NUNAMI
STANTEC LIMITED

Iqaluit Emergency Water Supply Project: Apex River Supplementary Pumping – DFO Authorization Monitoring Report

January 2019

Prepared for:
City of Iqaluit
Iqaluit, Nunavut

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Abbreviations

m ..... metres
m^3/s ..... cubic metres per second
City ..... City of Iqaluit
DFO ..... Fisheries and Oceans Canada
MAD ..... Mean annual discharge
UTM ..... Universal Transverse Mercator
WSC ..... Water Survey of Canada

1 INTRODUCTION

In August/September 2018, the City of Iqaluit, Nunavut (the City) undertook an emergency water supply project whereby water from the Niaqunguk (Apex) River was withdrawn and conveyed to their Lake Geraldine reservoir to supplement the community's drinking water supply. Supplementation of the Lake Geraldine reservoir supply was considered necessary to provide sufficient water for the community through the 2018-2019 winter period, until spring freshet in 2019 replenishes the reservoir.

This report outlines the results of water withdrawal and environmental monitoring completed along the Niaqunguk River, during the supplementary pumping, to support the City's emergency *Fisheries Act* Authorization obtained from Fisheries and Oceans Canada (DFO) in advance of pumping.

1.1 Background

On August 16, 2018, Fisheries and Oceans Canada (DFO) issued to the City of Iqaluit (the City) a Paragraph 35(2)(b) *Fisheries Act* Authorization – Emergency Circumstances (DFO Authorization). The DFO Authorization was for the withdrawal of water from the Niaqunguk River for the purpose of supplementing the City's drinking water supply in the Lake Geraldine reservoir. At the time it was unknown whether withdrawal of water from the Niaqunguk River would exceed DFO's low risk criteria for Serious Harm: 10% of instantaneous flow when natural flow is at or above 30% of the mean annual discharge (MAD) and the likelihood of serious harm to fish. The emergency DFO Authorization included conditions for implementation of measures to avoid and mitigate serious harm to fish, monitoring and reporting.

Nunami Stantec Ltd. (Nunami) was contracted by the City to monitor and assess the potential risk for serious harm to Arctic charr (*Salvelinus alpinus*) related to the withdrawal of water from the Niaqunguk River. In particular, the potential existed for water levels in the Niaqunguk River, at and/or below the location of water withdrawal (herein referred to as the "study area"), to drop to a point where fish, if present, could become stranded or could lack sufficient water depth to overwinter. The Niaqunguk River is located approximately 1 km east of Iqaluit, Nunavut (Figure 1). The river is formed from numerous lower order streams and unnamed lakes to the north and east of Iqaluit, that combine into a main channel that flows from north to south, eventually draining into the Koojesse Inlet of Frobisher Bay.

A fish and fish habitat assessment conducted in 2016 (Nunami 2017) reported the presence of a resident population of Arctic charr in the Niaqunguk River study area, specifically the Swimming Lake area of the river. The presence of a permanent barrier at the outlet of the Niaqunguk River prevents anadromous Arctic charr from utilizing the river. This report provides results of the fall 2018 monitoring required under the emergency DFO Authorization.


Figure 1: Apex River Pumping Location (August/September 2018)
Iqaluit Emergency Water Supply Project: Apex River Supplementary Pumping - DFO Authorization Monitoring Report
Legend
IQA-10 SNP
Swimming Lake Area
WSC 10UH002
Lake Geraldine Reservoir
IQA-10 SNP
Iqaluit
Koojesse Inlet
WSC 10UH002
Apex
Google earth
© 2018 Google
Image © 2018 DigitalGlobe
N
1 km

2 NIAQUNGUK RIVER WATER WITHDRAWAL

Water withdrawal from the Niaqunguk River was conducted using two pumps (Pump A and Pump B) at the pumping location SNP IQA-10 (as per the City's Water Licence 3AM-IQA1626; UTM coordinates 525785 Easting, 7070476 Northing; see Figure 1). Pumps were housed in a screened cage to meet DFO's Freshwater Intake End-of-Pipe fish Screen Guidelines (DFO 1995).

3 FISH AND FISH HABITAT MONITORING PLAN

A Fish and Fish Habitat Monitoring Plan (Appendix A) was prepared to monitor the potential effects on fish and fish habitat due to the supplementary pumping of water from the Niaqunguk River in fall 2018. Monitoring included:

- Daily monitoring of pump rate, water withdrawal volumes and river discharge.
- Monitoring of potential fish stranding or mortality if water withdrawal (pump rate) exceeded 10% of instantaneous flow when natural flow is at or above 30% of the MAD.
- Fish rescue, if fish stranding was observed.
- Calculations of wetted width to be initiated at selected sites when water withdrawal exceeded 10% instantaneous flow.

4 PRE-PUMPING SURVEYS

Water level surveys were conducted on August 16 and 17, 2018, along the Niaqunguk River, before pumping began, to establish monitoring stations. Fish and fish habitat surveys were conducted along the Niaqunguk River between August 22 and 31, 2018 to further assess monitoring stations (Figure 2). Supplementary pumping from the Niaqunguk River began on August 19, 2018.

4.1 Water Level

Water level monitoring stations were established along the Niaqunguk River at six locations, including two stations upstream of the pumping location and four stations downstream of the pumping location (see Figure 2). At each station, stakes were installed to measure relative water levels before pumping began, and during pumping if the water withdrawal rate exceeded 10% of instantaneous flow. From the pre-pumping water levels, estimated water level at 30% of MAD were then calculated for each monitoring station. Pre-pumping water levels, and calculated 30% MAD water levels, relative to the top of installed stakes, are outlined in Table 1.

4.2 Fish Habitat

The fish habitat survey included wetted width, depth, substrate composition and general site description at nine sites along the Niaqunguk River, including the six water level stations. At the time of the fish habitat surveys, water levels in Niaqunguk River had been influenced by recent precipitation events that resulted in water overflowing the banks and extending into the vegetated riparian areas. Results of the survey are provided in Table 1.

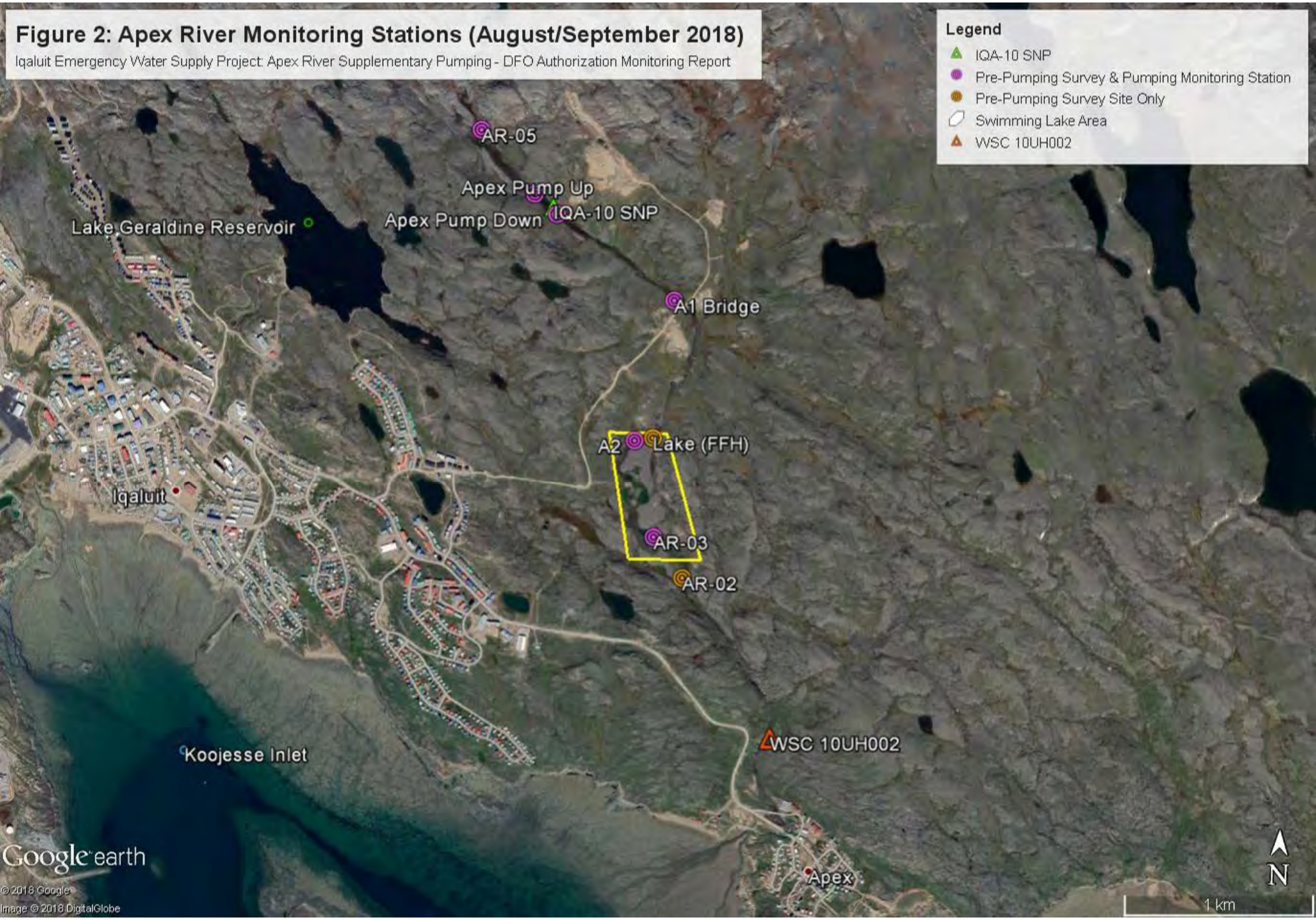
Figure 2: Apex River Monitoring Stations (August/September 2018)
Iqaluit Emergency Water Supply Project: Apex River Supplementary Pumping - DFO Authorization Monitoring Report
Legend
IQA-10 SNP
Pre-Pumping Survey & Pumping Monitoring Station
Pre-Pumping Survey Site Only
Swimming Lake Area
WSC 10UH002
AR-05
Apex Pump Up
Apex Pump Down
IQA-10 SNP
Lake Geraldine Reservoir
A1 Bridge
A2
Lake (FFH)
Iqaluit
AR-03
AR-02
WSC 10UH002
Koojesse Inlet
Apex
Google earth
© 2018 Google
Image © 2018 DigitalGlobe
N
1 km

Table 1: Pre-Pumping Water Levels and Fish and Fish Habitat Characteristics at Niaqunguk River Monitoring Stations[1]

Site ID	UTM Coordinates		Site Description and Channel Characteristics	Pre-Pumping Water Level (m)[2]	30% MAD Water Level (m)[2]	Channel Width (m)	Wetted Width (m)	Maximum Depth (m)	Substrate	Incidental Observations	Carried into Pumping Monitoring Program?
	Easting	Northing									
AR-05 (Hydro 1)	525421	7070859	Approximately 400 m above the pool where pumping will occur. Transition area from a riffle (upstream) to a run (downstream).	RS: 0.261 LS: 0.386	RS: 0.441 LS: 0.566	20	7.9	0.90	75% large angular boulders and rocks with deep interstitial spaces. 25% large rounded rocks with large interstitial spaces. There is 0% embeddedness, and the substrate is prone to movement.	Excellent water clarity. No fish observed. No aquatic invertebrates observed.	Yes
Apex Pump Up	525718	7070532	The head of the pool from which the water is being drawn. The site is immediately below a riffle.	RS: 0.456 LS: 0.302	RS: 0.536 LS: 0.382	40	28.6	0.45	80% large rounded rocks, with 20% large rounded boulders. 0% embeddedness with visible interstitial spaces. The substrate is prone to movement.	Excellent water clarity. No fish observed. No aquatic invertebrates observed.	Yes
Apex Pump Location (SNP IQA-10)	525785	7070476	Approximately half-way between the head (Up) and the tail (Down) of the pool	—	—	55	—	≤ 2.0	Not assessed as this was an active construction site and water too deep to wade.	Not assessed as this was an active construction site and water too deep to wade.	No
Apex Pump Down	525841	7070429	The tail end of the pool from which the water is being drawn. The site is the transition zone at which the pool becomes a riffle.	RS: 0.358 LS: 0.380	RS: 0.478 LS: 0.500	49	32.5	0.40	95% large rounded rocks, with 5% large rounded boulders. 0% embeddedness with visible interstitial spaces. The substrate is prone to movement.	Excellent water clarity. No fish observed. No aquatic invertebrates observed.	Yes
A1 Bridge	526480	7070000	The site is the transition zone at which a riffle (upstream) becomes a deeper run.	RS: 0.120 LS: 0.170	RS: 0.325 LS: 0.375	27	13.5	1.1	A mix of large angular boulders (25%), rounded boulders (25%), large rounded rocks (25%) and sand (25%). The sand is distributed equally across the channel and at such depth such there is ≥50% embeddedness of boulders and rocks and little to no interstitial spacing.	Excellent water clarity. No fish observed. No aquatic invertebrates observed.	Yes
Lake (FFH)	526397	7069268	Approximately 60 m upstream of A2. This is the deepest pool in the Study Area and is located immediately downstream of a 100 m stretch of cascades and falls carved through the bedrock in a narrow gorge.	—	—	40	—	> 2	Northern half of the pool is predominantly bedrock with rock, cobble, and gravel comprising the bottom substrate in the southern half and in the deeper areas.	Excellent water clarity. No fish observed. No aquatic invertebrates observed. Arctic charr were observed here in 2016. The cascades/falls upstream of the Swimming Lake may pose a barrier to the upstream passage of fish.	No
A2	526300	7069250	Riffle	RS: 0.279 LS: 0.328	RS: 0.484 LS: 0.533	24	14.8	0.42	95% rounded rocks, with 5% large rounded boulders. 0% embeddedness with visible interstitial spaces. The substrate is prone to movement.	Excellent water clarity. No fish observed. No aquatic invertebrates observed. Arctic charr were captured here in 2016.	Yes
AR-03	526422	7068738	The tail end of a pool just upstream of where the river transitions into a run.	RS: 0.349 LS: 0.163	RS: 0.569 LS: 0.383	27	15.8	1.0	80% rounded rocks, 10% rounded cobble, and 10% sand. 25% embeddedness with little to no interstitial spaces.	Excellent water clarity. No fish observed. No aquatic invertebrates observed.	Yes
AR-02 (Lower Reach)	526869 (up) 527028 (down)	7068178 (up) 7067177 (down)	Predominantly a fast-flowing run through a narrow gorge with series of cascades.	—	—	8 to 35	—	1.4	80% bedrock, 20% large rock. Little to no interstitial spaces. There is a vertical drop of ≥1.5 m in height located just downstream of the bridge on Nìaqunnusiariaq Road.	Excellent water clarity. No fish observed. No aquatic invertebrates observed. Vertical drop near outlet could pose barrier to upstream passage of fish.	No

NOTES:
1. — = not measured
2. Water levels provided as distance from top of stake to water level in metres for stake on right bank (RS) and stake on left bank (LS); pre-pumping water levels measured August 16 or 17, 2018

4.3 Fish Surveys

A Smith-Root LR-24 electrofisher was used to survey seven monitoring stations (see Table 2 and Figure 2) in the study area for the presence of fish on August 24, 2018. A small mesh (6 mm) dip net was used to allow for the capture of small-bodied fish (e.g., sticklebacks) that may also be present as well as invertebrates that may have been incidentally dislodged during electrofishing. Water clarity was excellent at each of the seven survey sites and overcast skies at the time of the survey reduced water surface glare that could otherwise impede the ability of the electrofisher operator to spot fish. Water levels were elevated on the day electrofishing was conducted due to recent precipitation events (e.g., 9.4 mm rain on August 23, 2018; ECCC 2018).

Table 2: Electrofishing results for Niaqunguk River, Iqaluit, Nunavut, August 24, 2018

Location	Start Time	Weather	Operator(s)	Voltage	Run Time (Seconds)	Results
AR-05	08h52	Overcast	T. Vickers I. Freda	585	194	No fish captured or observed No invertebrates captured or observed
Apex Pump Up	09h27	Overcast	T. Vickers I. Freda	585 to 600	184	No fish captured or observed No invertebrates captured or observed
Apex Pump Down	09h42	Overcast	T. Vickers I. Freda	640	129	No fish captured or observed No invertebrates captured or observed
A1 Bridge	10h04	Overcast	T. Vickers I. Freda	505	114	No fish captured or observed No invertebrates captured or observed
A2	10h23	Overcast	T. Vickers I. Freda	605	70	No fish captured or observed No invertebrates captured or observed
AR-03	10h41	Overcast	T. Vickers I. Freda	450	167	No fish captured or observed No invertebrates captured or observed
AR-02	10h52	Overcast	T. Vickers I. Freda	530	106	No fish captured or observed No invertebrates captured or observed

No fish or invertebrates were captured or observed at the seven sites surveyed. The highwater levels that followed recent rainfalls could have decreased the efficacy of electrofishing.

Sampling for environmental DNA (eDNA) was conducted on August 29 and 30, -2018 at six of the seven sites selected for electrofishing using a portable eDNA backpack sampler; site AR-03 was not sampled. A sample was also collected from the Sylvia Grinnell River (see Figure 2) to serve as a positive control since Arctic charr were known to be in the river at the time. A negative control and post-positive negative control were also sampled to assess the sampling protocols, including decontamination techniques.

Established protocols for the sampling of eDNA in the field were unsuccessful because the 5 µm pore filters that collect the eDNA were inadvertently discarded, and only the pre-filters were retained for analysis. Analyses of these pre-filters by Precision Biomonitoring (Guelph, ON) did not produce evidence of eDNA in the Niaqunguk River locations nor in the positive control from the Sylvia Grinnell River and results could not be relied upon. During the survey, a local Elder indicated that there are fish throughout the Niaqunguk River system (Mary Ellen Thomas, personal communication) although she did not specify the species.

5 WATER WITHDRAWAL MONITORING

Water withdrawal at SNP IQA-10 began on August 19, 2018, using Pump A while water withdrawal began on August 20, 2018, using Pump B. Pump A was shut down on September 12, 2018, and Pump B was shut down on September 16, 2018, and no water withdrawal occurred after this date. Water withdrawal from both pumps was continuous from start-up to shut down, though pump time varied daily. In total, there were 10 days where the cumulative water withdrawal rate (from both Pump A and Pump B) exceeded the 10% instantaneous flow threshold, which was measured as the scaled 24-hour discharge at the pumping location SNP IQA-10 (see Table 3). Water levels did not fall below the calculated 30% MAD water levels at five monitoring stations (one upstream and four downstream of the pump) over the pumping period. Water levels did fall below the calculated 30% MAD water level at one upstream monitoring station (Apex Pump Up, left bank only). Daily water withdrawal and environmental monitoring records are provided in Appendix B. Plots of monitoring station relative water levels with the 30% MAD water levels are provided in Appendix C.

Table 3: Pumping Days and Pump Rate that Exceeded the 10% Instantaneous Flow Threshold

Pumping Date (2018)	Estimated Average Pump Rate (m^3/s)[1]	24-hour Discharge at Pumping Site (SNP IQA-10) (m^3/s)[2]	% Average Pump Rate of 24-Hour Discharge at Pumping Site
August 30	0.092	0.814	11.34
August 31	0.092	0.736	12.55
September 6	0.093	0.828	11.19
September 7	0.090	0.745	12.12
September 8	0.091	0.670	13.62
September 9	0.093	0.623	14.87
September 10	0.093	0.658	14.06
September 11	0.092	0.591	15.62
September 12	0.093	0.529	17.64
September 15	0.050	0.481	10.38

NOTES:
1. Estimated average pump rate is the cumulative rate for Pump A and Pump B on each day, except September 15 which is for Pump B only (Pump A shut down September 12)
2. 24-hour discharge at the pumping site (SNP IQA-10) scaled from the Water Survey of Canada Station 10UH002 located near the Apex River mouth; scaled discharge accounts for daily withdrawals.

Monitoring for potential fish stranding of stations downstream of the pump location was conducted when there was an exceedance in water withdrawal rate above the 10% instantaneous flow and one week after pumping ceased (see Appendix B for daily monitoring records). Monitoring of stations occurred daily from September 1 to September 17, 2018, and a final time on September 24, 2018. No fish were observed during any of the daily monitoring, nor were any isolated pools where stranding would likely occur. Given the overall reduction in water levels at each monitoring station over the monitoring period.

At the six monitoring stations where the wetted width was calculated, a reduction in wetted width was observed both upstream and downstream of the pumping location during water withdrawal in September, except at the monitoring station immediately downstream of the pumping site (Table 4). Station AR-05 upstream o the pumping site had a loss of wetted width of 6-8%, likely due natural flow conditions during the fall. Stations downstream of the pumping site, except the station immediately downstream of the pumping site had approximate reductions in wetted width between 8 – 14%. This reduction can be likely be attributed to three factors; natural flow conditions as observed upstream of the pumping station, the low slope and shallow depth at the downstream stations and water withdrawal. Although wetted width was reduced at monitoring stations within the Swimming Lake area (i.e., A2 and AR-02; see Figure 2), where Arctic charr were previously observed, water levels remained relatively consistent from September 9 through to September 17, and on the final monitoring date of September 24 (see plots in Appendix C). Throughout the monitoring period water flows continued through the main channel of the Niaqunguk River.

Table 4: Wetted Widths Calculated at Monitoring Stations on the Niaqunguk River

Date	AR-05 (u/s pump) Wetted Width (m)	PUMP (u/s pump) Wetted Width (m)	PUMP (d/s pump) Wetted Width (m)	A1 (u/s bridge) Wetted Width (m)	A2 (u/s Swim Lk) Wetted Width (m)	AR-02 (d/s Swim Lk) Wetted Width (m)
8/16/2018	12.10	34.50	45.90	n/m	n/m	n/m
8/17/2018	n/m	n/m	n/m	24.40	22.30	25.50
9/1/2018	12.10	35.10	48.10	22.70	22.20	25.50
9/2/2018	12.60	36.00	49.30	24.20	22.30	25.90
9/3/2018	11.90	35.10	48.10	22.70	22.20	25.00
9/4/2018	11.50	34.80	48.10	22.60	21.90	24.20
9/5/2018	11.40	34.50	47.80	22.60	21.90	23.90
9/6/2018	11.40	34.30	47.10	22.50	20.70	23.50
9/7/2018	11.40	34.00	47.10	22.50	20.20	23.20
9/8/2018	11.30	33.70	46.80	22.50	20.20	22.90
9/9/2018	11.30	33.70	46.50	22.40	19.90	22.60
9/10/2018	11.30	33.50	46.80	22.40	20.20	22.90
9/11/2018	11.30	33.50	46.50	22.40	19.90	22.60
9/12/2018	11.30	33.50	46.50	22.40	19.90	22.60
9/13/2018	11.30	33.20	46.20	22.40	19.50	22.60
9/14/2018	11.10	33.20	45.90	22.40	19.50	22.60
9/15/2018	11.10	33.20	45.90	22.40	19.50	22.60
9/16/2018	11.10	32.90	45.90	22.40	19.50	22.60
9/17/2018	11.10	32.90	45.90	22.40	19.20	22.60
9/24/2018	11.40	34.50	47.40	22.40	19.20	22.90

NOTE:
n/m = no measurement

6 DISCUSSION

Supplemental water withdrawal from the Niaqunguk River was conducted over 29 days from August 19 to September 12, 2018. No fish were observed at the pumping location SNP IQA-10 over the pumping duration. There were 10 days in which water withdrawal rate exceeded the 10% threshold of instantaneous flow, measured as the scaled 24-hour discharge at SNP IQA-10. These water withdrawals ranged from 10.38 to 17.64% of instantaneous flow. Water levels did not fall below the calculated 30% MAD water levels at most monitoring stations over the pumping duration, with the exception of one station upstream of the pump location. This may be due to less flow inputs into the river further upstream.

A resident population of Arctic charr has been reported in the Niaqunguk River in the Swimming Lake area (Nunami 2017). A waterfall at the mouth of the Niaqunguk River provides a barrier for anadromous charr to use the river for upstream migration. Several pools downstream of the SNP IQA-10 pumping location, locally referred to as lakes (e.g., Swimming Lake), may provide overwintering habitat for this resident population of Arctic charr (Nunami 2017). It is unknown if water depth in these pools were ultimately decreased due to the supplemental water withdrawal, however. Flow in the Niaqunguk River would be expected to return to natural levels shortly after the cessation of water withdrawal and these pools/overwintering areas would be recharged.

Reductions in wetted width occurred both upstream and downstream of the pumping site. Changes in wetted width is a naturally occurring function related to many different parameters including precipitation events, seasonal cooler temperatures, bank slope, river bed morphology and water depth. It is unknown how much of wetted width was reduced through water withdrawal however at least a portion of this reduction would be due to natural conditions. The loss of wetted width at downstream station locations is unlikely to have significant effects on fish as ample and higher quality habitat still existed. Before freeze-up the Niaqunguk River would have resumed its natural flow and depth patters for that time of year.

No stranding or mortality of fish were observed during the pumping duration. Decreases in wetted width observed were near the shallow banks of the river likely provide marginal habitat for the resident population of charr due to a lack of cover. Flows continued in the main channel of the Niaqunguk River during the period of supplemental water withdrawal.

Potential effects to fish and fish habitat, if any, were temporary and of low magnitude. It is unlikely that water withdrawal from the Niaqunguk River resulted in serious harm to fish.

7 LIMITATIONS

This document titled Iqaluit Emergency Water Supply Project: 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 2018. 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,

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