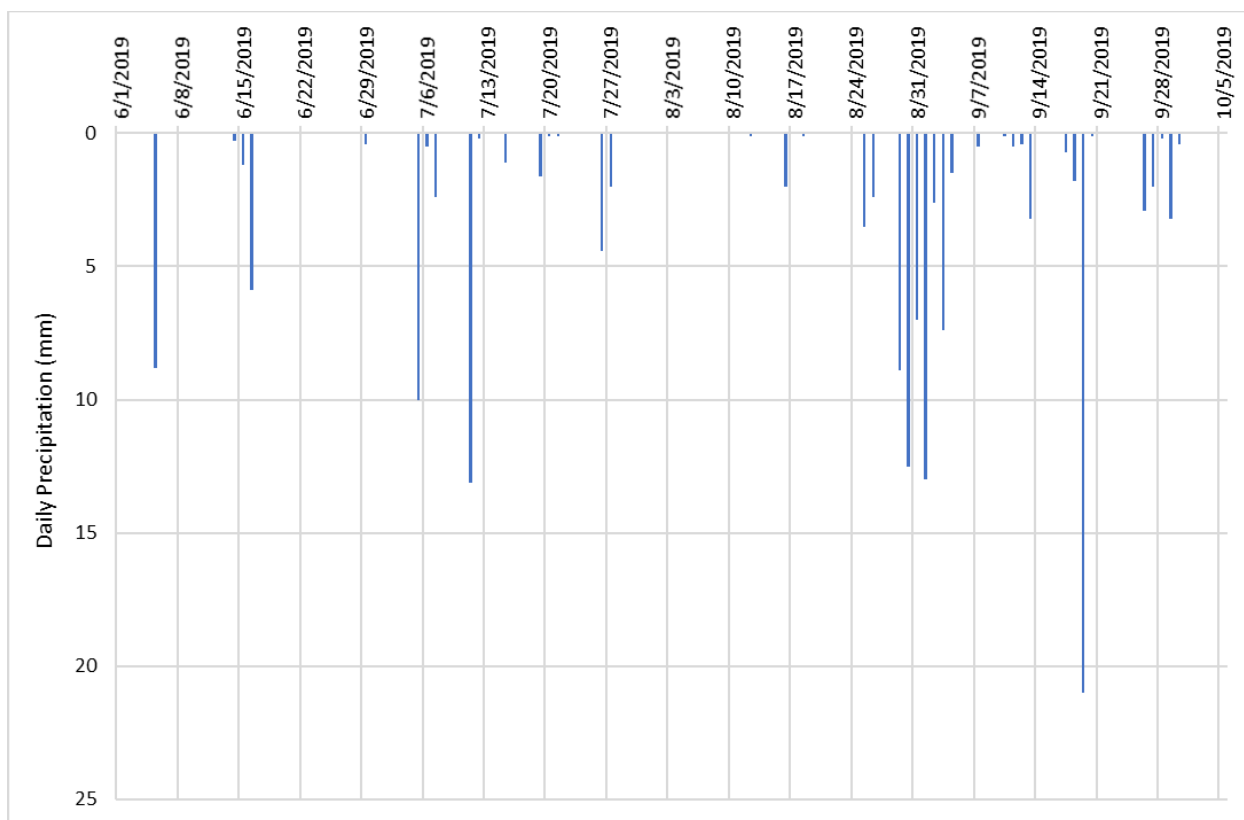


Figure 5-5 Iqaluit Daily Precipitation for 2019

5.4 Lake Geraldine Water Level

Lake Geraldine water level data were collected and analyzed daily using the WSC online portal. Data was downloaded and plotted daily to assess lake levels against the reservoir spill point elevation, as shown in Figure 5-6 below. Figure 5-6 also shows 2018 water levels in Lake Geraldine for comparison.

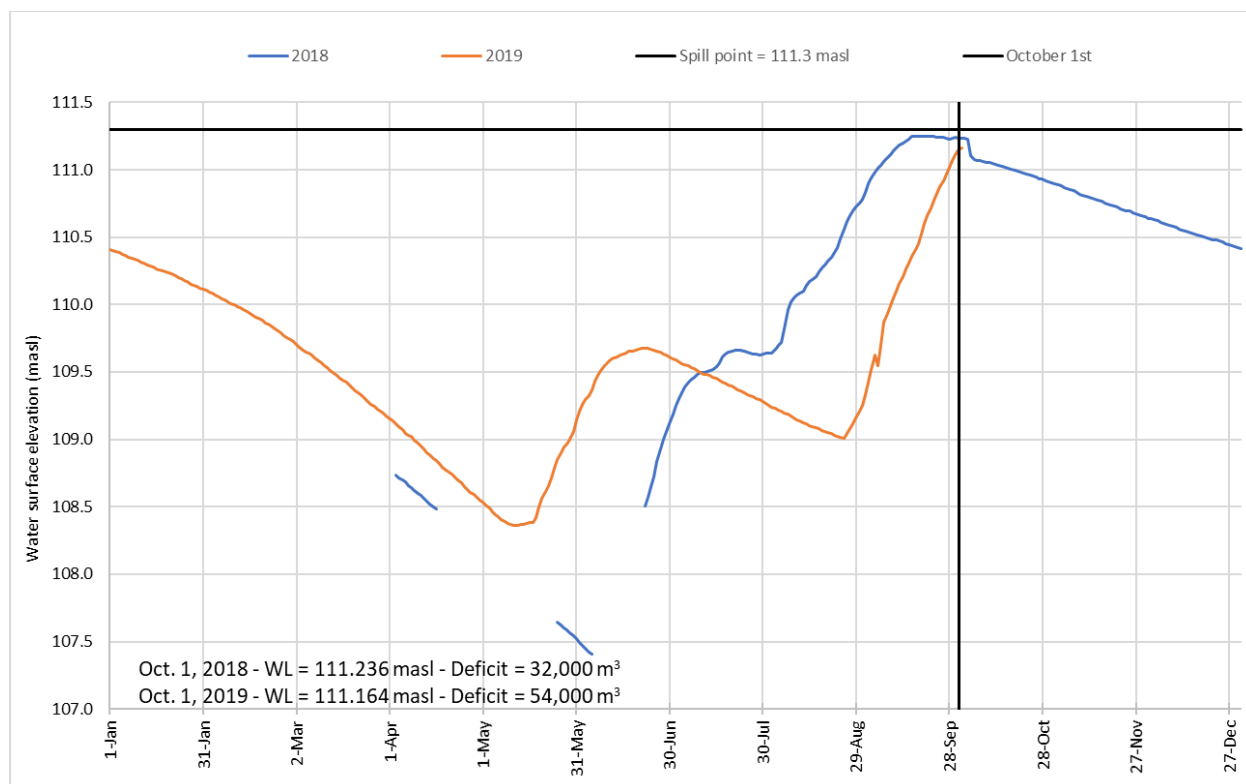


Figure 5-6 Lake Geraldine Water Levels for Summer 2019

Daily averages were calculated for downloaded water level data and used with a stage-storage curve to develop an estimated volume remaining to fill in the reservoir. The estimated volume remaining to fill the reservoir was used with the average daily pumping rates, to estimate the number of pumping days required to complete pumping. This information was not reported but was used by the project team to assess the pumping progress and as a check on schedule.

5.5 Water Quality

Water quality was monitored during the 2019 Emergency Water Supplementation Program for two purposes:

- 1) Grab samples of surface water were collected from Unnamed Lake and submitted for laboratory analysis of a suite of parameters to be compared with drinking water quality guidelines, and;
- 2) In-situ turbidity samples were collected throughout the pumping program as part of the operational monitoring to detect signs of possible channel erosion in the Apex River.

LABORATORY ANALYTICAL RESULTS

Analytical results for surface water quality samples are provided in Table F-1, Appendix F. All water quality parameters were reported to be below the applicable standards with the exception of total alkalinity at all five locations and Langelier Index (at 4°C) at four locations. Total alkalinity was below the lower threshold put forth in the Northern Health Public Health Protection Table 1, but it is noted that the lower limit of 30 mg/L identified in this standard is listed as approximate. Additionally, results for Langelier Index were slightly below the lower limit given by the Northern Health Public Health Protection Table 1, which is also listed as approximate.

Results for BTEX and PHC were all below the laboratory's detection limit. Total coliforms and *Escherichia coli* (E.Coli) were reported as zero colony-forming units (cfu) for all sample locations. Nutrient and metals analytical results were generally low, with many parameters reporting values below the laboratories detection limit.

Field parameters were measured using a YSI multi-parameter probe and are summarized in Table 5-4 below.

Table 5-4 Field Parameters Summary

| Location ID | Temperature (°C) | pH | Conductivity (µs/cm) |
|-------------|------------------|------|----------------------|
| SW19-01 | 9.03 | 7.03 | 30 |
| SW19-02 | 9.04 | 7.05 | 30 |
| SW19-03 | 9.00 | 6.96 | 29 |
| SW19-04 | 8.62 | 7.06 | 29 |
| SW19-05 | 12.22 | 7.80 | 34 |

IN-SITU OPERATIONAL MONITORING RESULTS

In order to confirm the limited erosion potential during the 2019 Emergency Water Supplementation Program, Nunami Stantec monitored four locations for in-situ turbidity (measured in NTU – nephelometric turbidity units):

- Apex W-1 – in Apex River, upstream of pumping effects from Unnamed Lake
- DSAD – in Apex River, downstream of the discharge from Unnamed lake
- Apex W-2 – in Apex River, upstream of the Apex River intake to Lake Geraldine
- Apex N-1 – in the outflow from Unnamed Lake, upstream of the Apex River

All measurements remained below 1 NTU (see Figure 5-7). Measurements began on August 21st and stopped on September 12th as it was determined that there was little observed impact from the pumping program or from precipitation events.

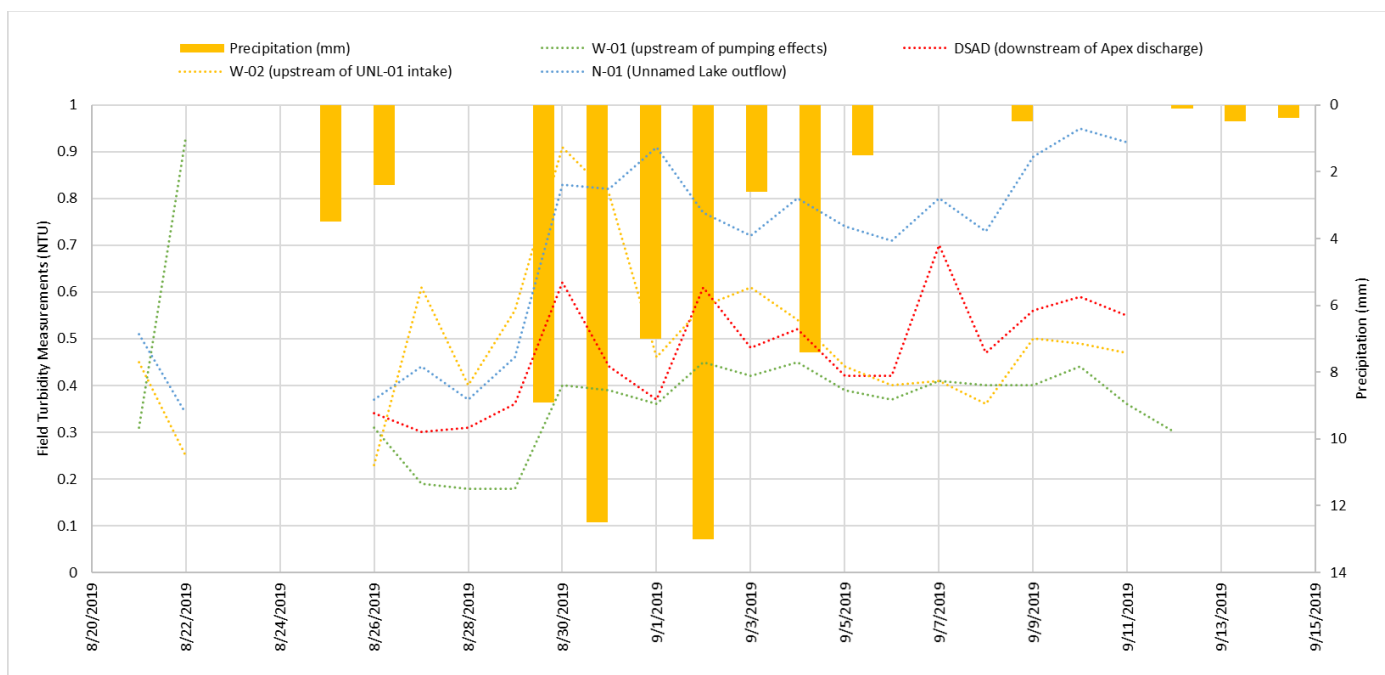


Figure 5-7 Turbidity Results - 2019 Emergency Water Supplementation Program

6 DISCUSSION

This section discusses some of the findings of the operational monitoring for the 2019 Emergency Water Supplementation Project, relative to baseline conditions or to anticipated conditions based on observations in 2018. This section also highlights some of the lessons learned, mitigation efforts, unanticipated impacts, and exceedances encountered during the 2019 Emergency Water Supplementation Project.

SYSTEM RESPONSE TO PRECIPITATION

Precipitation was monitored in conjunction with flows in the Apex River and water levels in Unnamed Lake, to determine the impacts of rain events on discharge and water levels. Flows in Apex River appeared to respond fairly quickly to rain, as indicated in Figure 6-1. Water levels in Unnamed Lake also appeared to respond fairly quickly, with lake water levels rising following significant rainfall events as shown in Figure 5-3 and in Appendix E.

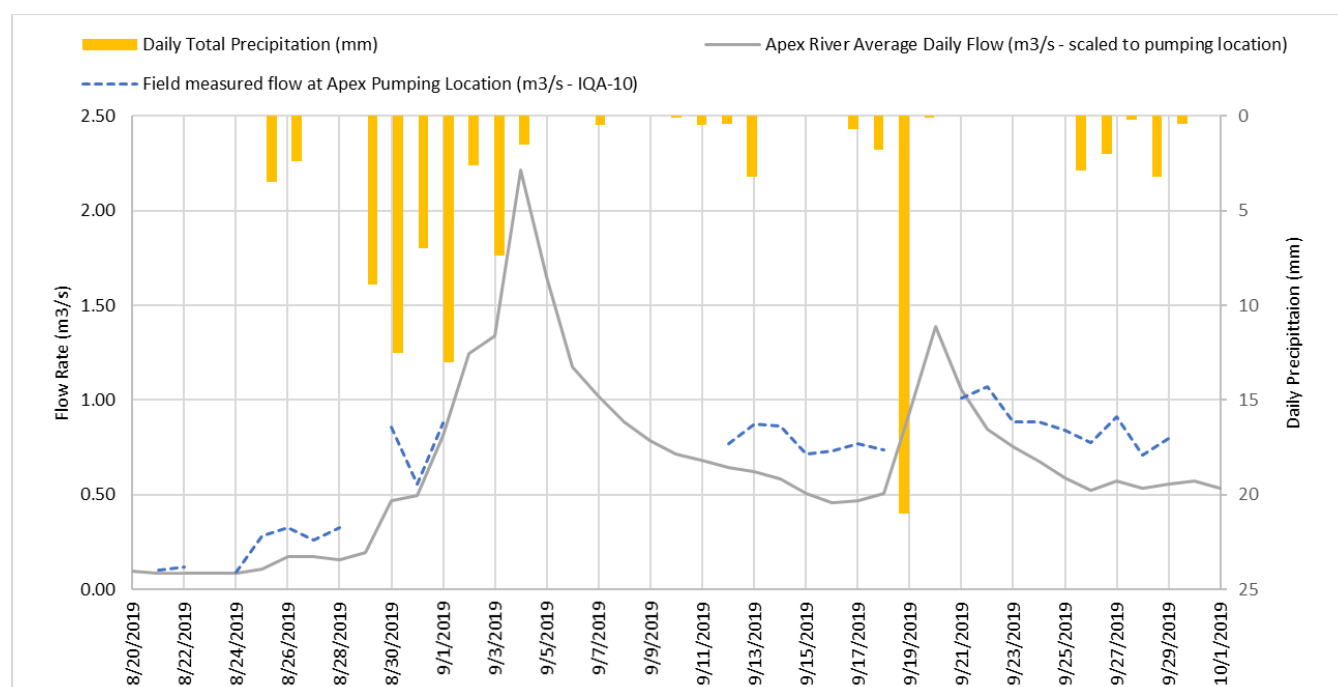


Figure 6-1 Daily Precipitation vs. Apex River Flow Rates During Pumping Program

The results of the in-situ turbidity monitoring (see Figure 5-7) indicated very little impact from turning the pumps on and off throughout the beginning of the pumping program, and increased only slightly following precipitation events.

EXCEEDANCES IN PUMPING RATES

Pumping rates and volumes were monitored throughout the 2019 Emergency Water Supplementation Project, to determine compliance with permitted rates and volumes. Pumping rates were adjusted daily based on observations of the previous day and forecasted precipitation for the week. Permitted pumping rates were exceeded on 6 days of the 38-day pumping program. Table 6-1 shows a summary of the days where pumping rates exceeded the 10% instantaneous flow threshold. On days where pumping rates exceeded the allowable limit, further adjustments were made the following day in accordance with the Operational Monitoring Plan. On days where natural flows in the Apex River were nearing 30% MAD, pumping rates at SNP IQA-10 were set to be less than pumping rates at SNP UNL-01, in order to limit effects from the pumping program on the natural system.

Table 6-1 Pumping Days Where Pump Rate Exceeded 10% Instantaneous Flow Threshold

| Pumping Date | Average Daily Pump Rate from IQA-10 (m³/s)¹ | Average Allowable Daily Pump Rate (10% natural flows + pumped flows from SNP UNL-01) (m³/s)² | Pumped Flow % of Estimated Natural Flow³ |
|--|--|---|--|
| September 14, 2019 | 0.193 | 0.180 | 12.0 |
| September 15, 2019 | 0.193 | 0.177 | 11.4 |
| September 16, 2019 | 0.185 | 0.181 | 10.7 |
| September 25, 2019 | 0.182 | 0.180 | 10.3 |
| September 26, 2019 | 0.183 | 0.172 | 11.8 |
| September 28, 2019 | 0.181 | 0.180 | 10.1 |
| Notes: 1. Estimated average pump rate is the average daily rate for all functioning pumps on each day, for the hours that pumps were operational 2. Calculated value, includes estimated natural flow rates in Apex River and pumped flow rate from Unnamed Lake (see Section 4.1) 3. Calculated value showing daily average natural flow pumped / daily average natural flow in Apex River; Permitted threshold = 10% | | | |

No exceedances in the total allowable pumped volumes from either Apex River or Unnamed Lake occurred during the 2019 Emergency Water Supplementation Program.

UNNAMED LAKE OUTFLOW IMPACTS

One of the objectives of the 2019 operational monitoring program was to determine the effects of pumping and subsequent drawdown of Unnamed Lake on the outflow from Unnamed Lake. Nunami Stantec conducted daily flow monitoring at location Apex N-1, as established during the baseline monitoring program. Results are presented in Figure 6-2 below. Flows from Unnamed Lake, similarly to water levels in Unnamed Lake, appeared to recover from the pumping program drawdown with the precipitation events observed in August and September, and this outlet-maintained flow throughout the program. Flows measured at Apex N-1 at the end of the pumping program were similar to those measured during the baseline monitoring program.

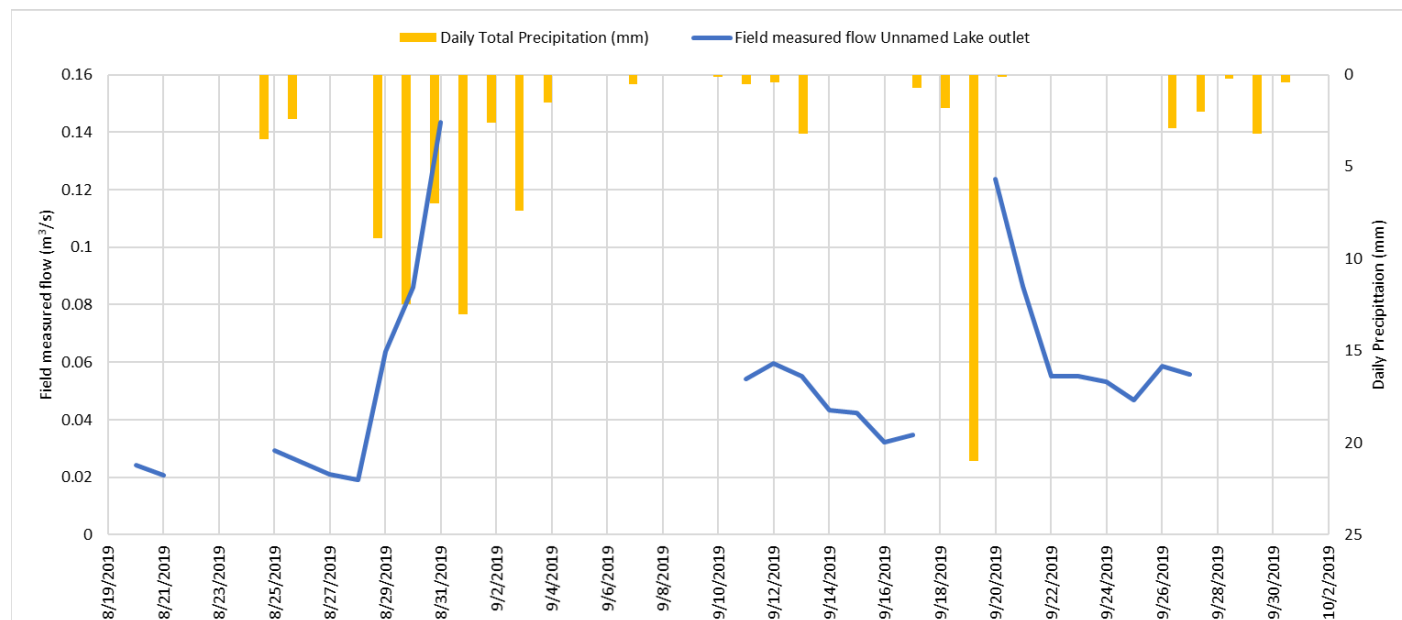


Figure 6-2 Field Measured flows at Location Apex N-

FIELD PROGRAM LESSONS LEARNED

Throughout the 2019 operational monitoring program, Nunami Stantec was unable to collect flow data on 13 of the 38 operational days. From September 2nd to September 10th, the FlowTracker being used to measure Apex River flows showed signs of water intrusion and could not be reliably used to collect field data. A new FlowTracker was sent to Iqaluit and the malfunctioning device was sent for repairs. There were also several days throughout the program where flows in the Apex River exceeded the thresholds where data could safely be collected by field staff. On these days, Nunami Stantec relied on data from WSC station 10UH002 to determine flow rate adjustments. Once flows subsided to allow safe access and data collection, Nunami Stantec field staff began collecting daily data again. A new WSC station located near SNP IQA-10 (station ID:10UH015) was also installed during the summer which provided real-time water level data through the 2019 operational monitoring program. It is anticipated that real-time flow data will soon be available from this station and should be used in the future.

EFFECTS TO FISH AND FISH HABITAT

The 2019 Emergency Water Supplementation Project was designed to obtain water from Apex River without adversely affecting a resident population of Arctic char present in the downstream segment of the river. It remains unknown whether Arctic char occupy the portion of the river above the Road to Nowhere bridge. Adding flow to the river from Unnamed Lake, allowed flows to be maintained at greater than 30% MAD. This may have had a positive effect on fish and fish habitat, by increasing flows at a time when they were at historical lows in August 2019. Flows at the time of ceasing pumping were naturally above 30% MAD. Withdrawals from Apex River exceeded 10% instantaneous flow marginally during six days of the 38-day program. Adjustments in pumping were made to re-establish appropriate pumping rates, and as such, no adverse effects to fish and fish habitat were expected.

7 LIMITATIONS

This document titled Iqaluit Emergency Water Supply Project: 2019 Apex River Supplementary Pumping – DFO Authorization Monitoring Report was prepared by Nunami Stantec Ltd. (“Nunami”) for the account of the City of Iqaluit (the “Client”). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Nunami’s professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Nunami and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Nunami did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Nunami shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

8 CLOSURE

Nunami Stantec Ltd. has prepared this report for the sole benefit of the City of Iqaluit (the City) for the purpose of summarizing the results from water withdrawal and environmental monitoring during the supplementary pumping from the Apex River in August, September, and October 2019. The report was prepared to support the City's emergency *Fisheries Act* Authorization, obtained in advance of pumping. The report may not be relied upon by any other person or entity, other than for its intended purposes, with the express written consent of Nunami Stantec Ltd. and the City. Any use of this report by a third party, or any reliance on decisions made based upon it, are the responsibility of such third parties.

The information provided in this report was compiled from existing documents and data provided by the City, and by field data compiled by Nunami Stantec Ltd. This report represents the best professional judgement of our personnel available at the time of its preparation. Nunami Stantec Ltd. reserves the right to modify the contents of this report, in whole or in part, to reflect any new information that becomes available. If any conditions become apparent that differ significantly from our understanding of conditions presented in this report, we requested that we be notified immediately to reassess the conclusions provided herein.

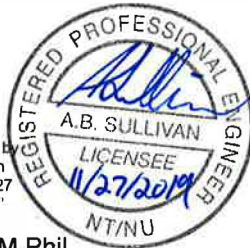
Respectfully Submitted,

NUNAMI STANTEC LIMITED

Written by:



Digitally signed by
Andrew Sullivan
Date: 2019.11.27
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Andrew Sullivan, P.Eng., M.Phil.
Water Resources Engineer
Phone: (902) 476-2391
Email: andrew.sullivan@stantec.com

Reviewed by:



Erica Bonhomme, M.Sc., P.Geo.
Team Lead, Environmental Services
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Email: erica.bonhomme@stantec.com

Written by:



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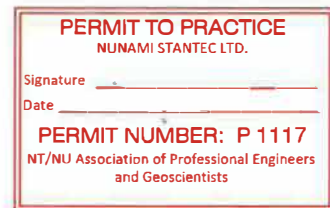
Alice Kruchten, P.Eng.
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Reviewed by:



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Senior Geomorphologist/Hydrologist
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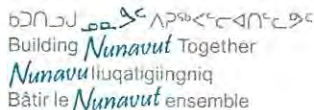


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APPENDIX A

Emergency Declaration Letter



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Minister of Community and Government Services
Ministaat Nunalingni Kavamatkunillu Pivikhakautikkut
Ministre des Services communautaires et gouvernementaux

JUL 31 2019

To whom it may concern:

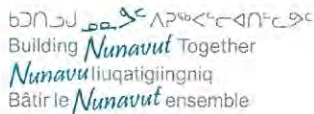
The City of Iqaluit (City) is at risk of a potable water shortage. The Lake Geraldine Reservoir is critically low and requires a resupply from “Unnamed Lake”.

Last year, the City applied for an emergency amendment to their water licence under the Nunavut Waters and Nunavut Surface Rights Tribunal Act to supplement the Lake Geraldine reservoir from the Apex River. To avoid requesting emergencies yearly, the City has applied to amend their water licence to pump supplemental water from the Apex River and other sources until 2026.

To avoid a water shortage this year, the City applied to the Nunavut Water Board for an emergency amendment on July 10th, 2019 to pump water from Apex River to Lake Geraldine.

On July 22, 2019, the Nunavut Water Board sought the consent of the CIRNAC Minister to process the licence amendment on an emergency basis under *Nunavut Waters and Nunavut Surface Right Tribunal Act, Section 52 (2) c* and also provided a recommendation to amend the City's water license to pump water from Apex River. Due to historic low water levels in the Apex River, it is no longer an option to resupply Lake Geraldine. The City is now seeking to resupply the Apex River and Lake Geraldine from "Unnamed Lake".

Pursuant to section 152(1) of the Nunavut Planning and Project Assessment Act, the City's request for a permit to take water from Unnamed Lake is exempt from Nunavut Planning Commission and Nunavut Impact Review Board's screening process if it is in response to an emergency:



1867-975-5074
867-975-2034



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NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATIMAYINGI
OFFICE DES EAUX DU NUNAVUT

**File: 3AM-IQA1626 /
Amendment No. 3**

August 2, 2019

By Courier, E-mail and Regular Mail

Honourable Carolyn Bennett, PC, MP
Minister of Crown-Indigenous Relations and Northern Affairs
21st Floor, 10 Wellington, North Tower
Gatineau, QC K1A 0H4
Email: carolyn.bennett@parl.gc.ca;

Subject: NWB Water Licence Type “A” No. 3AM-IQA1626 – Request for the Minister’s Consent to Process Amendment No. 3 on an Emergency Basis and Attached Reasons for Decision and Amendment No. 3 for the Minister’s Consideration

Dear Honourable Minister Bennett:

This correspondence is in relation to the July 31, 2019 request from the City of Iqaluit to amend Type “A” Water Licence No. 3AM-IQA1626 (Licence) for a “Municipal Undertaking” on an emergency basis (Amendment No. 3).¹ The basis for the City of Iqaluit’s request was stated in the City’s correspondence as follows:

...based on a water balance assessment of the reservoir completed in June 2019, the reservoir will not recharge naturally in 2019. The City will face an overwinter water supply shortage this year if it is not able to supplement the reservoir.²

As the Minister may recall, the City of Iqaluit requested, and was granted, an emergency amendment in August 2018 for this type of additional water use from the Niaqunguk River (Apex River) for a period of one season (August to October, 2018; Amendment No. 1), with the clear direction that if the City of Iqaluit anticipates that pumping from alternative water sources to replenish the reservoir may be needed on a permanent basis, that the City of Iqaluit should submit an amendment application for a longer term supplemental pumping program. The NWB requested that in order to allow sufficient time for the amendment to be processed by the NWB in accordance

¹ As defined under Schedule 1 of the *Nunavut Waters Regulations*, SOR/2013-69.

² Application for Water Licence Amendment, July 31, 2019.

with the Board's normal timelines, notice, and public hearing requirements, that the City of Iqaluit should submit the longer-term amendment application by October 2018.

On February 1, 2019, following the completion of the land use planning conformity assessment by the Nunavut Planning Commission (NPC) and the screening assessment requirements of the Nunavut Impact Review Board (the NIRB) as required under *the Agreement Between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in right of Canada* (the *Nunavut Agreement*) and the *Nunavut Planning and Project Assessment Act*, S.C. 2013, c. 14, s. 2 (*NuPPAA*), the City of Iqaluit submitted an application to the NWB to amend the Licence to allow for additional water use from the Niaqunguk River (Apex River) and to increase the total annual volume of water use authorized under the Licence for the period of 2019-2026 (the Amendment Application). The NWB's processing of the Amendment Application is currently underway and the Amendment Application is proceeding to the final stages, with an in-person Public Hearing scheduled to take place in the City of Iqaluit for August 8 and 9, 2019.

Although the Board and all parties have processed the Amendment Application with diligence, the final decision-making required of both the NWB and the Minister in respect of the Amendment Application will not be completed until after the potential pumping window (August-October) from the additional water source may have closed, resulting in a significant risk that the City of Iqaluit may not have sufficient water to supply to the residents of Iqaluit throughout the winter of 2019-2020. Consequently, the Board advised all parties on July 11, 2019 that the Board would consider whether the request for a temporary amendment to authorize supplemental water use (pumping) from the Niaqunguk River (Apex River) for the 2019 pumping season (Amendment No. 2) constitutes emergency circumstances and should therefore be processed by the NWB without public comment, notice and a public hearing.³

The scope of Amendment No. 2 (pumping directly from Niaqunguk River (Apex River)) was specifically chosen because it is the same as the scope of the longer-term Amendment Application which was assessed for conformity by the NPC and screened by the NIRB earlier this year. Consequently, Amendment No. 2 did not require an additional conformity assessment by the Nunavut Planning Commission and the Nunavut Impact Review Board under Articles 10 and 12 of the *Nunavut Agreement* and Part 3 of *NuPPAA*. On this basis, the NWB proceeded to consider Amendment No. 2 on an emergency basis. On July 22, 2019 the NWB issued correspondence to the Minister seeking her consent to the NWB waiving the notice and public hearing requirements of the *NWNSRTA* to process the Application for Amendment No. 2 under emergency circumstances and providing the Minister with Amendment No. 2 (authorization to pump directly from Niaqunguk River (Apex River) to replenish Lake Geraldine) for her consideration.

Since the Board submitted the decision recommending the issuance of Amendment No. 2, the City of Iqaluit has confirmed that due to the ongoing dry conditions in the area, the Niaqunguk River (Apex River) alone will not have enough water to supplement the Lake Geraldine Reservoir, and pumping from an additional water source is required.

³ As set out in ss. 52(2)(c), 55(5) and 56 of the *Nunavut Waters and Nunavut Surface Rights Tribunal Act*, S.C. 2002, c. 10 (*NWNSTRA*)

Therefore, on July 31, 2019 the Honourable, Lorne Kusugak, the Government of Nunavut's Minister of Community and Government Services (GN-CGS) under s. 11(1) of the Emergency Measures Act declared a state of emergency having formed the opinion that: "*the current water shortage in Lake Geraldine, combined with historic low water levels in the Apex River constitutes an emergency*". The GN-CGS Minister further noted that as set out in s. 152 of *NuPPAA* the land use planning and assessment requirements of *NuPPAA* do not apply to measures taken to prevent an emergency or remedy or minimize its effects if a federal or territorial minister is of the opinion that an emergency exists.

Following the receipt of the GN-CGS Minister's declaration of an emergency, the City of Iqaluit wrote to the NWB proposing to obtain water to supplement the Lake Geraldine reservoir in 2019 from both the Niaqunguk River (Apex River), and a source north of the Niaqunguk River (Apex River), unofficially called "Unnamed Lake." On this basis, **the City of Iqaluit has requested to withdraw the "Water Withdrawal Apex River 2019" project application**, (Amendment No. 2) and is substituting a new Emergency Amendment Application (Amendment No. 3) which combines in its scope authorization to pump from both from the Niaqunguk River (Apex River) and Unnamed Lake in 2019.

Reflecting this urgency, the NWB convened a teleconference meeting of the duly appointed three-member City of Iqaluit Panel (Panel P6) responsible for decision-making with respect to the file on Friday, August 2 to consider the City of Iqaluit's Amendment No. 3 Application. By way of Panel Motion No.: 2019-10-P6-03 Panel P6 acknowledges that in light of the GN-CGS Minister's declaration of emergency circumstances that the application for Amendment No. 3 for Water Licence 3AM-IQA1626 received on July 31st is exempt from the land use conformity and impact assessment requirements of *NuPPAA* and should be processed by the NWB on an emergency basis under the *NWNSRTA*. The Panel noted that the City of Iqaluit is experiencing exceptionally dry weather and that both the Lake Geraldine Reservoir and Niaqunguk (Apex) River are currently at historic lows.

The Board is therefore requesting the Minister's consent to the Board's processing of Amendment No. 3 in emergency circumstances as permitted by ss. 52(2)(c) and 55(5) of the *NWNSTRA*, allowing the Board to waive the normal notice, public hearing and comment requirements typically associated with the Board's consideration of an application to amend a Type "A" Water Licence.

Also reflecting the urgent circumstances, the Panel P6 decided during the teleconference that if the Minister consents to the NWB processing of Amendment No. 3 on an emergency basis, the NWB would recommend that Amendment No. 3 should be issued. By way of Panel Motion No.: 2019-10-P6-04, Panel P6 has decided to grant the Emergency Amendment (No. 3) to the Type "A" Water Licence No. 3AM-IQA1626 and is attaching, for the Minister's consideration, the Board's Reasons for Decision and the amended Licence to reflect Amendment No. 3.

In recommending the processing and issuance of Amendment No. 3 in emergency circumstances for the 2019 pumping season, Panel P6 wished to emphasize to all parties that the NWB will continue to process the longer-term Amendment Application (2020-2026) in accordance with the schedule confirmed with the parties at the Pre-Hearing Conference held in May 2019. Accordingly, the Board looks forward to the participation of the City of Iqaluit, interveners and

interested members of the community at the in-person Public Hearing for the Amendment Application to be held on August 8 and 9, 2019.

Conclusion

The Board recommends that Amendment No. 3 be considered by the Minister for approval under s. 56(1) of the *NWNSRTA*. Given the urgent nature of this matter, the Board would appreciate receiving, as soon as possible, the Minister's decisions regarding whether the Minister consents to the NWB's processing of Amendment No. 3 under emergency circumstances and, if so, the Minister's consideration of whether to approve the issuance of Amendment No. 3.

If the Minister has any questions or concerns regarding this matter, please contact Stephanie Autut, the NWB's Executive Director at Stephanie.Autut@nwb-oen.ca.

Sincerely,

Lootie Toomasie
Nunavut Water Board, Chair

LT/dd/rqd

Enclosure: **Licence No. 3AM-IQA1626 – Emergency Amendment Decision and Licence Amendment No. 3**

cc. Amy Elgersma, City of Iqaluit
Erica Bonhomme, Stantec / Nunami Stantec Ltd.
Iqaluit Distribution List

DECISION

WATER LICENCE 3AM-IQA1626 - EMERGENCY AMENDMENT

| | |
|-----------------------------------|-----------------------------|
| Licensee: | The City of Iqaluit |
| Licence No: | 3AM-IQA1626 Type “A” |
| Licence Issued: | June 17, 2016 |
| Amendment No. 3 Effective: | August 2, 2019 |
| Amendment No. 3 Expiry: | March 31, 2020 |
| Licence Expiry: | June 16, 2026 |

Pursuant to its authority under Article 13 of the *Agreement between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in Right of Canada (Nunavut Agreement)* and the *Nunavut Waters and Nunavut Surface Rights Tribunal Act (NWNSTR or Act)*, with respect to the Application for an emergency amendment to the Licence noted above, dated July 31, 2019, provided by the City of Iqaluit, the Nunavut Water Board (NWB or Board) hereby grants the following licence amendments (Amendment No. 3).

The Licence issued June 17, 2016, with an expiry date of June 16, 2026, shall be amended to include the following terms and conditions, with respect to the use of Waters and the deposit of Waste, to allow for:

- the temporary withdrawal (August 2019 – October 2019) of up to 700,000 m³ of Water from the large unnamed source water lake (Unnamed Lake) and transferring it to the Niaqunguk River (Apex River), and/or subsequently withdrawing up to 700,000 m³ of water from the Apex River, and transferring it to Lake Geraldine Reservoir for storage over the winter of 2019-2020; and
- the increase in the total amount allowed to be withdrawn from Lake Geraldine, from 1,100,000 m³/year to 2,000,000 m³/year.

Procedural History

On July 10, 2019, the Nunavut Water Board (NWB or Board) received notice from the City of Iqaluit (the City or Applicant) of the City’s intention to submit an application to amend Water Licence No. 3AM-IQA1626.⁴ The notice requested that due to the potential for the situation to result in a water shortage in the upcoming winter, the amendment be dealt with on an emergency basis under the provisions of Article 13 of the *Agreement between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in Right of Canada (Nunavut Agreement)* and the *Nunavut Waters and Nunavut Surface Rights Tribunal Act (NWNSTR)*. As provided for under ss. 52(2)(c) and 55(5) of the *NWNSTR* with the consent of the Minister, the Board may declare the amendment to be required on an emergency basis. With the consent of the Minister, this declaration allows the Board to waive the normal notice, public hearing and comment requirements

⁴ Amy Elgersma (City of Iqaluit Chief Administrative Officer) to Lootie Toomasie (NWB Chairperson); RE: City of Iqaluit Request for Immediate Approval to Supplement Drinking Water Supply; June 10, 2019.

typically associated with the Board’s consideration of an application to amend a Type “A” Water Licence and to process the amendment application on an expedited basis.

On July 11, 2019, the NWB issued correspondence acknowledging receipt of the City of Iqaluit’s request to amend the Type “A” Water Licence No. 3AM-IQA1626 (Licence) on an emergency basis (Amendment No. 2), and highlighted that that the NWB is currently processing the City of Iqaluit’s non-emergency-amendment application to authorize the additional water use (2020-2026) (the Amendment Application), with that Amendment Application set down to proceed to an in-person Public Hearing in the City of Iqaluit on August 8 and 9, 2019.⁵ The Board emphasized that regardless of the Board’s disposition of the City of Iqaluit’s Amendment No. 2 request, the NWB will be proceeding with the in-person Public Hearing on August 8 and 9, 2019 to consider the longer term Amendment Application for the term of 2020-2026.

On July 12, 2019, the City of Iqaluit submitted an application and associated information for Amendment No. 2, to authorize the use of water from the Niaqunguk River (Apex River) to support a 2019 Supplementary Pumping Program (SPP). On July 22, 2019 the NWB issued correspondence to the Minister seeking:

- the consent of the Minister to process the Application for Amendment No. 2 on an emergency basis; and
- if the Minister provided her consent, the Minister’s consideration of the Board’s recommendation to grant Amendment No. 2 to the water licence.

Following the NWB’s issuance of correspondence to the Minister, on July 25, 2019, the NWB was notified by the city of Iqaluit that water levels in the Niaqunguk River (Apex River) were also at historic low, and an additional water source would need to be used.

On July 31, 2019, the City of Iqaluit submitted an application to amend the Type “A” Water Licence No. 3AM-IQA1626 on an emergency basis (Amendment No. 3), with additional scope added to the scope of Amendment No. 2. The basis for the City of Iqaluit’s request was stated in the City’s correspondence as follows:

...Due to ongoing exceptionally dry conditions in 2019, flows in the Apex River are at historic lows and the reservoir is experiencing the lowest levels ever recorded for this time period. The City is aware that the Apex River alone may not provide sufficient water to fill the reservoir prior to winter.⁶

Also on July 31, 2019, the Minister of Community and Government Services, declared that the low water levels in both Lake Geraldine and Niaqunguk River (Apex River) constitute an emergency, under s. 11(1) of the *Emergency Measures Act*. Therefore, as provided for under the emergency provisions of s. 152(1) of the *Nunavut Planning and Project Assessment Act (NuPPAA)*, the additional water uses proposed in Amendment No. 3 are exempt from the conformity and impact assessment requirements of *NuPPAA*.

⁵ Stephanie Autut (NWB Executive Director) to Amy Elgersma (City City of Iqaluit Chief Administrative Officer); Subject: July 10, 2019 Request to Process Amendment to NWB Water Licence Type “A” No. 3AM-IQA1626 to Authorize Immediate Pumping from Additional Temporary Water Sources on an Emergency Basis; July 11, 2019.

⁶ Application for Water Licence Amendment, July 31, 2019.

On this basis, on August 2, 2019, the NWB’s decision-making panel responsible for the file, Iqaluit Panel (Panel P6) met via teleconference and concluded that emergency circumstances have been established by the City of Iqaluit. Consequently, Panel P6 issued this decision seeking the Minister’s consent for the Board to process the Application for Amendment No. 3 on an emergency basis and to consider the Board’s recommendation to grant Amendment No. 3 in accordance with the following terms and conditions.

General Considerations

The City of Iqaluit considers the situation as an emergency because their drinking water source, Lake Geraldine Reservoir (Reservoir) *“has not recharged following spring melt and will not be full prior to freeze-up. Ongoing dry conditions have resulted in flows in local watersheds at or near historic lows.”* Further, the City of Iqaluit asserts that *“Without supplementation, the City is likely to face an overwinter shortage of potable water in 2019/2020”*.

The scope of Amendment No. 3 includes the following activities:

- Construction, operation, and removal of temporary facilities, consisting of pumps, pipe/hose, intake, and related temporary facilities to use fresh Water from the Niaqunguk River (Apex River);
- The temporary withdrawal (August 2019 – October 2019) of up to 700,000 m³ of Water from Unnamed Lake for transfer to the Apex River, and/or the subsequent withdrawal of up to 700,000 m³ of water from the Apex River and for transfer to the Lake Geraldine Reservoir for storage over the winter of 2019-2020; and
- An increase to the amount allowed to be withdrawn from Lake Geraldine, to 2,000,000 m³.

The NWB has recommended the term of the 2019 Emergency Amendment should be limited to the works and activities required to replenish the Lake Geraldine Reservoir in 2019 as required to meet the City’s water needs for this winter only.

Amendment No. 3 seeks authorization for the City to undertake pumping of fresh Water from the large unnamed source water lake (Unnamed Lake) for transfer to the Niaqunguk River (Apex River), and subsequent transfer from the Apex River into the Lake Geraldine Reservoir. The period of withdrawal is expected to be August 2019 through October 2019, to ensure that there will be sufficient water in the Reservoir to provide drinking water to the community throughout the winter. The Apex River and the large Unnamed Lake will be the only additional sources of water. Water would be pumped directly into Lake Geraldine Reservoir from the same locations as the 2018 Supplementary Pumping Program approved under Amendment No. 1.

On this basis, the Panel P6, by way of Motion No.: 2019-10-P6-03 has acknowledged that in light of the GN-CGS Minister’s declaration of emergency circumstances that the application for Amendment No. 3 for Water Licence 3AM-IQA1626 received on July 31st should be processed by the NWB on an emergency basis. Further, if the Minister consents to processing the 2019 Application for Amendment No. 3 on an emergency basis, the Panel P6 has, by way of Motion No.: 2019-10-P6-04, authorized the issuance of this Decision and the specified amendments to Water Licence No. 3AM-IQA1626 (Amendment No. 3) as follows:

EMERGENCY AMENDMENT

Amend Page 3 **Quantity of Water not to be exceeded** to read:

2,000,000 CUBIC METERS ANNUALLY FROM LAKE GERALDINE RESERVOIR, 700,000 CUBIC METERS IN 2019 FROM NIAQUNGUK RIVER (APEX RIVER), AND 700,000 CUBIC METERS IN 2019 FROM THE LARGE UNNAMED SOURCE WATER LAKE (Unnamed Lake) FOR TRANSFER TO THE NIAQUNGUK RIVER (APEX RIVER).

PART A: SCOPE, DEFINITIONS, AND ENFORCEMENT

Insert Item 1. k.:

Construction, operation, and removal of temporary facilities for the Supplementary Pumping Program (SPP).

PART D: CONDITIONS APPLYING TO THE USE OF WATER AND WATER MANAGEMENT PLANS

Amend Item 1 to Read:

The Licensee is authorized to withdraw, from the Lake Geraldine Reservoir at Monitoring Station No. IQA-01, up to 2,000,000 cubic metres of Water annually for the relevant activities, works, and undertakings authorized under the scope of this Licence.

The Licensee is authorized to withdraw in 2019, from the Niaqunguk River (Apex River) at Monitoring Station No. IQA-10, up to a total of 700,000 cubic metres of Water in 2019 for the supplementation of Water levels in the Lake Geraldine Reservoir.

The Licensee is authorized to withdraw in 2019, from the large unnamed source water lake (Unnamed Lake) at Monitoring Station No. IQA-13, up to 700,000 cubic metres of Water in 2019, for augmentation of flow in the Niaqunguk River (Apex River).

Insert Item 10:

The Licensee shall ensure that withdrawals from the Niaqunguk River (Apex River) at Monitoring Station No.: IQA-10 are only taken when natural flow is above 30% of the mean annual discharge (MAD) and do not exceed 10% of the instantaneous flow; and do not exceed the rate and volume that is considered acceptable by Fisheries and Oceans Canada. If, at any time, Fisheries and Oceans Canada advises the Licensee that withdrawals from the Niaqunguk River (Apex River) are no longer acceptable, the withdrawals must cease until Fisheries and Oceans Canada indicates that withdrawals can resume.

Insert Item 11:

The Licensee shall ensure that withdrawal of Water from the large unnamed source water lake at Monitoring Station No.: IQA-13 only as necessary to provide water

towards Monitoring Station No. IQA-10.

Insert Item 12:

The Licensee shall cease all withdrawals associated with the SPP (Monitoring Station Nos. IQA-10 and IQA-13), if sufficient water has been transferred into Lake Geraldine Reservoir to provide enough drinking water for Iqaluit for the winter of 2019 and into early 2020.

PART I: CONDITIONS APPLYING TO MONITORING

Insert Item 13:

The Licensee shall monitor the SPP in accordance with requirements included under Schedule I.

SCHEDULE A: DEFINITIONS

Insert Item:

“**Supplementary Pumping Program (SPP)**” means the pumps, pipe/hose, intakes, coffer dams, and related temporary facilities to use fresh Water from the Niaqunguk River (Apex River) and unnamed source water lake (Unnamed Lake), to augment Water levels in the Lake Geraldine Reservoir. The active pumping under the SPP is authorized to proceed in accordance with the terms and conditions of the Licence from August to October 2019 to address a pending Water shortage in the winter of 2019 and early 2020.

SCHEDULE B: ANNUAL REPORT REQUIREMENTS

Insert Item q:

The 2019 Annual Report referred to in Part B, Item 1, shall provide the following information about the SPP including:

1. A summary of the SPP program, including lessons learned, based on monitoring and mitigation efforts.
2. GPS co-ordinates (in degrees, minutes and seconds of latitude and longitude) and datum for the locations of all water withdrawals.
3. The daily and monthly quantities in cubic metres of fresh Water withdrawn from the Niaqunguk River (Apex River) watershed at Monitoring Station IQA-10.
4. The daily and monthly quantities in cubic metres of fresh Water withdrawn from the large unnamed source water lake (Unnamed Lake) at Monitoring Station IQA-13.
5. A comparison of withdrawals at Monitoring Station Nos. IQA-10 and IQA13.
6. The daily water levels and/or flow rates in the Niaqunguk River when withdrawals are occurring at Monitoring Station No. IQA-10.
7. All other monitoring conducted to meet DFO requirements.
8. Discussion of any observed trends, exceedances, or unanticipated impacts.

SCHEDULE I: CONDITIONS APPLYING TO MONITORING

Add to the end of Table 2:

| Station ID | Description | Status | Parameter | Testing/ Measurement Frequency | Reporting Frequency |
|------------|---|------------------|-----------|---|------------------------|
| IQA-10 | Withdrawal from Upper Niaqunguk River for transfer directly into the Reservoir. | Active in 2019 | F | Daily when withdrawals occurring at this station. | 2019 Annual Report |
| IQA-11 | Withdrawal from Middle Niaqunguk River watershed for transfer directly into the Reservoir. Withdrawal point to be located on an ephemeral tributary near where it enters the Niaqunguk River or on the river itself just downstream of the confluence with the tributary. | Inactive in 2019 | F | Daily when withdrawals occurring at this station. | N/A |
| IQA-12 | Withdrawal from small unnamed source water lakes adjacent to Lake Geraldine Reservoir for transfer directly to the reservoir. | Inactive in 2019 | F | Daily when withdrawals occurring at this station. | N/A |
| IQA-13 | Withdrawal from large unnamed source water lake for transfer into ephemeral tributary to Niaqunguk River. Intent of withdrawal is to provide water to withdrawal point at Monitoring Station IQA-10. | Active in 2019 | F | Daily when withdrawals occurring at this station. | 2019 Annual Report |

All remaining terms and conditions of Type “A” Water Licence 3AM-IQA1626 dated June 17, 2016, still apply.

This Licence Amendment No. 3 issued and recorded at Gjoa Haven, NU on August 2, 2019.

Lootie Toomasie
Chairperson, Nunavut Water
Board

APPROVED
BY: _____
Carolyn Bennett
Minister of Crown-
Indigenous Relations and
Northern Affairs

DATE: _____



AUG 09 2019

Ottawa, Canada K1A 0H4

Mr. Lootie Toomasie
Chairman
Nunavut Water Board
PO Box 119
GJOA HAVEN NU X0B 1J0

Dear Mr. Toomasie:

Thank you for the Nunavut Water Board's correspondence of August 2, 2019, conveying the Board's Reasons for Decision and the issued amendment (Amendment No. 3) to the City of Iqaluit's existing Type A Water Licence 3AM-IQA1626 for my consideration.

I understand that, on July 31, 2019, the Government of Nunavut's Minister of Community and Government Services, under his subsection 11(1) *Emergency Measures Act* authority, declared a state of emergency citing exceptionally dry weather conditions and historically low water levels that place the health of Iqaluit residents at risk.

As requested in consideration of the time-sensitive nature of the situation, I have expedited my review, pursuant to subsection 56(2) of the *Nunavut Waters and Nunavut Surface Rights Tribunal Act*. I am pleased to inform you that I consent to the Nunavut Water Board's processing of the City of Iqaluit's Amendment No. 3 Application on an emergency basis and I approve the issuance of Amendment No. 3, as recommended by the Nunavut Water Board. The signed original is enclosed.

Sincerely,

A handwritten signature in black ink, reading "Carolyn Bennett".

Hon. Carolyn Bennett, M.D., P.C., M.P.

Encl.

c.c.: Her Worship Mayor Madeleine Redfern

Nunavut Water Board Type "A" Water Licence No: 3AM-IQA1626 - Emergency Amendment Decision and Licence Amendment No. 3

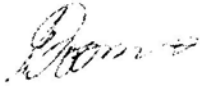
SCHEDULE 1: CONDITIONS APPLYING TO MONITORING


Add to the end of Table 2:

| Station ID | Description | Status | Parameter | Testing/ Measurement Frequency | Reporting Frequency |
|------------|---|------------------|-----------|---|---------------------|
| IQA-10 | Withdrawal from Upper Niaqunguk River for transfer directly into the Reservoir. | Active in 2019 | F | Daily when withdrawals occurring at this station. | 2019 Annual Report |
| IQA-11 | Withdrawal from Middle Niaqunguk River watershed for transfer directly into the Reservoir. Withdrawal point to be located on an ephemeral tributary near where it enters the Niaqunguk River or on the river itself just downstream of the confluence with the tributary. | Inactive in 2019 | F | Daily when withdrawals occurring at this station. | N/A |
| IQA-12 | Withdrawal from small unnamed source water lakes adjacent to Lake Geraldine Reservoir for transfer directly to the reservoir. | Inactive in 2019 | F | Daily when withdrawals occurring at this station. | N/A |
| IQA-13 | Withdrawal from large unnamed source water lake for transfer into ephemeral tributary to Niaqunguk River. Intent of withdrawal is to provide water to withdrawal point at Monitoring Station IQA-10. | Active in 2019 | F | Daily when withdrawals occurring at this station. | 2019 Annual Report |

All remaining terms and conditions of Type "A" Water Licence 3AM-IQA1626 dated June 17, 2016, still apply.

This Licence Amendment No. 3 issued and recorded at Gjoa Haven, NU on August 2, 2019.


Lottie Toomasie
Chairperson, Nunavut Water Board


APPROVED BY: Carolyn Bennett
Minister of Crown-Indigenous Relations

DATE: AUG 09 2019

APPENDIX B

Apex River Supplementary Pumping 2019: Monitoring Plan

August 23, 2019
Attention: Josip Deronja
Page 1 of 13



Reference: City of Iqaluit 2019 Emergency Water Supplementation Program – Operational Monitoring Plan

VIA E-MAIL

August 23, 2019
File No.: 144902884

Josip Deronja, Acting Engineering Manager
City of Iqaluit
Building 901
Iqaluit, NU X0A0H0

Attention: Josip Deronja

Dear Josip:

Reference: City of Iqaluit 2019 Emergency Water Supplementation Program – Operational Monitoring Plan

1 INTRODUCTION

Nunami Stantec Limited (Nunami) is submitting this Operational Monitoring Plan for the Unnamed Lake to Apex River Water Withdrawal Program in 2019. This “monitoring plan” is to be implemented during water withdrawal activities associated with the recently issued amendment to the City of Iqaluit’s (the City) Type A Water Licence 3AM-IQA1626 (Amendment No. 3) (Nunavut Water Board 2019), collectively referred to as the City of Iqaluit 2019 Emergency Water Supplementation Program. The monitoring plan is also guided by advice provided by Fisheries and Oceans Canada in a Letter of Advice issued August 15, 2019.

2 OBJECTIVE

The objective of the monitoring plan is to establish the parameters, frequency, methods, contingencies and communications that will guide monitoring of water withdrawal activities approved in Emergency Amendment No. 3 and in DFO’s Letter of Advice. The monitoring plan developed herein addresses stipulations provided in Schedule 1 of Amendment No. 3 of the water licence.

August 23, 2019

Attention: Josip Deronja

Page 2 of 13

Reference: City of Iqaluit 2019 Emergency Water Supplementation Program – Operational Monitoring Plan

3 BACKGROUND

The City obtains its potable water from Lake Geraldine. Lake Geraldine is an engineered reservoir designed to contain the volume of water necessary to satisfy the drinking water needs of the City. The reservoir is refilled annually during spring and summer by natural inflows from snowmelt and precipitation and draws down the available water in the reservoir during winter. In years when natural inflows or precipitation are low and the reservoir does not fill to full capacity, or, when seasonal demand has been high, there is a potential for a shortage of drinking water available to the City over the winter.

The City has received Amendment No. 3 to its water licence to supplement the Lake Geraldine reservoir from the Apex (Niaqunguk) River. Due to ongoing exceptionally dry conditions in 2019, flows in the Apex River are currently at historic lows and the Apex River alone is unlikely to provide sufficient water to fill the reservoir prior to winter conditions (freeze up). The City is proposing to obtain additional water in 2019 from a large lake located approximately 3km north of the Apex River, unofficially called “Unnamed Lake”. The City proposes to withdraw water from the Unnamed Lake and pump it approximately 1.2 km via flexible hoses into the Apex River at a location approximately 2.3 km upstream of the Apex River pumping site, as shown by the blue and green arrows in Figure 1. This water will then be captured at the Apex River pumping site and pumped to Lake Geraldine, as shown by the yellow arrow in Figure 1. The amendment recently received by the City adds the following conditions to licence 3AM-IQA1626 which remains in effect:

- Construction, operation and removal of temporary facilities, including pumps, hoses, intakes and related facilities to facilitate taking of fresh water from the Apex River.
- Temporary withdrawal (August 2019 – October 2019) of up to 700,000 m³ of water from “Unnamed Lake”, transfer to the Apex River, and subsequent withdrawal of up to 700,000 m³ to the Lake Geraldine Reservoir.
- To increase the amount allowed to be withdrawn from Lake Geraldine to 2,000,000 m³ The Licensee shall ensure that withdrawals from the Niaqunguk River (Apex River) at Monitoring Station No.: IQA-10 are only taken when natural flow is above 30% of the mean annual discharge (MAD) and do not exceed 10% of the instantaneous flow; and do not exceed the rate and volume that is considered acceptable by Fisheries and Oceans Canada. If, at any time, Fisheries and Oceans Canada advises the Licensee that withdrawals from the Niaqunguk River (Apex River) are no longer acceptable, the withdrawals must cease until Fisheries and Oceans Canada indicates that withdrawals can resume.
- The Licensee shall ensure that withdrawal of Water from the large unnamed source water lake at Monitoring Station No.: IQA-13 only as necessary to provide water towards Monitoring Station No. IQA-10.

August 23, 2019

Attention: Josip Deronja

Page 3 of 13

Reference: City of Iqaluit 2019 Emergency Water Supplementation Program – Operational Monitoring Plan

- The Licensee shall cease all withdrawals associated with the SPP (Monitoring Station Nos. IQA-10 and IQA-13), if sufficient water has been transferred into Lake Geraldine Reservoir to provide enough drinking water for Iqaluit for the winter of 2019 and into early 2020.
- The Licensee shall monitor the SPP in accordance with requirements included under Schedule I (as provided below).

| Station ID | Description | Status | Parameter | Testing/ Measurement Frequency | Reporting Frequency |
|------------|--|----------------|-----------|---|------------------------|
| IQA-10 | Withdrawal from Upper Niaqunguk River for transfer directly into the Reservoir. | Active in 2019 | F | Daily when withdrawals occurring at this station. | 2019 Annual Report |
| IQA-13 | Withdrawal from large unnamed source water lake for transfer into ephemeral tributary to Niaqunguk River. Intent of withdrawal is to provide water to withdrawal point at Monitoring Station IQA-10. | Active in 2019 | F | Daily when withdrawals occurring at this station. | 2019 Annual Report |

The approval of the licence has been accompanied by a Letter of Advice from the Department of Fisheries and Oceans Canada (DFO) requiring implementation of a monitoring program proposed by the City in its application for the amendment of the licence on August 2, 2019. This monitoring program is the basis for the monitoring plan proposed herein.

August 23, 2019

Attention: Josip Deronja

Page 4 of 13

Reference: City of Iqaluit 2019 Emergency Water Supplementation Program – Operational Monitoring Plan

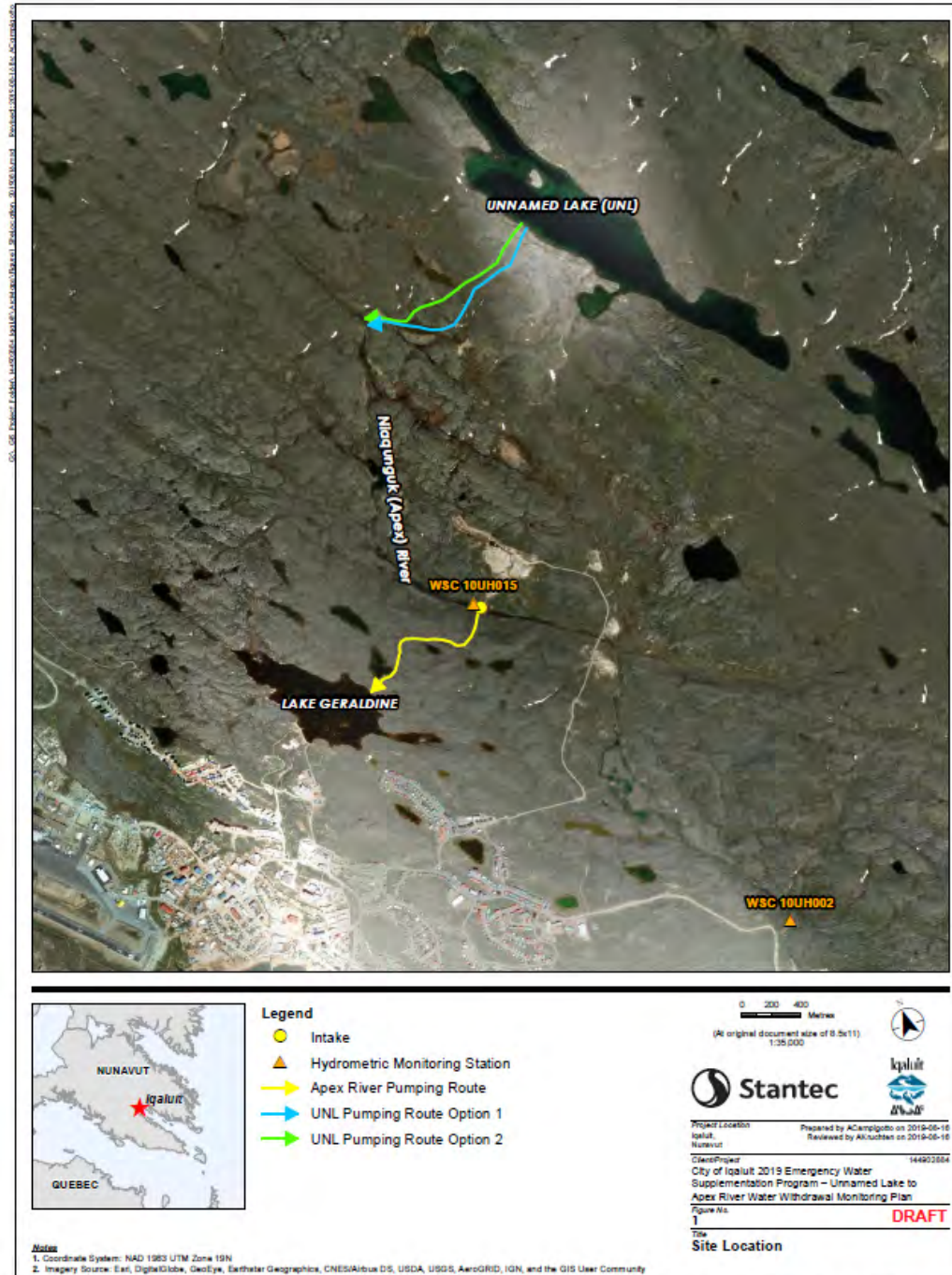


Figure 1 Unnamed Lake to Lake Geraldine Water Conveyance

Reference: City of Iqaluit 2019 Emergency Water Supplementation Program – Operational Monitoring Plan

3.1 Apex River Flows and Withdrawals

Apex River natural flows (recorded at the Water Survey of Canada station Apex River at Apex, station ID 10UH002) have ranged from 0 m³/s to 6.24 m³/s during the months of August to October for the available period of record from 1973 to 2018.

Previous water licence applications requested water withdrawals following DFO extraction guidelines - proponents are permitted to withdraw water from a waterbody at a rate up to 10% of the instantaneous flow as long as flows are above 30% of mean annual discharge (MAD). Scaling the calculated MAD from the Apex River station (using the complete 35-year record and excluding 0 values) Nunami Stantec has calculated a MAD of 1.056 m³/s at the pumping location, which equates to a 30% MAD threshold of 0.316 m³/s.

As of August 12, 2019, Apex River flows are at daily record lows of 0.131 m³/s, and therefore are not currently sufficient to allow for pumping following DFO guidelines. Exceeding these guidelines increase risk of serious harm to the resident population of Arctic char present downstream of the pumping site. The City proposes to withdraw only water that is added to the river, thus maintaining natural flows when conditions are below 30% MAD.

3.2 Unnamed Lake Volume and Withdrawals

A recent bathymetry survey of Unnamed Lake, conducted by Tetra Tech in July 2019, indicated a total estimated water volume at the time of the survey (July 2019) of 6,616,900 m³ +/- 5%, with an estimated surface area of 911,300 m². The estimated volume of Unnamed Lake will be updated throughout the monitoring program as pumped volumes and lake water level data are available.

4 MONITORING PLAN FRAMEWORK

This monitoring plan has been developed following an adaptive monitoring framework which allows for data collection and monitoring plans to evolve as data is collected, and for adjustments to project implementation (pumping) to be made based on monitoring data. This approach will allow for focused and efficient data collection and allow the monitoring plan to focus on areas of concern that may become evident once data is reviewed. This is considered an appropriate approach due to the lack of baseline data currently available and limited understanding of how the natural system will react to the planned pumping rates.

5 MONITORING PLAN

The following sections outline the monitoring locations, parameters that will be monitored, the methods used to measure them, and associated reporting.

Reference: City of Iqaluit 2019 Emergency Water Supplementation Program – Operational Monitoring Plan

5.1 Monitoring Parameters

Existing and proposed monitoring locations are shown on Figure 2. The parameters to be monitored will be specific for each location and will consist of water levels, spot flow measurements, pumped flow measurements and visual observations. The monitoring is intended to achieve several objectives consistent with the water licence and DFO requirements:

- Water withdrawals do not exceed 10% of natural flows in the Apex River, when flows are greater than 30% MAD
- Water withdrawals do not change natural flows in the Apex River, when flows are below 30% MAD
- Water withdrawals do not exceed licenced amounts
- Water withdrawn at the Apex River pump site reflects water added at the Unnamed Lake discharge site, taking into account losses in the riverine system
- Water withdrawals are not causing serious harm to fish

5.1.1 Apex River Continuous Flow Monitoring

Two existing hydrometric stations have been established by the Water Survey of Canada (WSC) and have real-time data available online:

- “Apex River at Apex” (station ID: 10UH002) has a period of record 1973-present and records water level and discharge in 5-min time increments. Nunami will use data provided on the WSC website and will not be collecting field data at this location. Data from this location will be used to monitor the water level and flow of Apex River at a location downstream of pumping activities.
- “Apex River Above The Bridge” (station ID: 10UH015) was installed July 2019 and currently records water level in 5-min time increments. Nunami will use data provided on the WSC website and will supplement by collecting field data (daily flow measurements) at this location. Data from this location will be used to monitor water level and flow of the Apex River downstream of the pump intake located on the Apex River.

It is noted that ‘real-time’ data available from the WSC website is delayed by several hours and therefore may not be ideal for real time pump operation decision making.

5.1.2 Apex River Spot Flow Measurements

Spot flow measurements are proposed at three locations:

- Apex River upstream of Unnamed Lake discharge location (Apex W-1) – to determine natural Apex River flows upstream of the confluence of discharged water from Unnamed Lake and the Apex River.

Reference: City of Iqaluit 2019 Emergency Water Supplementation Program – Operational Monitoring Plan

- Apex River upstream of Apex River pump intake location (Apex W-2) – to determine augmented Apex River flows upstream of the Apex River pump intake location.
- Unnamed Lake natural outflows (Apex N-1) – to determine the contribution of Unnamed Lake outflow to Apex River downstream of the Apex River pumping location and to establish the impact on Apex River flows if the Unnamed Lake outflow is cut off during pumping activities.

Flow measurements will be conducted by Nunami staff using Sontek Flowtracker equipment and following Environment Canada guidance (Water Survey of Canada June 2015).

5.1.3 Pumped Flow Measurements

Pumped flows from Unnamed Lake to Apex River and from Apex River to Lake Geraldine will be recorded using inline flow meters connected to the discharge of each pump. Two sets of measurements will be available:

- Water pumped from Unnamed Lake to Apex River (SNP IQA-13; shown as UNL-01 on map).
- Water pumped from Apex River to Lake Geraldine (SNP IQA-10).

It is assumed that Nunami will be provided pumped flow data, including start times, stop times, volumes, and water levels daily from the pumping contractor.

5.1.4 Water Levels

Water levels will be monitored at several monitoring locations including:

- Unnamed Lake water levels (Transducer #1, Transducer #2, Transducer #3) - will be monitored using the level loggers installed by Nunami in September 2018 and June 2019 and used to determine the impact that withdrawing water is having on Unnamed Lake water levels.
- Unnamed Lake water levels (UNL-01) – a staff gauge has been installed near the pump intake location in Unnamed Lake. The staff gauge will allow for real time operational decisions to be made, such as determining change in water levels observed during periods of pumping. Staff gauge readings will be recorded by the pump contractor prior to starting and just after stopping any pumping activities.
- Lake Geraldine water levels (WSC station “Lake Geraldine Near Iqaluit” station ID: 10UH013) – this station provides real-time water level data available in 10-min increments (period of record 2007-present) and will be monitored to establish the recharge effects of pumping water from the Apex River. Nunami will use data provided on the WSC website and will not be collecting field data at this location.
- Apex River upstream of Apex River intake location (Apex W-2) – a staff gauge has been installed near the same location that flow measurements are taken. While WSC station 10UH015 is located nearby, water levels upstream of the pump intake location are required. A staff gauge will allow for real time

August 23, 2019

Attention: Josip Deronja

Page 8 of 13

Reference: City of Iqaluit 2019 Emergency Water Supplementation Program – Operational Monitoring Plan

operational decisions to be made, such as determining when pumped flows from the Unnamed Lake have reached the Apex River intake location.

5.1.5 Visual Monitoring

Visual monitoring of the channel downstream of the Road to Nowhere bridge, up to “Swimming Lakes” will be conducted daily to observe any areas where fish may be stranded. The program will occur once and if flows from the Unnamed Lake, as measured at N-01 cease due to water levels in Unnamed Lake dropping below the outlet elevation. The purpose of this monitoring will be to observe effects on fish and fish habitat as a result of the pumping program.

August 23, 2019

Attention: Josip Deronja

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Reference: City of Iqaluit 2019 Emergency Water Supplementation Program – Operational Monitoring Plan

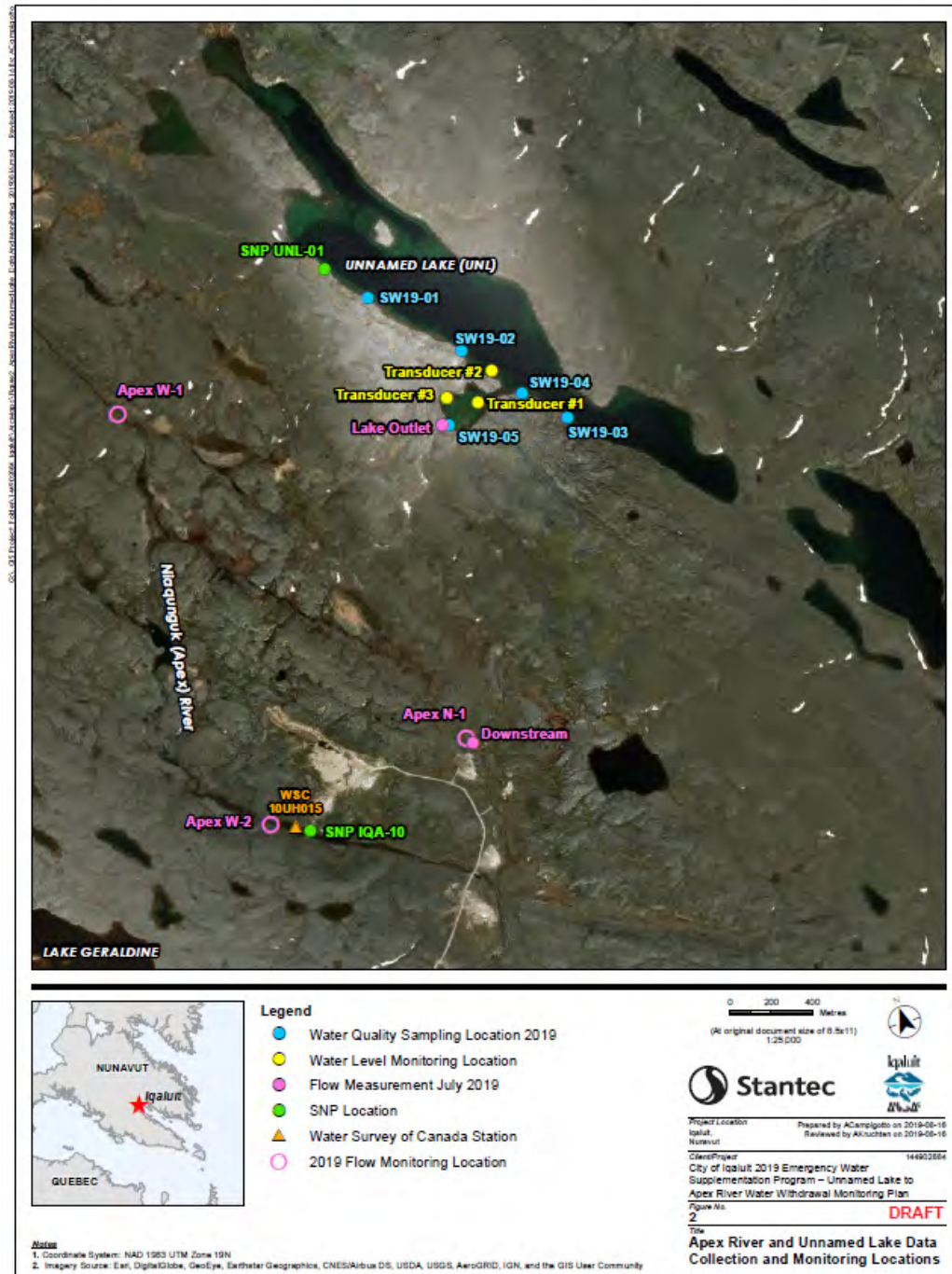


Figure 2 Apex River and Unnamed Lake Data Collection and Monitoring Locations

August 23, 2019

Attention: Josip Deronja

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Reference: City of Iqaluit 2019 Emergency Water Supplementation Program – Operational Monitoring Plan

5.2 Monitoring Program

Table 1 outlines the monitoring program, providing frequency, rationale, thresholds and coordinates for each monitoring location.



Reference: City of Iqaluit 2019 Emergency Water Supplementation Program – Operational Monitoring Plan

| Monitoring Location ID | Parameter | Frequency | Rationale | Regulatory Thresholds | Latitude | Longitude |
|---|----------------------|--|--|--|-------------|--------------|
| SNP IQA-13 / UNL-01 | Water Level | Baseline, Daily, Operationally before turning pumps on and after turning pumps off | A staff gauge installed near the pump intake on Unnamed Lake will allow for real time lake water levels to be recorded and monitored | Up to 700,000 m³ can be withdrawn as per Amendment No.3 | 63.783274 | -68.455219 |
| | Pumped Flow | Daily, As-needed during pumping operations | Pumped flow volumes will be used to determine how much water has been withdrawn from Unnamed Lake | Flows limited to 200 L/s, volumes not to exceed permitted quantity of 700,000 m³ | 63.783274 | -68.455219 |
| SNP IQA-10 | Pumped Flow | Daily during pumping operations | Pumped flow volumes will be used to determine how much water has been withdrawn from the Apex River | Flows limited to 200L/s at all times, volumes not to exceed permitted quantity of 700,000 m³ | 63.760535 | -68.475915 |
| Apex W-1 | Spot Flow | Baseline, Daily | To collect baseline flows in the Apex River upstream of the confluence with pumped flows from Unnamed Lake | None | 63.78050629 | -68.47932967 |
| | Temperature, TDS | Baseline, Operationally immediately after turning pumps on, after rain events | As required in Application for Amendment 3 | None | | |
| Apex W-2 | Water Level | Baseline, Daily, Operationally before turning pumps on and after turning pumps off | A staff gauge installed near the pump intake on Apex River will allow for real time water levels to be recorded and monitored | None | 63.7614205 | -68.47936781 |
| | Spot Flow | Baseline, Daily | To collect flow measurements just upstream of the Apex Intake pumping location (SNP IQA-10) | None | 63.7614205 | -68.47936781 |
| Apex N-1 | Spot Flow | Baseline, Daily | To collect flows from the outlet of Unnamed Lake prior to the confluence with Apex River | None | 63.76196846 | -68.45829888 |
| Transducer #1 | Water Level | Baseline, As-needed during pumping operations | To collect continuous water level measurements in Unnamed Lake (boat required to download) | None | 63.775478 | 68.44567 |
| Transducer #2 | Water Level | Baseline, As-needed during pumping operations | To collect continuous water level measurements in the southern bay of Unnamed Lake (boat required to download) | None | 63.776598 | 68.443248 |
| Transducer #3 | Water Level | Baseline, As-needed during pumping operations | To collect continuous water level measurements in the southern bay of Unnamed Lake - site accessible by land (no boat required) | None | 63.776198 | -68.448332 |
| “Apex River at Apex” (station ID: 10UH002) | Water level and flow | Baseline, Daily | Water level and discharge measurements from WSC to be used to establish flow in Apex River downstream of the pump intake on the Apex River | None | 63° 44' 09" | 68° 27' 05" |
| “Apex River Above The Bridge” (station ID: 10UH015) | Water level | Baseline, Daily | Water level measurements from WSC. The Station is collecting discharge measurements that will be used in the future to establish flow in Apex River upstream of the pump site. | None | 63° 45' 41" | 68° 28' 37" |
| “Lake Geraldine near Iqaluit” (station ID: 10UH013) | Water Level | Baseline, Daily | Water levels to be used to assess the re-filling efforts in Lake Geraldine reservoir | None | 63° 45' 23" | 68° 30' 15" |

August 23, 2019

Attention: Josip Deronja

Page 12 of 13

Reference: City of Iqaluit 2019 Emergency Water Supplementation Program – Operational Monitoring Plan

6 CONTINGENCY PLANNING

Should information collected during the monitoring program indicate that regulatory thresholds are not being met, Nunami PM will notify the City of Iqaluit as soon as it is identified (within 24 hours of observations or measurements). Concerns associated with water levels or pumping rates nearing regulatory thresholds will be noted in the daily reporting. Additional notification to DFO or the Inspector may be required.

Additional monitoring, beyond the scope outlined in this plan may be required once baseline and initial pumping data is collected and analyzed. This may include increased frequency of flow and water level measurements, additional monitoring stations, or other measures agreed upon with the appropriate authorities.

7 REPORTING

Daily, weekly and final reporting should be completed for the monitoring plan. Reporting should consist of the following:

- Daily reporting (via email) – Daily and total volume of water pumped from Unnamed Lake and water level / drawdown in Unnamed Lake, daily and total volume of water pumped from Apex River to Lake Geraldine, water level in Lake Geraldine, daily flows recorded at the WSC stations, any operationally significant observations to note (pump down time, unexpected water levels or flows). Additionally, Nunami will provide comment on the progress of re-filling Lake Geraldine reservoir based on the established stage-storage curve and daily water level observations.
- Weekly reporting – A weekly memo report will be prepared summarizing the activities of the proceeding week. This report will include all flow and water level data recorded that week and further discussion on the collected data, progress of the pumping program, and adherence to regulatory requirements.
- Final reporting – A monitoring plan summary report will be prepared following the completion of the Fall 2019 water withdrawal activities. This report will summarize the data collected and provide appropriate interpretation and analysis.
- Information required to be included in the water licence annual report: a summary of the program, including: daily and monthly quantities withdrawn at SNP IQA-10 and IQA-13; a comparison of withdrawals at these locations; daily water levels and/or flows in the Apex River; other monitoring required by DFO; discussion of observations and project impacts.

8 CLOSING

A detailed estimate of the costs associated with this work is appended to this document. We believe this plan to be adequate for pumping operations from Apex River and Unnamed Lake. The costs consider an October 1, 2019 project completion. Additional days may be required to bring this project to completion; however, a separate CO will be issued at that time if required.

Sincerely,

NUNAMI STANTEC LIMITED



Erica Bonhomme, M.Sc., P.Geo.
Environmental Services Team Lead –
Northern Canada
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Email: Erica.Bonhomme@stantec.com

Matt Follett, M.A.Sc., P.Eng.
Civil Engineer -
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ORIGINAL SIGNED BY

Andrew Sullivan, P.Eng.
Environmental Engineer
902-469-7777
Andrew.sullivan@stantec.com

9 REFERENCES



Fisheries and Oceans Canada. 2019. Letter of Advice 19-HCAA-00969



Nunavut Water Board. 2019. "NWB Water Licence Type "A" No. 3AM-IQA1626 - Request for the Minister's Consent to Process Amendment No.3 on an Emergency Basis and Attached Reasons for Decision and Amendment No.3 for the Minister's Consideration." Gjoa Haven.



Water Survey of Canada. June 2015. *Measuring Discharge with FlowTracker Acoustic Doppler Velocimeters - Revision 4*. Ottawa: Environment Canada.



APPENDIX C


Photo Log

| | | | |
|---|--|-----------------------|------------------|
| Client: | City of Iqaluit | Project: | 144902884 |
| Site Name: | Iqaluit Emergency Water Supply Project | Site Location: | Iqaluit, Nunavut |
| Photograph ID: 1 |  | | |
| Photo Location: Apex W1 | | | |
| Direction: Looking Downstream - September 13, 2019 | | | |
| Survey Date: 9/13/2019 | | | |
| Comments: | | | |
| Photograph ID: 2 |  | | |
| Photo Location: Apex W1 | | | |
| Direction: Left bank to right bank - August 21, 2019 | | | |
| Survey Date: 8/21/2019 | | | |
| Comments: | | | |

| | | | |
|--|--|-----------------------|------------------|
| Client: | City of Iqaluit | Project: | 144902884 |
| Site Name: | Iqaluit Emergency Water Supply Project | Site Location: | Iqaluit, Nunavut |
| Photograph ID: 3 |  | | |
| Photo Location: Apex W2 | | | |
| Direction: Looking downstream - August 22, 2019 | | | |
| Survey Date: 8/22/2019 | | | |
| Comments: | | | |
| Photograph ID: 4 |  | | |
| Photo Location: Apex W2 | | | |
| Direction: Staff gauge - August 20, 2019 | | | |
| Survey Date: 8/20/2019 | | | |
| Comments: | | | |

| | | | |
|--|--|-----------------------|------------------|
| Client: | City of Iqaluit | Project: | 144902884 |
| Site Name: | Iqaluit Emergency Water Supply Project | Site Location: | Iqaluit, Nunavut |
| Photograph ID: 5 |  | | |
| Photo Location: Apex N2 | | | |
| Direction: Looking upstream - August 21, 2019 | | | |
| Survey Date: 8/21/2019 | | | |
| Comments: | | | |
| Photograph ID: 6 |  | | |
| Photo Location: Apex N2 | | | |
| Direction: Looking downstream - September 12, 2019 | | | |
| Survey Date: 9/12/2019 | | | |
| Comments: | | | |

| | | | |
|--|--|-----------------------|------------------|
| Client: | City of Iqaluit | Project: | 144902884 |
| Site Name: | Iqaluit Emergency Water Supply Project | Site Location: | Iqaluit, Nunavut |
| Photograph ID: 7 |  | | |
| Photo Location: Unnamed Lake | | | |
| Direction: Staff Gauge - September 13, 2019 | | | |
| Survey Date: 9/13/2019 | | | |
| Comments: | | | |
| Photograph ID: 8 |  | | |
| Photo Location: Unnamed Lake | | | |
| Direction: Pumping set up at Unnamed Lake - September 12, 2019 | | | |
| Survey Date: 9/12/2019 | | | |
| Comments: | | | |

| | | | |
|--|---|-----------------------|------------------|
| Client: | City of Iqaluit | Project: | 144902884 |
| Site Name: | Iqaluit Emergency Water Supply Project | Site Location: | Iqaluit, Nunavut |
| Photograph ID: 9 |  | | |
| Photo Location: Apex Pumping | | | |
| Direction: Looking downstream towards the construction of Apex Pumping site - August 21, 2019 | | | |
| Survey Date: 8/21/2019 | | | |
| Comments: | | | |

APPENDIX D

Daily Monitoring Records

APEX RIVER and UNNAMED LAKE - Daily Environmental Monitoring Report
City of Iqaluit - 2019 Emergency Water Supplementation Program

| | | | | |
|--------------------------------|--|-----------------|----------------------------|--|
| Date of Pumping Record Summary | | 25-Aug-19 | [enter value] | |
| Date Record Completed | | 28-Aug-19 | [enter value] | |
| Time Record Completed | | 12pm | [enter value] | |
| Prepared by | | Alice Kruchten | [enter name] | |
| Reviewed by | | Andrew Sullivan | [enter name when reviewed] | |

| | | | | | |
|-----------|--|---|-------|---------------|---|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 196 | [enter value] | <div>Additional Notes and Comments:</div> <div>- Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location - UNL-01 turned on at 8:45am August 25 - IQA-10 turned on at 4:00pm and 6:30pm on August 25</div> |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.196 | | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 134 | [enter value] | |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.134 | | |
| | Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | OK | |

| | | | | | | | |
|-----------------|---|-------|--------|------------------------------------|---|------------------------|--------------------|
| Pump Volume | Pumping Time for pumps (hours) | Comb. | 15 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 10,830 | | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 0 | [enter value] |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 10,830 | | | | |
| | Pumping Time for pumps (hours) | Comb. | 7 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 4,167 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 0 | [enter value] |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 4,167 | | | | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | OK | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 | No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |

| | | | | | | | |
|--|--|--|-------------------|-------------------------|--|-------|---------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | | 0.0453 | [enter value] | measured on August 24 (baseline) | | |
| | Measured flow at Apex W-2 (m3/s) | | 0.0925 / 0.2838 | [enter value] | measured on August 24 (baseline) / August 25 (post start-up) | | |
| | Measured flow at Apex N-1 (m3/s) | | 0.0242 | [enter value] | measured on August 24 (baseline) | | |
| | Average 24hr water level at WSC 10UH015 (m) | | 6.459 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | 6.445 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | | 0.149 | [enter value] | Previous day average 24 hr flow at 10UH0002 (m3/s) | 0.114 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | | 0.087 | | | | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | | 0.109 | | | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | | Flows below 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is flow currently over 30% MAD at IQA-10? | | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | | |
| | When flows are above 30% MAD | | N/A | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is extracted flow less than 10% of instantaneous flows at IQA-10? | | | If pumped flow < 10% IF | No action required | | |

| | | | | | | | |
|----------------|--|--|---------|---------------|---|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | | 109.024 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | 109.029 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | | 729,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

| | | | | | | | |
|--------------|--|--|-------|---------------|--|-------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | | 0.740 | [enter value] | Previous day average 24 hr water level staff gauge (m) | 0.740 | [enter value] |
| | Estimated drawdown (m) | | 0 | [enter value] | | | |

APEX RIVER and UNNAMED LAKE - Daily Environmental Monitoring Report
City of Iqaluit - 2019 Emergency Water Supplementation Program

| | | | | |
|--------------------------------|--|-----------------|----------------------------|--|
| Date of Pumping Record Summary | | 26-Aug-19 | [enter value] | |
| Date Record Completed | | 28-Aug-19 | [enter value] | |
| Time Record Completed | | 12pm | [enter value] | |
| Prepared by | | Alice Kruchten | [enter name] | |
| Reviewed by | | Andrew Sullivan | [enter name when reviewed] | |

| | | | | |
|-----------|--|---|-------|---------------|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 181 | [enter value] |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.181 | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 156 | [enter value] |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.156 | |
| | Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | OK |

Additional Notes and Comments:

- Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location

| | | | | |
|-----------------|---|-------|--------|--|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 15,590 | |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 26,420 | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 13,888 | |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 18,055 | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | OK | If IQA-10 > UNL-01 Notify Nunami Stantec PM |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m ³ Notify Nunami Stantec PM |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m ³ Notify Nunami Stantec PM |
| | | | | |

If IQA-10 < UNL-01
No action required

If volume < 700,000 m3
No action required

If volume < 700,000 m3
No action required

Previous day cumulative pump volume withdrawn SNP UNL-01 (m3)

10,830

[enter value]

Previous day cumulative pump volume withdrawn SNP IQA-10 (m3)

4,167

[enter value]

| | | | | |
|--|--|-------------------|-------------------------|---|
| Apex River | Measured flow at Apex W-1 (m3/s) | | 0.0922 | [enter value] |
| | Measured flow at Apex W-2 (m3/s) | | 0.3268 | [enter value] |
| | Measured flow at Apex N-1 (m3/s) | | 0.0294 | [enter value] |
| | Average 24hr water level at WSC 10UH015 (m) | | 6.470 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | | 0.239 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | | 0.214 | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | | 0.174 | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows below 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction |
| | When flows are above 30% MAD | N/A | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) |
| | Is extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF | No action required |

Previous day average 24 hr water level at 10UH015 (m)

6.459

[enter value]

Previous day average 24 hr flow at 10UH0002 (m3/s)

0.149

[enter value]

| | | | | |
|----------------|--|--|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | | 109.059 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | | 718,000 | [enter value] |

Previous day average 24 hr water level at 10UH013 (m)

109.024

[enter value]

→ Based on stage-storage curve developed by Nunami Stantec 2018

| | | | | |
|--------------|--|--|-------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | | 0.740 | [enter value] |
| | Estimated drawdown (m) | | 0 | [enter value] |

Previous day average 24 hr water level staff gauge (m)

0.740

[enter value]

APEX RIVER and UNNAMED LAKE - Daily Environmental Monitoring Report
City of Iqaluit - 2019 Emergency Water Supplementation Program

Date of Pumping Record Summary

Date Record Completed

Time Record Completed

Prepared by

Reviewed by

27-Aug-19

28-Aug-19

12pm

Alice Kruchten

Andrew Sullivan

[enter value]

[enter value]

[enter value]

[enter name]

[enter name when reviewed]

Pump Rate

Threshold Check

Average Estimated Pump Rate for SNP UNL-01 (L/s)

Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s)

Average Estimated Pump Rate for SNP IQA-10 (L/s)

Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s)

Is pumping rate at IQA-10 < pumping rate at UNL-01?

Comb.

TOTAL

Comb.

TOTAL

181

0.181

150

0.150

OK

[enter value]

[enter value]

Pump Volume

Threshold Check

Pumping Time for Pumps (hours)

Daily Pump Volume Withdrawn SNP UNL-01 (m3)

Cumulative Pump Volume Withdrawn SNP UNL-01 (m3)

Pumping Time for pumps (hours)

Daily Pump Volume Withdrawn SNP IQA-10 (m3)

Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3)

Is daily pumped volume at IQA-10 < pumped volume at UNL-01?

Is cumulative pumped volume at UNL-01 below permitted amount?

Is cumulative pumped volume at IQA-10 below permitted amount?

Comb.

Comb.

24

15,638

42,058

24

11,791

29,846

OK

OK

OK

[enter value]

calculated

[enter value]

If IQA-10 > UNL-01

If volume > 700,000 m³

If volume > 700,000 m³

Notify Nunami Stantec PM

Notify Nunami Stantec PM

Notify Nunami Stantec PM

If IQA-10 < UNL-01

If volume < 700,000 m3

If volume < 700,000 m3

No action required

No action required

No action required

Apex River

Threshold Check When flows > 30%MAD

Measured flow at Apex W-1 (m3/s)

Measured flow at Apex W-2 (m3/s)

Measured flow at Apex N-1 (m3/s)

Average 24hr water level at WSC 10UH015 (m)

Average 24hr flow at WSC 10UH002 (m3/s)

Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s)

Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73)

When flows are above 30% MAD

Is flow currently over 30% MAD at IQA-10?

When flows are above 30% MAD

Is extracted flow less than 10% of instantaneous flows at IQA-10?

0.0903

0.2626

0.0251

6.468

0.235

0.204

0.172

Flows below 30MAD

N/A

[enter value]

[enter value]

[enter value]

[enter value]

[enter value]

[enter value]

24hr flow <0.316

24hr flow >0.316

If pumped flow > 10% IF

If pumped flow < 10% IF

Notify Nunami Stantec PM, reduce pumping rate (if required)

Adjust pumping rate to reflect allowable extraction

Notify Nunami Stantec PM, reduce pumping rate (if required)

No action required

Lake Geraldine

Average 24hr level at WSC 10UH013 (m)

Estimated volume available to spillway elevation 111.3 masl (m3)

109.096

706,000

[enter value]

[enter value]

Previous day average 24 hr water level at 10UH013 (m)

→ Based on stage-storage curve developed by Nunami Stantec 2018

109.059

[enter value]

Unnamed Lake

Average 24hr water level staff gauge (m)

Estimated drawdown (m)

not available

not calculated

[enter value]

[enter value]

Previous day average 24 hr water level staff gauge (m)

0.740

[enter value]

APEX RIVER and UNNAMED LAKE - Daily Environmental Monitoring Report
City of Iqaluit - 2019 Emergency Water Supplementation Program

| | | | | |
|--------------------------------|--|-----------------|----------------------------|--|
| Date of Pumping Record Summary | | 28-Aug-19 | [enter value] | |
| Date Record Completed | | 29-Aug-19 | [enter value] | |
| Time Record Completed | | 12pm | [enter value] | |
| Prepared by | | Alice Kruchten | [enter name] | |
| Reviewed by | | Andrew Sullivan | [enter name when reviewed] | |

| | | | | | |
|-----------------|--|-------|-------|---------------|---|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 181 | [enter value] | <div>Additional Notes and Comments:</div> <div>- Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location - Flow meter malfunction at UNL-01, assumed August 26th flow rate for August 28th</div> |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.181 | | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 145 | [enter value] | |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.145 | | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | OK | | |

| | | | | | | | |
|-----------------|---|-------|--------|------------------------------------|---|------------------------|--------------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 15,638 | calculated | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 42,058 | [enter value] |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 57,697 | | | | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 12,677 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 29,846 | [enter value] |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 42,523 | | | | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | OK | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 | No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |

| | | | | | | | |
|--|--|--|-------------------|-------------------------|---|-------|---------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | | 0.0604 | [enter value] | | | |
| | Measured flow at Apex W-2 (m3/s) | | 0.3248 | [enter value] | | | |
| | Measured flow at Apex N-1 (m3/s) | | 0.0211 | [enter value] | | | |
| | Average 24hr water level at WSC 10UH015 (m) | | 6.467 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | 6.468 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | | 0.212 | [enter value] | Previous day average 24 hr flow at 10UH0002 (m3/s) | 0.239 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | | 0.176 | | | | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | | 0.155 | | | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | | Flows below 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is flow currently over 30% MAD at IQA-10? | | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | | |
| | When flows are above 30% MAD | | N/A | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is extracted flow less than 10% of instantaneous flows at IQA-10? | | | If pumped flow < 10% IF | No action required | | |

| | | | | | | | |
|----------------|--|--|---------|---------------|---|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | | 109.131 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | 109.096 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | | 696,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

| | | | | | | | |
|--------------|--|--|----------------|---------------|--|-----|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | | not available | [enter value] | Previous day average 24 hr water level staff gauge (m) | n/a | [enter value] |
| | Estimated drawdown (m) | | not calculated | [enter value] | | | |

APEX RIVER and UNNAMED LAKE - Daily Environmental Monitoring Report
City of Iqaluit - 2019 Emergency Water Supplementation Program

| | | |
|--------------------------------|-----------------|----------------------------|
| Date of Pumping Record Summary | 29-Aug-19 | [enter value] |
| Date Record Completed | 30-Aug-19 | [enter value] |
| Time Record Completed | 12pm | [enter value] |
| Prepared by | Alice Kruchten | [enter name] |
| Reviewed by | Andrew Sullivan | [enter name when reviewed] |

| | | | | |
|-----------|--|---|-------|---------------|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 181 | [enter value] |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.181 | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 145 | [enter value] |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.145 | |
| | Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | OK |

Additional Notes and Comments:

- Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location
- Flow meter malfunction at UNL-01, assumed August 26th flow rate for August 29th
- High winds at location W-2, no measurement due to unsafe conditions
- High winds at Unnamed Lake, staff gauge readings are estimated

| | | | | | | | |
|-----------------|---|-------|--------|------------------------------------|---|------------------------|--------------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 15,638 | calculated | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 57,697 | [enter value] |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 73,335 | | | | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 12,698 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 42,523 | [enter value] |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 55,221 | | | | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | OK | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 | No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |

| | | | | | | |
|--|--|-------------------|-------------------------|---|-------|---------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | 0.0696 | [enter value] | | | |
| | Measured flow at Apex W-2 (m3/s) | no measurement | [enter value] | | | |
| | Measured flow at Apex N-1 (m3/s) | 0.0191 | [enter value] | | | |
| | Average 24hr water level at WSC 10UH015 (m) | 6.477 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | 6.467 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 0.267 | [enter value] | Previous day average 24 hr flow at 10UH0002 (m3/s) | 0.212 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 0.231 | | | | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 0.195 | | | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows below 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | | |
| | When flows are above 30% MAD | N/A | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF | No action required | | |

| | | | | | | |
|----------------|--|---------|---------------|---|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 109.171 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | 109.131 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 683,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

| | | | | | | |
|--------------|--|----------------|---------------|--|-----|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.6-0.7 | [enter value] | Previous day average 24 hr water level staff gauge (m) | n/a | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] | | | |

APEX RIVER and UNNAMED LAKE - Daily Environmental Monitoring Report
City of Iqaluit - 2019 Emergency Water Supplementation Program

Date of Pumping Record Summary

Date Record Completed

Time Record Completed

Prepared by

Reviewed by

30-Aug-19

31-Aug-19

2pm

Alice Kruchten

Andrew Sullivan

[enter value]

[enter value]

[enter value]

[enter name]

[enter name when reviewed]

| | | | | |
|-----------------|--|-------|-------|---------------|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 169 | [enter value] |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.169 | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 143 | [enter value] |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.143 | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | OK | |

Additional Notes and Comments:

- Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location
- Flow meter malfunction at UNL-01, assumed August 26th flow rate for August 30th as follows:
1 pump shut off at 5pm, assumed 181L/s (2pumps) for 17 hours, 140L/s (1pump) for 7 hours

Pump Volume

Pumping Time for Pumps (hours)

Daily Pump Volume Withdrawn SNP UNL-01 (m3)

Cumulative Pump Volume Withdrawn SNP UNL-01 (m3)

Pumping Time for pumps (hours)

Daily Pump Volume Withdrawn SNP IQA-10 (m3)

Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3)

Comb.

24

14,605

87,940

Comb.

24

12,502

67,723

[enter value]

calculated

[enter value]

Previous day cumulative pump volume withdrawn SNP UNL-01 (m3)

73,335

[enter value]

Previous day cumulative pump volume withdrawn SNP IQA-10 (m3)

55,221

[enter value]

Threshold Check

Is daily pumped volume at IQA-10 < pumped volume at UNL-01?

Is cumulative pumped volume at UNL-01 below permitted amount?

Is cumulative pumped volume at IQA-10 below permitted amount?

OK

OK

OK

If IQA-10 > UNL-01

If volume > 700,000 m³

If volume > 700,000 m³

Notify Nunami Stantec PM

Notify Nunami Stantec PM

Notify Nunami Stantec PM

If IQA-10 < UNL-01

If volume < 700,000 m3

If volume < 700,000 m3

No action required

No action required

No action required

Apex River

Measured flow at Apex W-1 (m3/s)

Measured flow at Apex W-2 (m3/s)

Measured flow at Apex N-1 (m3/s)

Average 24hr water level at WSC 10UH015 (m)

Average 24hr flow at WSC 10UH002 (m3/s)

Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s)

Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73)

0.2682

0.8587

0.0638

6.506

0.642

0.616

0.469

[enter value]

[enter value]

[enter value]

[enter value]

[enter value]

Previous day average 24 hr water level at 10UH015 (m)

6.477

[enter value]

Previous day average 24 hr flow at 10UH0002 (m3/s)

0.267

[enter value]

Threshold Check When flows > 30%MAD

When flows are above 30% MAD

Is flow currently over 30% MAD at IQA-10?

When flows are above 30% MAD

Is net extracted flow less than 10% of instantaneous flows at IQA-10?

Flows above 30MAD

OK

24hr flow <0.316

24hr flow >0.316

If pumped flow > 10% IF

If pumped flow < 10% IF

Notify Nunami Stantec PM, reduce pumping rate (if required)

Adjust pumping rate to reflect allowable extraction

Notify Nunami Stantec PM, reduce pumping rate (if required)

No action required

Lake Geraldine

Average 24hr level at WSC 10UH013 (m)

Estimated volume available to spillway elevation 111.3 masl (m3)

109.228

665,000

[enter value]

[enter value]

Previous day average 24 hr water level at 10UH013 (m)

109.171

[enter value]

→ Based on stage-storage curve developed by Nunami Stantec 2018

Unnamed Lake

Average 24hr water level staff gauge (m)

Estimated drawdown (m)

0.68

not calculated

[enter value]

[enter value]

Previous day average 24 hr water level staff gauge (m)

0.6-0.7

[enter value]

APEX RIVER and UNNAMED LAKE - Daily Environmental Monitoring Report
City of Iqaluit - 2019 Emergency Water Supplementation Program

| | | |
|--------------------------------|-----------------|----------------------------|
| Date of Pumping Record Summary | 31-Aug-19 | [enter value] |
| Date Record Completed | 1-Sep-19 | [enter value] |
| Time Record Completed | 2pm | [enter value] |
| Prepared by | Alice Kruchten | [enter name] |
| Reviewed by | Andrew Sullivan | [enter name when reviewed] |

| | | | | |
|-----------------|--|-------|-------|---------------|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 150 | [enter value] |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.150 | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 148 | [enter value] |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.148 | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | OK | |

| |
|---|
| Additional Notes and Comments: |
| - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location - Flow meter reinstalled at UNL-01 on August 31st. Metered flow rate assumed to apply all day. - Pumps shut off at IQA-10 for approximately 4 hours on August 31st. Pumping restarted with 3 pumps at 3pm August 31st. |

| | | | | |
|-----------------|---|-------|---------|------------------------------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 12,995 | |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 100,935 | |
| | Pumping Time for pumps (hours) | Comb. | 20 | [enter value] |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 10,809 | |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 78,532 | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | OK | If IQA-10 > UNL-01 |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m ³ |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m ³ |

| | | |
|---|--------|---------------|
| Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 87,940 | [enter value] |
|---|--------|---------------|

| | | |
|---|--------|---------------|
| Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 67,723 | [enter value] |
|---|--------|---------------|

| | |
|------------------------|--------------------|
| If IQA-10 < UNL-01 | No action required |
| If volume < 700,000 m3 | No action required |
| If volume < 700,000 m3 | No action required |

| | | | |
|--|---|-------------------|-------------------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | 0.2841 | [enter value] |
| | Measured flow at Apex W-2 (m3/s) | 0.5538 | [enter value] |
| | Measured flow at Apex N-1 (m3/s) | 0.0860 | [enter value] |
| | Average 24hr water level at WSC 10UH015 (m) | 6.508 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 0.677 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 0.675 | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 0.494 | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow <0.316 |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow >0.316 |
| | When flows are above 30% MAD | OK | If pumped flow > 10% IF |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF |

| | | |
|---|-------|---------------|
| Previous day average 24 hr water level at 10UH015 (m) | 6.506 | [enter value] |
| Previous day average 24 hr flow at 10UH0002 (m3/s) | 0.642 | [enter value] |

Notify Nunami Stantec PM, reduce pumping rate (if required)
Adjust pumping rate to reflect allowable extraction

Notify Nunami Stantec PM, reduce pumping rate (if required)
No action required

| | | | |
|----------------|--|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 109.271 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 651,000 | [enter value] |

| | | |
|---|---------|---------------|
| Previous day average 24 hr water level at 10UH013 (m) | 109.228 | [enter value] |
| → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

| | | | |
|--------------|--|----------------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.68 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] |

| | | |
|--|------|---------------|
| Previous day average 24 hr water level staff gauge (m) | 0.68 | [enter value] |
|--|------|---------------|

APEX RIVER and UNNAMED LAKE - Daily Environmental Monitoring Report
City of Iqaluit - 2019 Emergency Water Supplementation Program

| | | |
|--------------------------------|-----------------|----------------------------|
| Date of Pumping Record Summary | 1-Sep-19 | [enter value] |
| Date Record Completed | 2-Sep-19 | [enter value] |
| Time Record Completed | 3pm | [enter value] |
| Prepared by | Alice Kruchten | [enter name] |
| Reviewed by | Andrew Sullivan | [enter name when reviewed] |

| | | | | |
|-----------|--|-------|-------|---------------|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 151 | [enter value] |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.151 | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 187 | [enter value] |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.187 | |

| | | |
|-----------------|---|-------------------|
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | Notify Stantec PM |
|-----------------|---|-------------------|

| | | | | |
|-------------|--|-------|---------|---------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 13,006 | |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 113,941 | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 16,168 | |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 94,700 | |

| | | | | | | |
|-----------------|---|-------------------|------------------------------------|--------------------------|------------------------|--------------------|
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | Notify Stantec PM | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 | No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |

| | | | |
|------------|--|--------|---------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | 0.3478 | [enter value] |
| | Measured flow at Apex W-2 (m3/s) | 0.8797 | [enter value] |
| | Measured flow at Apex N-1 (m3/s) | 0.1433 | [enter value] |
| | Average 24hr water level at WSC 10UH015 (m) | 6.538 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 1.117 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 1.153 | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 0.815 | |

| | | | | |
|--|---|-------------------|-------------------------|---|
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction |
| | When flows are above 30% MAD | OK | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF | No action required |

| | | | |
|----------------|--|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 109.346 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 628,000 | [enter value] |

| | | |
|---|---------|---------------|
| Previous day average 24 hr water level at 10UH013 (m) | 109.271 | [enter value] |
| → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

| | | | |
|--------------|--|----------------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.70 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] |

| | | |
|--|------|---------------|
| Previous day average 24 hr water level staff gauge (m) | 0.68 | [enter value] |
|--|------|---------------|

| | |
|--|--|
| Additional Notes and Comments: | |
| - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location - Flow meter reinstalled at UNL-01 on August 31st. | |

| | | |
|---|---------|---------------|
| Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 100,935 | [enter value] |
| Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 78,532 | [enter value] |

APEX RIVER and UNNAMED LAKE - Daily Environmental Monitoring Report
City of Iqaluit - 2019 Emergency Water Supplementation Program

| | | | | |
|--------------------------------|--|-----------------|----------------------------|--|
| Date of Pumping Record Summary | | 2-Sep-19 | [enter value] | |
| Date Record Completed | | 3-Sep-19 | [enter value] | |
| Time Record Completed | | 3pm | [enter value] | |
| Prepared by | | Alice Kruchten | [enter name] | |
| Reviewed by | | Andrew Sullivan | [enter name when reviewed] | |

| | | | | |
|-----------|--|-------|-------|---------------|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 148 | [enter value] |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.148 | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 189 | [enter value] |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.189 | |

| | | |
|-----------------|---|-------------------|
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | Notify Stantec PM |
|-----------------|---|-------------------|

| | | | | |
|-------------|--|-------|---------|---------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 12,722 | |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 126,663 | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 16,287 | |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 110,987 | |

| | | | | | | |
|-----------------|---|-------------------|------------------------------------|--------------------------|------------------------|--------------------|
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | Notify Stantec PM | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 | No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |

| | | | |
|------------|--|--------------|---------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | not measured | [enter value] |
| | Measured flow at Apex W-2 (m3/s) | not measured | [enter value] |
| | Measured flow at Apex N-1 (m3/s) | not measured | [enter value] |
| | Average 24hr water level at WSC 10UH015 (m) | 6.587 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 1.704 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 1.745 | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 1.244 | |

| | | |
|---|-------|---------------|
| Previous day average 24 hr water level at 10UH015 (m) | 6.538 | [enter value] |
| Previous day average 24 hr flow at 10UH0002 (m3/s) | 1.117 | [enter value] |

| | | | | |
|--|---|-------------------|-------------------------|---|
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction |
| | When flows are above 30% MAD | OK | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF | No action required |

| | | | |
|----------------|--|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 109.438 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 599,000 | [enter value] |

| | | |
|---|---------|---------------|
| Previous day average 24 hr water level at 10UH013 (m) | 109.346 | [enter value] |
| → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

| | | | |
|--------------|--|----------------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.73 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] |

| | | |
|--|------|---------------|
| Previous day average 24 hr water level staff gauge (m) | 0.70 | [enter value] |
|--|------|---------------|

| | |
|---|--|
| Additional Notes and Comments: | |
| - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location - Flow measurements not completed at W-1, W-2, N-1 due to equipment malfunction | |

APEX RIVER and UNNAMED LAKE - Daily Environmental Monitoring Report
City of Iqaluit - 2019 Emergency Water Supplementation Program

| | | | | |
|--------------------------------|--|-----------------|----------------------------|--|
| Date of Pumping Record Summary | | 3-Sep-19 | [enter value] | |
| Date Record Completed | | 4-Sep-19 | [enter value] | |
| Time Record Completed | | 12pm | [enter value] | |
| Prepared by | | Alice Kruchten | [enter name] | |
| Reviewed by | | Andrew Sullivan | [enter name when reviewed] | |

| | | | | | |
|-----------------|--|-------|-------------------|---------------|---|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 146 | [enter value] | <div>Additional Notes and Comments:</div> <div>- Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location - Flow measurements not completed at W-1, W-2, N-1 due to equipment malfunction</div> |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.146 | | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 187 | [enter value] | |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.187 | | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | | |

| | | | | | | | |
|-----------------|---|-------|-------------------|------------------------------------|---|------------------------|--------------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 12,615 | | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 126,663 | [enter value] |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 139,278 | | | | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 16,257 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 110,987 | [enter value] |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 127,244 | | | | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | Notify Stantec PM | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 | No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |

| | | | | | | | |
|--|---|--|-------------------|-------------------------|---|-------|---------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | | not measured | [enter value] | | | |
| | Measured flow at Apex W-2 (m3/s) | | not measured | [enter value] | | | |
| | Measured flow at Apex N-1 (m3/s) | | not measured | [enter value] | | | |
| | Average 24hr water level at WSC 10UH015 (m) | | 6.592 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | 6.587 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | | 1.834 | [enter value] | Previous day average 24 hr flow at 10UH0002 (m3/s) | 1.704 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | | 1.875 | | | | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | | 1.339 | | | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is flow currently over 30% MAD at IQA-10? | | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | | |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | | 1.369 | | | | |
| | Available natural flow that can be pumped (m3/s) | | 0.137 | | | | |
| | When flows are above 30% MAD | | OK | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | | If pumped flow < 10% IF | No action required | | |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | | 0.283 | | | | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | | 0.096 | | | | |

| | | | | | | | |
|----------------|--|--|---------|---------------|---|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | | 109.531 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | 109.438 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | | 569,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

| | | | | | | | |
|--------------|--|--|----------------|---------------|--|------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | | 0.73 | [enter value] | Previous day average 24 hr water level staff gauge (m) | 0.73 | [enter value] |
| | Estimated drawdown (m) | | not calculated | [enter value] | | | |

APEX RIVER and UNNAMED LAKE - Daily Environmental Monitoring Report
City of Iqaluit - 2019 Emergency Water Supplementation Program

| | | |
|--------------------------------|-----------------|----------------------------|
| Date of Pumping Record Summary | 4-Sep-19 | [enter value] |
| Date Record Completed | 5-Sep-19 | [enter value] |
| Time Record Completed | 2pm | [enter value] |
| Prepared by | Alice Kruchten | [enter name] |
| Reviewed by | Andrew Sullivan | [enter name when reviewed] |

| | | | | |
|-----------------|--|-------|-------------------|---------------|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 147 | [enter value] |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.147 | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 188 | [enter value] |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.188 | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | |

| |
|---|
| Additional Notes and Comments: |
| - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location - Flow measurements not completed at W-1, W-2, N-1 due to equipment malfunction |

| | | | | |
|-----------------|---|-------------------|---------|---------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 12,661 | |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 151,939 | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 16,235 | |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 143,479 | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | Notify Stantec PM | | |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | OK | | |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | OK | | |

| | | |
|---|---------|---------------|
| Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 139,278 | [enter value] |
|---|---------|---------------|

| | | |
|---|---------|---------------|
| Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 127,244 | [enter value] |
|---|---------|---------------|

| | |
|------------------------------------|--------------------|
| If IQA-10 < UNL-01 | No action required |
| If volume < 700,000 m ³ | No action required |
| If volume < 700,000 m ³ | No action required |

| | | | |
|--|---|-------------------|-------------------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | not measured | [enter value] |
| | Measured flow at Apex W-2 (m3/s) | not measured | [enter value] |
| | Measured flow at Apex N-1 (m3/s) | not measured | [enter value] |
| | Average 24hr water level at WSC 10UH015 (m) | 6.644 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 3.033 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 3.074 | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 2.214 | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow < 0.316 |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow > 0.316 |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | 2.244 | |
| | Available natural flow that can be pumped (m3/s) | 0.224 | |
| | When flows are above 30% MAD | OK | If pumped flow > 10% IF |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | 0.371 | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | 0.041 | |

| | | |
|---|-------|---------------|
| Previous day average 24 hr water level at 10UH015 (m) | 6.592 | [enter value] |
| Previous day average 24 hr flow at 10UH0002 (m3/s) | 1.834 | [enter value] |

| | | | |
|----------------|--|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 109.641 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 535,000 | [enter value] |

| | | |
|---|---------|---------------|
| Previous day average 24 hr water level at 10UH013 (m) | 109.531 | [enter value] |
| → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

| | | | |
|--------------|--|----------------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.75 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] |

| | | |
|--|------|---------------|
| Previous day average 24 hr water level staff gauge (m) | 0.73 | [enter value] |
|--|------|---------------|

| | | |
|--------------------------------|-----------------|----------------------------|
| Date of Pumping Record Summary | 5-Sep-19 | [enter value] |
| Date Record Completed | 6-Sep-19 | [enter value] |
| Time Record Completed | 1pm | [enter value] |
| Prepared by | Alice Kruchten | [enter name] |
| Reviewed by | Andrew Sullivan | [enter name when reviewed] |

| | | | | |
|-----------------|--|-------|-------------------|---------------|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 94 | [enter value] |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.094 | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 189 | [enter value] |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.189 | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | |

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|--|
| Additional Notes and Comments: |
| - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location - Flow measurements not completed at W-1, W-2, N-1 due to equipment malfunction - Pumps at UNL were shut-off for 8.5 hour window on September 5th due to observed natural flows in the Apex River - Reported pumping rates reflect daily average rate and includes the 8.5 hours of no pumping (average instantaneous rate was 146L/s) - WSC station 10UH013 Lake Geraldine reset September 5th, data after 15:00 was removed |

| | | | | | | |
|-----------------|---|-------------------|------------------------|--------------------------|---|-----------------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 16 | [enter value] | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 6,622 | | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 151,939 [enter value] |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 158,561 | | | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 16,369 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 143,479 [enter value] |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 159,848 | | | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | Notify Stantec PM | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 | No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | OK | If volume > 700,000 m³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | OK | If volume > 700,000 m³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |

| | | | | |
|--|---|-------------------|-------------------------|---|
| Apex River | Measured flow at Apex W-1 (m3/s) | not measured | [enter value] | |
| | Measured flow at Apex W-2 (m3/s) | not measured | [enter value] | |
| | Measured flow at Apex N-1 (m3/s) | not measured | [enter value] | |
| | Average 24hr water level at WSC 10UH015 (m) | 6.613 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 2.259 | [enter value] | Previous day average 24 hr flow at 10UH0002 (m3/s) |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 2.354 | | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 1.649 | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | 1.718 | | |
| | Available natural flow that can be pumped (m3/s) | 0.172 | | |
| | When flows are above 30% MAD | OK | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF | No action required |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | 0.266 | | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | 0.095 | | |
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 109.721 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 509,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 |
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.75 | [enter value] | Previous day average 24 hr water level staff gauge (m) |
| | Estimated drawdown (m) | not calculated | [enter value] | |

| | | |
|--------------------------------|-----------------|----------------------------|
| Date of Pumping Record Summary | 6-Sep-19 | [enter value] |
| Date Record Completed | 7-Sep-19 | [enter value] |
| Time Record Completed | 11am | [enter value] |
| Prepared by | Alice Kruchten | [enter name] |
| Reviewed by | Andrew Sullivan | [enter name when reviewed] |

| | | | | |
|-----------------|--|-------|-------------------|---------------|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 145 | [enter value] |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.145 | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 187 | [enter value] |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.187 | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | |

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|---|
| Additional Notes and Comments: |
| - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location - Flow measurements not completed at W-1, W-2, N-1 due to equipment malfunction - WSC station 10UH013 Lake Geraldine reset September 5th, data before 5:00 September 6th was removed |

| | | | | |
|-----------------|---|-------|-------------------|------------------------------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 11,863 | |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 170,424 | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 16,198 | |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 176,046 | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | Notify Stantec PM | If IQA-10 > UNL-01 |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m ³ |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m ³ |

| | | |
|---|---------|---------------|
| Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 158,561 | [enter value] |
|---|---------|---------------|

| | | |
|---|---------|---------------|
| Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 159,848 | [enter value] |
|---|---------|---------------|

| | | | |
|--|---|-------------------|-------------------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | not measured | [enter value] |
| | Measured flow at Apex W-2 (m3/s) | not measured | [enter value] |
| | Measured flow at Apex N-1 (m3/s) | not measured | [enter value] |
| | Average 24hr water level at WSC 10UH015 (m) | 6.586 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 1.610 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 1.652 | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 1.175 | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow < 0.316 |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow > 0.316 |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | 1.206 | |
| | Available natural flow that can be pumped (m3/s) | 0.121 | |
| | When flows are above 30% MAD | OK | If pumped flow > 10% IF |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | 0.266 | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | 0.042 | |

| | | |
|---|-------|---------------|
| Previous day average 24 hr water level at 10UH015 (m) | 6.613 | [enter value] |
| Previous day average 24 hr flow at 10UH0002 (m3/s) | 2.259 | [enter value] |

| | | | |
|----------------|--|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 109.809 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 482,000 | [enter value] |

| | | |
|---|---------|---------------|
| Previous day average 24 hr water level at 10UH013 (m) | 109.721 | [enter value] |
| → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

| | | | |
|--------------|--|----------------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.75 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] |

| | | |
|--|------|---------------|
| Previous day average 24 hr water level staff gauge (m) | 0.75 | [enter value] |
|--|------|---------------|

| | | |
|--------------------------------|-----------------|----------------------------|
| Date of Pumping Record Summary | 7-Sep-19 | [enter value] |
| Date Record Completed | 8-Sep-19 | [enter value] |
| Time Record Completed | 12pm | [enter value] |
| Prepared by | Alice Kruchten | [enter name] |
| Reviewed by | Andrew Sullivan | [enter name when reviewed] |

| | | | | |
|-----------------|--|-------|-------------------|---------------|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 141 | [enter value] |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.141 | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 183 | [enter value] |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.183 | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | |

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| Additional Notes and Comments: |
| - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location - Flow measurements not completed at W-1, W-2, N-1 due to equipment malfunction |

| | | | | |
|-----------------|---|-------------------|---------|---------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 12,224 | |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 182,648 | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 14,437 | |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 190,483 | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | Notify Stantec PM | | |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | OK | | |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | OK | | |

| | | |
|---|---------|---------------|
| Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 170,424 | [enter value] |
|---|---------|---------------|

| | | |
|---|---------|---------------|
| Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 176,046 | [enter value] |
|---|---------|---------------|

| | |
|------------------------------------|--------------------|
| If IQA-10 < UNL-01 | No action required |
| If volume < 700,000 m ³ | No action required |
| If volume < 700,000 m ³ | No action required |

| | | | |
|--|---|-------------------|---------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | not measured | [enter value] |
| | Measured flow at Apex W-2 (m3/s) | not measured | [enter value] |
| | Measured flow at Apex N-1 (m3/s) | not measured | [enter value] |
| | Average 24hr water level at WSC 10UH015 (m) | 6.569 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 1.395 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 1.437 | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 1.018 | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | 1.049 | |
| | Available natural flow that can be pumped (m3/s) | 0.105 | |
| | When flows are above 30% MAD | OK | If pumped |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | 0.246 | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | 0.042 | |

| | | |
|---|-------|---------------|
| Previous day average 24 hr water level at 10UH015 (m) | 6.586 | [enter value] |
| Previous day average 24 hr flow at 10UH0002 (m3/s) | 1.610 | [enter value] |

Notify Nunami Stantec PM, reduce pumping rate (if required)

Adjust pumping rate to reflect allowable extraction

| | | | |
|----------------|--|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 109.870 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 462,000 | [enter value] |

| | | |
|---|---------|---------------|
| Previous day average 24 hr water level at 10UH013 (m) | 109.809 | [enter value] |
| → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

| | | | |
|--------------|--|----------------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.74 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] |

| | | |
|--|------|---------------|
| Previous day average 24 hr water level staff gauge (m) | 0.75 | [enter value] |
|--|------|---------------|

| | | |
|--------------------------------|-----------------|----------------------------|
| Date of Pumping Record Summary | 8-Sep-19 | [enter value] |
| Date Record Completed | 9-Sep-19 | [enter value] |
| Time Record Completed | 12pm | [enter value] |
| Prepared by | Alice Kruchten | [enter name] |
| Reviewed by | Andrew Sullivan | [enter name when reviewed] |

| | | | | | |
|-----------------|--|-------|-------------------|---------------|--|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 148 | [enter value] | <div>Additional Notes and Comments:</div> <div>- Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location</div> <div>- Flow measurements not completed at W-1, W-2, N-1 due to equipment malfunction</div> |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.148 | | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 186 | [enter value] | |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.186 | | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | | |

| | | | | | | | |
|-----------------|---|-------|-------------------|------------------------------------|---|------------------------|--------------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 12,607 | | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 182,648 | [enter value] |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 195,255 | | | | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 18,198 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 190,483 | [enter value] |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 208,681 | | | | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | Notify Stantec PM | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 | No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |

| | | | | | | | |
|--|---|--|-------------------|-------------------------|---|-------|---------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | | not measured | [enter value] | | | |
| | Measured flow at Apex W-2 (m3/s) | | not measured | [enter value] | | | |
| | Measured flow at Apex N-1 (m3/s) | | not measured | [enter value] | | | |
| | Average 24hr water level at WSC 10UH015 (m) | | 6.556 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | 6.569 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | | 1.210 | [enter value] | Previous day average 24 hr flow at 10UH0002 (m3/s) | 1.395 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | | 1.248 | | | | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | | 0.883 | | | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is flow currently over 30% MAD at IQA-10? | | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | | |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | | 0.911 | | | | |
| | Available natural flow that can be pumped (m3/s) | | 0.091 | | | | |
| | When flows are above 30% MAD | | OK | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | | If pumped flow < 10% IF | No action required | | |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | | 0.239 | | | | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | | 0.038 | | | | |

| | | | | | | |
|----------------|--|---------|---------------|---|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 109.937 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | 109.870 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 441,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

| | | | | | | |
|--------------|--|----------------|---------------|--|------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.73 | [enter value] | Previous day average 24 hr water level staff gauge (m) | 0.74 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] | | | |

| | | |
|--------------------------------|-----------------|----------------------------|
| Date of Pumping Record Summary | 9-Sep-19 | [enter value] |
| Date Record Completed | 10-Sep-19 | [enter value] |
| Time Record Completed | 3pm | [enter value] |
| Prepared by | Alice Kruchten | [enter name] |
| Reviewed by | Andrew Sullivan | [enter name when reviewed] |

| | | | | | |
|-----------------|--|-------|-------------------|---------------|--|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 162 | [enter value] | <div>Additional Notes and Comments:</div> <div>- Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location</div> <div>- Flow measurements not completed at W-1 due to equipment malfunction</div> |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.162 | | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 186 | [enter value] | |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.186 | | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | | |

| | | | | | | | |
|-----------------|---|-------|-------------------|------------------------------------|---|------------------------|--------------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 15,408 | | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 195,255 | [enter value] |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 210,663 | | | | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 16,113 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 208,681 | [enter value] |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | Notify Stantec PM | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 | No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |

| | | | | | | | |
|--|---|-------|-------------------|-------------------------|---|-------|---------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | | not measured | [enter value] | | | |
| | Measured flow at Apex W-2 (m3/s) | | not measured | [enter value] | | | |
| | Measured flow at Apex N-1 (m3/s) | | not measured | [enter value] | | | |
| | Average 24hr water level at WSC 10UH015 (m) | | 6.546 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | 6.556 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | | 1.073 | [enter value] | Previous day average 24 hr flow at 10UH0002 (m3/s) | 1.210 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | | 1.098 | | | | |
| Threshold Check When flows > 30%MAD | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | | 0.783 | | | | |
| | When flows are above 30% MAD | | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is flow currently over 30% MAD at IQA-10? | | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | | |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | | 0.801 | | | | |
| | Available natural flow that can be pumped (m3/s) | | 0.080 | | | | |
| | When flows are above 30% MAD | | OK | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | | If pumped flow < 10% IF | No action required | | |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | | 0.242 | | | | |
| Natural flow pumped from Apex at IQA-10 (m3/s) | | 0.025 | | | | | |

| | | | | | | |
|----------------|--|---------|---------------|---|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 109.994 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | 109.937 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 423,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

| | | | | | | |
|--------------|--|----------------|---------------|--|------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.73 | [enter value] | Previous day average 24 hr water level staff gauge (m) | 0.73 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] | | | |

| | | |
|--------------------------------|-----------------|----------------------------|
| Date of Pumping Record Summary | 10-Sep-19 | [enter value] |
| Date Record Completed | 11-Sep-19 | [enter value] |
| Time Record Completed | 2pm | [enter value] |
| Prepared by | Alice Kruchten | [enter name] |
| Reviewed by | Andrew Sullivan | [enter name when reviewed] |

| | | | | | |
|-----------------|--|-------|-------------------|---------------|---|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 146 | [enter value] | <div>Additional Notes and Comments:</div> <div>- Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location</div> <div>- Flow measurements not completed at W-2, N-1 due to equipment malfunction</div> |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.146 | | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 185 | [enter value] | |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.185 | | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | | |

| | | | | | | | |
|-------------|---|---|------------------------------------|--------------------------|---|--------------------|--------------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 9,841 | | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 210,663 | [enter value] |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 220,504 | | | | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 16,002 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 224,794 | [enter value] |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 240,796 | | | | |
| | Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | Notify Stantec PM | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 | No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required | |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required | |

| | | | | | | |
|--|---|-------------------|-------------------------|---|-------|---------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | not measured | [enter value] | | | |
| | Measured flow at Apex W-2 (m3/s) | 1.0478 | [enter value] | | | |
| | Measured flow at Apex N-1 (m3/s) | 0.0556 | [enter value] | | | |
| | Average 24hr water level at WSC 10UH015 (m) | 6.538 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | 6.546 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 0.978 | [enter value] | Previous day average 24 hr flow at 10UH0002 (m3/s) | 1.073 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 1.017 | | | | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 0.714 | | | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | | |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | 0.742 | | | | |
| | Available natural flow that can be pumped (m3/s) | 0.074 | | | | |
| | When flows are above 30% MAD | OK | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF | No action required | | |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | 0.220 | | | | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | 0.039 | | | | |

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|----------------|--|---------|---------------|---|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 110.050 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | 109.994 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 406,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

| | | | | | | |
|--------------|--|----------------|---------------|--|------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.72 | [enter value] | Previous day average 24 hr water level staff gauge (m) | 0.73 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] | | | |

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|--------------------------------|-----------------|----------------------------|
| Date of Pumping Record Summary | 11-Sep-19 | [enter value] |
| Date Record Completed | 12-Sep-19 | [enter value] |
| Time Record Completed | 2pm | [enter value] |
| Prepared by | Alice Kruchten | [enter name] |
| Reviewed by | Andrew Sullivan | [enter name when reviewed] |

| | | | | |
|-----------------|--|-------|-------------------|---------------|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 141 | [enter value] |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.141 | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 168 | [enter value] |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.168 | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | |

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| Additional Notes and Comments: |
| - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location - Pump at UNL-01 shut down fro ~50 minutes on September 11 (maintenance) - Pumps at IQA-10 shut down for ~3 hours on September 11 (maintenance) - Flow measurements not completed at W-2, N-1 due to equipment malfunction |

| | | | | |
|-----------------|---|-------|------------------------------------|--------------------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 23 | [enter value] |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 15,233 | |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 235,737 | |
| | Pumping Time for pumps (hours) | Comb. | 21 | [enter value] |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 14,739 | |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 255,535 | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | OK | If IQA-10 > UNL-01 | Notify Nunami Stantec PM |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM |

| | | |
|---|---------|---------------|
| Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 220,504 | [enter value] |
|---|---------|---------------|

| | | |
|---|---------|---------------|
| Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 240,796 | [enter value] |
|---|---------|---------------|

| | | | |
|--|---|-------------------|-------------------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | 0.4246 | [enter value] |
| | Measured flow at Apex W-2 (m3/s) | not measured | [enter value] |
| | Measured flow at Apex N-1 (m3/s) | not measured | [enter value] |
| | Average 24hr water level at WSC 10UH015 (m) | 6.536 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 0.937 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 0.964 | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 0.684 | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow < 0.316 |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow > 0.316 |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | 0.703 | |
| | Available natural flow that can be pumped (m3/s) | 0.070 | |
| | When flows are above 30% MAD | OK | If pumped flow > 10% IF |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | 0.212 | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | 0.027 | |

| | | |
|---|-------|---------------|
| Previous day average 24 hr water level at 10UH015 (m) | 6.538 | [enter value] |
| Previous day average 24 hr flow at 10UH0002 (m3/s) | 0.978 | [enter value] |

| | | | |
|----------------|--|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 110.102 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 389,000 | [enter value] |

| | | |
|---|---------|---------------|
| Previous day average 24 hr water level at 10UH013 (m) | 110.050 | [enter value] |
| → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

| | | | |
|--------------|--|----------------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.72 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] |

| | | |
|--|------|---------------|
| Previous day average 24 hr water level staff gauge (m) | 0.72 | [enter value] |
|--|------|---------------|

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|--------------------------------|-----------------|----------------------------|
| Date of Pumping Record Summary | 12-Sep-19 | [enter value] |
| Date Record Completed | 13-Sep-19 | [enter value] |
| Time Record Completed | 11am | [enter value] |
| Prepared by | Alice Kruchten | [enter name] |
| Reviewed by | Andrew Sullivan | [enter name when reviewed] |

| | | | | | |
|-----------------|--|-------|-------------------|---------------|---|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 141 | [enter value] | <div>Additional Notes and Comments:</div> <div>- Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location</div> <div>- Pump rates at UNL-01 were adsjuted to reduce flows on Septmeber 12th, and will continue to be monitored relative to natural flows in Apex and pumped flows at IQA-10</div> |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.141 | | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 184 | [enter value] | |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.184 | | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | | |

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|-----------------|---|-------|-------------------|------------------------------------|---|------------------------|--------------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 12,517 | | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 235,737 | [enter value] |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 248,254 | | | | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 15,880 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 255,535 | [enter value] |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 271,415 | | | | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | Notify Stantec PM | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 | No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |

| | | | | | | | |
|--|---|--|-------------------|-------------------------|---|-------|---------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | | 0.4056 | [enter value] | | | |
| | Measured flow at Apex W-2 (m3/s) | | 0.7679 | [enter value] | | | |
| | Measured flow at Apex N-1 (m3/s) | | 0.0541 | [enter value] | | | |
| | Average 24hr water level at WSC 10UH015 (m) | | 6.531 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | 6.536 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | | 0.884 | [enter value] | Previous day average 24 hr flow at 10UH0002 (m3/s) | 0.937 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | | 0.927 | | | | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | | 0.645 | | | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is flow currently over 30% MAD at IQA-10? | | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | | |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | | 0.677 | | | | |
| | Available natural flow that can be pumped (m3/s) | | 0.068 | | | | |
| | When flows are above 30% MAD | | OK | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | | If pumped flow < 10% IF | No action required | | |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | | 0.209 | | | | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | | 0.043 | | | | |

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|----------------|--|---------|---------------|---|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 110.155 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | 110.102 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 373,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

| | | | | | | |
|--------------|--|----------------|---------------|--|------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.72 | [enter value] | Previous day average 24 hr water level staff gauge (m) | 0.72 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] | | | |

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|--------------------------------|----------------|----------------------------|
| Date of Pumping Record Summary | 13-Sep-19 | [enter value] |
| Date Record Completed | 14-Sep-19 | [enter value] |
| Time Record Completed | 4pm | [enter value] |
| Prepared by | Alice Kruchten | [enter name] |
| Reviewed by | David Luzi | [enter name when reviewed] |

| | | | | |
|-----------------|--|-------|-------------------|---------------|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 122 | [enter value] |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.122 | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 186 | [enter value] |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.186 | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | |

| Additional Notes and Comments: |
|--|
| - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location |

| | | | | |
|-----------------|---|-------------------|---------|---------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 10,537 | |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 258,791 | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 16,029 | |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 287,444 | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | Notify Stantec PM | | |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | OK | | |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | OK | | |

| | | |
|---|---------|---------------|
| Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 248,254 | [enter value] |
|---|---------|---------------|

| | | |
|---|---------|---------------|
| Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 271,415 | [enter value] |
|---|---------|---------------|

| | |
|------------------------------------|--------------------|
| If IQA-10 < UNL-01 | No action required |
| If volume < 700,000 m ³ | No action required |
| If volume < 700,000 m ³ | No action required |

| | | | |
|--|---|-------------------|-------------------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | 0.4035 | [enter value] |
| | Measured flow at Apex W-2 (m3/s) | 0.8737 | [enter value] |
| | Measured flow at Apex N-1 (m3/s) | 0.0597 | [enter value] |
| | Average 24hr water level at WSC 10UH015 (m) | 6.528 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 0.855 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 0.919 | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 0.624 | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow < 0.316 |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow > 0.316 |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | 0.671 | |
| | Available natural flow that can be pumped (m3/s) | 0.067 | |
| | When flows are above 30% MAD | OK | If pumped flow > 10% IF |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | 0.189 | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | 0.064 | |

| | | |
|---|-------|---------------|
| Previous day average 24 hr water level at 10UH015 (m) | 6.531 | [enter value] |
| Previous day average 24 hr flow at 10UH0002 (m3/s) | 0.884 | [enter value] |

Notify Nunami Stantec PM, reduce pumping rate (if required)

Adjust pumping rate to reflect allowable extraction

| | | | |
|----------------|--|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 110.209 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 355,000 | [enter value] |

| | | |
|---|---------|---------------|
| Previous day average 24 hr water level at 10UH013 (m) | 110.155 | [enter value] |
| → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

| | | | |
|--------------|--|----------------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.71 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] |

| | | |
|--|------|---------------|
| Previous day average 24 hr water level staff gauge (m) | 0.72 | [enter value] |
|--|------|---------------|

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|--------------------------------|-----------------|----------------------------|
| Date of Pumping Record Summary | 14-Sep-19 | [enter value] |
| Date Record Completed | 15-Sep-19 | [enter value] |
| Time Record Completed | 2pm | [enter value] |
| Prepared by | Alice Kruchten | [enter name] |
| Reviewed by | Andrew Sullivan | [enter name when reviewed] |

| | | | | | |
|-----------------|--|-------|-------------------|---------------|--|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 116 | [enter value] | Additional Notes and Comments: - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.116 | | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 193 | [enter value] | |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.193 | | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | | |

| | | | | | | | |
|-----------------|---|-------|-------------------|------------------------------------|---|------------------------|--------------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 10,049 | | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 258,791 | [enter value] |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 268,840 | | | | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 16,065 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 287,444 | [enter value] |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 303,509 | | | | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | Notify Stantec PM | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 | No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |

| | | | | | | | |
|--|---|--|-------------------|-------------------------|---|-------|---------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | | 0.3830 | [enter value] | | | |
| | Measured flow at Apex W-2 (m3/s) | | 0.8623 | [enter value] | | | |
| | Measured flow at Apex N-1 (m3/s) | | 0.0550 | [enter value] | | | |
| | Average 24hr water level at WSC 10UH015 (m) | | 6.525 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | 6.528 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | | 0.797 | [enter value] | Previous day average 24 hr flow at 10UH0002 (m3/s) | 0.855 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | | 0.874 | | | | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | | 0.582 | | | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is flow currently over 30% MAD at IQA-10? | | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | | |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | | 0.638 | | | | |
| | Available natural flow that can be pumped (m3/s) | | 0.064 | | | | |
| | When flows are above 30% MAD | | Reduce Flows | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | | If pumped flow < 10% IF | No action required | | |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | | 0.180 | | | | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | | 0.077 | | | | |

| | | | | | | |
|----------------|--|---------|---------------|---|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 110.261 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | 110.209 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 339,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

| | | | | | | |
|--------------|--|----------------|---------------|--|------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.71 | [enter value] | Previous day average 24 hr water level staff gauge (m) | 0.71 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] | | | |

| | | |
|--------------------------------|-----------------|----------------------------|
| Date of Pumping Record Summary | 15-Sep-19 | [enter value] |
| Date Record Completed | 16-Sep-19 | [enter value] |
| Time Record Completed | 12pm | [enter value] |
| Prepared by | Alice Kruchten | [enter name] |
| Reviewed by | Andrew Sullivan | [enter name when reviewed] |

| | | | | | |
|-----------------|--|-------|-------------------|---------------|---|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 121 | [enter value] | <div>Additional Notes and Comments:</div> <div>- Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location</div> |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.121 | | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 185 | [enter value] | |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.185 | | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | | |

| | | | | | | | |
|-----------------|---|-------|-------------------|------------------------------------|---|------------------------|--------------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 7,538 | | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 268,840 | [enter value] |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 276,378 | | | | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 14,699 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 303,509 | [enter value] |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 318,208 | | | | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | Notify Stantec PM | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 | No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |

| | | | | | | | |
|--|---|--|-------------------|-------------------------|---|-------|---------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | | 0.3579 | [enter value] | | | |
| | Measured flow at Apex W-2 (m3/s) | | 0.7131 | [enter value] | | | |
| | Measured flow at Apex N-1 (m3/s) | | 0.0434 | [enter value] | | | |
| | Average 24hr water level at WSC 10UH015 (m) | | 6.519 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | 6.525 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | | 0.696 | [enter value] | Previous day average 24 hr flow at 10UH0002 (m3/s) | 0.797 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | | 0.760 | | | | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | | 0.508 | | | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is flow currently over 30% MAD at IQA-10? | | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | | |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | | 0.555 | | | | |
| | Available natural flow that can be pumped (m3/s) | | 0.055 | | | | |
| | When flows are above 30% MAD | | Reduce Flows | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | | If pumped flow < 10% IF | No action required | | |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | | 0.177 | | | | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | | 0.064 | | | | |
| | | | | | | | |

| | | | | | | |
|----------------|--|---------|---------------|---|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 110.310 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | 110.261 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 324,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

| | | | | | | |
|--------------|--|----------------|---------------|--|------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.70 | [enter value] | Previous day average 24 hr water level staff gauge (m) | 0.71 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] | | | |

| | | | | | | | | |
|--------------------------------|--|--|-----------------|----------------------------|--|--|--|--|
| Date of Pumping Record Summary | | | 16-Sep-19 | [enter value] | | | | |
| Date Record Completed | | | 17-Sep-19 | [enter value] | | | | |
| Time Record Completed | | | 11am | [enter value] | | | | |
| Prepared by | | | Alice Kruchten | [enter name] | | | | |
| Reviewed by | | | Andrew Sullivan | [enter name when reviewed] | | | | |

| | | | | | | | |
|-----------------|--|-------|-------------------|---------------|--|--|--|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 132 | [enter value] | Additional Notes and Comments: - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location | | |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.132 | | | | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 185 | [enter value] | | | |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.185 | | | | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | | | | |

| | | | | | | | |
|-----------------|---|-------------------|------------------------------------|--------------------------|---|--------------------|---------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 14,474 | | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 276,378 | [enter value] |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 290,852 | | | | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | | | |
| Pump Volume | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 16,987 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 318,208 | [enter value] |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 335,195 | | | | |
| | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | Notify Stantec PM | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 | No action required | |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required | |
| Threshold Check | Is cumulative pumped volume at IQA-10 below permitted amount? | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required | |

| | | | | | | | |
|--|---|-------------------|-------------------------|---|---------|---------------|--|
| Apex River | Measured flow at Apex W-1 (m3/s) | 0.3493 | [enter value] | | | | |
| | Measured flow at Apex W-2 (m3/s) | 0.7303 | [enter value] | | | | |
| | Measured flow at Apex N-1 (m3/s) | 0.0425 | [enter value] | | | | |
| | Average 24hr water level at WSC 10UH015 (m) | 6.514 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | 6.519 | [enter value] | |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 0.626 | [enter value] | Previous day average 24 hr flow at 10UH0002 (m3/s) | 0.696 | [enter value] | |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 0.679 | | | | | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 0.457 | | | | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, adjust pumping rate (if required) | | | |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | | | |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | 0.496 | | | | | |
| | Available natural flow that can be pumped (m3/s) | 0.050 | | | | | |
| | When flows are above 30% MAD | Adjust pump rates | If pumped flow > 10% IF | Notify Nunami Stantec PM, adjust pumping rate (if required) | | | |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF | No action required | | | |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | 0.181 | | | | | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | 0.053 | | | | | |
| | | | | | | | |
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 110.357 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | 110.310 | [enter value] | |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 309,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | | | |
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.70 | [enter value] | Previous day average 24 hr water level staff gauge (m) | 0.70 | [enter value] | |
| | Estimated drawdown (m) | not calculated | [enter value] | | | | |

Date of Pumping Record Summary

Date Record Completed

Time Record Completed

Prepared by

Reviewed by

17-Sep-19

18-Sep-19

2:00 PM

Andrew Sullivan

[enter value]

[enter value]

[enter value]

[enter name]

[enter name when reviewed]

| | | | | | |
|-----------------|--|-------|-------------------|---------------|--|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 169 | [enter value] | Additional Notes and Comments: - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.169 | | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 196 | [enter value] | |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.196 | | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | | |

| | | | | | | | |
|-----------------|---|-------|-------------------|------------------------|---|------------------------|--------------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 14,711 | | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 290,852 [enter value] | |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 305,563 | | | | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 16,489 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 335,195 [enter value] | |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 351,684 | | | | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | Notify Stantec PM | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 | No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |

| | | | | | | | |
|--|---|-------------------|-------------------------|---|--|-------|---------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | 0.3180 | [enter value] | | | | |
| | Measured flow at Apex W-2 (m3/s) | 0.7688 | [enter value] | | | | |
| | Measured flow at Apex N-1 (m3/s) | 0.0322 | [enter value] | | | | |
| | Average 24hr water level at WSC 10UH015 (m) | 6.511 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | | 6.514 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 0.638 | [enter value] | Previous day average 24 hr flow at 10UH0002 (m3/s) | | 0.626 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 0.665 | | | | | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 0.466 | | | | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | | | |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | | | |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | 0.486 | | | | | |
| | Available natural flow that can be pumped (m3/s) | 0.049 | | | | | |
| | When flows are above 30% MAD | OK | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | | | |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF | No action required | | | |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | 0.217 | | | | | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | 0.027 | | | | | |
| | | | | | | | |

| | | | | | | | |
|----------------|--|---------|---------------|---|--|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 110.404 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | | 110.357 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 294,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | | | |

| | | | | | | | |
|--------------|--|----------------|---------------|--|--|------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.70 | [enter value] | Previous day average 24 hr water level staff gauge (m) | | 0.70 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] | | | | |

Date of Pumping Record Summary

Date Record Completed

Time Record Completed

Prepared by

Reviewed by

18-Sep-19

19-Sep-19

4:00 PM

Andrew Sullivan

[enter value]

[enter value]

[enter value]

[enter name]

[enter name when reviewed]

| | | | | | |
|-----------------|--|-------|-------|---------------|--|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 218 | [enter value] | Additional Notes and Comments: - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.218 | | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 184 | [enter value] | |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.184 | | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | OK | | |

| | | | | | | |
|-----------------|---|-------|---------|------------------------------------|---|------------------------------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 18,821 | | | |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 324,384 | | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | |
| | | | | | 305,563 | [enter value] |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 16,245 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | OK | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m ³ |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m ³ |

| | | | | | | |
|--|---|-------------------|-------------------------|---|--|--|
| Apex River | Measured flow at Apex W-1 (m3/s) | 0.3060 | [enter value] | | | |
| | Measured flow at Apex W-2 (m3/s) | 0.7355 | [enter value] | | | |
| | Measured flow at Apex N-1 (m3/s) | 0.0348 | [enter value] | | | |
| | Average 24hr water level at WSC 10UH015 (m) | 6.517 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | | |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 0.691 | [enter value] | Previous day average 24 hr flow at 10UH0002 (m3/s) | | |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 0.657 | | | | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 0.504 | | | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | | |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | 0.480 | | | | |
| | Available natural flow that can be pumped (m3/s) | 0.048 | | | | |
| | When flows are above 30% MAD | OK | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF | No action required | | |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | 0.266 | | | | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | -0.034 | | | | |

| | | | | | | | |
|----------------|--|---------|---------------|---|--|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 110.452 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | | 110.404 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 279,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | | | |

| | | | | | | | |
|--------------|--|----------------|---------------|--|--|------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.69 | [enter value] | Previous day average 24 hr water level staff gauge (m) | | 0.70 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] | | | | |

Date of Pumping Record Summary

Date Record Completed

Time Record Completed

Prepared by

Reviewed by

19-Sep-19

20-Sep-19

10:00 AM

Andrew Sullivan

[enter value]

[enter value]

[enter value]

[enter name]

[enter name when reviewed]

| | | | | |
|-----------------|--|-------|-------------------|---------------|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 185 | [enter value] |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.185 | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 186 | [enter value] |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.186 | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | |

Additional Notes and Comments:

- Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location
- Flows were not measured Sept 18 due to high winds and flow conditions.

| | | | | | | |
|-----------------|---|-------|---------|------------------------------------|---|------------------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 16,832 | | | |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 341,216 | | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | |
| | | | | | 324,384 | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 15,996 | | | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | OK | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m3 |
| | | | | | | No action required |

| | | | | | | |
|--|---|-------------------|-------------------------|---|--|--|
| Apex River | Measured flow at Apex W-1 (m3/s) | not measured | [enter value] | | | |
| | Measured flow at Apex W-2 (m3/s) | not measured | [enter value] | | | |
| | Measured flow at Apex N-1 (m3/s) | not measured | [enter value] | | | |
| | Average 24hr water level at WSC 10UH015 (m) | 6.525 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | | |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 1.286 | [enter value] | | | |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 1.287 | | Previous day average 24 hr flow at 10UH0002 (m3/s) | | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 0.939 | | 0.691 | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | | |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | 0.940 | | | | |
| | Available natural flow that can be pumped (m3/s) | 0.094 | | | | |
| | When flows are above 30% MAD | OK | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF | No action required | | |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | 0.279 | | | | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | 0.001 | | | | |
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 110.518 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | | |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 258,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

Unnamed Lake

Average 24hr water level staff gauge (m)

Estimated drawdown (m)

0.69

not calculated

[\[enter value\]](#)

[\[enter value\]](#)

Previous day average 24 hr water level staff gauge (m)

0.69

[\[enter value\]](#)

Date of Pumping Record Summary

Date Record Completed

Time Record Completed

Prepared by

Reviewed by

20-Sep-19

22-Sep-19

5:00 PM

Andrew Sullivan

[enter value]

[enter value]

[enter value]

[enter name]

[enter name when reviewed]

| | | | | | |
|-----------------|--|-------|-------------------|---------------|--|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 133 | [enter value] | Additional Notes and Comments: - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.133 | | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 184 | [enter value] | |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.184 | | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | | |

| | | | | | | |
|-----------------|---|-------|-------------------|------------------------------------|---|--|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 8,001 | | | |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 349,217 | | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | |
| | | | | | 341,216 | [enter value] |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 14,560 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | Notify Stantec PM | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m ³ No action required |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m ³ No action required |

| | | | | | | |
|--|---|-------------------|-------------------------|---|--|-----------------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | not measured | [enter value] | | | |
| | Measured flow at Apex W-2 (m3/s) | note measured | [enter value] | | | |
| | Measured flow at Apex N-1 (m3/s) | not measured | [enter value] | | | |
| | Average 24hr water level at WSC 10UH015 (m) | 6.573 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | | 6.525 [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 1.901 | [enter value] | Previous day average 24 hr flow at 10UH0002 (m3/s) | | 1.286 [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 1.953 | | | | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 1.388 | | | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | | |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | 1.425 | | | | |
| | Available natural flow that can be pumped (m3/s) | 0.143 | | | | |
| | When flows are above 30% MAD | OK | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF | No action required | | |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | 0.275 | | | | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | 0.052 | | | | |
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 110.600 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | | 110.518 [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 232,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | | |
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.70 | [enter value] | Previous day average 24 hr water level staff gauge (m) | | 0.69 [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] | | | |

| | | |
|--------------------------------|-----------------|----------------------------|
| Date of Pumping Record Summary | 21-Sep-19 | [enter value] |
| Date Record Completed | 22-Sep-19 | [enter value] |
| Time Record Completed | 5:00 PM | [enter value] |
| Prepared by | Andrew Sullivan | [enter name] |
| Reviewed by | | [enter name when reviewed] |

| | | | | |
|-----------------|--|-------|-------------------|---------------|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 115 | [enter value] |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.115 | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 183 | [enter value] |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.183 | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | |

| |
|--|
| Additional Notes and Comments: |
| - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location |

| | | | | |
|-----------------|---|-------------------|---------|---------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 9,998 | |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 359,215 | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 15,770 | |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 414,255 | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | Notify Stantec PM | | |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | OK | | |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | OK | | |

| | | |
|---|---------|---------------|
| Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 349,217 | [enter value] |
|---|---------|---------------|

| | | |
|---|---------|---------------|
| Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 398,485 | [enter value] |
|---|---------|---------------|

| | |
|------------------------------------|--------------------|
| If IQA-10 < UNL-01 | No action required |
| If volume < 700,000 m ³ | No action required |
| If volume < 700,000 m ³ | No action required |

| | | | |
|--|---|-------------------|-------------------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | 0.5528 | [enter value] |
| | Measured flow at Apex W-2 (m3/s) | 1.0077 | [enter value] |
| | Measured flow at Apex N-1 (m3/s) | 0.1238 | [enter value] |
| | Average 24hr water level at WSC 10UH015 (m) | 6.551 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 1.442 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 1.510 | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 1.053 | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow < 0.316 |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow > 0.316 |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | 1.102 | |
| | Available natural flow that can be pumped (m3/s) | 0.110 | |
| | When flows are above 30% MAD | OK | If pumped flow > 10% IF |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | 0.225 | |
| Natural flow pumped from Apex at IQA-10 (m3/s) | 0.068 | | |

| | | | |
|----------------|--|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 110.662 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 213,000 | [enter value] |

| | | |
|---|---------|---------------|
| Previous day average 24 hr water level at 10UH013 (m) | 110.600 | [enter value] |
| → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

| | | | |
|--------------|--|----------------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.78 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] |

| | | |
|--|------|---------------|
| Previous day average 24 hr water level staff gauge (m) | 0.70 | [enter value] |
|--|------|---------------|

Date of Pumping Record Summary

Date Record Completed

Time Record Completed

Prepared by

Reviewed by

22-Sep-19

23-Sep-19

7:00 PM

Andrew Sullivan

[enter value]

[enter value]

[enter value]

[enter name]

[enter name when reviewed]

| | | | | | |
|-----------|--|---|-------------------|---------------|--|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 115 | [enter value] | Additional Notes and Comments: - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.115 | | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 184 | [enter value] | |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.184 | | |
| | Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | Notify Stantec PM | | |

| | | | | | | | |
|-----------------|---|-------------------|------------------------------------|--------------------------|---|--------------------|---------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 359,215 | [enter value] |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 9,900 | | | | |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 369,115 | | | | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 414,255 | [enter value] |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 15,486 | | | | |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 429,741 | | | | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | Notify Stantec PM | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 | No action required | |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m ³ | No action required | |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m ³ | No action required | |

| | | | | | | | |
|--|---|-------------------|-------------------------|---|--|---------------|---------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | 0.4977 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | 6.551 | [enter value] | |
| | Measured flow at Apex W-2 (m3/s) | 1.0702 | [enter value] | | Previous day average 24 hr flow at 10UH0002 (m3/s) | 1.442 | [enter value] |
| | Measured flow at Apex N-1 (m3/s) | 0.0865 | [enter value] | | | | |
| | Average 24hr water level at WSC 10UH015 (m) | 6.541 | [enter value] | | | | |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 1.162 | [enter value] | | | | |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 1.231 | | | | | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 0.848 | | | | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | | | |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | | | |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | 0.899 | | | | | |
| | Available natural flow that can be pumped (m3/s) | 0.090 | | | | | |
| | When flows are above 30% MAD | OK | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | | | |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF | No action required | | | |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | 0.205 | | | | | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | 0.069 | | | | | |
| | | | | | | | |

| | | | | | | |
|----------------|--|---------|---------------|---|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 110.719 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | 110.662 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 195,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

| | | | | | | |
|--------------|--|----------------|---------------|--|------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.77 | [enter value] | Previous day average 24 hr water level staff gauge (m) | 0.78 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] | | | |

APEX RIVER and UNNAMED LAKE - Daily Environmental Monitoring Report
City of Iqaluit - 2019 Emergency Water Supplementation Program

Date of Pumping Record Summary

Date Record Completed

Time Record Completed

Prepared by

Reviewed by

23-Sep-19

24-Sep-19

7:00 PM

Andrew Sullivan

[enter name when reviewed]

Pump Rate

Average Estimated Pump Rate for SNP UNL-01 (L/s)

Comb.

115

[enter value]

Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s)

TOTAL

0.115

Average Estimated Pump Rate for SNP IQA-10 (L/s)

Comb.

188

[enter value]

Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s)

TOTAL

0.188

Threshold Check

Is pumping rate at IQA-10 < pumping rate at UNL-01?

Notify Stantec PM

Additional Notes and Comments:

- Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location

Pump Volume

Pumping Time for Pumps (hours)

Comb.

24

[enter value]

Daily Pump Volume Withdrawn SNP UNL-01 (m3)

9,909

Cumulative Pump Volume Withdrawn SNP UNL-01 (m3)

379,024

Pumping Time for pumps (hours)

Comb.

24

[enter value]

Daily Pump Volume Withdrawn SNP IQA-10 (m3)

16,282

Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3)

446,023

Threshold Check

Is daily pumped volume at IQA-10 < pumped volume at UNL-01?

Notify Stantec PM

If IQA-10 > UNL-01

Is cumulative pumped volume at UNL-01 below permitted amount?

OK

If volume > 700,000 m³

Is cumulative pumped volume at IQA-10 below permitted amount?

OK

If volume > 700,000 m³

Previous day cumulative pump volume withdrawn SNP UNL-01 (m3)

369,115

[enter value]

Previous day cumulative pump volume withdrawn SNP IQA-10 (m3)

429,741

[enter value]

If IQA-10 < UNL-01

No action required

If volume < 700,000 m3

No action required

If volume < 700,000 m3

No action required

Apex River

Measured flow at Apex W-1 (m3/s)

0.4309

[enter value]

Measured flow at Apex W-2 (m3/s)

0.8849

[enter value]

Measured flow at Apex N-1 (m3/s)

0.0552

[enter value]

Average 24hr water level at WSC 10UH015 (m)

6.535

[enter value]

Average 24hr flow at WSC 10UH002 (m3/s)

1.033

[enter value]

Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s)

1.106

Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73)

0.754

Threshold Check When flows > 30%MAD

When flows are above 30% MAD

Flows above 30MAD

24hr flow <0.316

Notify Nunami Stantec PM, reduce pumping rate (if required)

Is flow currently over 30% MAD at IQA-10?

24hr flow >0.316

Adjust pumping rate to reflect allowable extraction

Average 24hr flow at IQA-10, subtract effects of pumping (m3/s)

0.807

Available natural flow that can be pumped (m3/s)

0.081

When flows are above 30% MAD

OK

If pumped flow > 10% IF

Notify Nunami Stantec PM, reduce pumping rate (if required)

Is net extracted flow less than 10% of instantaneous flows at IQA-10?

If pumped flow < 10% IF

No action required

Total flow that can be pumped from Apex at IQA-10 (m3/s)

0.196

Natural flow pumped from Apex at IQA-10 (m3/s)

0.073

Previous day average 24 hr water level at 10UH015 (m)

6.541

[enter value]

Previous day average 24 hr flow at 10UH0002 (m3/s)

1.162

[enter value]

Lake Geraldine

Average 24hr level at WSC 10UH013 (m)

110.772

[enter value]

Estimated volume available to spillway elevation 111.3 masl (m3)

178,000

[enter value]

Previous day average 24 hr water level at 10UH013 (m)

110.719

[enter value]

→ Based on stage-storage curve developed by Nunami Stantec 2018

Unnamed Lake

Average 24hr water level staff gauge (m)

0.77

[enter value]

Estimated drawdown (m)

not calculated

[enter value]

Previous day average 24 hr water level staff gauge (m)

0.77

[enter value]

Date of Pumping Record Summary

Date Record Completed

Time Record Completed

Prepared by

Reviewed by

24-Sep-19

25-Sep-19

1:00 PM

Andrew Sullivan

[enter value]

[enter value]

[enter value]

[enter name]

[enter name when reviewed]

| | | | | | |
|-----------------|--|-------|-------------------|---------------|--|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 116 | [enter value] | Additional Notes and Comments: - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.116 | | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 176 | [enter value] | |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.176 | | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | | |

| | | | | | | |
|-----------------|---|-------|-------------------|------------------------------------|---|--|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 12,973 | | | |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 391,997 | | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | |
| | | | | | 379,024 | [enter value] |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 15,479 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | Notify Stantec PM | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m ³ No action required |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m ³ No action required |

| | | | | | | |
|--|---|--|-------------------|-------------------------|---|---------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | | 0.4309 | [enter value] | | |
| | Measured flow at Apex W-2 (m3/s) | | 0.8849 | [enter value] | | |
| | Measured flow at Apex N-1 (m3/s) | | 0.0552 | [enter value] | | |
| | Average 24hr water level at WSC 10UH015 (m) | | 6.526 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | |
| | Average 24hr flow at WSC 10UH002 (m3/s) | | 0.926 | [enter value] | Previous day average 24 hr flow at 10UH0002 (m3/s) | |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | | 0.986 | | 1.033 | [enter value] |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | | 0.676 | | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | |
| | Is flow currently over 30% MAD at IQA-10? | | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | | 0.720 | | | |
| | Available natural flow that can be pumped (m3/s) | | 0.072 | | | |
| | When flows are above 30% MAD | | OK | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | | If pumped flow < 10% IF | No action required | |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | | 0.188 | | | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | | 0.060 | | | |
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | | 110.824 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | | 162,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | |
| Unnamed Lake | Average 24hr water level staff gauge (m) | | 0.77 | [enter value] | Previous day average 24 hr water level staff gauge (m) | |
| | Estimated drawdown (m) | | not calculated | [enter value] | 0.77 | [enter value] |

Date of Pumping Record Summary

Date Record Completed

Time Record Completed

Prepared by

Reviewed by

25-Sep-19

26-Sep-19

1:00 PM

Andrew Sullivan

[enter value]

[enter value]

[enter value]

[enter name]

[enter name when reviewed]

| | | | | | |
|-----------------|--|-------|-------------------|---------------|--|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 116 | [enter value] | Additional Notes and Comments: - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.116 | | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 182 | [enter value] | |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.182 | | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | | |

| | | | | | | | |
|-----------------|---|-------|-------------------|------------------------|---|------------------------|--------------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 7,018 | | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) 391,997 [enter value] | | |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 399,015 | | | | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 15,758 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) 461,502 [enter value] | | |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 477,260 | | | | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | Notify Stantec PM | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 | No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |

| | | | | | | | |
|--|---|-------------------|-------------------------|---|--|---------|---------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | 0.3824 | [enter value] | | | | |
| | Measured flow at Apex W-2 (m3/s) | 0.8432 | [enter value] | | | | |
| | Measured flow at Apex N-1 (m3/s) | 0.0533 | [enter value] | | | | |
| | Average 24hr water level at WSC 10UH015 (m) | 6.520 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | | 6.526 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 0.810 | [enter value] | Previous day average 24 hr flow at 10UH0002 (m3/s) | | 0.926 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 0.876 | | | | | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 0.591 | | | | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | | | |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | | | |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | 0.639 | | | | | |
| | Available natural flow that can be pumped (m3/s) | 0.064 | | | | | |
| | When flows are above 30% MAD | Adjust Flows | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | | | |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF | No action required | | | |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | 0.180 | | | | | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | 0.066 | | | | | |
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 110.871 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | | 110.824 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 147,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | | | |
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.77 | [enter value] | Previous day average 24 hr water level staff gauge (m) | | 0.77 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] | | | | |

Date of Pumping Record Summary

Date Record Completed

Time Record Completed

Prepared by

Reviewed by

26-Sep-19

27-Sep-19

1:00 PM

Andrew Sullivan

[enter value]

[enter value]

[enter value]

[enter name]

[enter name when reviewed]

| | | | | | |
|-----------------|--|-------|-------------------|---------------|--|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 116 | [enter value] | Additional Notes and Comments: - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.116 | | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 183 | [enter value] | |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.183 | | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | | |

| | | | | | | | |
|-----------------|---|-------|-------------------|------------------------|---|------------------------|--------------------|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 10,008 | | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 399,015 [enter value] | |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 409,023 | | | | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 15,798 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 477,260 [enter value] | |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 493,058 | | | | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | Notify Stantec PM | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 | No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m³ | Notify Nunami Stantec PM | If volume < 700,000 m3 | No action required |

| | | | | | | | |
|--|---|-------------------|-------------------------|---|--|-------|---------------|
| Apex River | Measured flow at Apex W-1 (m3/s) | 0.3319 | [enter value] | | | | |
| | Measured flow at Apex W-2 (m3/s) | 0.7775 | [enter value] | | | | |
| | Measured flow at Apex N-1 (m3/s) | 0.0470 | [enter value] | | | | |
| | Average 24hr water level at WSC 10UH015 (m) | 6.514 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | | 6.520 | [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 0.713 | [enter value] | Previous day average 24 hr flow at 10UH0002 (m3/s) | | 0.810 | [enter value] |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 0.781 | | | | | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 0.520 | | | | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | | | |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | | | |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | 0.570 | | | | | |
| | Available natural flow that can be pumped (m3/s) | 0.057 | | | | | |
| | When flows are above 30% MAD | Reduce Flows | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | | | |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF | No action required | | | |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | 0.172 | | | | | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | 0.068 | | | | | |
| | | | | | | | |

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|----------------|--|---------|---------------|---|--|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 110.920 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | | 110.871 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 131,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | | | |

| | | | | | | | |
|--------------|--|----------------|---------------|--|--|------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.76 | [enter value] | Previous day average 24 hr water level staff gauge (m) | | 0.77 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] | | | | |

Date of Pumping Record Summary

Date Record Completed

Time Record Completed

Prepared by

Reviewed by

28-Sep-19

29-Sep-19

1:00 PM

Andrew Sullivan

[enter value]

[enter value]

[enter value]

[enter name]

[enter name when reviewed]

| | | | | | |
|-----------------|--|-------|-------------------|---------------|--|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 123 | [enter value] | Additional Notes and Comments: - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location - UNL pump was shut down between 2 am and 9:30 due to equipment issues |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.123 | | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 181 | [enter value] | |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.181 | | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | | |

| | | | | | | |
|-----------------|---|-------|-------------------|------------------------------------|---|--|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 17 | [enter value] | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 7,964 | | | |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 428,269 | | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | |
| | | | | | 420,305 | [enter value] |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 15,020 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | Notify Stantec PM | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m ³ No action required |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m ³ No action required |

| | | | | | |
|--|---|-------------------|-------------------------|---|--|
| Apex River | Measured flow at Apex W-1 (m3/s) | 0.3541 | [enter value] | | |
| | Measured flow at Apex W-2 (m3/s) | 0.7117 | [enter value] | | |
| | Measured flow at Apex N-1 (m3/s) | 0.0559 | [enter value] | | |
| | Average 24hr water level at WSC 10UH015 (m) | 6.513 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 0.728 | [enter value] | Previous day average 24 hr flow at 10UH0002 (m3/s) | |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 0.786 | | 0.786 | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 0.531 | | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | 0.574 | | | |
| | Available natural flow that can be pumped (m3/s) | 0.057 | | | |
| | When flows are above 30% MAD | Reduce Flows | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF | No action required | |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | 0.180 | | | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | 0.058 | | | |
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 111.017 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 101,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | |
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.78 | [enter value] | Previous day average 24 hr water level staff gauge (m) | |
| | Estimated drawdown (m) | not calculated | [enter value] | 0.78 | |

Date of Pumping Record Summary

Date Record Completed

Time Record Completed

Prepared by

Reviewed by

29-Sep-19

30-Sep-19

1:00 PM

Andrew Sullivan

[enter value]

[enter value]

[enter value]

[enter name]

[enter name when reviewed]

| | | | | | |
|-----------------|--|-------|-------------------|---------------|---|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 146 | [enter value] | Additional Notes and Comments: - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location - Flows were not measured at N-2 due to equipment issues. |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.146 | | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 181 | [enter value] | |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.181 | | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | | |

| | | | | | | |
|-----------------|---|-------|-------------------|------------------------------------|---|--|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 12,665 | | | |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 440,934 | | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | |
| | | | | | 428,269 | [enter value] |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 15,988 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | |
| Threshold Check | | | 539,758 | | 523,770 | [enter value] |
| | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | Notify Stantec PM | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m ³ No action required |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m ³ No action required |

| | | | | | | |
|--|---|-------------------|-------------------------|---|--|--|
| Apex River | Measured flow at Apex W-1 (m3/s) | 0.3121 | [enter value] | | | |
| | Measured flow at Apex W-2 (m3/s) | 0.7952 | [enter value] | | | |
| | Measured flow at Apex N-1 (m3/s) | not measured | [enter value] | | | |
| | Average 24hr water level at WSC 10UH015 (m) | 6.516 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | | |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 0.759 | [enter value] | Previous day average 24 hr flow at 10UH0002 (m3/s) | | |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 0.794 | | 0.728 | | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 0.554 | | | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | | |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | 0.580 | | | | |
| | Available natural flow that can be pumped (m3/s) | 0.058 | | | | |
| | When flows are above 30% MAD | OK | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF | No action required | | |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | 0.204 | | | | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | 0.035 | | | | |

| | | | | | | |
|----------------|--|---------|---------------|---|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 111.064 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | 111.017 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 86,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | | |

| | | | | | | | |
|--------------|--|----------------|---------------|--|--|------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.77 | [enter value] | Previous day average 24 hr water level staff gauge (m) | | 0.78 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] | | | | |

Date of Pumping Record Summary

Date Record Completed

Time Record Completed

Prepared by

Reviewed by

30-Sep-19

1-Oct-19

1:00 PM

Andrew Sullivan

[enter value]

[enter value]

[enter value]

[enter name]

[enter name when reviewed]

| | | | | | |
|-----------------|--|-------|-------------------|---------------|--|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 146 | [enter value] | Additional Notes and Comments: - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location - Flows were not measured on Sept. 30. |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.146 | | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 181 | [enter value] | |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.181 | | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | | |

| | | | | | | |
|-----------------|---|-------|-------------------|------------------------------------|---|--|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 24 | [enter value] | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 12,889 | | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | 440,934 [enter value] |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 453,823 | | | |
| | Pumping Time for pumps (hours) | Comb. | 24 | [enter value] | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 16,349 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | 539,758 [enter value] |
| | Cumulative Pump Volume Withdrawn SNP-IQA-10 (m3) | | 556,107 | | | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | Notify Stantec PM | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m ³ No action required |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m ³ No action required |

| | | | | | |
|--|---|-------------------|-------------------------|---|---|
| Apex River | Measured flow at Apex W-1 (m3/s) | not measured | [enter value] | | |
| | Measured flow at Apex W-2 (m3/s) | not measured | [enter value] | | |
| | Measured flow at Apex N-1 (m3/s) | not measured | [enter value] | | |
| | Average 24hr water level at WSC 10UH015 (m) | 6.517 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | 6.516 [enter value] |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 0.783 | [enter value] | | |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 0.818 | | Previous day average 24 hr flow at 10UH0002 (m3/s) | 0.759 [enter value] |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 0.572 | | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | 0.597 | | | |
| | Available natural flow that can be pumped (m3/s) | 0.060 | | | |
| | When flows are above 30% MAD | OK | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF | No action required | |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | 0.206 | | | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | 0.035 | | | |
| | | | | | |
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 111.113 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | 111.064 [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 70,000 | [enter value] | | → Based on stage-storage curve developed by Nunami Stantec 2018 |
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.77 | [enter value] | Previous day average 24 hr water level staff gauge (m) | 0.77 [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] | | |

Date of Pumping Record Summary

Date Record Completed

Time Record Completed

Prepared by

Reviewed by

1-Oct-19

2-Oct-19

1:00 PM

Andrew Sullivan

[enter value]

[enter value]

[enter value]

[enter name]

[enter name when reviewed]

| | | | | | |
|-----------------|--|-------|-------------------|---------------|--|
| Pump Rate | Average Estimated Pump Rate for SNP UNL-01 (L/s) | Comb. | 144 | [enter value] | Additional Notes and Comments: - Pump rates at UNL-01 and IQA-10 cumulative estimate for all pumps at each location - UNL pumps were shut off at 4:30 PM and Apex pumps were shut off at 5:30 PM |
| | Total Averaged Estimated Pump Rate SNP UNL-01 (m3/s) | TOTAL | 0.144 | | |
| | Average Estimated Pump Rate for SNP IQA-10 (L/s) | Comb. | 181 | [enter value] | |
| | Total Averaged Estimated Pump Rate for SNP IQA-10 (m3/s) | TOTAL | 0.181 | | |
| Threshold Check | Is pumping rate at IQA-10 < pumping rate at UNL-01? | | Notify Stantec PM | | |

| | | | | | | |
|-----------------|---|-------|-------------------|------------------------------------|---|--|
| Pump Volume | Pumping Time for Pumps (hours) | Comb. | 17 | [enter value] | | |
| | Daily Pump Volume Withdrawn SNP UNL-01 (m3) | | 8,571 | | | |
| | Cumulative Pump Volume Withdrawn SNP UNL-01 (m3) | | 462,394 | | Previous day cumulative pump volume withdrawn SNP UNL-01 (m3) | |
| | | | | | 453,823 | [enter value] |
| | Pumping Time for pumps (hours) | Comb. | 18 | [enter value] | | |
| | Daily Pump Volume Withdrawn SNP IQA-10 (m3) | | 10,207 | | Previous day cumulative pump volume withdrawn SNP IQA-10 (m3) | |
| Threshold Check | Is daily pumped volume at IQA-10 < pumped volume at UNL-01? | | Notify Stantec PM | If IQA-10 > UNL-01 | Notify Nunami Stantec PM | If IQA-10 < UNL-01 No action required |
| | Is cumulative pumped volume at UNL-01 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m ³ No action required |
| | Is cumulative pumped volume at IQA-10 below permitted amount? | | OK | If volume > 700,000 m ³ | Notify Nunami Stantec PM | If volume < 700,000 m ³ No action required |

| | | | | | | |
|--|---|-------------------|-------------------------|---|--|--|
| Apex River | Measured flow at Apex W-1 (m3/s) | 0.2994 | [enter value] | | | |
| | Measured flow at Apex W-2 (m3/s) | 0.9078 | [enter value] | | | |
| | Measured flow at Apex N-1 (m3/s) | 0.0532 | [enter value] | | | |
| | Average 24hr water level at WSC 10UH015 (m) | 6.516 | [enter value] | Previous day average 24 hr water level at 10UH015 (m) | | |
| | Average 24hr flow at WSC 10UH002 (m3/s) | 0.734 | [enter value] | Previous day average 24 hr flow at 10UH0002 (m3/s) | | |
| | Average 24hr flow at WSC 10UH002, subtract effects of pumping (m3/s) | 0.771 | | 6.517 | | |
| | Average 24hr flow at IQA-10 (m3/s) (scaled using 0.73) | 0.536 | | 0.783 | | |
| Threshold Check When flows > 30%MAD | When flows are above 30% MAD | Flows above 30MAD | 24hr flow <0.316 | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is flow currently over 30% MAD at IQA-10? | | 24hr flow >0.316 | Adjust pumping rate to reflect allowable extraction | | |
| | Average 24hr flow at IQA-10, subtract effects of pumping (m3/s) | 0.563 | | | | |
| | Available natural flow that can be pumped (m3/s) | 0.056 | | | | |
| | When flows are above 30% MAD | OK | If pumped flow > 10% IF | Notify Nunami Stantec PM, reduce pumping rate (if required) | | |
| | Is net extracted flow less than 10% of instantaneous flows at IQA-10? | | If pumped flow < 10% IF | No action required | | |
| | Total flow that can be pumped from Apex at IQA-10 (m3/s) | 0.200 | | | | |
| | Natural flow pumped from Apex at IQA-10 (m3/s) | 0.037 | | | | |

| | | | | | | | |
|----------------|--|---------|---------------|---|--|---------|---------------|
| Lake Geraldine | Average 24hr level at WSC 10UH013 (m) | 111.154 | [enter value] | Previous day average 24 hr water level at 10UH013 (m) | | 111.113 | [enter value] |
| | Estimated volume available to spillway elevation 111.3 masl (m3) | 57,000 | [enter value] | → Based on stage-storage curve developed by Nunami Stantec 2018 | | | |

| | | | | | | | |
|--------------|--|----------------|---------------|--|--|------|---------------|
| Unnamed Lake | Average 24hr water level staff gauge (m) | 0.77 | [enter value] | Previous day average 24 hr water level staff gauge (m) | | 0.77 | [enter value] |
| | Estimated drawdown (m) | not calculated | [enter value] | | | | |

APPENDIX E

Transducer results – Water Surface Elevations In Unnamed Lake During Pumping

Appendix E – Pressure Transducer Data – Unnamed Lake

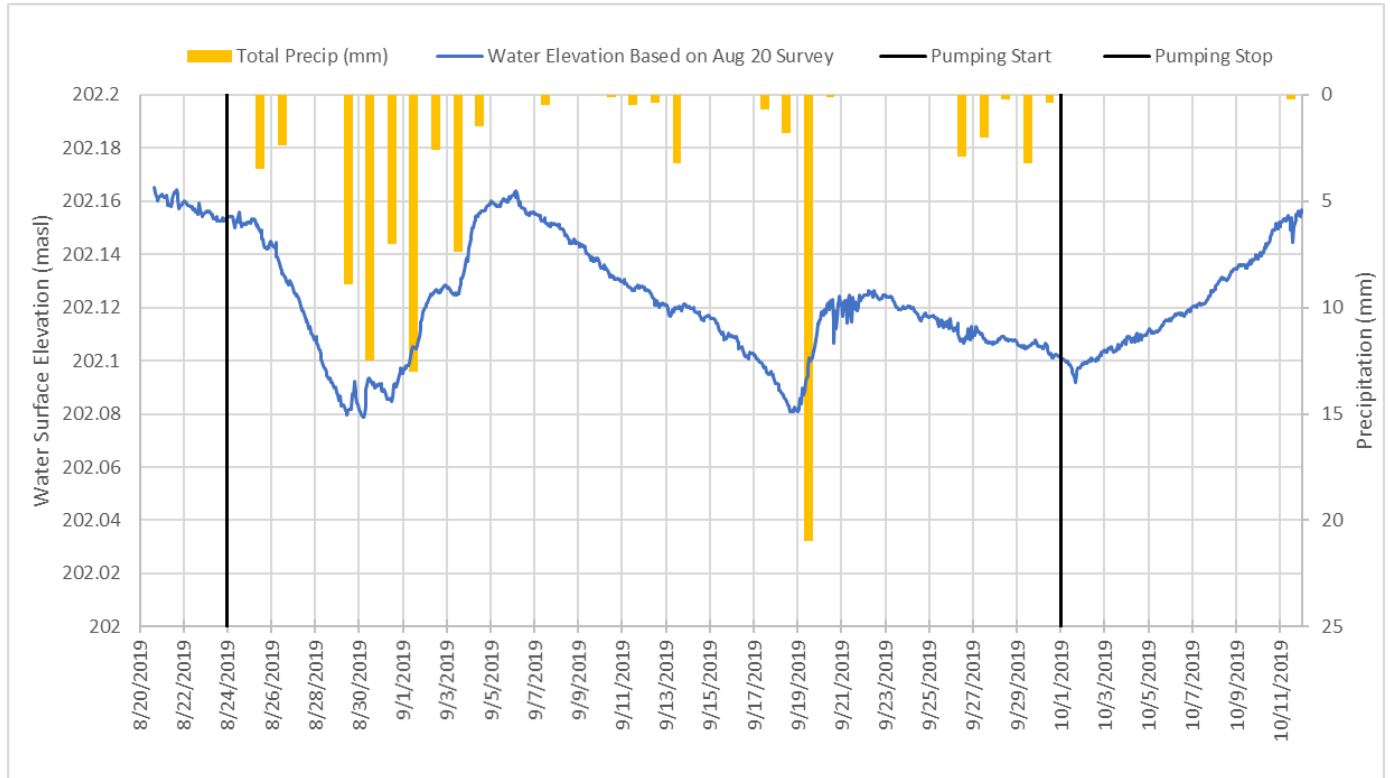


Figure E-1 Transducer #1 Water Surface Elevations in Unnamed Lake During Pumping

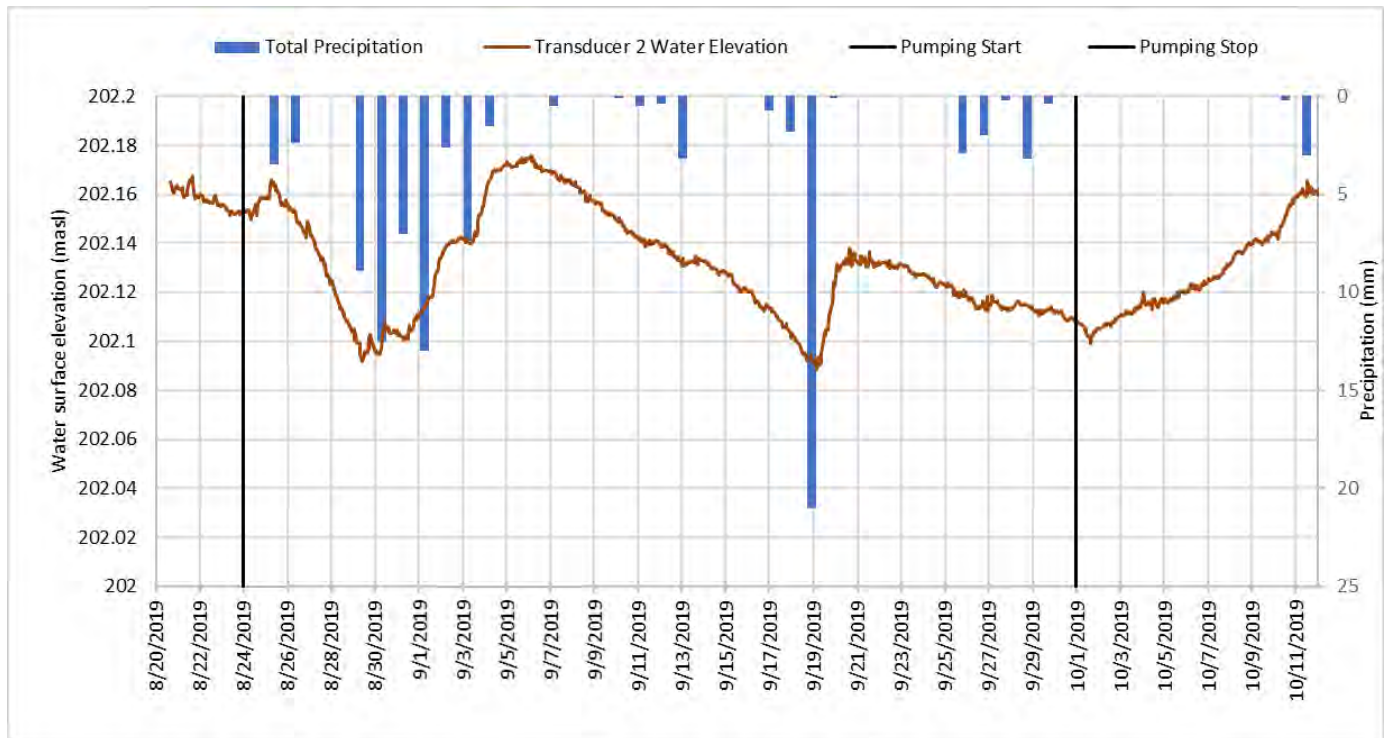


Figure E-2 Transducer #2 Water Surface Elevations in Unnamed Lake During Pumping

APPENDIX F

Water Quality Table

Table F-1
Summary of Surface Water Analytical Results
Lake Geraldine Water Supply
Nunami Stantec Limited

| Sample Location | | | | SW19-01 | | SW19-02 | | SW19-03 | | SW19-04 | | SW19-05 | |
|-------------------------------------|-----------|---------------------------------------|---------------------------------------|--------------------|-----------|--------------------|-----------|--------------------|-----------|--------------------|-----------|-----------------|-----------|
| Sample Date | | | | 4-Jul-19 | 12-Sep-19 | 4-Jul-19 | 12-Sep-19 | 4-Jul-19 | 12-Sep-19 | 4-Jul-19 | 12-Sep-19 | 4-Jul-19 | 12-Sep-19 |
| Sample ID | | | | SW19-01 | SW19-01 | SW19-02 | SW19-02 | SW19-03 | SW19-03 | SW19-04 | SW19-04 | SW19-05 | SW19-05 |
| Sampling Company | | | | STANTEC | STANTEC | STANTEC | STANTEC | STANTEC | STANTEC | STANTEC | STANTEC | STANTEC | STANTEC |
| Laboratory | | | | BV | BV | BV | BV | BV | BV | BV | BV | BV | BV |
| Laboratory Work Order | | | | B9I5722 | B9P9085 | B9I5722 | B9P9085 | B9I5722 | B9P9085 | B9I5722 | B9P9085 | B9I5722 | B9P9085 |
| Laboratory Sample ID | Units | Health Canada | Northern Health | KEV013 | KUI442 | KEV014 | KUI443 | KEV015 | KUI444 | KEV016 | KUI445 | KEV017 | KUI446 |
| General Chemistry | | | | | | | | | | | | | |
| Alkalinity, Carbonate (as CaCO3) | mg/L | n/v | n/v | <1.0 | - | <1.0 | - | <1.0 | - | <1.0 | - | <1.0 | - |
| Alkalinity, Total (as CaCO3) | mg/L | n/v | 30-500 ^D | 16 ^D | - | 16 ^D | - | 16 ^D | - | 16 ^D | - | 17 ^D | - |
| Ammonia (as N) | mg/L | n/v | 1.5 ₍₃₎ ^D | 0.15 | - | 0.25 | - | 0.072 | - | <0.050 | - | <0.050 | - |
| Bicarbonate(as CaCO3, Calculated) | mg/L | n/v | n/v | 16 | - | 16 | - | 16 | - | 16 | - | 17 | - |
| Chloride | mg/L | ≤250 ^A | 250 ^D | 1.6 | - | 1.3 | - | 1.5 | - | 1.2 | - | 1.4 | - |
| Electrical Conductivity, Lab | µmhos/cm | n/v | 800 ^D | 46 | - | 45 | - | 45 | - | 45 | - | 47 | - |
| Hardness (as CaCO3) | mg/L | n/v | 250 ^D | 20 | - | 19 | - | 19 | - | 19 | - | 20 | - |
| Langellier Index (at 20 C) | none | n/v | -2 to +2 ^D | -1.77 | - | -1.85 | - | -1.78 | - | -1.79 | - | -1.67 | - |
| Langellier Index (at 4 C) | none | n/v | -2 to +2 ^D | -2.02 ^D | - | -2.10 ^D | - | -2.03 ^D | - | -2.04 ^D | - | -1.92 | - |
| Nitrate (as N) | mg/L | 10 ^B | 10 ₍₃₎ ^D | <0.10 | - | <0.10 | - | <0.10 | - | <0.10 | - | <0.10 | - |
| Nitrite (as N) | mg/L | 1 ^B | 1 ₍₃₎ ^D | <0.010 | - | <0.010 | - | <0.010 | - | <0.010 | - | <0.010 | - |
| Orthophosphate (as P) | mg/L | n/v | n/v | <0.010 | - | <0.010 | - | <0.010 | - | <0.010 | - | <0.010 | - |
| pH, lab | S.U. | 7.0-10.5 ^A | 6.5-8.5 ^D | 7.48 | - | 7.43 | - | 7.49 | - | 7.47 | - | 7.54 | - |
| Phosphorus, Total | mg/L | n/v | 0.1 ₍₂₎ ^D | 0.006 | - | 0.013 | - | 0.008 | - | 0.005 | - | 0.008 | - |
| Saturation pH (at 20 C) | none | n/v | n/v | 9.25 | - | 9.28 | - | 9.27 | - | 9.26 | - | 9.22 | - |
| Saturation pH (at 4 C) | none | n/v | n/v | 9.50 | - | 9.53 | - | 9.52 | - | 9.52 | - | 9.47 | - |
| Sulfate | mg/L | ≤500 ^A | 500 ^D | 2.7 | - | 2.5 | - | 2.4 | - | 2.4 | - | 2.8 | - |
| Total Dissolved Solids (Calculated) | mg/L | ≤500 ^A | 500 ^D | 23 | - | 22 | - | 22 | - | 22 | - | 24 | - |
| Total Organic Carbon | mg/L | n/v | 2.5 ^D | 1.6 | - | 1.4 | - | 1.4 | - | 1.3 | - | 1.4 | - |
| Turbidity, Lab | NTU | ≤0.3/1.0/0.1 ^C | 1 ^D | <0.1 | - | <0.1 | - | <0.1 | - | <0.1 | - | <0.1 | - |
| BTEX and Petroleum Hydrocarbons | | | | | | | | | | | | | |
| Benzene | µg/L | 5 ^B | 5 ₍₃₎ ^D | - | <0.20 | - | <0.20 | - | <0.20 | - | <0.20 | - | <0.20 |
| Toluene | µg/L | 24 ^A 60 ^B | 24 ₍₉₎ ^D | - | <0.20 | - | <0.20 | - | <0.20 | - | <0.20 | - | <0.20 |
| Ethylbenzene | µg/L | 1.6 ^A 140 ^B | 2 ₍₉₎ ^D | - | <0.20 | - | <0.20 | - | <0.20 | - | <0.20 | - | <0.20 |
| Xylene, m & p- | µg/L | n/v | n/v | - | <0.40 | - | <0.40 | - | <0.40 | - | <0.40 | - | <0.40 |
| Xylene, o- | µg/L | n/v | n/v | - | <0.20 | - | <0.20 | - | <0.20 | - | <0.20 | - | <0.20 |
| Xylenes, Total | µg/L | 20 ^A 90 ^B | 300 ₍₉₎ ^D | - | <0.40 | - | <0.40 | - | <0.40 | - | <0.40 | - | <0.40 |
| PHC F2 (>C10-C16 range) | µg/L | n/v | n/v | - | <100 | - | <100 | - | <100 | - | <100 | - | <100 |
| PHC F3 (>C16-C34 range) | µg/L | n/v | n/v | - | <200 | - | <200 | - | <200 | - | <200 | - | <200 |
| PHC F4 (>C34-C50 range) | µg/L | n/v | n/v | - | <200 | - | <200 | - | <200 | - | <200 | - | <200 |
| Chromatogram to baseline at C50 | none | n/v | n/v | - | YES | - | YES | - | YES | - | YES | - | YES |
| Metals, Dissolved | | | | | | | | | | | | | |
| Calcium | mg/L | n/v | 100 ₍₂₎ ^D | 6.6 | - | 6.4 | - | 6.5 | - | 6.5 | - | 6.7 | - |
| Magnesium | mg/L | n/v | 30 ₍₂₎ ^D | 0.80 | - | 0.77 | - | 0.74 | - | 0.76 | - | 0.81 | - |
| Potassium | mg/L | n/v | 400 ₍₂₎ ^D | <1 | - | <1 | - | <1 | - | <1 | - | <1 | - |
| Sodium | mg/L | ≤200 ^A | 1,000 ₍₂₎ ^D | 0.7 | - | 0.7 | - | 0.7 | - | 0.7 | - | 0.7 | - |
| Metals, Total | | | | | | | | | | | | | |
| Aluminum | µg/L | <100/200 ₉ ^A | n/v | 5.5 | - | 5.5 | - | 5.1 | - | 5.1 | - | 8.0 | - |
| Antimony | µg/L | 6 ^B | 6 ₍₂₎ ^D | <0.50 | - | <0.50 | - | <0.50 | - | <0.50 | - | <0.50 | - |
| Arsenic | µg/L | 10 ^B | 20 ₍₂₎ ^D | <1.0 | - | <1.0 | - | <1.0 | - | <1.0 | - | <1.0 | - |
| Barium | µg/L | 1,000 ^B | 1,000 ₍₂₎ ^D | <2.0 | - | <2.0 | - | <2.0 | - | <2.0 | - | <2.0 | - |
| Beryllium | µg/L | n/v | n/v | <0.50 | - | <0.50 | - | <0.50 | - | <0.50 | - | <0.50 | - |
| Boron | µg/L | 5,000 ^B | 5,000 ₍₂₎ ^D | <10 | - | <10 | - | <10 | - | <10 | - | <10 | - |
| Cadmium | µg/L | 5 ^B | 5 ₍₂₎ ^D | <0.10 | - | <0.10 | - | <0.10 | - | <0.10 | - | <0.10 | - |
| Calcium | µg/L | n/v | 100,000 ₍₂₎ ^D | 6,700 | - | 6,800 | - | 6,700 | - | 6,900 | - | 7,400 | - |
| Chromium | µg/L | 50 ^B | 50 ₍₂₎ ^D | <5.0 | - | <5.0 | - | <5.0 | - | <5.0 | - | <5.0 | - |
| Cobalt | µg/L | n/v | n/v | <0.50 | - | <0.50 | - | <0.50 | - | <0.50 | - | <0.50 | - |
| Copper | µg/L | ≤1000 ^A 2,000 ^B | 1,000 ₍₂₎ ^D | <1.0 | - | <1.0 | - | <1.0 | - | <1.0 | - | <1.0 | - |
| Iron | µg/L | ≤300 ^A | 300 ₍₂₎ ^D | <100 | - | <100 | - | <100 | - | <100 | - | <100 | - |
| Lead | µg/L | 5 ^B | 10 ₍₂₎ ^D | <0.50 | - | <0.50 | - | <0.50 | - | <0.50 | - | <0.50 | - |
| Magnesium | µg/L | n/v | 30,000 ₍₂₎ ^D | 760 | - | 710 | - | 740 | - | 750 | - | 820 | - |
| Manganese | µg/L | ≤20 ^A 120 ^B | 50 ₍₂₎ ^D | 3.1 | - | 2.6 | - | 2.9 | - | 3.5 | - | 2.8 | - |
| Mercury | µg/L | 1 ^B | 1 ₍₂₎ ^D | - | <0.01 | - | <0.01 | - | <0.01 | - | <0.01 | - | <0.01 |
| Molybdenum | µg/L | n/v | n/v | <0.50 | - | <0.50 | - | <0.50 | - | <0.50 | - | <0.50 | - |
| Nickel | µg/L | n/v | n/v | <1.0 | - | <1.0 | - | <1.0 | - | <1.0 | - | <1.0 | - |
| Potassium | µg/L | n/v | 400,000 ₍₂₎ ^D | <200 | - | <200 | - | <200 | - | <200 | - | <200 | - |
| Selenium | µg/L | 50 ^B | 10 ₍₂₎ ^D | <2.0 | - | <2.0 | - | <2.0 | - | <2.0 | - | <2.0 | - |
| Silicon | µg/L | n/v | n/v | 480 | - | 460 | - | 460 | - | 450 | - | 540 | - |
| Silver | µg/L | n/v | n/v | <0.10 | - | <0.10 | - | <0.10 | - | <0.10 | - | <0.10 | - |
| Sodium | µg/L | ≤200000 ^A | 1,000,000 ₍₂₎ ^D | 660 | - | 670 | - | 660 | - | 650 | - | 730 | - |
| Strontium | µg/L | n/v | n/v | 10 | - | 9.7 | - | 9.9 | - | 9.9 | - | 10 | - |
| Thallium | µg/L | n/v | n/v | <0.050 | - | <0.050 | - | <0.050 | - | <0.050 | - | <0.050 | - |
| Titanium | µg/L | n/v | n/v | <5.0 | - | <5.0 | - | <5.0 | - | <5.0 | - | <5.0 | - |
| Vanadium | µg/L | n/v | n/v | <0.50 | - | <0.50 | - | <0.50 | - | <0.50 | - | <0.50 | - |
| Zinc | µg/L | ≤5000 ^A | 5,000 ₍₂₎ ^D | <5.0 | - | <5.0 | - | <5.0 | - | <5.0 | - | <5.0 | - |
| Microbiological Analysis | | | | | | | | | | | | | |
| Total Coliform Background | cfu/100mL | n/v | n/v | 0 | - | 7 | - | 8 | - | 0 | - | 2 | - |
| Total Coliforms | cfu/100mL | 0 ^C | 0 ^D | 0 | - | 0 | - | 0 | - | 0 | - | 0 | - |
| Escherichia coli (E.Coli) | cfu/100mL | 0 ^C | 0 ^D | 0 | - | 0 | - | 0 | - | 0 | - | 0 | - |

See notes on last page.

Table F-1
Summary of Surface Water Analytical Results
Lake Geraldine Water Supply
Nunami Stantec Limited

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|------------------|---|
| Notes: | |
| Health Canada | Health Canada (June 2019). Guidelines for Canadian Drinking Water Quality—Summary Table. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. |
| A | Guidelines for Canadian Drinking Water Quality - Aesthetic Objectives/ Operational Guidelines |
| B | Guidelines for Canadian Drinking Water Quality - Maximum Acceptable Concentration |
| C | Guidelines for Canadian Drinking Water Quality - Microbiological Parameters |
| Northern Health | Public Health Protection, Environmental Health |
| D | Table 1. Required Water Quality Parameters |
| 6.5 ^A | Concentration exceeds the indicated standard. |
| 15.2 | Measured concentration did not exceed the indicated standard. |
| <0.50 | Laboratory reporting limit was greater than the applicable standard. |
| <0.03 | Analyte was not detected at a concentration greater than the laboratory reporting limit. |
| n/v | No standard/guideline value. |
| - | Parameter not analyzed / not available. |
| (2) | Total metals required. Dissolved metals optional, but recommended if turbidity is elevated. Scan to include both high and low level metals. |
| (3) | Required for source water characterisation. If all are < 1 mg/L as N, later samples may be analysed for Total N only. |
| (9) | Required if hydrocarbon/gasoline type contamination is suspected. Contat laboratory for sampling procedure. |
| a | This is an operational guidance value, designed to apply only to drinking water treatment plants using aluminum-based coagulants; it does not apply to naturally occurring aluminum found in groundwater. The operational guidance values of 0.1 mg/L applies to conventional treatment plants, and 0.2 mg/L applies to other types of treatment systems. |
| i | High levels (above 500 mg/L) can cause physiological effects such as diarrhea or dehydration. |