NUNAMI
STANTEC LIMITED

Project Summary Report:

Iqaluit 2020 Lake Geraldine Resupply (Apex Pumping): Report of Activities

Final

January 15, 2021

Prepared for:
City of Iqaluit
Iqaluit, Nunavut

Prepared by:
Nunami Stantec Limited

Project Number: 144902988

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 2020 Niaqunguk River (Apex River) Supplementary Pumping Program (SPP). The 2020 SPP was completed between May 21, 2020 (kickoff meeting) and October 1, 2020. 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 21 to July 28, 2020. A total of 358,615 m^3 were pumped with daily pumped volumes ranging from 0 to 17,520 m^3. Pumping records were maintained by the contractor at the pumping site and provided to the City's representative (Nunami Stantec Limited) for review and tabulation daily. No supplementary pumping occurred between July 29 and October 2, 2020, when Lake Geraldine water level was recorded at 111.161 masl, or 1,625,462 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.

In May 2020, a contractor was retained by the City of Iqaluit (City) to complete the SPP during the open water season of 2020. 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 supplementation purposes.

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 2020 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 Iqaluit 2020 Apex River Pumping Project (Supplementary Pumping Project – "SPP") was completed between May 21, 2020 (kickoff meeting) and October 1, 2020. 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.

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 21, 2020 and July 27, 2020. All temporary infrastructure and equipment were demobilized by October 2, 2020. 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 352,225 m^3 were withdrawn from the Niaqunguk River and directed to Lake Geraldine during the SPP in 2020. Lake Geraldine was filled to the spillway elevation by July 27, 2020. Pumping was not required at a later date in the summer / early fall with the Lake Geraldine water level recorded at 111.161 masl, or 1,625,462 m^3 on October 2, 2020. Pumping rates are summaries in Figure 4-1. Niaqunguk River flows are summaries in Figure 4-2. Lake Geraldine levels are summarized in Figure 4-3.

Prior to, during and after supplementation activities, Nunami Stantec Limited (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).

Stantec

- WSC or SNP Station
- Point of Interest
- Discharge Point
- Pipeline
- Pumping Site

N

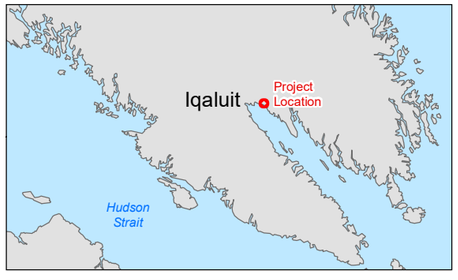
0 160 320 metres

(At original document size of 11x17)
1:8,500

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 19N

2. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community



Project Location

Iqaluit
Nunavut

Client/Project 144902988-001

Iqaluit Water Supply

Figure No.

2.1

Title

Iqaluit 2020 Apex Pumping Project
Site Overview

V:\121\active\XXX - Other PCs\144902988\gis\mapping\mxd\144902988-001.mxd Revised: 2021-01-11 By: mhuskinsthupe

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 CIRNAC 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 2020 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 2020 Apex River Pumping Project on the natural system. The following sections describe the methods undertaken to collect data during the 2020 Apex River Pumping Program.

4.1 Water Withdrawal Pumping Volumes

Permitted extraction volumes for the 2020 Apex River Pumping Program were limited to 10% of IF at the withdrawal location when flows were above 30% MAD in the Niaqunguk River.

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 by Nunami Stantec
- Recorded the daily average pump volumes at SNP IQA-10
    - pump volumes recorded by the contractor on an hourly basis and provided to Nunami Stantec daily; 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).

Niaqunguk River flow and level data from WSC stations was analyzed daily to guide pumping rates. Weekly summaries were compiled and reported via email to the City of Iqaluit, Colliers Project Leaders (City representatives), and TAL. The summaries included a compilation of measured flow and water level data, as well as commentary on equipment maintenance and shutdowns, weather impacts, and recommended pump rate adjustments.

Pumping from the Niaqunguk River to the Lake Geraldine Reservoir was completed between June 21 to July 27, 2020. A total of 352,225 m3 were pumped with daily pumped volumes ranging from 0 to 17,520 m3. Pumping records were maintained by the contractor at the pumping site and provided to Stantec for review and tabulation daily. A summary of daily pumping volumes for the 2020 season can be found in Figure 4-1.

Table 4-1 Daily Pumped Volumes

Date	Pumped Volume (m^3)	Available Volume to Pump (m^3)
6/21/2020	3,810	22,016
6/22/2020	10,990	27,000
6/23/2020	16,654	28,145
6/24/2020	14,144	24,013
6/25/2020	17,520	25,849
6/26/2020	15,526	25,840
6/27/2020	16,484	23,195
6/28/2020	15,264	19,929
6/29/2020	15,472	15,897
6/30/2020	16,813	14,524
7/1/2020	14,808	12,803
7/2/2020	14,014	13,687
7/3/2020	12,856	11,447
7/4/2020	10,276	9,563
7/5/2020	6,987	9,546
7/6/2020	6,995	9,148
7/7/2020	6,777	8,821
7/8/2020	6,938	8,154
7/9/2020	6,954	7,243
7/10/2020	6,965	6,363
7/11/2020	6,305	5,731
7/12/2020	6,694	5,516
7/13/2020	4,034	4,935
7/14/2020	0	4,261
7/15/2020	1,220	3,803
7/16/2020	3,436	3,804
7/17/2020	3,387	3,828
7/18/2020	3,091	3,779
7/19/2020	3,205	4,093
7/20/2020	3,586	4,627
7/21/2020	6,284	29,610
7/22/2020	15,072	41,167
7/23/2020	15,647	25,045
7/24/2020	15,752	16,479
7/25/2020	15,378	11,954
7/26/2020	11,275	10,128
7/27/2020	1,612	8,060

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, Nunami Stantec and the City understood the challenges with operation and importance of daily monitoring for compliance with the water licence. Different from the previous two years, the system was operational during the spring melt and Lake Geraldine was filled with water captured during the Niaqunguk River spring freshet.

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

Previous years of pumping were executed later in the summer months. 2020 was the first year of operation for the semi-permanent system and ice was observed at the pumping location during the start of freshet when flows in the Niaqunguk River were highest. The contractor was required to break ice and prepare the location for pumping operations. We are unsure if this was an abnormal condition or if it is something that will be experienced each year of pumping.

4.2 Niaqunguk River Flows

Flows in the Niaqunguk River were monitored throughout the 2020 Apex River Pumping Program by use of real-time Water Survey of Canada data from the Apex at Apex station (ID 10UH002). Flows were above the 30% MAD pumping threshold for much of the summer, until late August but pumping was only required into late July. Figure 4-2 shows a later freshet than last year and a large spike in flow (rainfall event) in mid-July. These increases in Apex flow compared with 2019 allowed for pumping to occur through June and July to supplement natural inflows to the Lake Geraldine Reservoir. The Niaqunguk River had a steady decline from the peak flow in mid-July through to the start of October, with no fall peaks as were observed in 2019. A summary of the Niaqunguk River flows for 2020 is shown in Figure 4-2.

4.3 Lake Geraldine Water Level

Water levels in the Lake Geraldine Reservoir were monitored throughout the 2020 pumping program using WSC data from the Lake Geraldine Near Iqaluit station (ID 10UH013). Water levels in the Lake Geraldine Reservoir were higher in the spring of 2020 compared with the previous two 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. Even with higher water levels in the spring, a pumping program was required to augment the natural inflows to the Reservoir to ensure that sufficient storage would be available for the winter 2020/21. Pumping activities were able to fill the reservoir in late July and natural precipitation kept it

near its spill point until mid-September. Water levels remained just below the reservoir spill point into early October as seen in Figure 4-3. Compared to the previous two years of pumping, the reservoir was filled to its spill point earlier in the summer, partly due to the early start of pumping operations this year, and partly due to several large rainfall events mid-summer. Early initiation of pumping activities while flows are highest, is recommended. A summary of Lake Geraldine water levels for 2020 is shown in Figure 4-3.

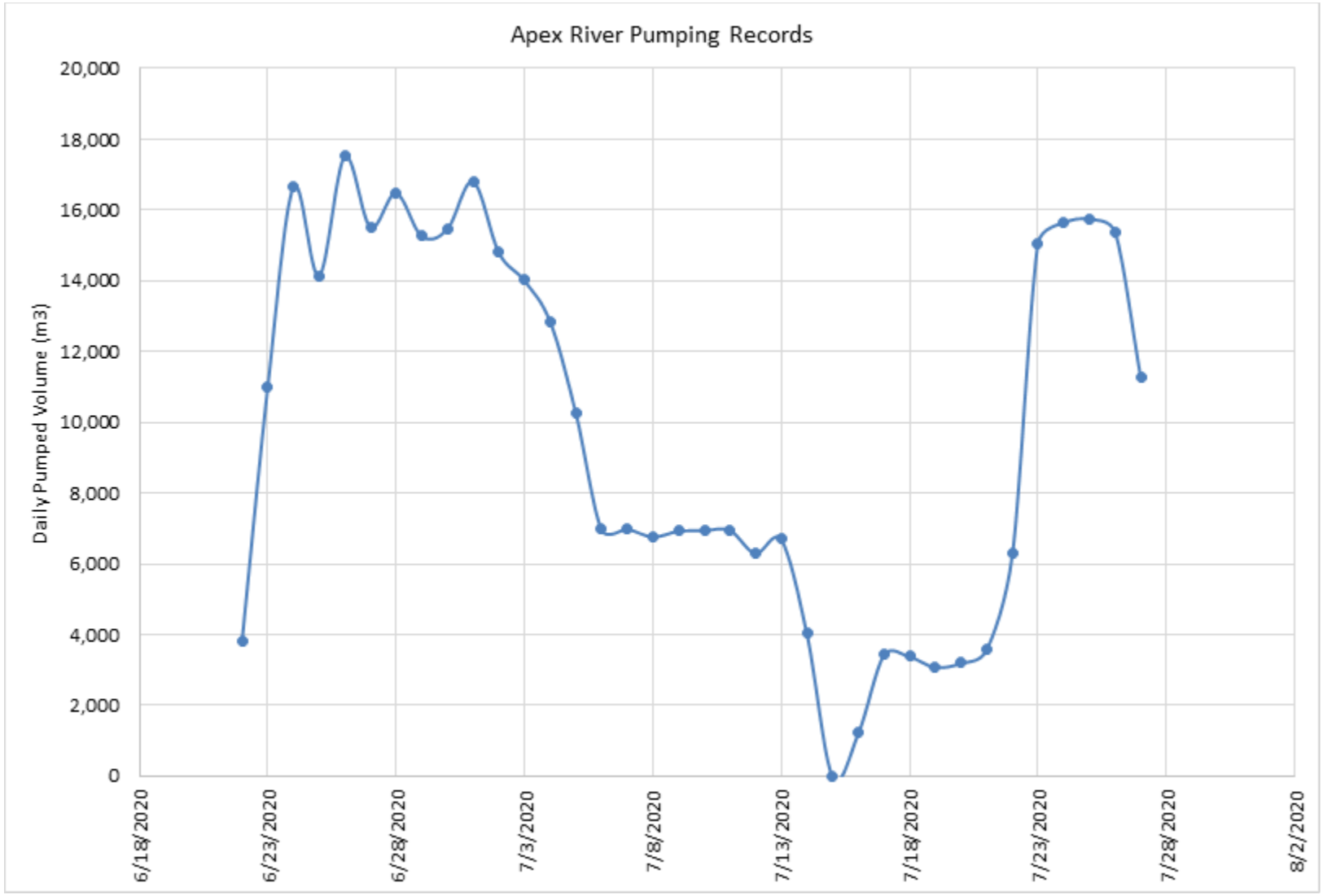


Figure 4-1 2020 Apex Pumping Project Pumping Summary

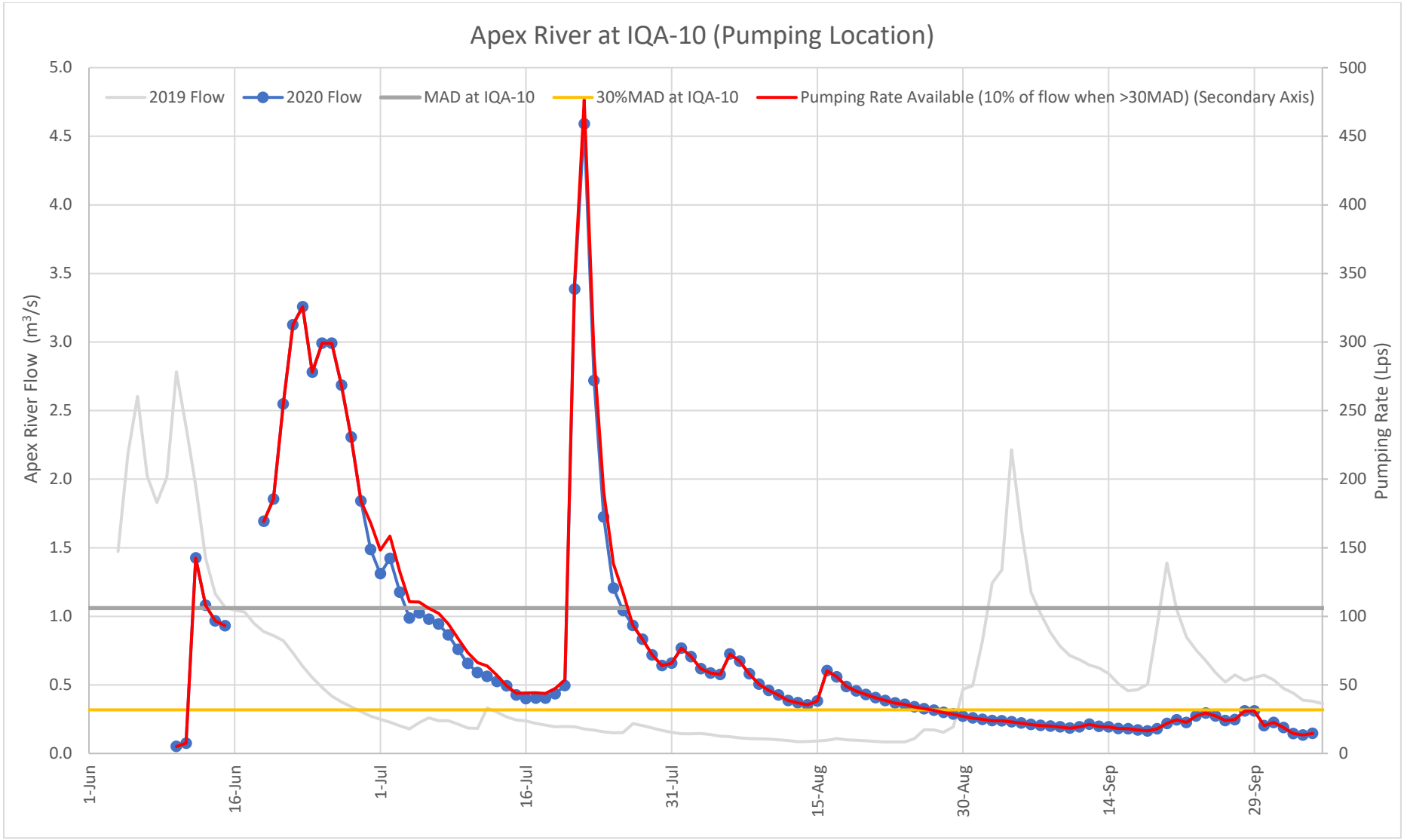


Figure 4-2 2020 Niaqunguk River Flows Summary

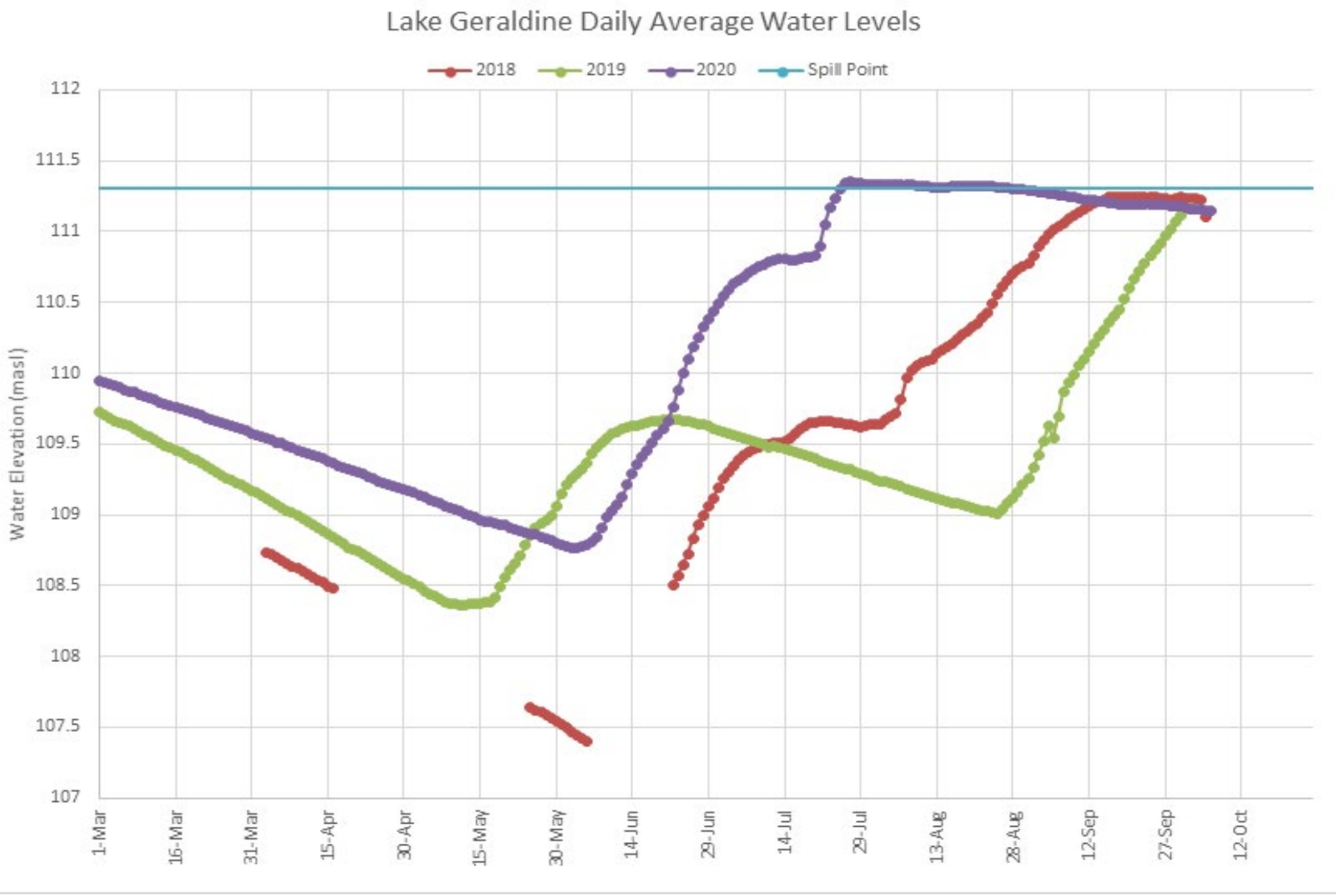


Figure 4-3 2020 Lake Geraldine Water Levels Summary

5 DEMOBILIZATION

Demobilization occurred at the end of September and was concluded on October 2, 2020. 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.

Outstanding items at this time were limited to two low point drain installations, including materials. The materials were received at the end of October; however, the reasonable construction season had passed. It is understood that TAL has received these materials and delivered them to Shane Turner and the City.

6 CONCLUSION

Pumping from the Niaqunguk River to the Lake Geraldine Reservoir was completed between June 21 to July 28, 2020 in accordance with water licence 3AM-IQA1626 Amendment No. 4. A total of 358,615 m^3 were pumped with daily pumped volumes ranging from 0 to 17,520 m^3. Pumping records were maintained by the contractor at the pumping site and provided to Stantec for review and tabulation daily. Pumping was not required later in the summer / early fall with the Lake Geraldine water level recorded at 111.161 masl, or 1,625,462 m^3 on October 2, 2020.

Lessons learned during the 2020 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 generation of a rating curve for the Apex Above Bridge to Nowhere station 10UH015. Once this curve is created, pumping activities can be determined based on water level measurements alone at the pumping site.
- Be prepared to facilitate some ice breakup at the pumping site so that pumping operations are not delayed in the event that 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.
- Low point drain materials have been received by the City and will require installation by the successful contractor before freeze-up in 2021.

7 LIMITATIONS

This document titled Final Report: Iqaluit 2020 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 and July 2020. This document was prepared to summarize pumping activities from the 2020 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

Written by:

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

Written by:

Matt Follett, M.A.Sc., P.Eng.
Project Engineer
Phone: (613) 223-1569
Email: matt.follett@stantec.com

Reviewed by:

Erica Bonhomme, M.Sc., P.Geo.
Team Lead, Environmental Services North
Phone: (867) 445-7388
Email: erica.bonhomme@stantec.com

9 REFERENCES

Deparment of Fisheries and Oceans . 1995. *Freshwater Intake end-of-pipe Fish Screen Guidelines.* Ottawa, Canada: Communications Directorate - Department of Fisheries and Oceans.

Nunami Stantec Ltd. 2019. "City of Iqaluit 2019 Emergency Water Supplementation Program - Operational Monitoring Plan." Iqaluit.

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.

APPENDIX A

Equipment Manifest October 2, 2020

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:	144902988 Apex Pumping 2020	Date:	October 1, 2020

Reference: 144902988 _ Apex Pumping 2020 _ Equipment Manifest and Project Closeout

The Lake Geraldine Resupply of 2020 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 is expected to be completed today (October 1, 2020).

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	IF		will go inside by city
Apex Fish Screens	It is understood that these are at the Coke Plant.	S.t	IF		"
Operator Shack	The operator shack has been delivered to the Coke Plant. **Please confirm location in a note.**	S.t	IF		outside, grey 8781
Manifolds	1 x Apex	S.t	IF		will go inside by city
Flow Meters	3 x Apex	S.t	IF		will go inside by city

Reference: **144902988 _ Apex Pumping 2020 _ Equipment Manifest and Project Closeout**

Hoses	Flexible hoses used for connection from pumps to manifold. The City had some existing hoses used in the 2020 pumping program and Tower Arctic Ltd. also ordered additional hose length. ***Confirm condition and length of hose delivered in notes.**	S.T	IF		Top great Middle 80% Bottom suggested to be changed 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.	IF		-Green seacan with hoses → elec cable is in gen. seacan
Apex Generator	The City-owned generator was used in the 2020 resupply program and has been delivered to the Coke Plant.	S.T.	IF		Grey seacan "22 G1"
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.	IF		-on tower lot to be left outside coke plant once signed
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	IF		-on tower garage to be put in elec seacan when signed
(confirm any additional items in the spaces below					
Outhouse		S.T.	IF		-on tower lot -to be dropped off monday Oct 5th

Reference: **144902988 _ Apex Pumping 2020 _ 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 13:00 – 17:00 on Thursday, October 1, 2020. In attendance were:

- Shane Turner, City of Iqaluit
- Eric Jacobsen, Tower Arctic Ltd.
- Isaac Freda, Nunami Stantec Ltd.

Outstanding items related to the project include:

- CO No. 3 Fuel tank, valve, and pipe connections for generator
- CO No. 4 Low point drain valves

Nunami Stantec Ltd.

Matt Follett, M.A.Sc., P.Eng.
Associate Civil Engineer

Phone: 613-223-1569
Email: Matt.Follett@stantec.com