NUNAMI
STANTEC LIMITED

Project Summary Report:

Iqaluit 2021 Lake Geraldine Resupply (Apex Pumping): Report of Activities

Final

November 26, 2021

Prepared for:
City of Iqaluit
Iqaluit, Nunavut

Prepared by:
Nunami Stantec Limited

Project Number: 144903156

Table of Contents

List of Tables

List of Figures

Appendices

Executive Summary

This report presents results of monitoring undertaken pursuant to water licence 3AM-IQA1626 Amendment No. 4, and specifically activities to be reported on per Schedule B, Item q of the licence as they pertain to the 2021 Niaqunguk River (Apex River) Supplementary Pumping Program (SPP). The 2021 SPP was completed between May 26, 2021 (kickoff meeting) and September 17, 2021 (demobilization). Works and activities completed include:

- Mobilization of equipment and infrastructure to Niaqunguk River pumping sites.
- Placement of pumps, screens, and connection to manifolds at Niaqunguk River.
- Installation and operation of pumps in Niaqunguk River.
- Conveyance of water from Niaqunguk River to Lake Geraldine.
- Supporting activities such as power supply, maintenance, refueling, and daily monitoring.
- Demobilization of equipment and infrastructure (except semi-permanent pipeline).

Supplementary pumping from the Niaqunguk River to the Lake Geraldine Reservoir was completed between June 24 to June 28, 2021. A total of 76,320 m^3 were pumped with maximum daily pumped volumes of 17,280 m^3. Pumping records were maintained by the contractor at the pumping site but had not been provided to City's representative (Nunami Stantec Limited) for review and tabulation at the time of issuance of this report. No supplementary pumping occurred between June 29 and September 17, 2021, when Lake Geraldine water level was recorded at 111.295 masl, or approximately 1,667,097 m^3. Equipment was demobilized thereafter.

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. Owing to the need to supplement the reservoir in 2018 and 2019 on an emergency basis from the nearby Niaqunguk River, the City applied to the Nunavut Water Board to supplement the Lake Geraldine Reservoir from the Niaqunguk River during summer months on an annual basis until 2026 (the term of the licence). In September 2019, the City received an amendment (Amendment #4) to is type A water licence 3AM-IQA1626 to permit supplementation from the Niaqunguk River on an annual basis as and if required (the Supplementary Pumping Program – SPP) (Nunavut Water Board 2019). The SPP is facilitated by a semi-permanent pipeline from the Niaqunguk River to Lake Geraldine installed in 2019. Temporary pumping infrastructure is required to be installed and operated annually to withdraw water. Supplementary pumping (non-emergency) was previously completed during the 2020 summer season.

In May 2021, a contractor was retained by the City of Iqaluit (City) to complete the SPP during the open water season of 2021. Oversight was provided by Nunami Stantec, also under contract to the City. The objective of the SPP was to maximize the volume of water in the reservoir prior to the onset of freezing conditions in compliance with the water licence. Notably, the water licence permits a maximum of 500,000 cubic metres (m^3) to be extracted from Niaqunguk River for transfer to the Lake Geraldine Reservoir.

1.2 Purpose of this Report

This report presents results of monitoring undertaken pursuant to water licence 3AM-IQA1626 Amendment No. 4 and includes a summary of the 2021 Apex River Pumping Project. Items included are:

1. A summary of the SPP including lessons learned, based on monitoring and mitigation.
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 watershed at Monitoring Station No. IQA-10.
4. The daily water levels and/or flow rates in the Niaqunguk River when withdrawals are occurring at Monitoring Station No. IQA-10.

2 PROJECT WORKS AND ACTIVITIES

The 2021 SPP was completed between May 26, 2021 (kickoff meeting) and September 17, 2021 (demobilization). It should be noted that pumping activities were limited to a few days in June (June 24-28). Works and activities completed include:

- Mobilization of equipment and infrastructure to Niaqunguk River pumping sites.
- Placement of pumps, screens, and connection to manifolds at Niaqunguk River.
- Installation and operation of pumps in Niaqunguk River.
- Conveyance of water from Niaqunguk 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. The Niaqunguk River pumping site was previously setup in 2018 and 2019, and the location in 2020 was fixed by the need to connect to a semi-permanent pipeline installed in 2019, and the location of a Water Survey of Canada (WSC) hydrological monitoring station located immediately upstream of the pumping site. The 2021 SPP followed the same protocol and operation as in 2020.

Water was pumped from the Niaqunguk River using three high-head 94 Hp submersible pumps and conveyed overland to Lake Geraldine. Pumps were housed in a screened cage to meet the Fisheries and Oceans Canada (DFO) Freshwater Intake End-of-Pipe fish Screen Guidelines (Deparment of Fisheries and Oceans 1995). Pumping took place continuously between June 24, 2021 and June 28, 2021. All temporary infrastructure and equipment were demobilized by September 17, 2021. An access trail and semi-permanent pipeline between the Niaqunguk River and Lake Geraldine have remained in place for future pumping requirements.

A total of 76,320 m^3 were withdrawn from the Niaqunguk River and directed to Lake Geraldine during the SPP in 2021. Lake Geraldine was filled to the spillway elevation by June 28, 2021 and continued overflowing for a period of time due to natural recharge. Pumping was not required during the remainder of the open water season, with the Lake Geraldine water level recorded at 111.295 masl, or 1,667,097 m^3 on September 17, 2021. Pumping rates were at the maximum pumping capacity (~200 L/s) over the pumping period. Lake Geraldine levels are summarized in Figure 4-1.

Prior to, during and after supplementation activities, Nunami Stantec conducted daily monitoring of river discharge and Lake Geraldine levels (WSC stations), as well as daily monitoring and guidance of pumping rates to the contractor (Tower Arctic Ltd., TAL).

Figure 2-1 Iqaluit 2021 Apex Pumping 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 and discussions with the Water Licence Inspector and DFO.

The objective of monitoring activities was to observe hydrologic conditions in Niaqunguk River during pumping operations and to inform changes in pumping rates that were required variably throughout the program. Water withdrawals of less than 10% of Instantaneous Flow (IF) when natural flows in the Niaqunguk River are below 30% of Mean Annual Discharge (MAD), are permitted without additional authorization by DFO. Nunami Stantec used WSC station data to advise TAL on when pumping operations could begin and when pumping rates needed to be changed based on river flows. Each day levels in Lake Geraldine and flows in Niaqunguk River were obtained from WSC stations, while comparing pumping logs provided by TAL, to advise on the maximum pumping rates to remain within withdrawal limits.

A summary of monitoring locations and activities completed during the program is presented in Table 3-1.

Table 3-1 2021 Monitoring Location Summary

Monitoring Location ID	Latitude	Longitude	Monitoring Parameter	Method	Data Source (Nunami Stantec, Contractor, or WSC Location)
SNP IQA-10	63.760535	-68.475915	Pumped Flow and Volume	Volumetric Flow Meter	Contractor
“Apex River at Apex” (station ID: UH10UH002)	63° 44' 09"	68° 27' 05"	Water level and flow data for Niaqunguk River approximately 4 km 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

4 METHODS & RESULTS

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 2021 Apex River Pumping Project on the natural system. The following sections describe the methods undertaken to collect data during the 2021 SPP.

4.1 Water Withdrawal Pumping Volumes

Permitted extraction volumes for the 2021 SPP were limited to 10% of IF at the withdrawal location when flows were above 30% MAD in the Niaqunguk River.

Daily, Nunami Stantec recorded the following data and observations:

- Average daily flows recorded at WSC “Apex River at Apex” station 10UH002 (WSC Apex) were downloaded and analyzed
- Daily average pump volumes at SNP IQA-10 as recorded by the contractor on an hourly basis and provided to Nunami Stantec; average pump rates were calculated for the daily period when pumps were operational.

To calculate 30% MAD, Nunami Stantec used the available period of record for the WSC Apex River at Apex station 10UH002 from 1973 to 2017 (> 35-year record and excluding 0 values). Nunami Stantec calculated a MAD of 1.056 m^3/s, which equates to a 30% MAD of 0.316 m^3/s (Nunami Stantec 2019).

Pumping from the Niaqunguk River to the Lake Geraldine Reservoir was completed between June 24 to June 28, 2021. A total of 76,320 m^3 were pumped with maximum daily pumped volumes of approximately 17,280 m3. Pumping records were maintained by TAL at the pumping site but complete records had not been received by Stantec at the time of submission of this report.

4.1.1 Operational Challenges

Operationally, the system performed as per the design. Based upon learned knowledge from previous years and emergency supplementations completed in 2018 and 2019, and the non-emergency operation of the Apex River semi-permanent infrastructure, Nunami Stantec and the City understood the challenges with operation and importance of daily monitoring for compliance with the water licence. Different from 2018 and 2019, the system was operational during the spring melt and Lake Geraldine was filled with water captured during the Niaqunguk River spring freshet, as the system was operated in 2020.

Two challenges were identified earlier in the project.

1. WSC Stations Data Availability

WSC stations require spring setup by WSC staff every year, including calibration. Due to Covid-19 related travel restrictions, WSC was delayed in setting up these stations and bringing data online. This setup was able to be completed before pumping operations began. Future pumping should be aware of this potential data limitation.

2. Ice at Niaqunguk River

The SPP was planned to be initiated at the start of freshet when flows in the Niaqunguk River were highest. Ice-cover of the Niaqunguk River was present in June of 2021 as in 2020. The contractor was required to break ice and prepare the location for pumping operations. We This will likely occur during each year of pumping.

4.2 Niaqunguk River Flows

The Water Survey of Canada (WSC) Station 10UH015 (Apex River at 1 km above Bridge to Nowhere) was not reporting discharges and the downstream WSC Station 10UH002) was not operational leading up to, and during, the pumping operations. Therefore, flows at the Flows in the Niaqunguk River were measured by Stantec leading up to, and during, the pumping operations in the river. The flow measurements were obtained using the mid-section method and an Acoustic Doppler Velocimeter (Sontek Flowtracker2).

Table 4-1: Niaqunguk River Flow Measurements

Date	Measured Flow (m^3/s)
Tuesday, June 22, 2021	3.310
Thursday, June 24, 2021	3.695
Monday, June 28, 2021	1.839

All flow measurements during the active pumping period showed flows to be above 30% MAD. The maximum pump capacity (200 L/s) was permitted if 200 L/s was less than 10% of the river flow; therefore given that river flow was greater than 2 m^3/s during pumping operations, maximum pumping rates were permitted from June 24-28, 2021. The June 28, 2021 flow measurement, which was slightly below 2 m^3/s, coincided with ceasing of pumping for 2021.

4.3 Lake Geraldine Water Level

Water levels in the Lake Geraldine Reservoir were monitored throughout the 2021 SPP using WSC data from the Lake Geraldine Near Iqaluit station (Station 10UH013). Water levels in the Lake Geraldine Reservoir were higher in the spring of 2021 compared with the previous three years. This increase in water levels compared with previous years may be due to the City's continued efforts to reduce leaks and wastage throughout the system. In general, 2021 was a high-water year and minimal pumping was required to supplement the Lake Geraldine storage volumes. Water levels remained just below the reservoir spill point into mid-September as seen in Figure 4-1. Compared to the previous two years of pumping, the reservoir was filled to its spill point earlier in the summer, largely due to the high meltwater contributions during freshet. Early initiation of pumping activities while flows are highest, is recommended in future years. A summary of Lake Geraldine water levels for 2021 is shown in Figure 4-1.

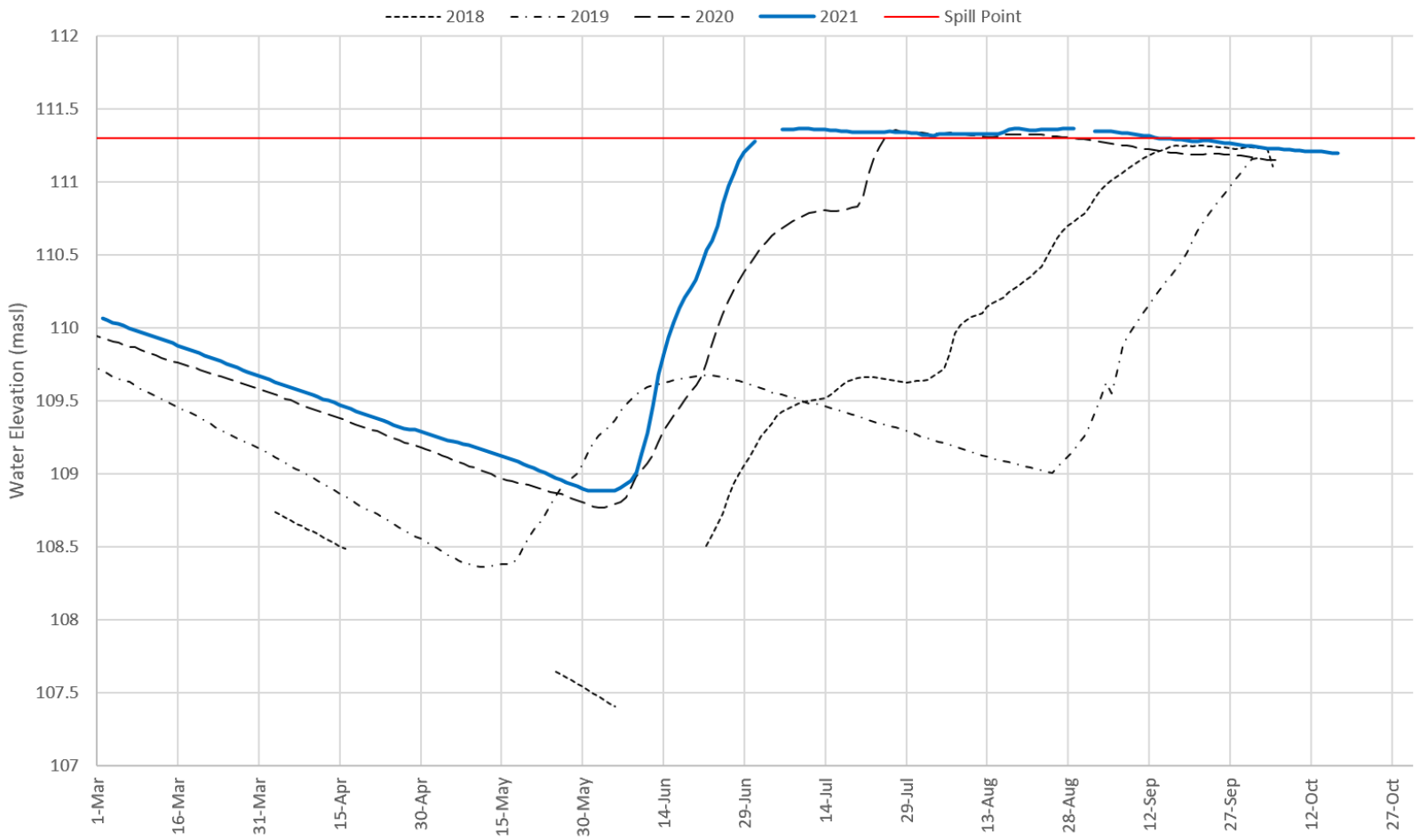

Figure 4-1 2021 Lake Geraldine Water Levels Summary

5 DEMOBILIZATION

Demobilization occurred in September and was concluded on September 17, 2021 with a formal equipment handover from TAL to the City. On this day, Nunami Stantec, the City (Shane Turner), and TAL (Eric Jacobsen) participated in a formal equipment handover. The manifest from this handover can be found in Appendix A.

Two low point drains were installed along the pipeline route in September.

6 CONCLUSION

Pumping from the Niaqunguk River to the Lake Geraldine Reservoir was completed between June 24 to June 29, 2021 in accordance with water licence 3AM-IQA1626 Amendment No. 4. A total of 76,320 m^3 were pumped with a maximum daily pumped volume of approximately 17,280 m3. Pumping records were maintained by the contractor at the pumping site but had not been provided to Stantec at the time of writing. Pumping was not required later in the summer / early fall with the Lake Geraldine water level recorded at 111.295 masl, or 1,667,097 m^3 on September 17, 2021.

Lessons learned during the 2021 pumping program that should be considered in future years pumping programs include:

- Be prepared to complete field flow measurements at the pumping site before ice break up in the event that WSC stations are not online, to avoid delay in pumping.
- Follow up with WSC regarding the ongoing development of a rating curve for the Apex Above Bridge to Nowhere station 10UH015. Once this curve is verified and discharge data published during the pumping period, pumping activities can be determined based on water level measurements alone at the pumping site.
- Have a flow measurement device (e.g., Flowtracker2) available in case WSC stations are not reporting the required data when it is needed (for reasons of station malfunction or maintenance issues).
- Be prepared to facilitate some ice breakup at the pumping site so that pumping operations are not delayed if ice is present during freshet flows.
- Within the Request for Tender, request a contractor standby rate for non-pumping periods that require only site security and no active pumping.
- Contractor to provide records daily in 2022.

7 LIMITATIONS

This document titled Final Report: Iqaluit 2021 Lake Geraldine Resupply (Apex Pumping): Report of Activities was prepared by Nunami Stantec Ltd. (“Nunami Stantec”) 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 Stantec’s professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Nunami Stantec 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 Stantec 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 Stantec 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 Niaqunguk River in June 2021. This document was prepared to summarize pumping activities from the 2021 pumping program. 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

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9 REFERENCES

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APPENDIX A

Equipment Manifest September 17, 2021

NUNAMI

Equipment Manifest and Project Closeout

To:	Amy Elgersma, CAO City of Iqaluit	From:	Matt Follett, M.A.Sc., P.Eng. Nunami Stantec Ltd.
File:	144903156 Apex Pumping 2021	Date:	September 17, 2021

Reference: 144903156 _ Apex Pumping 2021 _ Equipment Manifest and Project Closeout

The Lake Geraldine Resupply of 2021 included pumping from the Apex River directly to Lake Geraldine. To complete this task, a number of items were mobilized permanently in 2019 (i.e. Apex River 300mm pipe), however, other items required demobilization and return to the City of Iqaluit (City) Coke Plant (City-owned equipment). Work was carried out by Tower Arctic Ltd.

At this time, it is understood that partial disconnection of electrical and fuel components has occurred. Demobilization was completed, with equipment handover to the City, on September 17, 2021.

The following list summarizes the equipment returned following the project demobilization. If any items have been missed from this list, please make note of them in the rows provided at the end of the table and have all parties sign.

Item	Notes	Signoff (Initials)			
		City of Iqaluit	Nunami Stantec	Tower Arctic	Notes
Apex Pumps	The City owns the three (3) pumps that were used in the Apex Pumping project. It is understood that these are at the Coke Plant. Pumps: Sulzer ABS submersible drainage pump (J604, spec sheet attached for records)	S.t.			Outside. Will be moved inside by City.
Apex Fish Screens	It is understood that these are at the Coke Plant.	S.t.			Outside. Will be moved inside by City.
Operator Shack	The operator shack has been delivered to the Coke Plant. **Please confirm location in a note.**	S.t.			Outside
Manifolds	1 x Apex	S.t.			Outside. Will be moved inside by City.
Flow Meters	3 x Apex	S.t.			Outside. Will be moved inside by City.

+ PUMP CONTROLS SEACAN + GENERATOR SEACAN

Reference: **144903156 _ Apex Pumping 2021 _ Equipment Manifest and Project Closeout**

Hoses	Flexible hoses used for connection from pumps to manifold.	S.T.	MJ	E.J	In green seacan
Electrical Cable and Equipment (Panels, Soft Starts)	Container for generator and pump panels has been delivered to the Coke Plant.	S.T.	MJ	E.J	In green seacan
Apex Generator	The City-owned generator was used in the 2020 resupply program and has been delivered to the Coke Plant.	S.T.	MJ	E.J	Grey seacan
Fuel Tanks	The City owns one fuel tank for the system and an additional tank has been quoted within CO No. 3. ***Confirm what was delivered in notes**	S.T.	MJ	E.J	Outside.
Fuel Pipe and Valve	CO No. 3 indicates some piping and a fire valve to be purchased by the City. ***Confirm what was delivered in notes**	S.T.	MJ	E.J	In seacan
Outhouse		S.T.	MJ	E.J	Outside
Additional Fuel in Tanks	5,555 L total	S.T.	MJ	E.J	Included on final PC

Reference: **144903156 _ Apex Pumping 2021 _ Equipment Manifest and Project Closeout**

All parties in attendance of this equipment handover have initialed above in agreeance of the accuracy of this document. Field review of equipment was completed between 13:30 – 14:30 on Friday, September 17, 2021. In attendance were:

- Shane Turner, City of Iqaluit
- Eric Jacobsen, Tower Arctic Ltd.
- Matt Follett, Nunami Stantec Ltd.

There are no outstanding items related to this project.

Nunami Stantec Ltd.

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