CITY OF IQALUIT

WATER LICENCE 3AM-IQA1626

2023 Annual Report Review Response

November 01, 2024

CIRNAC COMMENTS ON THE 2023 ANNUAL REPORT

1. Sewage volumes discharged from IQA-02

Comment:

Schedule B item b of Water Licence No. 3AM-IQA1626 requires that the annual report provide "the monthly and annual quantities in cubic metres of any discharges from the Wastewater Treatment Facilities (Monitoring Stations No. IQA-02, IQA-04, IQA-08)." The 2023 Annual Water License Report states that "Effluent was discharged from the Sewage Lagoon to Frobisher Bay (Station ID IQA-02) between May 31, 2023 and June 16, 2023." The 2023 Annual Report does not include volumes discharged from the Sewage Lagoon as specified in Schedule B of the Water Licence.

Recommendation:

(R-01) CIRNAC recommends the City of Iqaluit record and report the annual treated sewage volumes discharged from the Sewage Lagoon (IQA-02) for 2023.

City of Iqaluit's response:

In 2023, there was no flow meter installed, so we do not have records or reports of the annual treated sewage volumes. Unfortunately, it is not possible to give an approximate of the annual treated sewage volumes. However, a flow meter was recently installed, and we expect to have the readings available next year.

3. ATCO Loop decommissioning and Federal Road Utilidor Extension

Comment:

Schedule B item g of Water Licence No. 3AM-IQA1626 requires that the annual report provide "a summary of all construction activities carried out for facilities under the Licence

In the 2023 Annual Report, the City made the following statements on construction activities carried out in 2023:

- "the City focused on construction services for the ATCO Loop decommissioning and Federal Road Utilidor Extension, both integral components of the Long-Term Water Distribution Upgrades project,"
- "Construction for the Federal Road Watermain Extension project commenced in September 2023. The scope of work encompassed extending the utilidor watermain along Federal Road, including the installation of approximately 240 meters of

underground water main and recirculation, as well as the installation of four new access vaults. The project achieved substantial completion on November 18, 2023," and

- "Construction services for the ACTO Loop Decommissioing, [sic] commencing in July 2023, included the decommissioning existing sanitary sewer and selected water mains within the ATCO Loop area. Substantial completion was issued in November 15, 2023."

These construction activities are not specified or defined in Water Licence No. 3AM-IQA1626 nor amendments.

Recommendation:

(R-03) CIRNAC recommends the City of Iqaluit clarify whether construction activities on the ATCO Loop sanitary sewer and watermain decommissioning and Federal Road Utilidor/ Watermain Extension were undertaken under Water Licence 3AM-IQA1626 and, if not, whether approval from the Nunavut Water Board has been obtained for these construction activities.

City of Iqaluit's response:

No, it was our understanding the City did not need approval for infrastructure replacement projects. Approval was required for new infrastructure only.

4. Water Treatment and Waste Treatment Facilities modifications and/or major maintenance work

Comment:

Schedule B item h of Water Licence No. 3AM-IQA1626 requires that the annual report provide "a summary of modifications and/or major maintenance work carried out on the potable Water Treatment and Waste Treatment Facilities, including all associated structures."

In the City of Iqaluit response (R-03a and R-03d) to CIRNAC Comment R-03 for the 2022 Annual Report, the City states "at the start of 2023, remedial actions were taken, resulting in the restoration of the DAF system and the resumption of the clarification process" and "the deficiencies referenced in the Annual Report pertain to the operation challenges with the HVAC system. The City is addressing and resolving these operational challenges with the WWTP HVAC System." Details on the work performed at the Wastewater Treatment Plant to restore the DAF system and HVAC system is not referenced under item h of the 2023 Annual Report.

In the updated City of Iqaluit 2022 Annual report (January 10, 2024), reference is made to replacement of the UV disinfection system in 2023 as the current system has exceeded its expected design life. The 2023 Annual Report does not make reference or provide an update on the UV replacement project.

Recommendation:

(R-04) CIRNAC recommends the City of Iqaluit provide a summary of the following:

- Any modifications or major maintenance work carried out at the Wastewater Treatment Plant in 2023 to address the DAF clarifier and HVAC system deficiencies noted in the 2022 Annual Report (R-04).
- Any modifications and/or major maintenance work carried out in 2023 for the UV disinfection system at the Water Treatment Plant.

City of Iqaluit's response:

There were no major renovations at the Wastewater Treatment Plant in 2023 to address the DAF clarifier and HVAC system deficiencies. There are plans to address these deficiencies pending the approval of the 2025 budget. Additionally, there were no modifications to the UV disinfection system at the Water Treatment plant. However, The UV reactors were replaced in 2024.

5. Changes projected implementation and status of the Upgraded Wastewater Treatment Plant

Comment:

Schedule B item n of Water Licence No. 3AM-IQA1626 requires that the annual report provide "a brief update on the implementation plan of all facilities within the scope of this Licence including changes projected implementation and status of the Upgraded Wastewater Treatment Plant."

In the City of Iqaluit response to CIRNAC Comments for the 2022 Annual Report (R-03) regarding troubleshooting the DAF clarifier and addressing deficiencies in the HVAC system, the response outlines that the City continues to address operational challenges at the Wastewater Treatment Plant that was brought online in 2022. This work includes troubleshooting the DAF clarifier and addressing deficiencies in the HVAC system, which was identified as one of the reasons limiting sludge sample collection. An update on the implementation plan and status of the upgraded Wastewater Treatment Plant is not referenced under item n of the 2023 Annual Report.

No update or reference to other sections was made on implementation plans for the WWTP, landfill or pumping project or the status of their implementation.

Recommendation:

(R-05) CIRNAC recommends the City of Iqaluit provide an update on the implementation plan for the Wastewater Treatment Plant, Landfill and Pumping Project, including changes projected implementation and status of their implementation.

City of Iqaluit's response:

There was no update to the implementation plan for the Wastewater Treatment Plant, Landfill and Pumping Project in 2023

7. Un-authorized discharges and spills

Comment:

Schedule B item k of Water Licence No. 3AM-IQA1626 requires that the annual report provide "a list and description, including volumes and Spill Report Line Identification Number, of all un-authorized Discharges, spills and summaries of follow-up action taken."

Spill entries report the spill volume as "Unknown," making it difficult to assess the impact of spills and adequacy of follow-up actions. The follow-up actions are repetitive and lack specificity.

Only wastewater spills were reported in Table 6 of the 2023 Annual Report; however, it is understood by CIRNAC that other spills have occurred, but are not being reported. All spills must be reported. While the Spill Line has a limit of 100 L as their reporting threshold, that is not the same for the water license where all uncontrolled releases of waste that may affect water are required to be reported. This is a requirement of the water license and failure to comply brings the proponent into non-compliance. The City is strongly encouraged to address this issue.

Recommendation:

(R-07a) CIRNAC recommends the City of Iqaluit provide the estimates or ranges for spill volumes when precise measurements are not available. If estimating is not possible, explain why.

(R-07b) CIRNAC recommends the City of Iqaluit provide clarification on how it was determined that the average volume spilled was less than 100 litres.

(R-07c) CIRNAC recommends the City of Iqaluit provide more details on the follow-up actions, especially if they differ between incidents. Provide details on how spills were collected and disposed of and specify if additional monitoring or corrective actions were taken.

(R-07d) CIRNAC recommends the City of Iqaluit provide information on spills in addition to the reported wastewater spills.

City of Iqaluit's response:

(R-07a) Due to the nature of spills there are no known estimates on their volumes and there is no process to estimate these values

(R-07b) This value provide was a broad estimation as all spills vary is size and duration.

(R-07c) Most spills that occur are due to a back up in the system. These back ups are cleared out by the operations team and disposed off after testing. Depending on the results of the test, if results show contamination waste is handed over to Qikiqtaaluk Environmental (QE) but if the results are clear the waste is disposed of in the lagoon.

(R-07d) There are no other spills that have were not reported is 2023.

8. Updated plans, manuals and reports

Comment:

Schedule B item j of Water Licence No. 3AM-IQA1626 requires that the annual report provide "any revisions required, in the form of addenda, to Plans, Manuals and Reports approved under the Licence."

The 2023 Annual Report indicates that the wastewater treatment plant O&M manual following substation completion and commission was provided. In the package of documents provided for review, the WWTP O&M manual was not included. The O&M manual for the sewage lagoon was included. The Water Treatment Plant O&M documents provided by the City do not include updates capturing the modification of the filters to GAC media.

Recommendation:

(R-08a) CIRNAC recommends the City of Iqaluit provide any new or updated Plans, Manuals and Reports that differ from those approved under the Licence to the Nunavut Water Board for review.

(R-08b) CIRNAC recommends the City of Iqaluit provide a summary on updates or revisions that were made to the WWTP and WTP O&M manuals, and in the summary provide confirmation of the most recent upgrades at both facilities.

City of Iqaluit's response:

(R-08a) The Waste Transfer Station and New Landfill are still under construction and these sites will not be operational until 2025/2026. So we have no new or updated Plans, Manuals and Reports.

(R-08b) There are no new updates or revisions that were made to the WWTP and WTP O&M manuals.

11. 2023 Sample Results

Comment:

2023 Potable Water Treatment Plant pH results (monthly laboratory samples) do not meet the Canadian Drinking Water Quality Guidelines of 7 to 10.5 for samples provided at IQA-01.

Several sets of results for TOC (July 2023, Sept 2023 as examples) show that treated water concentrations were equal to or greater than concentrations measured in the raw water, indicating that the GAC media is likely not removing TOC. This could be an indication that the GAC media is becoming exhausted for TOC removal. Further consideration/review is recommended be completed to determine if GAC media exhausted for TOC still has capacity to remove hydrocarbons in the event hydrocarbons are present in the source water.

Recommendation:

(R-11a) CIRNAC recommends the City of Iqaluit advise if consideration has been given for exhaustion of GAC media and its ability to continue to remove hydrocarbons.

City of Iqaluit's response:

The GAC media was installed in 2022. It has a life span of approximately 10 years. As the GAC media has been functioning as expected, the City does not expect it to be exhausted in the near future.

12. Water Treatment Plant Report

Comment:

The dual media filters were upgraded to replace the existing anthracite/sand media with granular activated carbon in response to the petroleum hydrocarbon (PHC) event. While not

stated in the report, it is assumed that the GAC media was selected for its ability to adsorb target parameters such as PHC. With adsorptive media such as GAC, the media over time reaches it adsorptive capacity and becomes exhausted. At this stage the filter media would act similarly to the dual media that the Water Treatment Plant had previously, with some limited adsorptive capacity. From the City of Iqaluit Return Service Plan, it is unclear if there are steps in place to evaluate the GAC capacity over time for removing PHC to determine if the media is reaching exhaustion.

Recommendation:

(R-12) CIRNAC recommends the City of Iqaluit provide information on how GAC capacity is being tracked and steps that are in place in the event that the GAC media has reached capacity and requires replacement.

City of Iqaluit's response:

GAC capacity is monitored using post-filter turbidity. There are set points for turbidity that trigger a backwash when exceeded. If turbidity levels remain below the set points for a certain period, the filter will still initiate a backwash based on a timed schedule to ensure the media stays fresh. If the media were exhausted, turbidity levels would not decrease after a backwash, or the frequency of backwashing would increase, indicating the media isn't being cleaned effectively. We do not anticipate frequent media replacements.

13. 2023 Apex Pumping Final Report

Comment:

The 2023 Apex Pumping Final Report includes discussions on exceedances and visualizations where pumping exceeded 10% of the instantaneous flow in Figure 4.2. However, the impact of these exceedances is not fully detailed, with the report merely stating that no harmful impacts were noted. This falls short of CIRNAC's 2022 recommendation (R□08b) to include a detailed discussion of observed trends, exceedances, and unanticipated impacts, especially when natural flow is below 30% of the mean annual discharge (MAD) and withdrawals exceed 10% of the instantaneous flow. The City had previously requested a meeting to collaborate with CIRNAC to determine the appropriate format and approach for this discussion. It would be beneficial to follow up on this meeting to ensure comprehensive coverage of these aspects.

The demobilization process is briefly described in Section 5 of the 2023 Apex Pumping Final Report but lacks details on the monitoring and maintenance activities conducted

post□season. The description of post-season activities, including equipment maintenance and site monitoring, is minimal.

Recommendation:

(R-13) CIRNAC recommends the City of Iqaluit provide a detailed analysis of the monitoring data that supports the conclusion of no harmful impacts, and provide information on the methods used to assess potential impacts and any specific observations or findings related to ecological effects.

City of Iqaluit's response:

In spring 2023, the City, in collaboration with Nunami Stantec Limited, developed a 2D hydraulic model that demonstrated no harm to fish and fish habitat when withdrawals of 20% of instantaneous flows occur. This approach was authorized by DFO. A copy of the authorization letter from the DFO and the Nunavut Water Board is available in the Appendix A. Therefore, it is assumed that no harm was caused to fish or fish habitat when pumping slightly exceeded 10% of instantaneous flow for three days last year, as shown in the table below detailing the percent of flow taken during the 2023 pumping season. Consequently, no monitoring or analysis data was completed. Further details are discussed in our 2023 pumping report, which is included in the Appendix.

Table A: Summary of Pumping Activities and Average Daily Flow

Date	Daily Average Flow WSC 10UH015 (m^3/s)	10% of Daily Flow at WSC 10UH015 (m^3/s)	Average Daily Pumping Rate (m^3/s)	Average Percent Flow Taken
6/26/2023	3.45	0.345	0.135	4%
6/27/2023	2.45	0.245	0.141	6%
6/28/2023	2.25	0.225	0.167	7%
6/29/2023	2.02	0.202	0.166	8%
6/30/2023	1.97	0.197	0.168	9%
7/1/2023	2.48	0.248	0.166	7%
7/2/2023	6.49	0.649	0.169	3%
7/3/2023	3.15	0.315	0.166	5%
7/4/2023	3.66	0.366	0.174	5%
7/5/2023	3.83	0.383	0.175	5%
7/6/2023	3.14	0.314	0.166	5%
7/7/2023	2.53	0.253	0.167	7%
7/8/2023	1.81	0.181	0.167	9%
7/9/2023	1.40	0.140	0.164	12%
7/10/2023	1.21	0.121	0.138	11%
7/11/2023	1.20	0.120	0.132	11%
7/12/2023	1.10	0.110	0.107	10%
7/13/2023	2.00	0.200	0.063	3%

16. Concerns Raised in Inspection Reports

Comment:

One inspection report was completed in 2023 on June 23. It identified the following action items:

1. The document indicates that there is hazardous waste present within the landfill, posing potential safety and environmental hazards.
2. There is an issue with blown away refuse, litter, and garbage found outside the landfill perimeter, including areas outside the fencing and nearby ditches, as well as across the road from the West 40 Landfill.

Recommendation:

(R-16) CIRNAC recommends the City of Iqaluit provide a response on how and when these concerns and non-compliances were rectified and required actions were completed. If any have not been addressed, provide a timeline for when they will be addressed.

City of Iqaluit's response:

The following are the action items flagged in the inspection report from June 23rd, 2023 that have been addressed:

1. *Majority hazardous waste was shipped out of Iqaluit in 2024. Moving forward there will be proper hazardous waste containers available in 2024 (secondary containment, vented), also we will have spill containment pallets for any liquid waste.*
2. *The lack of fencing in the West 40 landfill is being addressed. A letter was sent stating that fencing would be installed from the tipping shack area to the tipping face (rock outcrop) this year, with the rest of the fencing to be completed at later as adjustments to the landfill footprint may be necessary. Pending budget approval, about 100 meters of fence is to be installed at the landfill in 2024.*

ENVIRONMENT AND CLIMATE CHANGE CANADA COMMENTS ON THE 2023 ANNUAL REPORT

5. Landfill water sampling locations

Comment:

The sample locations at the landfill are not clear because the same sample ID (IQA-08) is used for three different sample names (Inside Landfill, Outside Landfill, and West 40 Landfill – Effluent discharge). It is necessary to understand where samples were collected to interpret sample results.

ECCC Recommendation(s):

ECCC recommends the Proponent clarify where the landfill samples were collected in 2023 and use location specific, clear sample names in future years.

City of Iqaluit's response:

The City can confirm that landfill samples were collected in 2023 at the sample points IQA-08, IQA-08A, IQA-08B. The locations of the samples points are marked on the map included in the Appendix C.

APPENDIX A – Authorization letters from DFO and Nunavut Water Board

Fisheries and Oceans Canada
Pêches et Océans Canada

Ontario and Prairie Region
Fish and Fish Habitat Protection Program
501 University Crescent
Winnipeg, Manitoba
R3T 2N6

Région de l'Ontario et des Prairies
Programme de la protection du poisson et son habitat
501 croissant Université
Winnipeg, Manitoba
R3T 2N6

March 25, 2024

Your file – Votre référence
Apex River Water Withdrawal, Iqaluit

Our file – Notre référence
23-HCAA-02636

City of Iqaluit
ATTENTION: Rod Mugford, Chief Administrative Officer
Building 901, City of Iqaluit
Box 460

Subject: Apex River Water Withdrawal – Request for Water Withdrawal to Exceed 10% of Instantaneous Discharge – Implementation of Measures to Avoid and Mitigate the Potential for Prohibited Effects to Fish and Fish Habitat

Dear Rod Mugford:

The Fish and Fish Habitat Protection Program (the Program) of Fisheries and Oceans Canada (DFO) received your original proposal on April 1, 2023. The Program understands that the City of Iqaluit relies on Lake Geraldine for potable water, which is supplemented through water withdrawal from the Apex River, and that an increase to the maximum water withdrawal rate to 20% of instantaneous discharge is being proposed. We understand that the project will:

- operate the Apex River water intake under water license 3AM-IQA1626;
- withdraw water only when flow of the Apex River exceeds 30% of Mean Average Discharge (MAD);
- withdraw water at a rate of 10% of instantaneous discharge when flow of the Apex River is between 0.143 m^3/s and 0.156 m^3/s; and
- withdraw water at a rate of 20% of instantaneous discharge when flow of the Apex River is greater than 0.156 m^3/s.

Our review considered the following information:

- Project Summary Report: Iqaluit 2022 Lake Geraldine Resupply (Apex River Supplementary Pumping Program): Report of Activities 3AM-IQA1626 and 22-HCAA-02043 dated March 15, 2023
- Analysis of Fisheries and Hydrologic Information of Apex River Prepared by Nunami Stantec Limited submitted April 21, 2023; and
- Virtual meetings between Stantec (David Luiz, Matthew Follett, Erin Kelly) and DFO (Nathan Entz, Carsten Slama) to discuss Apex River hydraulic modelling on February 12 and March 15, 2024.

Your proposal has been reviewed to determine whether it is likely to result in:

- the death of fish by means other than fishing and the harmful alteration, disruption or destruction of fish habitat which are prohibited under subsections 34.4(1) and 35(1) of the *Fisheries Act*;
- effects to listed aquatic species at risk, any part of their critical habitat or the residences of their individuals in a manner which is prohibited under sections 32, 33 and subsection 58(1) of the *Species at Risk Act*; and
- the introduction of aquatic species into regions or bodies of water frequented by fish where they are not indigenous, which is prohibited under section 10 of the *Aquatic Invasive Species Regulations.*

The aforementioned outcomes are prohibited unless authorized under their respective legislation and regulations.

To avoid and mitigate the potential for prohibited effects to fish and fish habitat (as listed above), we recommend implementing the measures outlined in your plan, including but not limited to those listed below:

- Avoid killing fish by means other than fishing.
    - Monitor for fish stranding caused by reduced water level and conduct fish rescues as needed.
- Limit the duration of in-water works, undertakings, and activities so as to not diminish the ability of fish to carry out one or more of their life processes (e.g., spawning, rearing, feeding, migrating).
- Ensure intake pipes are screened and sized appropriately to prevent entrainment or impingement of fish.
    - Adhere to the Interim code of practice: End-of-pipe fish protection screens for small water intakes in freshwater.
- Maintain an appropriate depth and flow (i.e., base flow and seasonal flow of water) for the protection of fish and fish habitat.
- Monitor the Apex River discharge using WSC stations 10UH015 and 10UH002 to ensure water is not withdrawn when flow is below 30% of MAD.
- Develop and immediately implement a spill response plan that minimizes risk of deleterious substances from entering a watercourse or water body and ensure containment kits are available during all phases of the pumping.

Provided that you incorporate these measures into your plans, the Program is of the opinion that your proposal is not likely to result in the contravention of the above mentioned prohibitions and requirements.

Should your plans change or if you have omitted some information in your proposal, further review by the Program may be required. Visit our website (http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html) or consult with a qualified environmental consultant to determine if further review may be necessary. It remains your responsibility to be in compliance with the *Fisheries Act*, the *Species at Risk Act,* and the *Aquatic Invasive Species Regulations.*

It is also your *Duty to Notify* DFO if you have caused, or are about to cause, the death of fish by means other than fishing and/or the harmful alteration, disruption, or destruction of fish habitat. Such notifications should be directed to FisheriesProtection@dfo-mpo.gc.ca.

Please notify this office at least 10 days before starting any in-water works. Send your notification to the DFO assessor (contact information below) and the DFO 10-day notification mailbox: DFO.OP.10DayNotification-Notification10Jours.OP.MPO@dfo-mpo.gc.ca. We recommend that a copy of this letter be kept on site while the work is in progress. It remains your responsibility to meet all other federal, territorial, provincial, and municipal requirements that apply to your proposal.

Please note that the advice provided in this letter will remain valid for a period of 10 years from the date of issuance. If you plan to execute your proposal after the expiry of this letter, we recommend that you contact the Program to ensure that the advice remains up-to-date and accurate. Furthermore, the validity of the advice is also subject to there being no change in the relevant aquatic environment, including any legal protection orders or designations, during the ten-year period.

If you have any questions regarding the content of this letter, please contact Nathan Entz at (431) 293-2418, or by email at Nathan.Entz@dfo-mpo.gc.ca. Please refer to the file number referenced above when corresponding with the Program.

Yours sincerely,

Carsten Slama
A/Senior Biologist, Hydro and Flows Regulatory Review
Fish and Fish Habitat Protection Program

cc: David Luzi, Stantec
Matthew Follett, Stantec
Simon Doiron, City of Iqaluit
Tamilore Adeleke, City of Iqaluit
Nathan Entz, DFO

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NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATIMAYINGI
OFFICE DES EAUX DU NUNAVUT

File: 3AM-IQA1626/D11

June 10, 2024

Tamilore Adeleke
EIT, Project Officer of Engineering and Capital Projects
City of Iqaluit
P.O. Box 460
Iqaluit, NU X0A 0H0

Email: T.Adeleke@iqaluit.ca

Mohamed ElDesouky
Assistant Project Manager
Colliers Project Leaders
Suite 700, 150 Isabella Street
Ottawa, ON K1S 1V7

Email: Mohamed.ElDesouky@colliersprojectleaders.com

Subject: Lake Geraldine 2024 Water Balance Model; Type "A" Water Licence 3AM-IQA1626; City of Iqaluit

Dear Tamilore Adeleke and Mohamed ElDesouky,

On June 04, 2024, the Nunavut Water Board (NWB or Board) acknowledged the receipt of the *2024 Lake Geraldine Water Balance Assessment* dated June 03, 2024 (Model) from the City of Iqaluit (the City or Licensee) as per the requirement of Part D, Item 11 of the Water Licence No: 3AM-IQA1626 (Licence). The NWB distributed the Model for information on June 04, 2024.

The Board acknowledges the submission from Fisheries and Oceans Canada (DFO) provided to the Board by the Licensee on June 05, 2024. As per Part D, Item 10 of the Licence, the City received approval from DFO to *"withdraw water at a rate of 20% of instantaneous discharge when flows at the River is greater than 0.156 m^3/s whilst maintaining the withdrawal only when flows exceed 30% Mean Average Discharge (MAD)"*. The City has also facilitated the 10-day notice to DFO in preparation for pumping.

While the NWB acknowledges that the *2024 Lake Geraldine Water Balance Assessment* dated June 03, 2024 addresses the requirement set out in Part D, Item 11 of the Licence the Board has the following comments and recommendations regarding the Model:

- The Board supports WSP's recommendation to update the stage-storage relationship of Lake Geraldine by conducting a bathymetric survey preferably before the next pumping season. Validation of the reduction of storage *from 1,875,000 m^3 as estimated by Golder to 1,680,000 m^3 as estimated by Nunami Stantec* is also recommended. The interpretation of updated bathymetric and topographic data should be submitted to the Board along with the next water balance assessment for Lake Geraldine.

- The meteorological dataset used to develop the Model includes meteorological information from 2008 to 2017 which might not be representative of the current conditions given the rapidly changing climate in the Arctic. The Board recommends recalibration of the Model by updating the dataset to incorporate the most recent data.

Copies of all documents received during the review can be accessed through the NWB's Public Registry and FTP site using the following link:

ftp://ftp.nwb-oen.ca/registry/3%20MUNICIPAL/3A/3AM%20-%20Municipality/3AM-IQA1626/3%20TECH/D%20WATER%20USE

The Licensee is advised that the Board's review of this document is a verification that the proposed activity is consistent with the existing terms and conditions of the Licence more specifically with Part D, Item 11, and may proceed with the City's Annual Supplemental Pumping Program for 2024. The Board is not opposed to the City's plans of initiating the pumping from Apex River earlier to take advantage of freshet.

Should you have any questions, please feel free to contact the undersigned at (867) 360-6338 (extension 32) or nidhi.singh@nwb-oen.ca at your earliest convenience.

Sincerely,

Nidhi Singh
Nunavut Water Board,
Technical Advisor

ns/rqd

Cc: Distribution List – Iqaluit

APPENDIX B - Iqaluit 2023 Lake Geraldine Resupply (Apex River Supplementary Pumping Program): Report of Activities 3AM-IQA1626

NUNAMI
STANTEC LIMITED

Project Summary Report:

Iqaluit 2023 Lake Geraldine Resupply (Apex River Supplementary Pumping Program): Report of Activities 3AM-IQA1626

April 18, 2024

Prepared for:
City of Iqaluit
Iqaluit, Nunavut

Prepared by:
Nunami Stantec Limited

Project Number: 144903395

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Executive Summary

This report presents results of monitoring undertaken pursuant to Water License 3AM-IQA1626 Amendment No. 4 issued to the City of Iqaluit. The report addresses the reporting requirements of the Amendment No. 4 as they pertain to the 2023 Apex River Supplementary Pumping Program (SPP).

The 2023 SPP was completed between June 6, 2023 (kickoff meeting) and October 28, 2023 (demobilization). Works and activities completed include:

- Mobilization of equipment and infrastructure to Apex River pumping sites
- Placement of pumps, screens, and connection to manifolds at Apex River
- Installation and operation of pumps in Apex River
- Conveyance of water from Apex 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 Apex River to the Lake Geraldine Reservoir was completed between June 26 and July 13, 2023. A total of 222,784 m^3 of water were transferred to Lake Geraldine Reservoir. The maximum daily pumped volume was 15,100 m^3 on July 5, 2023. Pumping records were maintained by the contractor at the pumping site and were provided to the City's representative (Nunami Stantec Limited) for review and tabulation throughout the program.

The Government of Nunavut (GN) Chief Electrical Inspector (Electrical Authority Having Jurisdiction, AHJ) visited the Apex River pumping site in September 2022. Some deficiencies in the electrical setup were identified. A final inspection report from the Electrical AHJ (December 2022) is also found in Appendix A. Electrical deficiencies and overall work completed in 2023 is summarized in Section 4.1.2.

Based upon the December 2022 Electrical AHJ inspection report and subsequent review by Nunami Stantec in February – March, 2023, deficiencies were addressed prior to commencing the 2023 Apex River SPP. Electrical upgrades were completed between May to June 24, 2023 by TAL and subcontractors, followed by a final inspection by Mat Abram (Electrical Inspector – Qikiqtaaluk Region, Government of Nunavut Safety Services Division) from the GN AHJ on June 25, 2023. A senior electrical engineer from Nunami Stantec provided an on-site review of the upgrades completed on the electrical system and, on June 24, 2023, provided the following list of outstanding items in advance of the AHJ inspection.

On June 26, 2023, the City informed Nunami Stantec that the AHJ had provided them with a notice to proceed with pumping operations, following their satisfactory review on June 25, 2023. The 2023 electrical setup should be suitable for the 2024 pumping season, assuming the setup remains unchanged and equipment condition remains good. The electrical AHJ should be contacted following the mobilization and before commencement of system operation. It is understood that the City and TAL are moving forward with an official servicing of the existing pumps by the supplier prior to 2024 mobilization.

Abbreviations

City	City of Iqaluit
DFO	Fisheries and Oceans Canada
FAA	*Fisheries Act* Authorization
GPS	Global Positioning System
km	kilometre
m	metre
m^3	cubic metres
m^3/s	cubic metres per second
MAD	Mean annual discharge
mg/L	milligram per litre
Apex River	Niaqunguk River
SPP	Supplementary Pumping Program
TAL	Tower Arctic Ltd.
UTM	Universal Transverse Mercator
WSC	Water Survey of Canada

1 INTRODUCTION

The City of Iqaluit (City) obtains and distributes potable water from Lake Geraldine, an engineered reservoir located approximately 1 kilometre (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 Apex River, the City applied to the Nunavut Water Board to amend its Type A Water License 3AM-IQA1626 to permit supplementation of the Lake Geraldine Reservoir from the Niaqunguk (Apex) River during the open water season on an annual basis until 2026 (the term of the license). In September 2019, the City received an amendment (Amendment No. 4) to its Water License. Amendment No. 4 of the City's Type A Water License 3AM-IQA1626, permits an annual maximum of 500,000 cubic m^3 of water to be extracted from Apex River for transfer to the Lake Geraldine. The water withdrawals can occur when flows in the Apex River exceed 30% of the mean annual discharge (MAD), and withdrawal rates do not exceed 10% of the instantaneous flow of the river, except if otherwise authorized by Fisheries and Oceans Canada (DFO).

The Supplementary Pumping Program (SPP) was facilitated by a semi-permanent pipeline from the Apex River to Lake Geraldine that was installed in 2019. Temporary pumping infrastructure was required to be installed and operated annually within the Apex River to withdraw water. Supplementary pumping (non-emergency) was previously completed during the 2020 and 2021 open water seasons. Emergency pumping under *Fisheries Act* Authorization 22-HCAA-02043 occurred in September 2022 to address the potential potable water shortage in Iqaluit due to low water levels in Lake Geraldine.

In late April 2023, Tower Arctic Ltd. (TAL; the contractor) submitted a proposal to complete electrical modifications to the Apex system to address 2022 deficiencies identified by the Government of Nunavut Electrical Authority Having Jurisdiction (AHJ). TAL were retained by the City to complete the SPP during the open water season of 2023, with the contract (CO No. 1 to SC1207) was fully executed on May 15, 2023. Oversight was provided by Nunami Stantec, also under contract to the City. On June 26, 2023, the City informed Nunami Stantec that the AHJ had provided them with a notice to proceed with pumping operations, following their satisfactory review on June 25, 2023.

The objective of the SPP, as with previous resupply programs, was to increase the volume of water in the reservoir prior to the onset of freezing conditions in compliance with Amendment No. 4. Water levels in the Lake Geraldine Reservoir were monitored throughout the 2023 SPP using data from the Water Survey of Canada (WSC) Station 10UH013 (Lake Geraldine Near Iqaluit).

1.1 Climate, Demand and Water Levels in Lake Geraldine

Lake Geraldine water levels for 2020 – 2023 as well as the historical minimum and maximum (2007 to 2018) are illustrated in Figure 1.1. As shown in Figure 1.1, the 2023 reservoir levels prior to freshet were the lowest observed over the last four years. However, the spill elevation (111.30 m) in Lake Geraldine was reached earlier on in the year in 2023 than in 2020 and 2022. 2023 water levels at the end of the year were lower than 2020 but higher than 2022 and 2021.

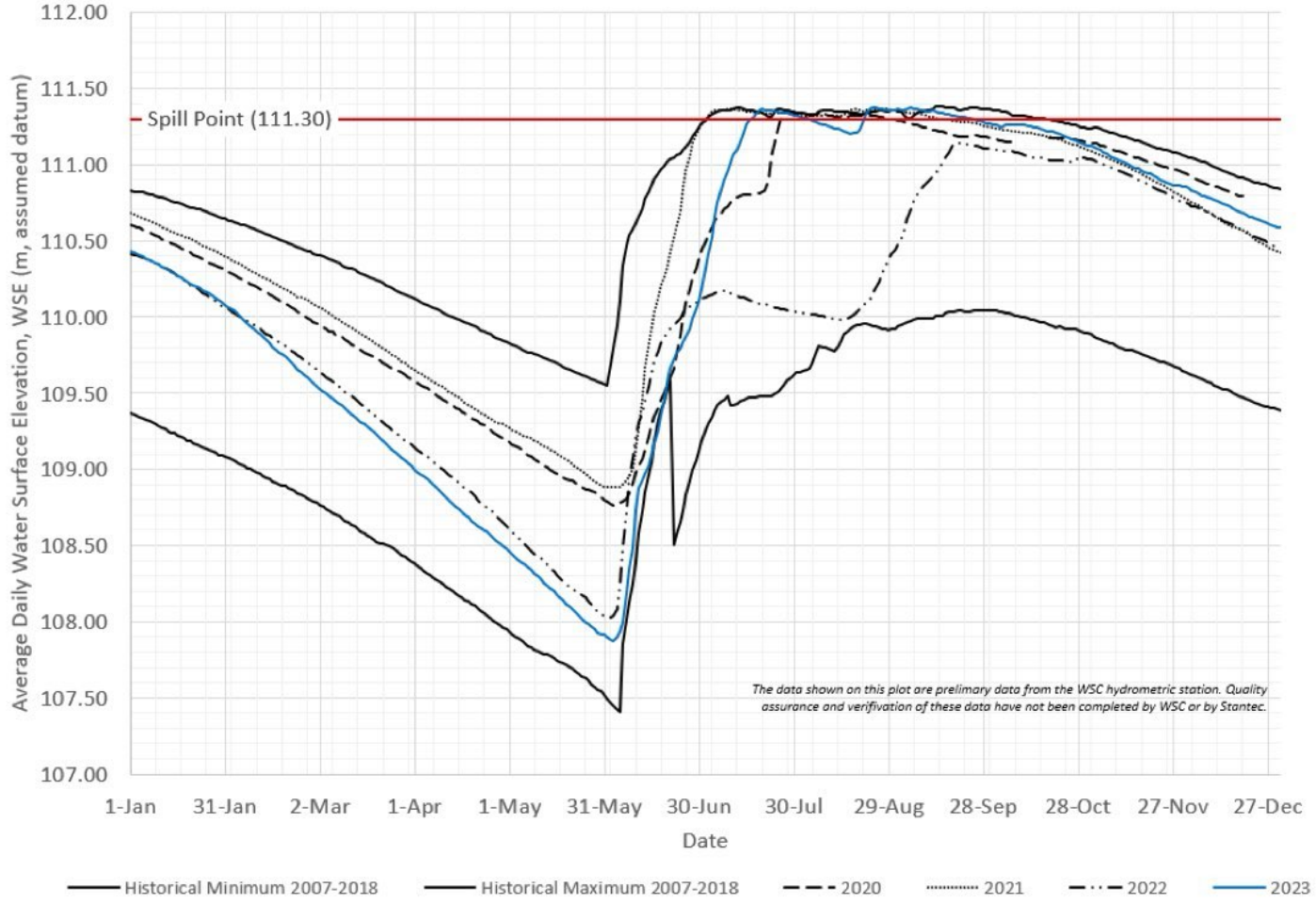


Figure 1.1 WSC Station 10UH013 – Lake Geraldine Near Iqaluit (Assumed Datum)

It is understood that inflows into Lake Geraldine are heavily influenced by freshet and precipitation, a small creek flows directly into the reservoir and is also monitored by WSC station 10UH012 (Inflow to Lake Geraldine near Iqaluit). Daily climate data from the Iqaluit Climate weather station operated by the Government of Canada (GoC) (GOC 2023a) was used to compare 2023 total monthly precipitation to the 1981 to 2010 climate normal for Iqaluit. The Iqaluit Climate weather station was used because it was the only weather station that reported precipitation values in 2023 in Iqaluit. In June 2023, the total monthly precipitation was below the 1981 to 2010 climate normals for Iqaluit A (GoC 2023b). In July 2023 the total monthly precipitation was more than double the climate normals (Figure 1.2). The increased precipitation in July 2023 resulted in increased flow into the Lake Geraldine in July. These above average inflows from precipitation coupled with the additional inflows from pumping of the Apex River helped water levels within Lake Geraldine reach spill elevation by July 17 2023 (Figure 1.1).

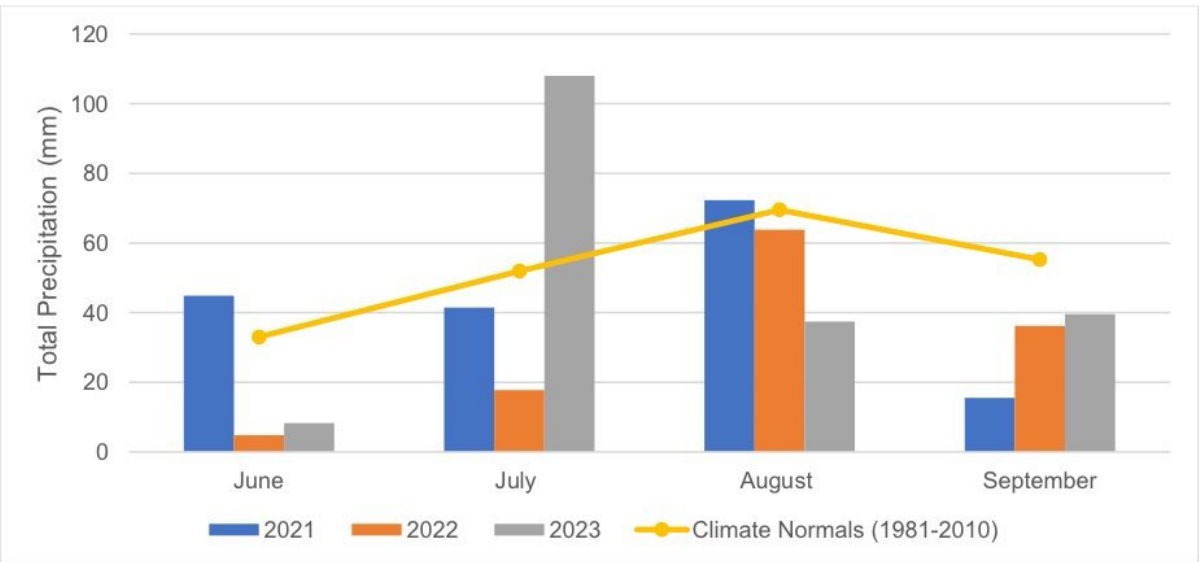


Figure 1.2 Total Precipitation recorded at Iqaluit Climate Weather Station in 2021, 2022 and 2023 and the Climate Normals (1981-2010) from Iqaluit A Weather Station

No climate normals data exists for the Iqaluit Climate weather station so climate normals data from the Iqaluit A weather station were used instead. The Iqaluit A weather station is located at the same elevation as the Iqaluit Climate weather station and is located approximately 1 km northeast from the Iqaluit Climate weather station. Therefore, it was determined that the data from the two stations would be sufficiently comparable and have been used interchangeably.

Opposing natural inflows such as precipitation and fresher, water demands from the City directly lower the water level in Lake Geraldine. Though an assessment of the City's demands are outside the scope of this project, a quick analysis of the reports compiled by Colliers Project Leaders on water demand will be described (R. Sithole, personal communication, March 5 2024). Monthly water demands for the City of Iqaluit over the past three years (2021, 2022 and 2023) are summarized in Figure 1.3.

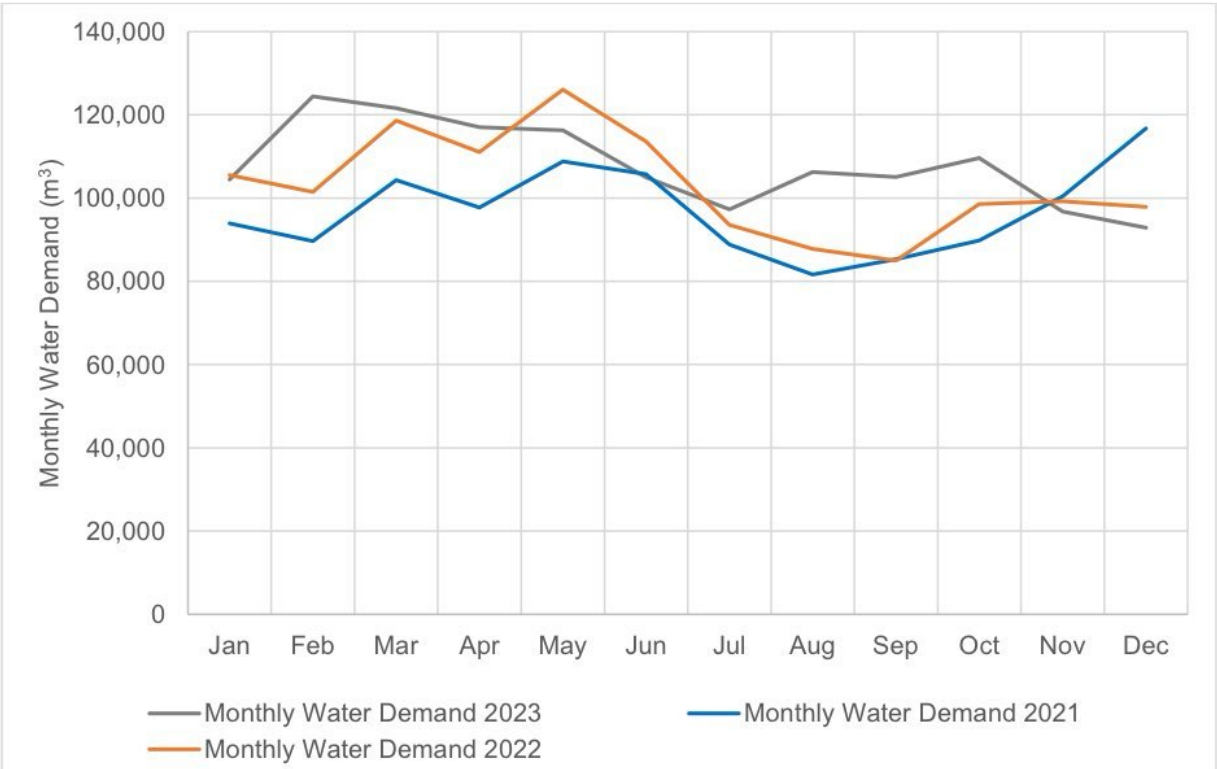


Figure 1.3 Monthly Water Demand for the City of Iqaluit in 2021, 2022 and 2023

As shown in Figure 1.3, monthly water demands were higher in January, February, March, April, July, August, September, October of 2023 than in 2022 and 2021.

February had the highest total demand in 2023, with a monthly total of 124,446 m^3. Averaging this value over 28 days equates to a daily average of 4,445 m^3/day. Assuming 7,750 people, this equates to a daily consumption rate of 573 L/person/day. The City uses 400 L/person/day as an estimate for daily consumption. As such, this shows that in February of 2023 demands were approximately 43% higher than expected. The City should consider improving their water distribution system to decrease the occurrence of leaks in addition to improving water conservation practices.

2 PROJECT WORKS AND ACTIVITIES

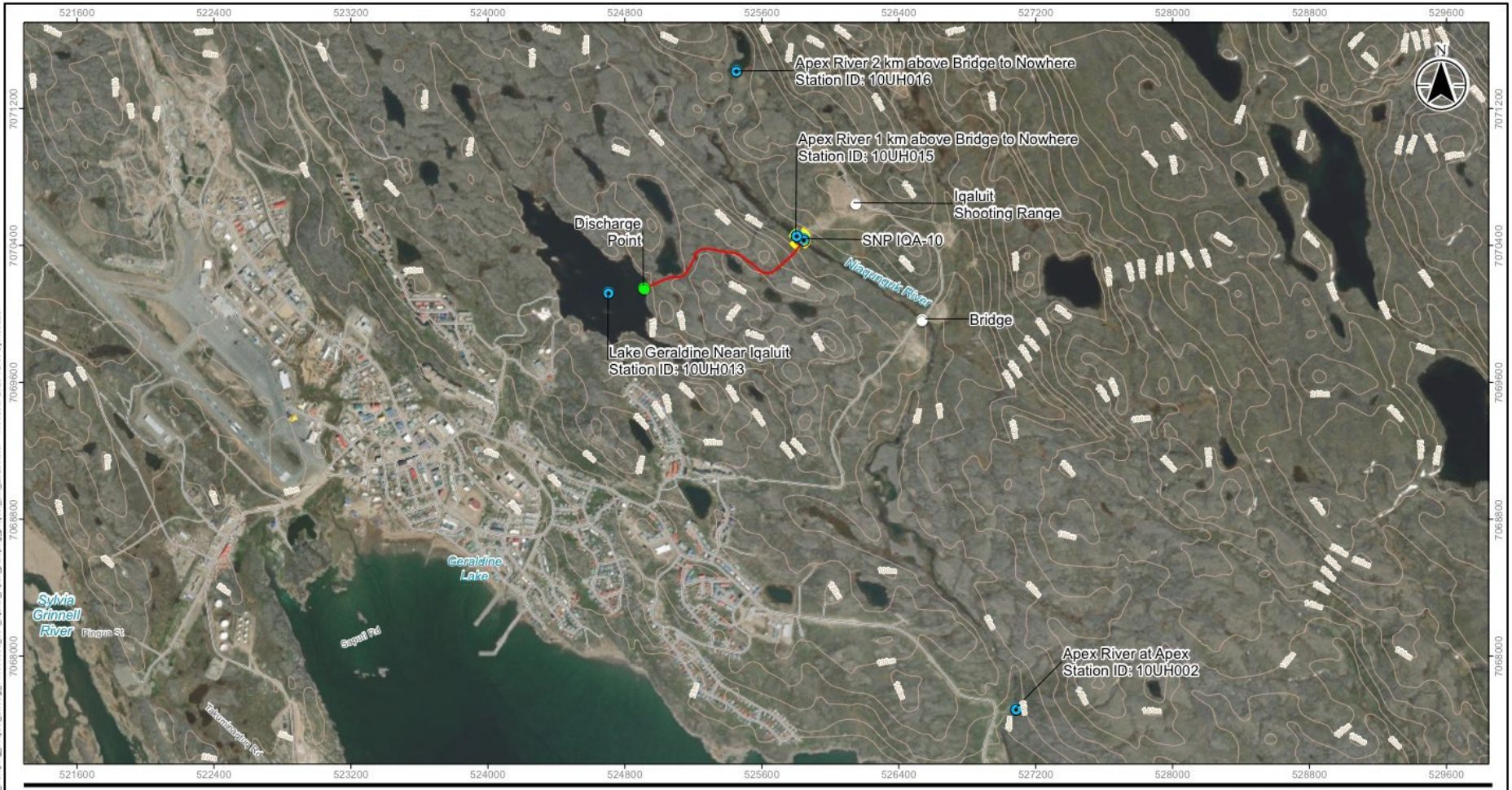
The 2023 SPP was completed between June 6, 2023 (kickoff meeting) and October 28, 2023 (demobilization). Pumping activities started on June 26, following notification from the City on AHJ acceptance of the electrical upgrades, and continued through to July 13. Electrical upgrades were completed between May to June 24, 2023 by TAL, followed by a final inspection by Mat Abram (Electrical Inspector – Qikiqtaaluk Region, Government of Nunavut Safety Services Division) from the GN AHJ on June 25, 2023.

Works and activities completed included:

- Mobilization of equipment and infrastructure to Apex River pumping sites
- Placement of pumps, screens, and connection to manifolds at Apex River
- Installation and operation of pumps in Apex River
- Conveyance of water 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 are shown in Figure 2.1. The Apex River pumping site was established at this location in 2018. The pumping location was fixed by the need to connect to a semi-permanent pipeline installed in 2019 as well as the location of WSC station 10UH015 (Apex River 1km Above Bridge to Nowhere) immediately upstream of the pumping site. The 2023 SPP followed the same protocol and operation as in previous years (2020, 2021 and 2022).

Water was pumped from the Apex River using three high-head 94 horsepower (Hp) submersible pumps and conveyed overland to Lake Geraldine. Pumps were housed in a screened cage, where mesh sizes met the DFO Freshwater Intake End-of-Pipe Fish Screen Guidelines (DFO 2020). Pumping took place between June 26, 2023 and July 13, 2023. Approximately 222,784 m^3 of water was transferred to Lake Geraldine from the Apex River in 2023. This volume is approximately half of what was pumped in 2022 (444,390 m^3, Nunami Stantec 2023). An access trail and semi-permanent pipeline between the Apex River and Lake Geraldine have remained in place for future pumping requirements.



Road
Topographic Contour
WSC or SNP Station
Point of Interest
Discharge Point
Pipeline
Pumping Site

0 200 400 600 800 1,000 m

1:35,000 (at original document size of 8.5x11)

Notes
1. Coordinate System: NAD 1983 CSRS UTM Zone 19N
2. Data Sources: Canvec NU, Canvec CA, Water Survey of Canada.
3. Orthoimagery: ESRI World Imagery

Stantec

Iqaluit

Project Location:
Iqaluit, NU

Project Number: 144903395
Prepared by TOSBERG on 20231103
Requested by EKELLY on 20231030
Checked by TCARDINAL on 20231103

Client/Project/Report
City of Iqaluit
Iqaluit Water Supply
Iqaluit 2023 Apex Pumping Project Site Overview

Figure No.
2-1

Title
Iqlauit 2023 Apex Pumping Project Site Overview

3 OPERATIONAL MONITORING PLAN

The objective of the operational monitoring plan was to observe hydrologic conditions in the Apex River during pumping operations and to inform changes in pumping rates that were varied daily throughout the program. In accordance to Amendment No. 4 which included compliance with the DFO Low Risk Criteria (DFO 2013), water withdrawals of no greater than 10% of instantaneous flow were permitted when natural flows in the Apex River were above 30% of MAD. Nunami Stantec used WSC Station 10UH015 data to advise TAL on when pumping operations could begin and when pumping rates needed to be changed based on river flows. Each day water levels in Lake Geraldine and flows in Apex River were obtained from their respective WSC stations and were compared to pumping logs provided by TAL. Daily scheduled emails were sent to TAL to advise on the maximum pumping rates to remain within withdrawal limits. Emails were sent more frequently if notable flow changes were observed that necessitated additional communication.

A summary of monitoring locations and activities completed during the program to satisfy the applicable criteria to the operational monitoring plan are presented in Table 3.1.

Table 3.1 Monitoring Location and Requirements Summary (per Water Licence Requirements)

Monitoring Location ID	UTM Coordinates (Zone 19V)		Monitoring Parameter	Method	Data Source (Nunami Stantec, Contractor, or WSC Location)
	Easting (m)	Northing (m)			
SNP IQA-10	525802	7070474	Pumped Flow and Volume	Volumetric Flow Meter	Contractor
“Apex River at Apex” (WSC station 10UH002)	527087	7067694	Water level and flow data for Apex River approximately 4 km downstream of pump site	Access data online	WSC
“Apex River 1km Above Bridge to Nowhere” (WSC station 10UH015)	525802	7070531	Water level and flow data for immediately upstream of Apex pump site	Access data online	WSC
“Lake Geraldine Near Iqaluit” (WSC station 10UH013)	524463	7069963	Water level in Lake Geraldine	Access data online	WSC
“Apex River 2Km Above Bridge to Nowhere” (WSC station 10UH016)	525451	7071425	Water level and flow data for upstream of Apex pump site	Access data online	WSC

4 2023 SUPPLEMENTAL PUMPING PROGRAM RESULTS

The intent of the 2023 SPP monitoring program was to maintain compliance with the requirements of the water licence (Amendment No.4). Pumping operations took place between June 26, 2023 and July 13, 2023 under the conditions that annual maximum withdrawal from the Apex River was not to exceed 500,000 m^3 and that a maximum withdrawal rate of 10% of instantaneous flow was permitted as long as flows were above 30% MAD.

4.1 Operational Challenges

4.1.1 Pumping Operations

Operationally, the system performed as per the design. Based upon experience from previous years, emergency supplementation programs completed in 2018 and 2019, and the non-emergency operation of the Apex River semi-permanent infrastructure in 2020 to 2022, Nunami Stantec and the City understood the challenges with operation and the importance of daily monitoring for compliance to Amendment No. 4. As in 2020, 2021 and 2022, the system began operations during spring melt in 2023.

In the 2022 pumping summary report (Nunami Stantec 2023), Nunami Stantec identified that pumping from the Apex River has an impact on recorded flows at WSC station 10UH015, which is immediately upstream of the pump site. It is likely that the WSC station is under reporting flows compared to real-time measured flows upstream of the pump site.

For purposes of the SPP and to apply conservatism to the protection of fish and fish habitat, Nunami Stantec assumed that flows recorded at WSC station 10UH015 were representative of flows directly upstream of the pumping location within the Apex River. In June 2023, an additional WSC station was installed 1 km upstream of WSC station 10UH015 (Apex River 1km above Bridge to Nowhere), Apex River 2km Above Bridge to Nowhere (WSC 10UH016). At the end of the 2023 pumping program this station was reporting both water level and discharge, but the reliability of the data could not be confirmed and was not relied upon during the current pumping program. The intent is to use flows from WSC station 10UH016 and WSC station 10UH015 to guide future pumping programs.

4.1.2 Electrical Upgrades & Mechanical Considerations

As mentioned, TAL submitted a plan and proposal to complete electrical modifications to the Apex system to address 2022 deficiencies identified by the Government of Nunavut Electrical AHJ. TAL were retained by the City to complete the SPP during the open water season of 2023, with the contract (CO No. 1 to SC1207) was fully executed on May 15, 2023. Oversight was provided by Nunami Stantec, also under contract to the City.

Nunami Stantec submitted a supplementary scope of work in November 2022 to complete a feasibility review of non-submersible pumping system at the Apex River pumping location and an on-site review of the existing electrical equipment to be used in the 2023 Apex SPP, including a meeting with the AHJ in Iqaluit. The scope of work was fully executed under SC1207 on January 26, 2023. The work was divided into three parts:

1. Feasibility review of new pumping system (non-submersible) and conceptual planning;
2. Site visit for senior electrical engineer to review equipment and generators and meet with the AHJ (February 28 – March 1); and
3. Site observation report and recommendations for electrical system upgrades.

Both the electrical site visit and recommendation (Appendix A) and the new pumping system feasibility study (Appendix B) reports were submitted to the City on March 27, 2023.

On March 27, 2023, Nunami Stantec completed an additional scope of work to provide some oversite and coordination throughout the construction (modification) period with TAL and during the Electrical AHJ review. This contract was fully executed on May 1, 2023. Electrical upgrades were completed between May to June 24, 2023 by TAL and subcontractors, followed by a final inspection by Mat Abram (Electrical Inspector – Qikiqtaaluk Region, Government of Nunavut Safety Services Division) from the GN AHJ on June 25, 2023. A senior electrical engineer from Nunami Stantec provided an on-site review of the upgrades completed on the electrical system and, on June 24, 2023, provided the following list of outstanding items in advance of the AHJ inspection.

4.1.2.1 Initial Electrical Deficiencies (December 2022)

A summary of the December 2022 electrical inspection deficiencies are listed below:

1. 600-480V (Generator) disconnect requires reconfiguration of feeder cables;
2. Generator (600V) ground requires rerouting;
3. Clearances around 600V generator need to be adjusted;
4. Fuel oil line requires bonding;
5. 480V pumps:
    a. Voltage supplying pumps shall not exceed 150 volts-to-ground;
    b. Pump motor bonded to ground by a bonding conductor that is sized in accordance Rule10-614 and is integral with the supply cable or within the same protective enclosure as the power supply cables if single-conductor cables used;
    c. Has the same type of insulation as the supply conductors; and
    d. Terminates adjacent to the location where the branch circuit conductors receive their supply.

6. Ground fault protection required for submersible pumps.

All details pertaining to the electrical deficiencies identified in 2022, including work completed to March 2023 are found in Appendix A.

4.1.2.2 Remaining Electrical Deficiencies (June 24-25, 2023)

1. Due to the orientation of the generator enclosure, the conductors ended up in front of the enclosure. In addition, the fuel tanks ended up behind the conductors. These factors warrant significant increase in protection of the conductors, with consideration for the refueling procedure. At a minimum:
    a. A ramp needs to be constructed over the conductors, to allow access to fuel tanks without stepping over the conductors.
    b. Measures need to be put in place (such as a clearly marked concrete barricade at the corner pallet) to ensure that a vehicle cannot come in contact with the pallets supporting the cables.
2. Support needs to be provided for the conductors connecting the generator to the splitter at the generator lugs. Connecting the cables to the pallets at this location is insufficient due to the associated forces (the cables would effectively be supporting the pallets).
    a. One option discussed on site was to weld additional strut channel to the strut channel already attached to the generator, then assemble a “ladder” from the existing strut channel on the generator to the nearest pallet, and clip the cables to the ladder, providing the required support.

4.1.2.3 Minor Electrical Deficiencies

1. Routing of cables via Bender CTs does not correspond to the installation manual. Wiring needs to be pulled back and reinstalled.
2. Bonding of conduit couplings on Eaton soft starter enclosures needs to be completed.
3. Termination of control wires needs to be completed at all Eaton soft start enclosures, Bender CT enclosure and at the Bender controller enclosure. The wires are in place, the terminals were discussed on site. Further clarification will be provided by Hinad to the Ryfan crew tonight.
4. Teck cable powering bender enclosure needs to be installed and terminated. (the cable has been pulled, but not terminated)

4.1.2.4 Items for Discussion with the AHJ:

1. Termination of 750MCM cables at the generator enclosure: will need to review with the AHJ.

2. Grounding plates were placed in water but were left exposed. Grounding plates were not covered or trenched. 600mm cover required by code, but code recognizes variance in site conditions.

On June 26, 2023, the City informed Nunami Stantec that the AHJ had provided them with a notice to proceed with pumping operations, following their satisfactory review on June 25, 2023.

4.2 Pumping Rates and Volumes

Nunami Stantec provided guidance on permitted pumping rates each day for TAL's pumping operations based on the instantaneous flow recorded at WSC station 10UH015. At the end of each day, TAL provided Nunami Stantec with the daily pump volumes at SNP IQA-10. Nunami Stantec converted the pump volumes into an average daily pumping rates. Figure 4.1 illustrates the flow in the Apex River throughout the 2023 pumping period, the flow that represents 30% MAD at the pumping station (0.130 m^3/s) is also included on the graph.

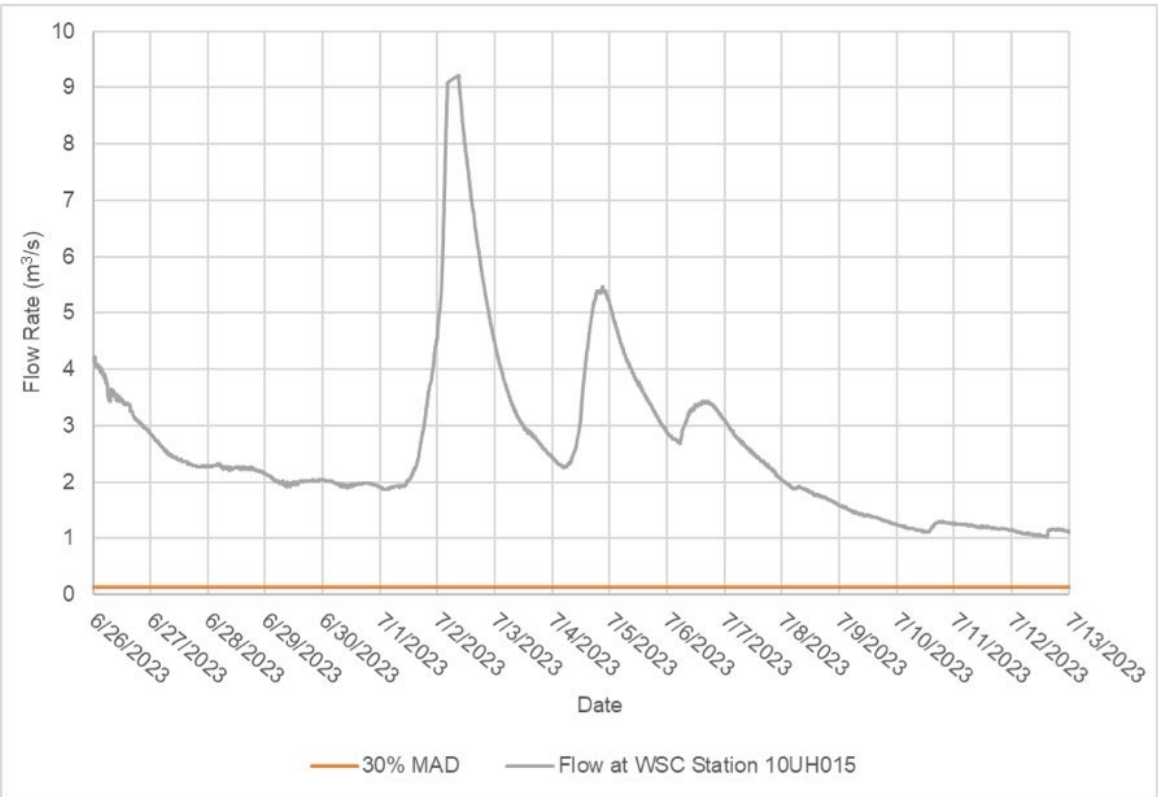


Figure 4.1 Flow at WSC Station 10UH015 Compared to 30% MAD

A total of 222,784 m^3 was pumped from the Apex River to Lake Geraldine during pumping operation in 2023. The maximum daily pumped volume was approximately 15,100 m^3 on July 5, 2023.

Figure 4.2 illustrates the average daily pumping rate compared to the 10% instantaneous flow criteria. A summary of daily pumping volumes during the SPP is provided in Appendix C.

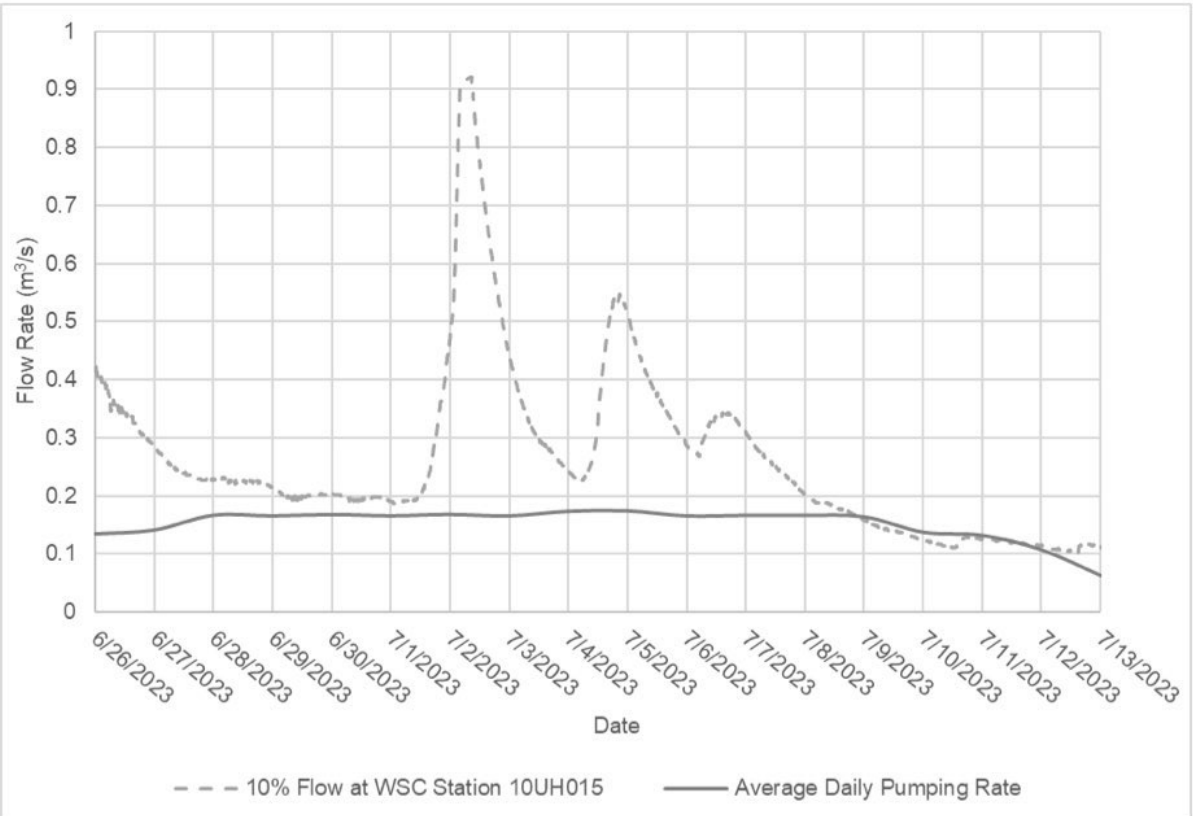


Figure 4.2 10% of Flow at WSC Station 10UH015 and Daily Average Pumping Rate

As shown in Figure 4.2 there were three days during the pumping period where the daily average pumping rate exceeded 10% of the instantaneous flow at WSC station 10UH015 at some point during that day. The recorded pumping rate during the days with exceedances were as follows: 12% was the rate for one day and 11% was the rate for two days. These minor exceedances occurred on days when the flow rate declined throughout the day after the daily permissible pump rate guidance was provided to TAL in the morning. A summary of daily average flow at WSC station 10UH015 and average daily pumping rate are provided in Appendix C.

It is Nunami Stantec's opinion that no unanticipated impacts including: harmful alteration, disruption and destruction of fish habitat resulted from the withdrawals and reduction of flow during the 2023 pumping program.

5 DEMOBILIZATION

As mentioned, pumping operations ended on July 13, 2023. The City requested all equipment remain mobilized and serviced continue with regular monitoring of both the Apex River and Lake Geraldine Reservoir until a later date in September. During a project meeting on Thursday, September 14, 2023, the City advised that the demobilization process could begin. Due to scheduling constraints with the contractor in mid-September, demobilization began on October 10, 2023 and was completed on October 28, 2023. Cold sensitive equipment (i.e., pumps that were in the Apex River) were prioritized and returned to the City first. All other items were demobilized and returned by the end of October. The equipment handover from TAL to the City throughout the demobilization period. Equipment manifest signoff was completed by TAL on November 2, 2023 and City signoff on December 6, 2023, completing the administrative requirements of the formal equipment handover. The manifest from this handover can be found in Appendix D, as well as a final site review memo (dated November 1, 2023).

6 CONCLUSION

Pumping from the Apex River to the Lake Geraldine Reservoir in accordance with Water Licence 3AM-IQA1626 Amendment No. 4 (up to 10% of observed flow when flows are more than 30% MAD) was completed between June 26 to July 13, 2023. A total of 222,784 m^3 were pumped with a maximum daily pumped volume of approximately 15,100 m^3. The total volume pumped was less than the maximum allowable pumped volume from the Apex River of 500,000 m^3 as defined in Amendment No. 4.

Pumping records were maintained by the contractor at the pumping site. Spill elevation within the Lake Geraldine reservoir was reached on July 17th, 4 days after the pumping program concluded.

It is Nunami Stantec's opinion that no unanticipated impacts including: harmful alteration, disruption and destruction of fish habitat resulted from the withdrawals and subsequent reduction of flow during the 2023 pumping program.

Based upon the December 2022 Electrical AHJ inspection report and subsequent review by Nunami Stantec in February – March, 2023, deficiencies were addressed prior to commencing the 2023 Apex River SPP. Electrical upgrades were completed between May to June 24, 2023 by TAL and subcontractors, followed by a final inspection by Mat Abram (Electrical Inspector – Qikiqtaaluk Region, Government of Nunavut Safety Services Division) from the GN AHJ on June 25, 2023. A senior electrical engineer from Nunami Stantec provided an on-site review of the upgrades completed on the electrical system and, on June 24, 2023, provided the following list of outstanding items in advance of the AHJ inspection.

On June 26, 2023, the City informed Nunami Stantec that the AHJ had provided them with a notice to proceed with pumping operations, following their satisfactory review on June 25, 2023. The 2023 electrical setup should be suitable for the 2024 pumping season, assuming the setup remains unchanged and equipment condition remains good. The electrical AHJ should be contacted following the mobilization and before commencement of system operation.

7 LIMITATIONS

This document titled Final Report: Iqaluit 2023 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”). This report is intended solely for the use by the Client in accordance with Stantec’s contract with the Client. While the Report may be provided to applicable authorities having jurisdiction and others for whom the Client is responsible, Stantec does not warrant the services to any third party. The report may not be relied upon by any other party without the expressed written consent of Stantec, which may be withheld at Stantec’s discretion. The material in this document 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 Apex River in 2023. This document was prepared to summarize pumping activities from the 2023 pumping program.

Nunami Stantec trusts the contents of this report meet your expectations at this time. If you have any questions, please do not hesitate to contact the undersigned

Respectfully Submitted,

NUNAMI STANTEC LIMITED

Written by:

Matt Follett, M.A.Sc., P.Eng.
Associate, Civil Engineering Lead Nunavut
Phone: (613) 223-1569
Email: Matt.Follett@stantec.com

Written by:

Erin Kelly, EIT, BIT.
River and Water Resources EIT and Biologist in Training
Phone: (867) 687-3904
Email: Erin.Kelly@stantec.com

Reviewed by:

David Luzi, Ph.D., P.Geo.
Senior Hydrologist
Phone: (604) 412-3276
Email: David.Luzi@stantec.com

Approved by:

Erica Bonhomme, M.Sc., P.Geo
Principal, Environmental Services Northern Canada
Direct: 867-731-0466
Email: Erica.Bonhomme@stantec.com

9 REFERENCES

Fisheries and Oceans Canada (DFO). 2022. Paragraphs 34.4(2)(b) and 35(2)(b) *Fisheries Act* Authorization Emergency Circumstances 22-HCAA-02043. Authorization Issued to the City of Iqaluit.

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APPENDIX A

Electrical Reports

Nunami Stantec Limited
P.O. Box 188
Rankin Inlet, Nunavut X0C 0G0
Tel: (867) 645-2805
Fax: (867) 645-2063

VIA E-MAIL – s.ghosh@iqaluit.ca

March 27, 2023
File No.: 144903352

Sumon Ghosh, Director of Engineering
City of Iqaluit
1085 Mivvik Street, P.O. Box 460
Iqaluit, NU X0A 0H0

Attention: Sumon Ghosh

Dear Mr. Ghosh,

Reference: Apex River Pumping Station Equipment Review.

Site Observations:

On February 28 and March 1, Andrei Aroutiounov (Nunami Stantec) reviewed the electrical equipment associated with the Apex River temporary pumping site between. The goal of the site review was to develop a plan of action to address code non-compliances flagged by the Authority Having Jurisdiction.

The equipment consisted of a 350kW / 437kVA 600V generator cw 450A-3P main breaker, 225kVA 600-277/480V step-down transformer, Eaton ECS95W1CAH-P23 motor starters, and Sulzer J604-HD-TB460V60CSA-30 submersible pumps, as well as a number of splitters fused disconnect switches.

Based on the site review and the follow up meeting with Jonathan Potts, Nunami Stantec produced a letter for the AHJ, providing a plan of action to address all the concerns flagged by the AHJ. The letter is complete with a single line diagram and details on the proposed equipment to address ground current leakage detection. (See Attachment 1).

Based on the site review, multiple concerns were flagged with regards to the existing 600V generator configuration used at the Apex site:

1. The current generator enclosure does not meet code requirements.
2. The existing generator is marginally sized to support the operation of all three pumps at full load. Considering the age of the generator and the repairs that have been done to the generator to-date, City of Iqaluit should engage a qualified third party to test the generator, update the generator nameplate rating (if required), and advise whether the generator in its current state is suitable for continuous operation of the three 94HP pumps.

3. The electrical distribution provided in the enclosure is undersized to operate three pumps in at the same time. In addition, several code non-compliances were observed during the review of the electrical distribution configuration in the generator sea can.

Several options were discussed to address the existing Apex generator enclosure non-compliance, including:

1. Build a temporary plywood enclosure around the existing Apex generator with sufficient clearances.
2. Use a pre-fabricated fire proof tent to house the existing Apex generator.
3. Use the 480V 500kW generator that was originally slated for the use at the Unnamed Lake site.

Recommendations:

Based on the issues identified with the existing Apex site generator, our recommendation to the City is as follows:

1. Use the 480V 500kW generator that was originally slated for the use at the Unnamed Lake site to start the 2023 pumping season.
    a. De-rate the generator main breaker from 2000A to 800A by replacing the breaker trip plug.
    b. Complete test on the generator to ensure that it is fully operational.
2. Complete repairs / maintenance on the 600V Apex site generator and determine whether the generator can be used as a backup.
    a. If it is confirmed that the generator can be used as a backup, derive a plan for a temporary generator enclosure that would maintain 1m clearance around the generator skid. The enclosure would have to accommodate the generator exhaust system, as well as manage combustion air intake and the airflow required for generator engine cooling.
3. Revise existing power distribution equipment configuration using the sea can that currently houses Eaton soft starts, so that there is a single connection point for the incoming power; keep all the distribution equipment in the sea can.
    a. Separation of generator enclosure and electrical distribution enclosure allows for placement of the electrical distribution sea can closer to the edge of the river, thus shortening the pump conductors. This in turn will reduce the leakage current associated with the pump cables.
4. Configure power distribution in a fashion that would facilitate transition between 480V and 600V generators:
    a. Design shall allow for re-configuration of the power distribution for a 600V incoming source. The provisions shall include space for one (existing) 600V-277/480V 225kVA transformer and one new 600V-277/480V transformer sized

between 150kVA and 225kVA. When not in use, both transformers shall be stored off-site, in accordance with manufacturer's recommendations.

b. Design shall include a provision for generator power, in the event a replacement generator requires external power source for auxiliary items such as battery charger.

5. Procure Bender ground leakage current detection system and add it downstream of the existing Eaton motor starters. Interface Bender controller with the existing Eaton motor starters.
    a. Based on our coordination with Eaton and based on the documentation supplied by Eaton, the existing motor starters do not require modifications to be wired to the Bender controller.

Notes:

1. The two generators considered by the City operate at different voltages (480V for Unnamed Lake; 600V for Apex) The pumps are rated for 480V. As such, transitioning between the generators would require re-wiring of the electrical distribution.

2. 480V is a common voltage in United States, but less common in Canada. 600V generators are much more common in Canada as compared to 480V. If the 2023 installation were to proceed with the Unnamed Lake (480V) generator, any backup generator is likely to be 600V. As such, while the addition of the second 600V-277/480V transformer is not anticipated to be needed on Day 1 of 2023 pumping, it may be prudent to ensure that a transformer is available on short notice if a transition from a 480V source to 600V source were to be required.

3. Failure to store transformers and pumps in accordance with manufacturer's recommendations when not in use may lead to premature equipment failure. When the above equipment is de-energized, we recommend that the City store the equipment in a dry, heated location. Where the above equipment was stored in an uncontrolled climate for extensive period of time, the equipment should be tested by a qualified contractor prior to being put back in operation.

4. The existing Apex river equipment configuration included provisions for a site trailer feeder. Our team will require an estimated peak load associated with the site trailer feeder to determine the best power source configuration for the site trailer.

Sincerely,

NUNAMI STANTEC LIMITED

Andrei Aroutiounov
Associate, Sr. Electrical Engineer
Tel: 204-898-2623
Fax: 204-289-5900
andrei.aroutiounov@stantec.com

Attachments:

1. Letter to Jonathan Potts, complete with attachments.

c. Jose Bueno (Colliers Project Leaders), Leo Korenbaum, P.Eng. (Nunami Stantec), Richard Sithole (City of Iqaluit), Matthew Follett (Nunami Stantec).

1 LETTER TO JONATHAN POTTS, COMPLETE WITH ATTACHMENTS.

Nunami Stantec Limited
P.O. Box 188
Rankin Inlet, Nunavut X0C 0G0
Tel: (867) 645-2805
Fax: (867) 645-2063

VIA E-MAIL – jpotts@gov.nu.ca

March 27, 2023
File No.: 144903352

Jonathan Potts, Chief Electrical Inspector
Government of Nunavut – Department of Community and Government Services
P.O. Box 1000 Station 610
Iqaluit, NU X0A 0H0

Attention: Jonathan Potts

Dear Mr. Potts,

Reference: Apex River Pumping Station Electrical Report

Our team reviewed the electrical inspection report issued on December 8, 2022 (Refer to Attachment 1), and proposes the following actions to address the items:

Item: 600-480V Disconnect Switch requires reconfiguration of feeder cables.
Resolution: Feeder cables will be reconfigured as a part of the changes to the distribution.

Item: Generator ground requires re-routing.
Resolution: Final routing of the ground conductor will include mechanical protection; equipment positioning on site will be coordinated to avoid the need to cross the ground conductor, or any other cables for day-to-day operation and maintenance of the equipment. A sketch of the site layout, complete with the cable routing path and the protection detail will included in the contract documents.

Item: Working Clearance around the generator:
Resolution: A different, self-enclosed generator with skin tight enclosure will be used in lieu of the existing unit. An electrical contractor will be engaged to revise breaker trip plug on the generator main breaker from the existing 2000A to a new matching 800A trip plug.

Item: Entrance and exit from the generator enclosure.
Resolution: A different, self-enclosed generator with skin tight enclosure will be used in lieu of the existing unit.

Item: Fuel Oil requires bonding.

Resolution: A #6AWG Cu bonding conductor will be used to bond fuel oil line and fuel oil storage tank.

Item: 480V pumps are currently being used.
Resolution:
As per the discussion at the meetings, the city will continue using 480V pumps (due to horsepower rating), while complying with Canadian Electrical Code sections 26-956 (2) (b), (c) and (d).

Contractor will maintain a site attendant and an on-call journeyman electrician. Site attendant will be trained to contact journeyman electrician immediately upon malfunction / trip of any of the electrical systems, and not touch or approach any electrical systems. Training will be documented and complete with sign-offs.

Contractor will fence off the area using high visibility orange fence complete with warning signage across the river, as well as construction fencing complete with warning signage on land. A sketch indicating location and extent of the fencing will be provided by the electrical contractor for AHJ review prior to the start of the 2023 pumping installation.

Item: ground fault protection is required for submersible pumps.
Resolution: Bender ground fault protection panel complete with three Zero-CT modules will be provided downstream of the existing soft start modules to monitor the leakage current on the pumps. Ground fault protection panel will be configured to limit the maximum ground leakage current to 10mA for 2.7 seconds or less. The assembly will be inspected at the factory and shipped complete with CSA approval label.

Nunami Stantec is in the process of coordinating a detailed design package with the City of Iqaluit. Once the package is awarded, the electrical contractor will follow the process outlined in the Nunavut Territory Electrical Safety Bulletin 2.1.03 – Requirements for Plan Review and formally submit the proposed design for AHJ's review, including signed, sealed design documents. Meanwhile, if you feel that any of the proposed resolutions, including the preliminary single line diagram and the preliminary grounding riser do not fully address the items raised in the report, please advise and we will further review the items.

Refer to Attachment 2 for the preliminary single line diagram and the grounding riser for the installation.

Refer to Attachment 3 for the details on the Bender hardware package proposed to address ground leakage current detection.

Sincerely,

NUNAMI STANTEC LIMITED

Andrei Aroutiounov
Associate, Sr. Electrical Engineer
Tel: 204-898-2623
Fax: 204-289-5900
andrei.aroutiounov@stantec.com

Attachments:

1. Copy of the Apex River Pumping Station Inspection Report
2. Preliminary single line diagram and grounding riser
3. Proposed ground leakage current monitoring hardware

c. Jose Bueno (Colliers Project Leaders), Sumon Gosh (City of Iqaluit), Richard Sithole (City of Iqaluit), Leo Korenbaum, P.Eng. (Stantec)

1 COPY OF THE APEX RIVER PUMPING STATION INSPECTION REPORT

08-Dec-2022

Government of Nunavut

Department of Community and Government Services

Baffin Region	Kivalliq Region	Kitikmeot Region
P.O. Box 1000 Station 610 Iqaluit, NU X0A 0H0 Phone: (867) 975-5423 Fax: (867) 975-5453	Bag 002 Rankin Inlet, NU X0C 0G0 Phone: (867) 645-8179 Fax: (867) 645-8196	Bag 200 Cambridge Bay, NU X0B 0C0 Phone: (867) 983-4157 Fax: (867) 983-4152

ELECTRICAL INSPECTION REPORT

PERMIT: 220259

INSTALLATION

Location

Community: Iqaluit
Street: Apex River Pumping Station
Lot: Block:
Owner: CITY OF IQALUIT
Phone: (867) 979-5637 ext:
Fax:

Permit

PermitType: multi/commercial/industrial
Amperes: 400
Voltage: 347/600

Contractor

Name: General
#: 0000E
Company: General Inspection
Address:
Postal:

INSPECTION

Date: 28-Sep-2022
Type: General
Corrections Due By:
Inspector: Mathew Abram
Outcome: Re Inspect Required
Fee: NO

DEFICIENCIES

CEC Section	Details	Status	Date

08-Dec-2022

Government of Nunavut

Department of Community and Government Services

Baffin Region	Kivalliq Region	Kitikmeot Region
P.O. Box 1000 Station 610	Bag 002	Bag 200
Iqaluit, NU	Rankin Inlet, NU	Cambridge Bay, NU
X0A 0H0	X0C 0G0	X0B 0C0
Phone: (867) 975-5423	Phone: (867) 645-8179	Phone: (867) 983-4157
Fax: (867) 975-5453	Fax: (867) 645-8196	Fax: (867) 983-4152

ELECTRICAL INSPECTION REPORT

PERMIT: 220259

12-108(4)	The orientation of single-conductor cables in parallel, with respect to each other and to those in other phases, shall be such as to minimize the difference in inductive reactance and the unequal division of current. 600-480V DISCONNECT REQUIRES RECONFIGURATION OF FEEDER CABLES. .	Open
2-112	The mechanical arrangement and execution of the work in connection with any electrical installation shall be acceptable. GENERATOR GROUND REQUIRES REROUTING. .	Open
2-308 (1)	A minimum working space of 1m with secure footing shall be provided and maintained about electrical equipment GENERATOR DOES NOT HAVE THIS. .	Open
2-310 (1)	2-310 Entrance to, and exit from, working space (see Appendices B and G) 1) Each room containing electrical equipment and each working space around equipment shall have unobstructed means of egress in compliance with the National Building Code of Canada. RELEVANT TO THE GENERATOR. .	Open
10-700	Equipotential bonding of non-electrical equipment (see Appendix B) The following parts of non-electrical equipment shall be made equipotential with the non-currentcarrying conductive parts of electrical equipment: a) the continuous metal water piping system of a building supplied with electric power; b) the continuous metal waste water piping system of a building supplied with electric power; c) the continuous metal gas piping system of a building supplied with electric power; d) raised floors of conductive material with electrical wiring under the raised floor; e) the conductive metal parts of structures that livestock access; and f) metal tower and station structures of passenger ropeways, passenger conveyors, or material ropeways. FUEL OIL LINE REQUIRES BONDING .	Open
26-956 (1)	1) Submersible pumps installed in bodies of water shall comply with the following: a) the voltage supplying the submersible pump shall not exceed 150 volts-to-ground; Δ b) the pump motor shall be bonded to ground by a bonding conductor that i) is sized in accordance with Rule 10-614; ii) is integral with the supply cable or within the same protective enclosure as the power supply cables if single-conductor cables are used; iii) has the same type of insulation as the supply conductors; and iv) terminates adjacent to the location where the branch circuit conductors receive their supply; 480V PUMPS CURRENTLY BEING USED.	Open

08-Dec-2022

Government of Nunavut

Department of Community and Government Services

Baffin Region	Kivalliq Region	Kitikmeot Region
P.O. Box 1000 Station 610	Bag 002	Bag 200
Iqaluit, NU	Rankin Inlet, NU	Cambridge Bay, NU
X0A 0H0	X0C 0G0	X0B 0C0
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ELECTRICAL INSPECTION REPORT

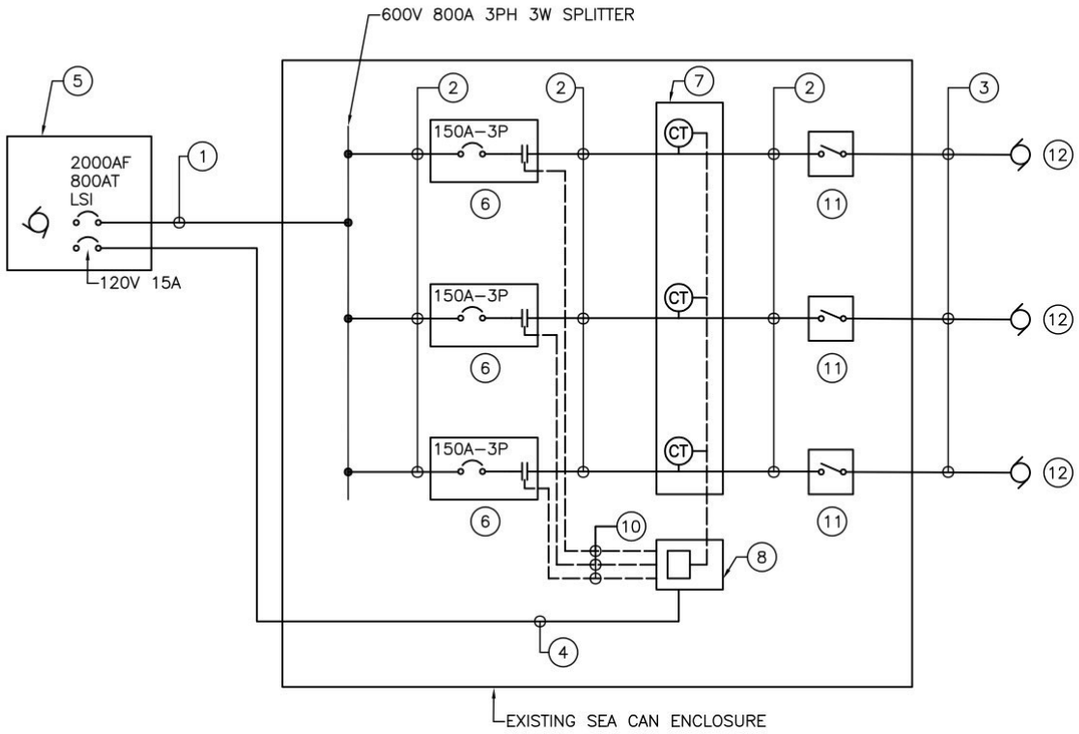
PERMIT: 220259

26-956 (1)(d)	26-956 Submersible pumps installed in bodies of water 1) Submersible pumps installed in bodies of water shall comply with the following: d) ground fault protection shall be provided to de-energize all normally ungrounded conductors supplying the submersible pump, with a ground fault current trip setting adjusted to function as low as practicable to permit normal operations of the pump, but in no case shall the ground fault current setting be greater than 10 mA for an operating time period not exceeding 2.7 s GROUND FAULT PROTECTION REQUIRED FOR SUBMERSIBLE PUMPS	Open

Please sign and return corrected deficiencies by the date listed above

Contractor Signature

2 PRELIMINARY SINGLE LINE DIAGRAM AND GROUNDING RISER



1 / E100 SINGLE LINE DIAGRAM
N.T.S.

GENERAL NOTES:

1. ARRANGE THE SITE IN A FASHION THAT WOULD NEGATE THE NEED TO CROSS CABLES AND RACEWAYS TO OPERATE AND MAINTAIN THE INSTALLATION.
2. SUPPLY AND INSTALL BENDER RCMS490 CONTROL MODULE COMPLETE WITH CT CABINET. WIRE AND CONNECT IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS. ENGAGE BENDER REPRESENTATIVE TO COMMISSION THE UNIT ON SITE.

KEYNOTES:

(1) 2x(3C750MCM CU TECK) + #6AWG CU GND IN GALVANIZED TRAY. ELEVATE TRAY OFF THE GROUND USING TREATED WOOD PLANKS EVERY 1200mm (MIN).

(2) #1/0AWG RW90 + #6AWG CU GND IN 53MM EMT C.

(3) EXISTING SUBMERSIBLE PUMP PORTABLE POWER CABLE (2000V 90 DEG SUN–RESISTANT, OIL–RESISTANT WET / DRY LOCATION). SHORTEN THE CONDUCTOR AS MUCH AS PRACTICAL UPON COMPLETION OF THE INSTALLATION TO MITIGATE GROUND LEAKAGE CURRENT. ELEVATE CONDUCTORS OFF THE GROUND USING TREATED WOOD PLANKS. TAPE OFF THE AREA.

(4) 3#12AWG CU CABTYRE CW 120V–20A TWIST–LOCK RECEPTACLE TO MATCH GENERATOR OUTLET PANEL.

(5) EXISTING 500KW / 625KVA / 277/480V GENERATOR CW 2000AF / 1000AT LSI TRIP UNIT. CONTRACTOR TO UPGRADE EXISTING SACE PR232/P–T8 TRIP UNIT CW 2000A TRIP PLUG TO T7–T7M–X1 800A TRIP PLUG. ENGAGE MANUFACTURER'S REPRESENTATIVE, AS REQUIRED, TO COMPLETE THE REPLACEMENT OF THE TRIP PLUG TO THE SATISFACTION OF THE AUTHORITY HAVING JURISDICTION. TURN UNUSED TRIP PLUG TO THE OWNER.

(6) RE–USE EXISTING EATON ESC95W1CAH–P23 PUMP SOFT STARTS. INTERFACE EACH SOFT START WITH BENDER RCMS490 ALARM CONTACTS.

(7) BENDER CT CABINET.

(8) BENDER RCMS490 GROUND LEAKAGE DETECTION CONTROLLER.

(9) CT WIRING SPECIFIED BY BENDER, SUPPLIED AND INSTALLED BY CONTRACTOR.

(10) 2C#14AWG CU TECH CONTROL WIRING.

(11) SUPPLY AND INSTALL 600V 150A 3PH 3W PUMP DISCONNECT SWITCH.

(12) EXISTING SULZER 480V 94HP J604–HD–TB460V60CSA–30 SUBMERSIBLE PUMP.

NUNAMI
STANTEC LIMITED
Nunami Stantec Ltd.
1088C Noble House
Iqaluit Nunavut X0A 0H0
Tel: (867) 979-0555
www.stantec.com

Notes

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Client/Project
COLLIERS PROJECT LEADERS / CITY OF IQALUIT
APEX RIVER TEMPORARY PUMPING INSTALLATION

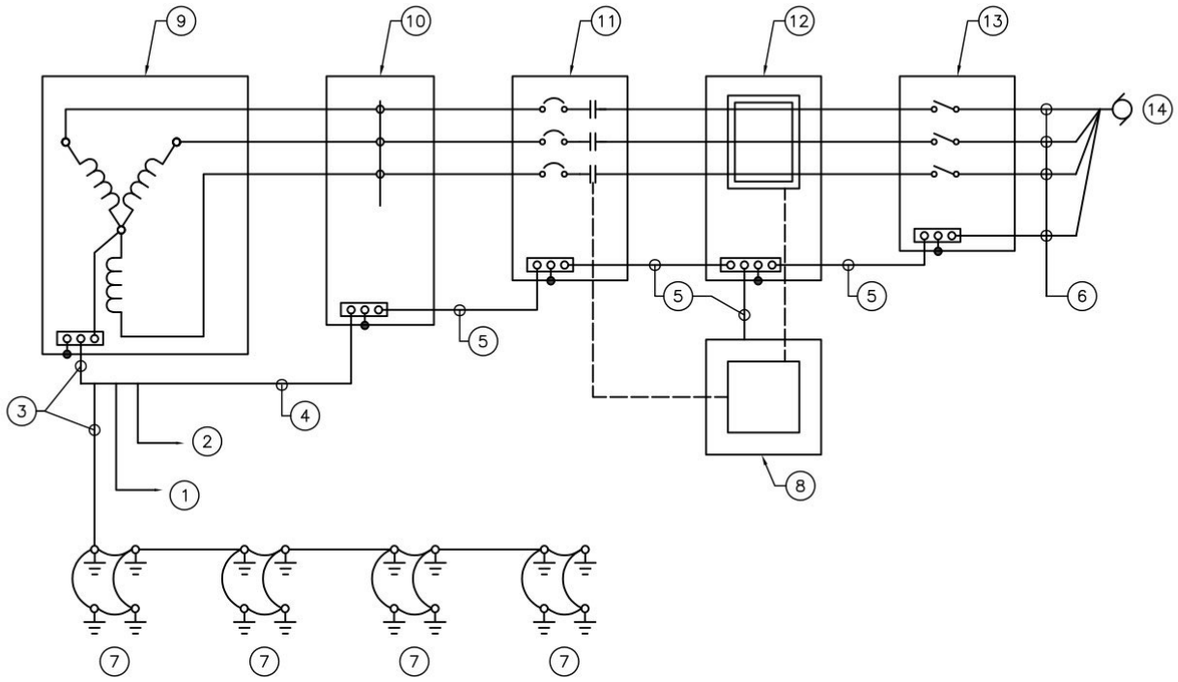
Project No.
144903352

Title
SINGLE LINE DIAGRAM

Revision
#

Date
2023.03.21

Sheet No.
E100



1 / E101 GROUNDING RISER DIAGRAM

N.T.S.

KEYNOTES:

1. BOND GENERATOR FUEL LINE AND GENERATOR STORAGE TANK TO THE GENERATOR ENCLOSURE USING #6AWG BARE CU CONDUCTOR. ROUTE THE CONDUCTOR ALONG THE FUEL LINE FOR PROTECTION.
2. BOND EACH PUMP CAGE AND PUMP HOUSING TO THE MAIN GROUND GRID USING 1/0AWG BARE CU CONDUCTOR. CONTRACTOR MAY DAISY-CHAIN THE DEVICES.
3. 1/0AWG BARE CU CONDUCTOR FROM THE GENERATOR GROUND LUG TO THE GROUND GRID.
4. 1/0AWG CU CONDUCTOR FROM THE GENERATOR HOUSING TO THE SPLITTER (INTEGRATED IN TECK CABLE).
5. #6AWG CU IN CONDUIT.
6. SUBMERSIBLE PUMP CABLE CW INTEGRATED BONDING CONDUCTOR.
7. TIN OR COPPER PLATED STEEL GROUNDING PLATES TIED TO THE GROUND GRID VIA 1/0AWG BARE CU CONDUCTOR, SUBMERSED IN WATER.
8. NEW BENDER CONTROLLER.
9. EXISTING 500KW / 277/480V GENERATOR.
10. NEW 800A SPLITTER.
11. EXISTING EATON SOFT START.
12. NEW BENDER CT ENCLOSURE.
13. NEW PUMP DISCONNECT SWITCH.
14. EXISTING 480V PUMP.

NUNAMI STANTEC LIMITED

Nunami Stantec Ltd.
1088C Noble House
Iqaluit Nunavut X0A 0H0
Tel: (867) 979-0555
www.stantec.com

Notes

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Client/Project
COLLIERS PROJECT LEADERS / CITY OF IQALUIT APEX RIVER TEMPORARY PUMPING INSTALLATION

Project No.
144903352

Title
GROUNDING RISER DIAGRAM

Revision
#

Date
2023.03.21

Sheet No.
E101

3 PROPOSED GROUND LEAKAGE CURRENT MONITORING HARDWARE

LINETRAXX® RCMS460-D/-L – RCMS490-D/-L

Multi-channel AC, pulsed DC and AC/DC sensitive residual current monitors for earthed AC, DC and AC/DC systems (TN and TT systems)

RCMS460-490_D00067_04_D_XXEN/11.2021

LINETRAXX®
RCMS460-D/-L – RCMS490-D/-L

Multi-channel AC, pulsed DC and AC/DC sensitive residual current monitors for earthed AC, DC and AC/DC systems (TN and TT systems)

LINETRAXX® RCMS460-D und RCMS490-L

Device features

- Optional AC, pulsed DC or AC/DC sensitive measurement by selecting the respective measuring current transformer for each channel
- True r.m.s. value measurement
- 12 measuring channels per device for residual current measurement or digital input
- Up to 90 RCMS… monitors, up to1080 measuring channels in the system
- Fast parallel scanning for all channels
- Response ranges:
  10 mA…10 A (0…2000 Hz),
  6 mA…20 A (42…2000 Hz),
  100 mA…125 A (42…2000 Hz) RCMS…-D4
- Preset function
- Adjustable time delays
- The frequency response characteristics can be set for the protection of persons, fire and plant protection
- History memory with date and time stamp for 300 data records
- Data logger for 300 data records/channel
- Analysis of the harmonics, DC, THF
- Two alarm relays with one changeover contact each
- Device version RCMS490 with one alarm contact per channel
- N/O or N/C operation and fault memory selectable
- Connection external test/reset button
- Backlit graphical display (7-segment display) and alarm LEDs
- Data exchange via BMS bus
- Password protection for device setting
- Continuous CT connection monitoring
- RoHS compliant

Product description RCMS460-D…/-L… and RCMS490-D…/-L…

The RCMS system consists of one or more RCMS460-D/-L or RCMS490-D/-L residual current monitors, which are able to detect and evaluate fault, residual and operating currents in earthed power supplies via the related measuring current transformers.
The maximum voltage of the system to be monitored depends on the nominal insulation voltage of the measuring current transformer used in the case of busbar systems, resp. depend on the cables or conductors that are routed through.

Closed CTBS25 or CTUB100 series measuring current transformers are required to measure AC/DC sensitive residual currents (according to IEC/TR 60755: Type B). They require one 24 V DC power supply unit (e.g. STEP-PS series).
CTAC… (closed), WR (rectangular), WS (split-core) and WF… (flexible) series measuring current transformers are used for alternating and pulsating currents (according to IEC/TR 60755: Type A).

Any combination of the various measuring current transformer series can be connected to the evaluator measuring channels.
Each RCMS460-D/-L and RCMS490-D/-L has 12 measuring channels. Up to 90 residual current monitors can be connected via a BMS bus (RS-485 interface with BMS protocol), thereby up to 1080 measuring channels (sub-circuits) can be monitored.

If this product is used for personnel protection, fire or plant protection, the frequency response can be set accordingly. The measured currents can be analysed for harmonics.

Typical applications

- Measuring and evaluating residual, fault and rated currents of loads and installations in the frequency range of
  – 0…2000 Hz (CTUB100 or CTBS25 series measuring current transformers)
  – 42…2000 Hz (CTAC…, WR…, WS…, WF… series measuring current transformers)
- Monitoring of currents regarded as fire hazards in flammable atmospheres
- EMC monitoring of TN-S systems for “stray currents” and additional N-PE connections.
- Monitoring of N conductors for overload caused by harmonics
- Monitoring of PE and equipotential bonding conductors to ensure they are free of current
- Residual current monitoring of stationary electrical equipment and systems to determine test intervals which meet practical requirements in compliance with the accident prevention regulations DGUV V3 (Germany).
- Personnel and fire protection due to rapid disconnection
- Monitoring of digital inputs

Function

The currents are detected and evaluated as true r.m.s. values in the frequency range of 0(42)…2000 Hz. All channels are scanned simultaneously so that the maximum scanning time for all channels is ≤180 ms if 1 x the response value is exceeded and ≤ 30 ms if 5 x the response value is exceeded.

The latest current values of all channels are shown on the LC display in bar graph format. If one of the two set response values is exceeded, the response delay ton begins. Once the response delay has elapsed, the common alarm relays “K1/K2” switch and the alarm LEDs 1/2 light up.

Two response values/common alarm relays, which can be set separately, allow a distinction to be made between prewarning and main alarm. The faulty channel(s) and the associated measured value are indicated on the LC display.
If the current falls below the release value (response value plus hysteresis), the release delay “toff” t_{off} begins. When the release delay has elapsed, the common alarm relays switch back to their initial state.

If the fault memory is enabled, the common alarm relays remain in the alarm state until the reset button is pressed or a reset command is sent via the BMS bus. The device function can be tested using the test button. Parameters are assigned to the device via the LC display and the control buttons on the front panel of one of the connected RCMS…-D devices or via connected panels, Ethernet gateways (COM465IP) and Condition Monitors (COMTRAXX CP9…).

With the adjustable preset function the response values can set for all channels taking the latest measured value for each channel into account.

Digital input
Each individual channel can be used for one of the following monitoring functions:

– As digital input using a potential-free contact 1/0
– Or for current or residual current monitoring in combination with measuring current transformers.

History memory in RCMS460-D, RCMS490-D

The device utilises a history memory for failsafe storing of up to 300 data records (date, time, channel, event code, measured value), so that all data about an outgoing circuit or an area can be traced back at any time (what happened when).

Analysis of harmonics

The analysis of the harmonics of the measured currents can be selected via a menu item in RCMS460-D, RCMS490-D. There, the DC component, the THF and the current value of the harmonics (1…40 at 50/60 Hz, 1…5 at 400 Hz) is displayed numerically and graphically.

Device variants

RCMS residual current monitoring systems differ in the type of residual current evaluator used. RCMS460… or RCMS490… are available as an option.

RCMS460-D
Device version RCMS460-D utilises a backlit graphical display. This version is applied when detailed information about all devices in the switchboard cabinet, connected to the bus, are to be displayed locally. This device is capable of assigning parameters to all RCMS devices connected to the BMS bus and displaying all measurement details. Several RCMS-D devices can be used in one system.

RCMS460-L
Device version RCMS460-L utilises a two-digit 7-segment display where the address of this device is displayed within the BMS bus. The alarm LEDs indicate in which measuring channel the response value has been exceeded. Parameters can be set via an RCMS…D, an Ethernet gateway (COM465IP) or a Condition Monitor (COMTRAXX CP9…).

RCMS490-D/RCMS490-L
The function of the device versions RCMS490-D/RCMS490-L corresponds to the function described above. In addition, a galvanically isolated alarm contact (N/O contact) is provided, for example, to trigger a circuit breaker in this sub-circuit when a response value has been exceeded or the value has fallen below the set response value.

RCMS…-D4/RCMS…-L4
The function of device version RCMS…-D4/RCMS…-L4 corresponds to the function described before. The functions of measuring channels k9 … k12 vary from those described before. They are exclusively designed for current measurements with type A measuring current transformers (measuring range 100 mA … 125 A). For that reason, the measuring channels k9…k12 cannot be used in combination with AC/DC sensitive measuring current transformers or as digital inputs.

Standards

The LINETRAXX® RCMS460/490 series complies with the requirements of the device standards:

- DIN EN 62020 (VDE 0663):2005-11

Approvals

UL File number: E173157

Overview of device types

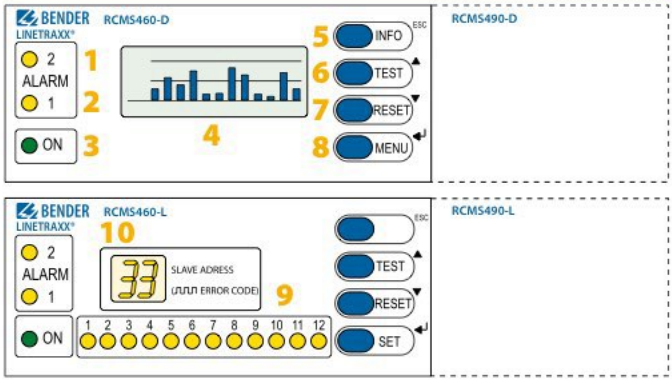
Distinctive device features			RCMS460-D…	RCMS460-L	RCMS490 -D…	RCMS490-L…
	Parameter setting function		■	–	■	–
	Master/Slave		■	■	■	■
	Address range		1…90	1…90	1…90	1…90
Measuring circuit	Measuring channels per device		12	12	12	12
	CTAC…, CTUB100, CTBS25, WR…S(P), WS…, W…F series measuring current transformers		■	■	■	■
	CT monitoring		■	■	■	■
	Rated residual operating current $I_{\Delta n2}$ (Alarm)	AC/DC sensitive 0…2000 Hz (Type B)	10 mA…10 A	10 mA…10 A	10 mA…10 A	10 mA…10 A
		pulsed DC sensitive 42…2000 Hz (Type A)	6 mA…20 A	6 mA…20 A	6 mA…20 A	6 mA…20 A
		pulsed DC sensitive 42…2000 Hz (Type A) for the channels 9…12 (RCMS4x0-D4/-L4)	100 mA…125 A	100 mA…125 A	100 mA…125 A	100 mA…125 A
	Rated residual operating current $I_{\Delta n1}$ (prewarning)		10…100 %, min. 5 mA	10…100 %, min. 5 mA	10…100 %, min. 5 mA	10…100 %, min. 5 mA
	Function selectable per channel off, <, >, I/O		■	■	■	■
	Cut-off frequency adjustable for personnel, plant and fire protection		■	*	■	*
	Preset function for $I_{\Delta n2}$ and I/O		■	■	■	■
	Hysteresis		2…40 %	2…40 %	2…40 %	2…40 %
	Factor for additional CT		■	■	■	■
Switching elements	Common alarm relay for all channels		2 x 1 changeover contact	2 x 1 changeover contact	2 x 1 changeover contact	2 x 1 changeover contact
	Alarm relay per channel		–	–	12 x 1 N/O contact	12 x 1 N/O contact
Time response	Start-up delay 0…99 s		■	■	■	■
	Response delay tv, adjustable 0…999 s		■	■	■	■
	Operating time at	$I_{\Delta n}$ = 1 x $I_{\Delta n2}$: ≤ 180 ms	■	■	■	■
		$I_{\Delta n}$ = 5 x $I_{\Delta n2}$: ≤ 30ms	■	■	■	■
Displays, memory	Analysis of the harmonics (/Δ, DC, THF)		■	*	■	*
	History memory 300 data records		■	–	■	––
	Data logger for 300 data records/ channel		■	–	■	–
	Internal clock		■	–	■	–
	Password		■	–	■	–
	Language English, German, French, Swedish		■	–	■	–
	Backlit graphics LC display		■	–	■	–
	7-segment display and LED line		–	■	–	■

* only in conjunction with RCMS4xx-D, MK2430 or COM465IP

The following table gives an overview of the measuring functions per channel:

Overview of measuring functions					
Type			RCMS460-D/-L, RCMS490-D/-L	RCMS460-D4/-L4, RCMS490-D4/-L4	
Measuring functions, selectable			Channel 1…12	Channel 1…8	Channel 9…12
I / $I_{\Delta n}$	6 mA…20 A	(42 …2000 Hz)	</>/OFF	</>/OFF	--
I/$I_{\Delta n}$	100 mA…125 A	(42 …2000 Hz)	--	--	</>/OFF
I/$I_{\Delta n}$	10 mA…10 A	(0 …2000 Hz)	</>/OFF	</>/OFF	--
I/0			I/0/OFF	I/0/OFF	--

Operating and display elements



1 - LED ALARM "2" lights up when the measured value falls below or exceeds the response value in a measuring channel or an error is indicated by the digital input.

2 - LED "ALARM 1" lights up if the measured value exceeds or falls below the "Prewarning" response value in a channel or in the event of device error.

3 - Power On LED "ON" lights up when the device is switched on or flashes until the device is ready for operation during switching on.

4 - Illuminated graphic LCD

5 - "INFO" button: to query standard information (does not apply to RCMS4…-L)

ESC button: to exit the menu function without changing parameters

6 - Test button "TEST": to call up the self test
Arrow up button: Parameter changes, scroll

7 - Reset button "RESET": to delete alarm and fault messages
Arrow down button: Parameter changes, scroll

8 - "MENU" button: RCMS460-D/490-D: to toggle between the standard display, menu and alarm display

"SET" button: RCMS460-L/490-L: to set the BMS address

Enter button: to confirm parameter changes

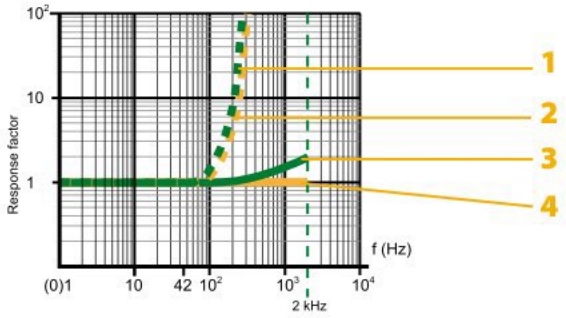
9 - Alarm LEDs "1…12" light up when a fault has been detected in the relevant measuring channel or flash if there is a fault with the measuring current transformer

10 - Digital display for device address and error codes.

Frequency settings

The frequency response of the equipment can be set to a linear frequency response (up to the maximum frequency of Hz) if used for fire protection or to a frequency response in accordance with IEC 60990 for personnel protection. For plant protection, the residual current is measured up to the rated system frequency. The figure below shows the corresponding frequency response.

Frequency curves



Response factor = $I_\Delta/I_{\Delta n}$

(I_Δ) Residual operating current: Measured value at which the RCMS responds.

($I_{\Delta n}$) Rated residual operating current: Set response value

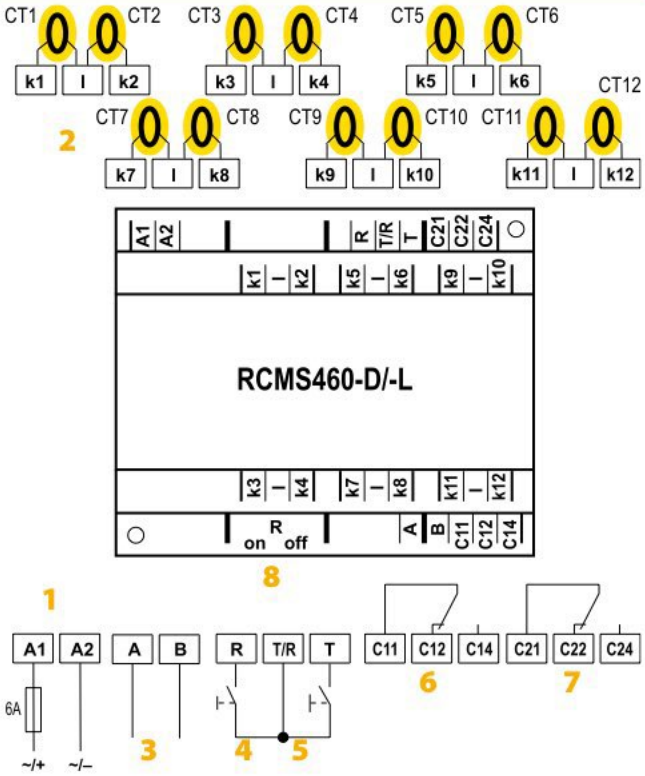
1 - Menu option "50 Hz" – plant protection: Only evaluates the fundamental component of the residual current.

2 - Menu selection "60 Hz"– Plant protection: Only evaluates the fundamental component of the residual current.

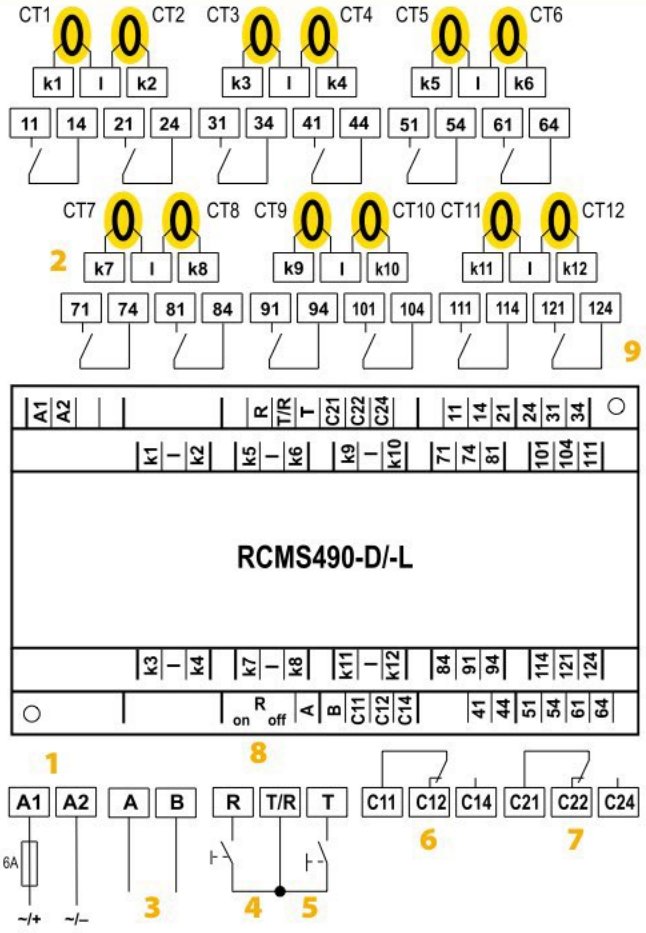
3 - Menu selection "IEC"– Touch current for let go (protection of persons) in accordance with IEC 60990

4 - Menu selection "None"– Fire protection: Response factor remains the same over the entire frequency range.

Wiring diagram RCMS460-D…/-L…



Wiring diagram RCMS490-D…/-L…



1 - **A1, A2** Connection of supply voltage U_s (see ordering information): we recommend the use of 6 A fuses.

2 - **k1, l… k12, l** Connection of measuring current transformers CT1…CT12. Either Type A or Type B measuring current transformers can be selected for each measuring channel. Six CTUB100 series measuring current transformers require one STEP-PS power supply unit. The channels k9…k12 of the device versions RCMS460-D4/-L4 require the connection of Type A measuring current transformers.

3 - **A, B** BMS bus (RS-485 interface with BMS protocol)

4 - **R, T/R** External reset button (N/O contact). The external reset buttons of several devices must not be connected to one another.

5 - **T, T/R** External test button (N/O contact). The external test buttons of several devices must not be connected to one another.

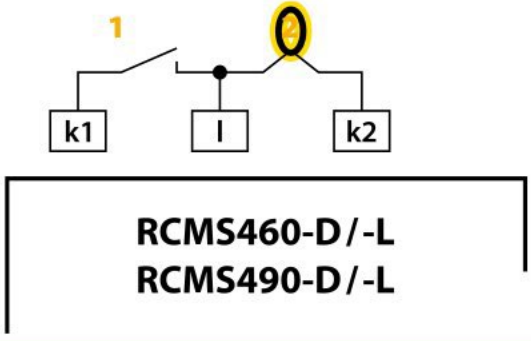
6 - **C11, C12, C14** Common alarm relay K1: Alarm 1, common message for alarm, prewarning, device error.

7 - **C21, C22, C24** Common alarm relay K2: ALARM 2, common message for alarm, prewarning, device error.

8 - **$R_{on/off}$** Activate or deactivate the terminating resistor of the BMS bus (120 Ω).

9 - **CT** Measuring current transformers (CTAC…, CTBS25, CTUB100, WR…, WS…, WF… series)

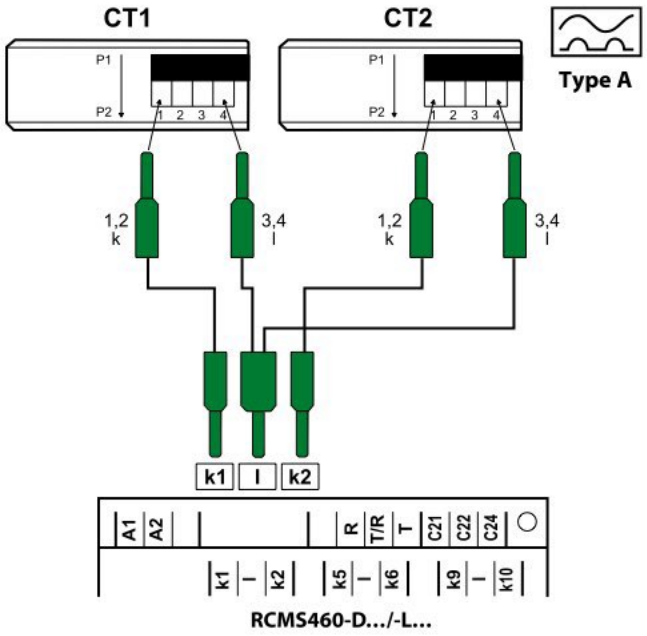
Wiring diagram– Digital input



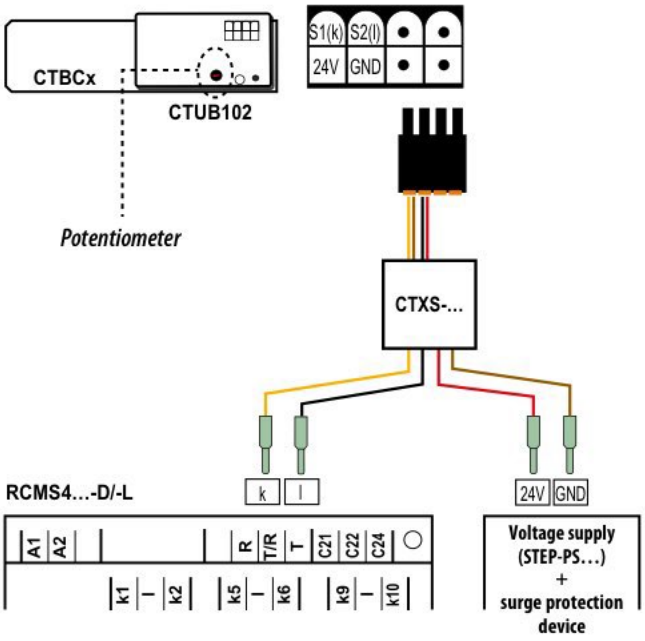
1 - Potential-free contact
0 ≙ Resistance between k and l > 250 Ω
l ≙ Resistance between k and l < 100 Ω

2 - Measuring current transformers

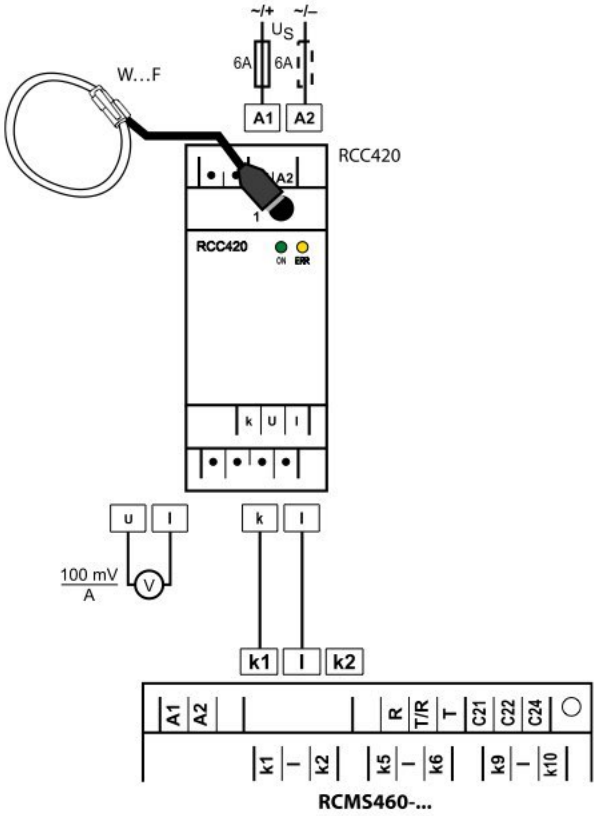
Connection CTAC..., WR..., WS... series measuring current transformers (pulsed current sensitive)



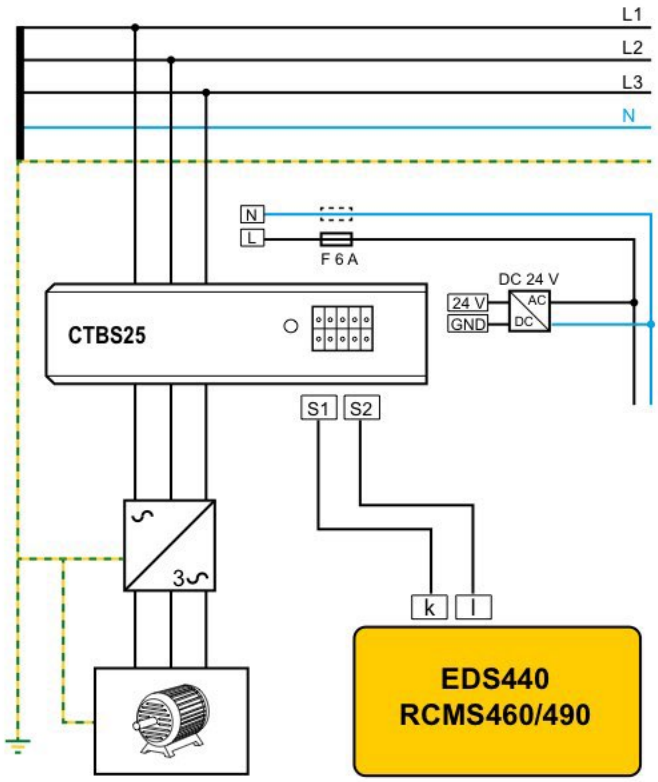
Connection CTUB100 series measuring current transformer (AC/DC current sensitive)



Connection WF... series measuring current transformers

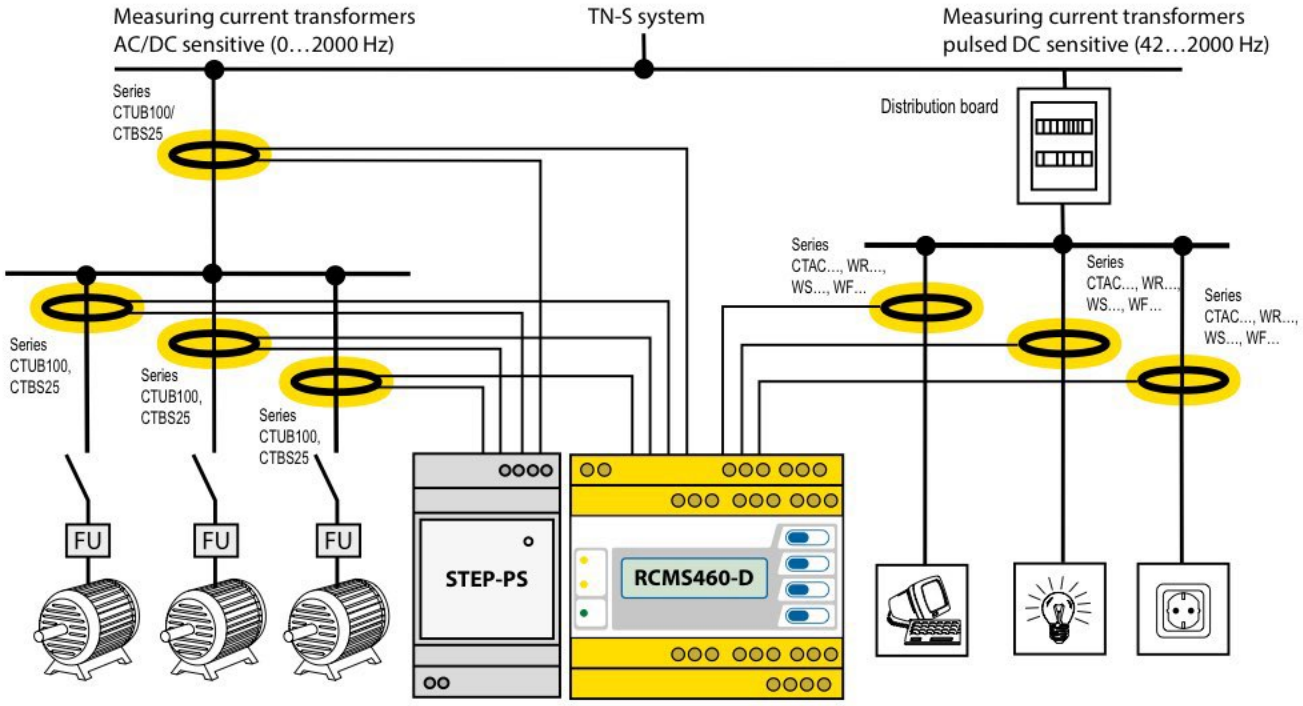


Anschluss Messstromwandler Serie CTBS25 (allstromsensitiv)

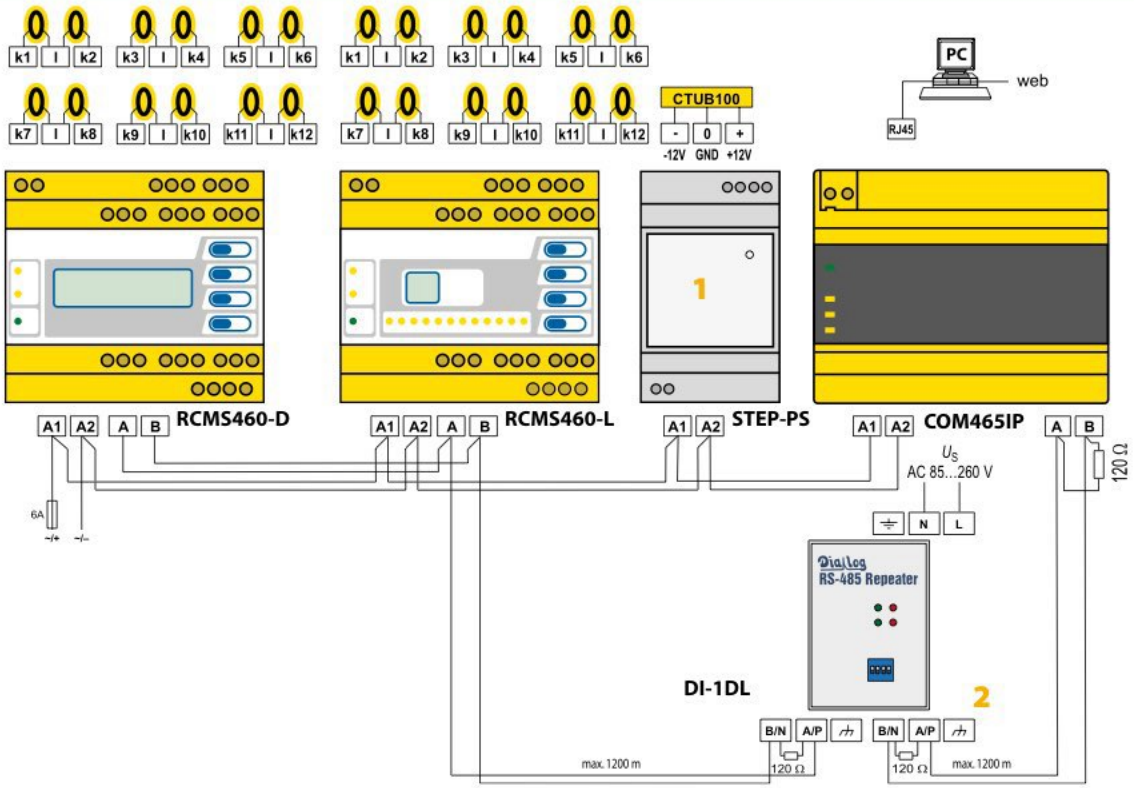


The connections k and l at the residual current monitor must not be interchanged.

Example for a design of a – minimum system consisting of an RCMS460-D and 12 measuring points



Example for a system design of – standard system consisting of an RCMS460-D and RCMS460-L and a protocol converter COM465IP



Note:

1 - When usingAC/DC current sensitive measuring current transformers of the CTUB100 and CTBS25 series , a DC 24 V power supply unit (e.g. STEP-PS series) is required to supply the measuring current transformers with voltage. For this purpose, the technical data of the respective measuring current transformer series must be observed.

2 - The DI-1DL repeater only is required when the length of the cable exceeds 1200 m.

Technical data

Insulation coordination acc. to IEC 60664-1/IEC 60664-3 for the versions:

a) RCMS4x0-D1

Supply voltage U_s	DC 24…75 V/AC 24…60 V (AC/DC ±20 %)
Supply voltage frequency	DC, 50/60 Hz
Rated insulation voltage	**100 V**
Rated impulse voltage/pollution degree	2.5 kV/3
Overvoltage category	III
Protective separation (reinforced insulation) between	(A1, A2) - (k1, l…k12, R, T/R, T, A, B)
Voltage test acc. to IEC 61010-1	1.344 kV
Rated insulation voltage	**250 V**
Rated impulse voltage/pollution degree	4 kV/3
Overvoltage category	III
Basic insulation between	(A1, A2), (k1, l…k12, R, T/R, T, A, B) - (C11, C12, C14), (C21, C22, C24), (11,14), (21,24), (31,34), (41,44), (51,54), (61,64), (71,74), (81,84), (91,94),(101,104), (111,114), (121,124)
Basic insulation between:	(11, 14) - (21, 24) - (31, 34) - (41, 44) - (51, 54) - (61, 64)
Voltage test acc. to IEC 61010-1	2.21 kV
Rated insulation voltage	**250 V**
Rated impulse voltage/pollution degree	6 kV/3
Overvoltage category	III
Protective separation (reinforced insulation) between	(C11, C12, C14) - (C21, C22, C24) - (11, 14, 21, 24, 31, 34) - (41, 44, 51, 54, 61, 64) - (71,74) - (81,84) - (91,94) - (101,104) - (111,114) - (121,124)
Voltage test acc. to IEC 61010-1	3.536 kV

b) RCMS4x0-D2

Supply voltage U_s	AC/DC 100…240 V (-20…+15 %)
Supply voltage frequency	DC, 50/60 Hz
Rated insulation voltage	**250 V**
Rated impulse voltage/pollution degree	6 kV/3
Overvoltage category	III
Protective separation (reinforced insulation) between	(A1, A2) - (k1, l…k12, R, T/R, T, A, B), (C11, C12, C14), (C21, C22, C24), (11,14), (21,24), (31,34), (41,44), (51,54), (61,64), (71,74), (81,84), (91,94),(101,104), (111,114), (121,124)
Protective separation (reinforced insulation) between	(C11, C12, C14) - (C21, C22, C24) - (11, 14, 21, 24, 31, 34) - (41, 44, 51, 54, 61, 64) - (71,74) - (81,84) - (91,94) - (101,104) - (111,114) - (121,124)
Voltage test acc. to IEC 61010-1	3.536 kV
Rated insulation voltage	**250 V**
Rated impulse voltage/pollution degree	4 kV/3
Overvoltage category	III
Basic insulation between:	k1, l…k12, R, T/R, T, A, B) - (C11, C12, C14), (C21, C22, C24)
Basic insulation between:	(11, 14) - (21, 24) - (31, 34) - (41, 44) - (51, 54) - (61, 64)
Voltage test acc. to IEC 61010-1	2.21 kV

Measuring circuit

External measuring current transformers	CTAC…, WR…, WS…, WF… series (Type A), CTUB100, CTBS25 series (Type B)
CT monitoring	on/off (on)*
Rated burden RCMS…-D/-L	68 Ω
Rated burden RCMS…-D4/-L4 (channels 9…12 only)	1 Ω
Rated insulation voltage (measuring current transformer)	800 V
Operating characteristics acc. to IEC/TR 60755	type A and type B depending on measuring current transformer series (type A)*
Rated frequency	0…2000 Hz (Type B) / 42…2000 Hz (type A)
Cut-off frequency	none, IEC, 50 Hz, 60 Hz (none)*
Measuring range RCMS…-D/-L	0…30 A (measuring current transformer type A) 0…20 A (measuring current transformer type B) Crest factor up to 10 A = 4, up to 20 A = 2
Measuring range RCMS…-D4/-L4 (channels 9…12 only)	100 mA…125 A
Rated residual operating current IΔn2 (alarm)	10 mA…10 A (type B) 6 mA…20 A (type A) (100 mA overcurrent)*
Rated residual operating current $I_{\Delta n2}$ (alarm) for RCMS…-D4/-L4 (channels 9…12 only)	100 mA…125 A (16 A overcurrent)*
Rated residual operating current $I_{\Delta n1}$ (prewarning)	10…100 % x $I_{\Delta n2}$ min. 5 mA (50 %)*
Digital input	1: < 100 Ω 0: > 250 Ω
Preset for alarm	I_Δ x factor 1…99 (3)* Offset 0…20 A (30 mA)*
Preset for digital input	0/1 (1)*
Relative uncertainty RCMS…-D/-L	0…-20 %**
Relative uncertainty RCMS…-D4/-L4 (channels 9…12 only)	+10…-20 %**
Hysteresis	2…40% (20 %)*
Factor for additional CT	/1…10; x 1…250 (x 1)*
Number of measuring channels (per device/system)	12/1080

Time response

Start-up delay t (start-up) per device	0…99 s (0 ms)*
Response delay t_{on} per channel	0…999 s (200 ms)*
Delay on release t_{off} per channel	0…999 s (200 ms)*
Operating time t_{ae} at $I_{\Delta n} = 1$ x $I_{\Delta n1/2}$	≤ 180 ms
Operating time t_{ae} at $I_{\Delta n} = 5$ x $I_{\Delta n1/2}$	≤ 30 ms
Response time t_{an} for residual current measurement	$t_{an} = t_{ae} + t_{on1/2}$
Operating time t_{ae} digital inputs	≤ 3.5 s
Scanning time for all measuring channels (residual current measurement)	≤ 180 ms
Recovery time t_b	500…600 ms

Displays, memory

Measured value display range RCMS…-D / -L	0…30 A (CT Type A) 0…20 A (CT type B)
Display range, measured value RCMS…-D4/-L4 (channels 9…12)	0…125 A (CT type A)
Error of indication	± 10 %
LEDs	ON/ALARM (RCMS…-D…) ON/ALARM / measuring channel 1…12 (RCMS…-L…)
LC display	backlit graphical display (RCMS…-D…)
7-segment display	2 x 7.62 mm (RCMS4…-L)
History memory	300 data records (RCMS…-D…)
Data logger	300 data records per measuring channel (RCMS…-D…)
Password	off / 0…999 (off)*
Language	D, GB, F (GB)*
Fault memory alarm relay	on/off (off)*

Inputs/outputs

Test/reset button	internal/external
Cable length for external test/reset button	0…10 m

Interface

Interface/protocol	RS-485/BMS
Baud rate	9.6 kbit/s
Cable length	0…1200 m
Cable (shielded, shield connected to PE on one side)	recommended: min. J-Y(St)Y min. 2x0.8
For UL application: Copper lines	at least 60/70 °C
Terminating resistor	120 Ω (0.25 W) connectable via DIP switch
Device address, BMS bus	1…90 (2)*

Cable lengths for CTAC…, WR…, WS…, WF… series measuring current transformers

Single wire ≥ 0.75 mm²	0…1 m
Single wire, twisted ≥ 0.75 mm²	0…10 m
Shielded cable ≥ 0.5 mm²	0…40 m
Cable (shielded, shield connected to terminal l at one end, must not be earthed)	recommended: J-Y(St)Y min. 2 x 0.8

Cable lengths for CTUB100 and CTBS25 series measuring current transformers

Single wire ≥ 0.75 mm²	0…10 m
Connection	plug-in connector, recommended CTXS…

Switching elements

Number	2 x 1 changeover contact (RCMS460) 2 x 1 changeover contact, 12 x 1 N/O contact (RCMS490)
Operating principle	NC or N/O operation (N/O operation)*
Electrical endurance under rated operating conditions, number of cycles	10.000

Contact data acc. to IEC 60947-5-1

Utilisation category	AC-13	AC-14	DC-1	DC-12	DC-12
Rated operational voltage	230 V	230 V	24 V	110 V	220 V
Rated operational current (common alarm relay)	5 A	3 A	1 A	0.2 A	0.1 A
Rated operational current (alarm relay)	2 A	0.5 A	5 A	0.2 A	0.1 A
Minimum contact rating					10 mA/5 V DC

Environment/EMC

EMC	DIN EN 62020
Operating temperature	-25…+ 55 °C

Climatic class acc. to IEC 60721 (except condensation and formation of ice)

Stationary use (IEC 60721-3-3	3K23
Transport (IEC 60721-3-2)	2K11
Long-term storage (IEC 60721-3-1)	1K22

Classification of mechanical conditions acc. to IEC 60721

Stationary use (IEC 60721-3-3)	3M11
Transport (IEC 60721-3-2)	2M4
Long-term storage (IEC 60721-3-1)	1M12

Connection

Connection	screw terminals
Connection properties:	
Rigid/flexible/conductor sizes	0.2…4/0.2…2.5 mm²/AWG 24…12
Multi-conductor connection (2 conductors with the same cross section):	
Rigid/flexible	0.2…1.5/0.2…1.5 mm2
Stripping length	8…9 mm
Tightening torque	0.5…0.6 Nm

Other

Operating mode	continuous operation
Mounting	display-oriented
Degree of protection, internal components (IEC 60529)	IP30
Degree of protection, terminals (IEC 60529)	IP20
Enclosure material	polycarbonate
Flammability class	UL94V-0
Screw mounting	2 x M4
DIN rail mounting acc. to	IEC 60715
Power consumption	≤10 VA (RCMS460) ≤12 VA (RCMS490)
Documentation number	D00067
Weight	≤ 300 g (RCMS460), ≤ 510 g (RCMS490)

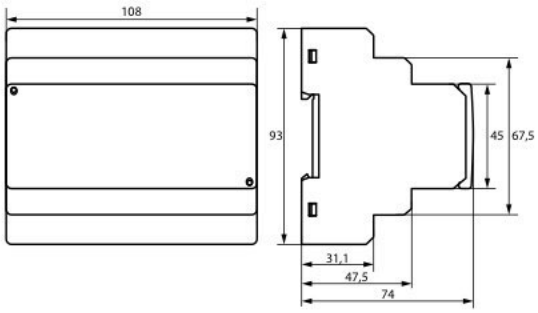
( )* factory setting

** In the frequency range of < 15 Hz, the relative uncertainty is between -35 % and 100 %.

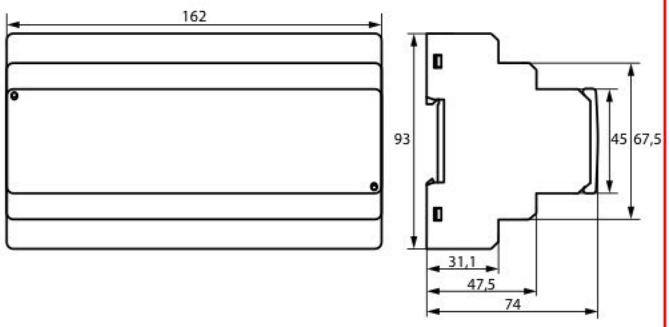
Dimension diagrams

Dimensions in mm

RCMS460-D/-L



RCMS490-D/-L



Ordering information RCMS460/490-D

Differential measurement method		Common alarm relay	Alarm relay per channel	4 channels for load current measurement	Supply voltage U_s		Type	Art. No.
pulsed DC sensitive	AC/DC sensitive				AC	DC		
6 mA…20 A	10 mA…10 A	2 x 1 changeover contact	–	–	16…72 V, 50/60 Hz	16…94 V	RCMS460-D-1	B94053001
					70…276 V, 50/60 Hz	70…276 V	RCMS460-D-2	B94053002
				100 mA…125 A	16…72 V, 50/60 Hz	16…94 V	RCMS460-D4-1	B94053009
					70…276 V, 50/60 Hz	70…276 V	RCMS460-D4-2	B94053010
			12 x 1 N/O contact	–	16…72 V, 50/60 Hz	16…94 V	RCMS490-D-1	B94053005
					70…276 V, 50/60 Hz	70…276 V	RCMS490-D-2	B94053006
				100 mA…125 A	16…72 V, 50/60 Hz	16…94 V	RCMS490-D4-1	B94053011
					70…276 V, 50/60 Hz	70…276 V	RCMS490-D4-2	B94053012

Ordering information RCMS460/490-L

Current measurement		Common alarm relay for all channels	Alarm relay per channel	Supply voltage U_s		Type	Art. No.
pulsed DC sensitive	AC/DC sensitive			AC	DC		
6 mA…20 A	10 mA…10 A	2 x 1 changeover contact	–	16…72 V, 50/60 Hz	16…94 V	RCMS460-L-1	B94053003
				70…276 V, 50/60 Hz	70…276 V	RCMS460-L-2	B94053004
		2 x 1 changeover contact	12 x 1 N/O contact	16…72 V, 50/60 Hz	16…94 V	RCMS490-L-1	B94053007
				70…276 V, 50/60 Hz	70…276 V	RCMS490-L-2	B94053008

Accessories

Description	Art. No.
XM460 mounting frame, 144 x 82 mm	B990995

Suitable system components

Description	Version	Type	Art. No.
Power supply unit	for supplying up to 4 CTUB100 series measuring current transformers	STEP-PS/1 AC/24 DC/0.5	B94053110
	for supplying up to 14 CTUB100 series measuring current transformers	STEP-PS/1 AC/24 DC/1.75	B94053111
	for supplying up to 34 CTUB100 series measuring current transformers	STEP-PS/1 AC/24 DC/4.2	B94053112
	RS-485 repeater	DI-1PSM	B95012044
Condition Monitor	Condition Monitor with integrated gateway: Bender system/Ethernet AC/DC 24…240 V, DC, 50…60 Hz	COM465IP	B95061065
	Individual text messages for all devices/channels, device failure monitoring, email in the event of an alarm	COM465IP Function package A	B75061011
	Modbus TCP server for max. 98 * 139 BMS nodes as well as BCOM and universal measuring devices, SNMP server	COM465IP Function package B	B75061012
	Parameter setting of BMS devices as well as BCOM and universal measuring devices	COM465IP Function package C	B75061013
	Visualisation of Bender systems, System visualisation	COM465IP Function package D	B75061014
	Virtual devices	COM465IP Function package E	B75061015
	Integration of third-party devices	COM465IP Function package F	B75061016
	Condition Monitor for the connection of Bender BMS devices and universal measuring devices to TCP/IP networks	CP907-I	B95061031
			B95061031
		CP915-I	B95061033
			B95061034
Alarm indicator and test combination	Alarm indicator and test combination in accordance with IEC 60364-7-710, with BMS bus and USB interface, 16 digital inputs, one relay output, alarm texts programmable via interfaces and personal computer, standard text display. Version: surfacemounting enclosure; menu languages: German English.	MK800A-11	B95100102
	Alarm indicator and test combination in accordance with IEC 60364-7-710, with BMS bus and USB interface, alarm texts programmable via interfaces and personal computer, standard text display. Version: surfacemounting enclosure; Menu languages: German, English.	MK800A-12	B95100103
	Alarm indicator and test combination in accordance with IEC 60364-7-710, with BMS bus and USB interface, 12 digital inputs, one relay output, alarm texts programmable via interfaces and personal computer, standard text display. Version: Flush-mounting enclosure	MK2430-11	B95100001
	Alarm indicator and test combination in accordance with IEC 60364-7-710, with BMS bus and USB interface, alarm texts programmable via interfaces and personal computer, standard text display. Version: Flush-mounting enclosure	MK2430-12	B95100002
	As MK2430-11, but factory-programmed	MK2430P-11	B95100003
	As MK2430-12, but factory-programmed	MK2430P-12	B95100004
	As MK2430-11, but with surfacemounting enclosure	MK2430A-11	B95100005
	As MK2430-12, but with surfacemounting enclosure	MK2430A-12	B95100006
	As MK2430A-11, but factory-programmed, surface-mounting enclosure version	MK2430PA-11	B95100007
	As MK2430A-12, but factory-programmed, surface-mounting enclosure version	MK2430PA-12	B95100008
	As MK2430-11, but front plate with screw fixing	MK2430S-11	B95100011
	As MK2430-12, but front plate with screw fixing	MK2430S-12	B95100012

[1] Absolute values

Measuring current transformers

Pulsating current sensitive measuring current transformers for RCMS460/490

Type of construction	Internal diameter/mm	Type	Art. No.
circular	20	CTAC20	B98110005
	35	CTAC35	B98110007
	60	CTAC60	B98110017
	120	CTAC120	B98110019
	210	CTAC210	B98110020
rectangular	70 x 175	WR70x175S	B911738
		WR70x175SP	B911790
	115 x 305	WR115x305S	B911739
		WR115x305SP	B911791
	150 x 350	WR150x350S	B911740
		WR150x350SP	B911792
	200 x 600	WR200x500S	B911763
		WR200x500SP	B911793
split-core	20 x 30	WS20x30	B98080601
	50 x 80	WS50x80	B98080603
	80 x 120	WS80x120	B98080606

Other measuring current transformer types on request.

Flexible measuring current transformers (pulsed DC sensitive) for RCMS460/490

Internal diameter/mm	Type	Art. No.
170	WF170-1	B78080201
	WF170-2	B78080202
250	WF250-1	B78080203
	WF250-2	B78080204
500	WF500-1	B78080205
	WF500-2	B78080206
800	WF800-1	B78080207
	WF800-2	B78080208
1200	WF1200-1	B78080209
	WF1200-2	B78080210
1800	WF1800-1	B78080221
	WF1800-2	B78080222

WF… series measuring current transformers consist of one flexible WF… series measuring current transformer and one RCC420 signal converter.

AC/DC sensitive measuring current transformers for RCMS460/490

Internal diameter/mm	Type	Art. No.
ø 20	CTUB102-CTBC20	B78120011
	CTUB102-CTBC20P	B78120021
ø 25, split-core	CTBS25	B98120060
ø 35	CTUB102-CTBC35	B78120013
	CTUB102-CTBC35P	B78120023
ø 60	CTUB102-CTBC60	B78120015
	CTUB102-CTBC60P	B78120025
ø 120	CTUB102-CTBC120	B78120017
	CTUB102-CTBC120P	B78120027
ø 210	CTUB102-CTBC210	B78120019
	CTUB102-CTBC210P	B78120029

Connection cable for CTUB… series measuring current transformers

Length/m	Type	Art. No.
1	CTXS-100	B98110090
2,5	CTXS-250	B98110091
5	CTXS-500	B98110092
10	CTXS-1000	B98110093

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Bender GmbH & Co. KG
Londorfer Straße 65 • 35305 Grünberg • Germany
Tel.: +49 6401 807-0 • info@bender.de • www.bender.de

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Measuring current transformers W0-S20...W5-S210 W10/600

W(0-5)-S-W10_D00142-D00143_06_D_XXEN/05.2021

Measuring current transformers
W0-S20...W5-S210
W10/600

Measuring current transformer W10/600

Measuring current transformer W0-S20

Measuring current transformer W1-S35

Product description

The highly sensitive W0-S20…W5-S210 series measuring current transformers convert residual currents up to 100 A into evaluable RCM or EDS signals. The CTs are connected to the respective evaluator by two wires. Depending on the connecting lead used, the distance between the CT and the evaluator may be up to 40 m.

Care should be taken that all current-carrying conductors are passed through the CT and that these conductors are not shielded.

Never route a PE conductor through the measuring current transformer!

Typical applications

- For residual current monitors (RCM)
- For residual current monitoring systems (RCMS)
- For insulation fault locators with additional EDS in AC and DC systems

Standards

W0-S20…W5-S210 series measuring current transformers comply with the device standard:

- IEC 61869-1.

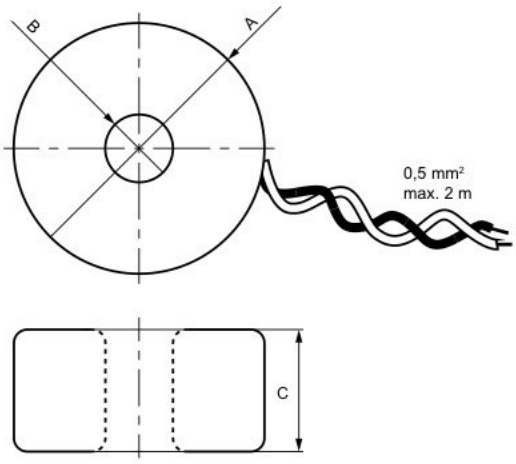
Approvals

Ordering information

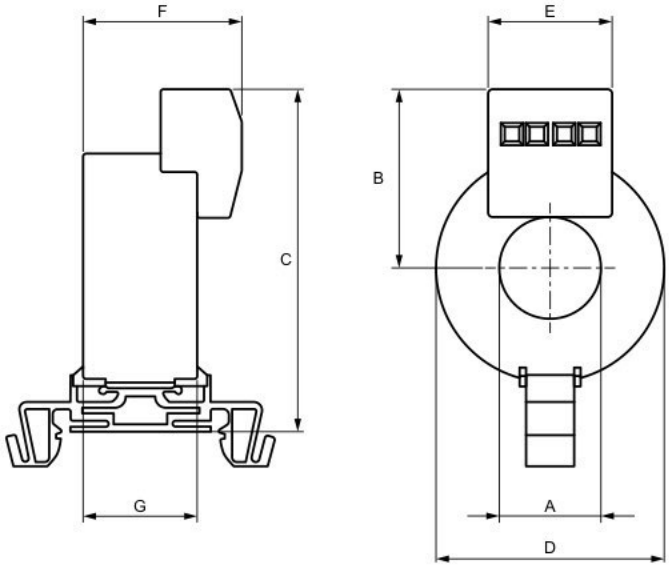
Inside diameter	Approvals			Type	Art. No.
	UL	EAC	LR		
10 mm	–	–	■	W10/600	B911761
20 mm	–	■	■	W0-S20	B911787
35 mm	■	■	■	W1-S35	B911731
70 mm	■	■	■	W2-S70	B911732
105 mm	■	■	■	W3-S105	B911733
140 mm	■	■	■	W4-S140	B911734
210 mm	■	■	■	W5-S210	B911735

Dimension diagrams

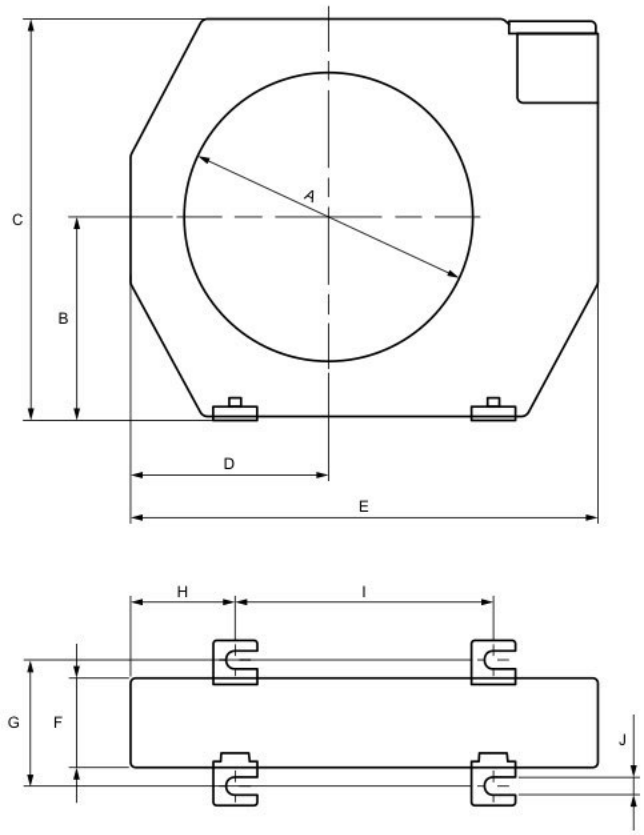
Type W10/600



Type W0-S20



Type W1-S35…W5-S210



Type	Dimensions (mm)										Weight
	A	B	C	D	E	F	G	H	I	J	
W10/600	ø 37	ø 10	18	–	–	–	–	–	–	–	85 g
W0-S20	ø 20.5	36	69	ø 46	25	32	23	–	–	–	70 g
W1-S35	ø 35	44	79	35	100	32.5	46	26.5	48	6.5	250 g
W2-S70	ø 70	58	110	52	130	32.5	46	32	66	6.5	380 g
W3-S105	ø 105	74	146	72	170	32.5	46	38	94	6.5	700 g
W4-S140	ø 140	99.5	197	97.5	220	32.5	46	48.5	123	6.5	1500 g
W5-S210	ø 210	143	285	150	300	32.5	46	69	161	6.5	2500 g

Technical data

Insulation coordination acc. to IEC 60044-1

Highest system voltage for electrical equipment U_m	AC 720 V
Rated impulse withstand voltage U_{isol}	3 kV

Measuring circuit

Rated transformation ratio	600/1
Rated burden	180 Ω (18 Ω at 100 A)
Phase displacement	<4°
Rated primary current	≤10 A (100 A)
Rated primary current	≥10 mA
Nominal power	50 mVA
Rated frequency	15…400 Hz
Internal resistance	5…8 Ω
Secondary overvoltage protection	with suppressor diode P6KE6V8CP
Accuracy class	3
Rated continuous thermal current	100 A
Rated short-time thermal current	14 kA 1 s
Rated dynamic current	35 kA 30 ms

Environment

Shock resistance IEC 60068-2-27 (device in operation)	15 g/11 ms
Bumping IEC 60068-2-29 (transport)	40 g/6 ms
Virbation resistance IEC 60068-2-6 (device in operation)	
W1-S35…W3-S105	1 g/10…150 Hz
W4-S140, W5-S210	1 g/10…150 Hz/0.075 mm
Vibration resistance IEC 60068-2-6 (device not in operation)	2 g/10…150 Hz
Ambient temperature (during operation/during storage)	-10…+ 50 °C/-40…+ 70 °C
Climatic class acc. to DIN IEC 60721-3-3	3K23

Connection

Connection	screw-type terminals
Connection	
rigid/flexible	0.2…/4/0.2…2.5 mm²
flexible with ferrules with/without plastic sleeve	0.25…2.5 mm²
Conductor sizes (AWG)	24…12
Connection to the evaluator	
single wire ≥ 0.75 mm²	0…1 m
single wire, twisted ≥ 0.75 mm²	0…10 m
shielded cable ≥ 0.6 mm²	0…40 m
Shielded cable (shield connected to PE on one side)	recommended cable J-Y(St)Y min. 2 x 0.6

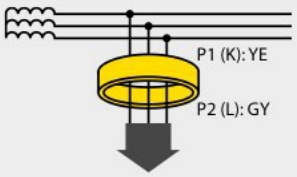
Other

Operating mode	continuous operation
Mounting	any position
Degree of protection, internal components (DIN EN 60529)	IP40
Degree of protection, terminals (DIN EN 60529)	IP20
Screw mounting	M5
Flammability class	UL94 V-0
Documentation number	D00142 (W(0-5)-S) D00143 (W10)

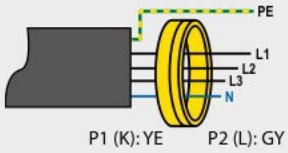
Installation instructions

- Do not pass shielded cables through the measuring current transformer.
- As a general principle, the PE conductor and low-resistance conductor loops must not be passed through the measuring current transformer!

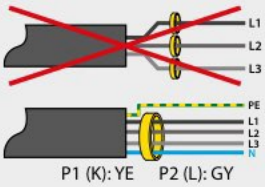
It is important that the leads are passed through the measuring current transformer in the right direction



Never pass a PE conductor through the measuring current transformer

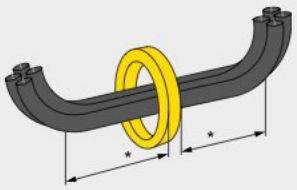


Make sure that all current-carrying leads are passed through the measuring current transformer

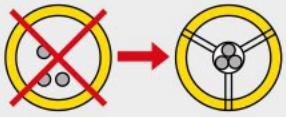


The primary conductors may only be bent from the specified minimum distance. The minimum bending radius specified by the manufacturers must be observed.

* Distance to 90° angle: 2x external diameter of the current transformer



The leads must be aligned with the centre of the measuring current transformer



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Bender GmbH & Co. KG
Londorfer Straße 65 • 35305 Grünberg • Germany
Tel.: +49 6401 807-0 • info@bender.de • www.bender.de

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APPENDIX B

Mechanical Reports

CITY OF IQALUIT TEMPORARY RAW WATER PUMPING SYSTEM FEASIBILITY STUDY

March 27, 2023

Prepared for:
City of Iqaluit
1085 Mivvik Street
P.O. Box 460
Iqaluit, NU X0A 0H0

- and -

Colliers Project Leaders
2720 Iris Street
Ottawa, ON K2C 1E6

Prepared by:
Nunami Stantec Limited
1088C Mivvik Street
Iqaluit, NU X0A 0H0

Project Number:
144903352

NUNAMI
STANTEC LIMITED

The conclusions in the Report titled City of Iqaluit Temporary Pumping System Feasibility Study are Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

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Prepared by: 

Signature

Rob Gillis, P.Eng.

Printed Name

Reviewed by: 

Signature

Andrei Aroutiounov, P.Eng.

Printed Name

Signature

Scott Bezak, P.Eng.

Printed Name

Approved by: 

Signature

Scott Bezak, P.Eng.

Printed Name

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1 INTRODUCTION

1.1 Background

The City of Iqaluit's (City) raw water supply lake, Geraldine Lake (lake), has had low water levels in recent years. The City has pumped raw water from nearby Apex River (river) into the lake during the non-winter months to increase the City's raw water supply quantity and avoid low water issues. This has been achieved using three submersible pumps placed in the river within fish screen structures and pumping water through an above ground watermain.

The Nunavut Chief Electrical Inspector (AHJ) in 2022 raised concerns with the use of submersible pumps in the river. The AHJ's interpretation of the Canadian Electrical Code is that all submersible pumps must be complete with ground current leakage detection that may not be achievable with the pumps currently in use.

To address the electrical concerns of the AHJ, the City has retained Nunami Stantec Ltd. (Stantec) to undertake a feasibility study to examine seasonal shore-based pumping alternatives. To improve schedule efficiency, Stantec has provided a conceptual description of modifications that would be required for each alternative discussed in this report.

Figure 1-1: Existing submersible pumps and fish screen

Figure 1-2: Existing pumps and fish screens in Apex River

2 DESIGN CRITERIA

2.1 Design Flow

The City has advised that the volume of water that can be pumped out of the river is dependent on the river water level. As per preliminary discussions, the City's requested maximum design flow rate is 200 L/s, and their requested minimum flow rate is 40 L/s. This report reviews alternatives to achieve the design flow rates using pump installations consisting of two, three, and four pumps.

For reference, the three existing submersible pumps are ABS J 604. Inserting these pumps into the hydraulic analysis described below, the expected duty points are:

- 61 L/s @ 54 m TDH when all 3 pumps are operating (183 L/s total flow)
- 73 L/s @ 48 m TDH when 2 pumps are operating (146 L/s total flow)
- 87 L/s @ 40 m TDH when 1 pump is operating.

Both individually and combined, these pumps are not capable of providing the maximum design flow rate of 200 L/s through the installed system. They also are not driven by variable frequency drives (VFD), and therefore cannot be run at reduced speed to achieve flows down to 40 L/s. There are three approximate flow rates that are achievable with the existing pumps: 87 L/s, 146 L/s, and 183 L/s.

2.2 Hydraulic Analysis

The focus of this section is to determine the pump head capacity required to achieve the maximum design flow rate. A preliminary model of the existing raw water pumping system was created using AFT Fathom®, based on the Iqaluit Apex Water Supply (2019) project drawings.

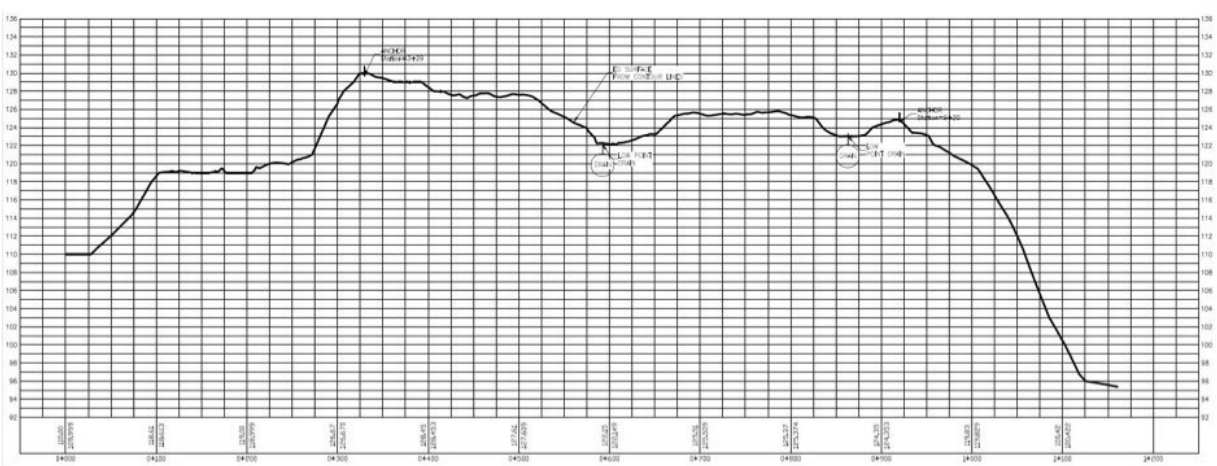


Figure 2-1: Existing watermain profile (Apex River on the right side)

The main features of the modelled pipe system include:

- Water level in the river assumed to be at elevation 95.4 m,
- Pumps on dry land and approximately 5 m away from their connection to the pipe connection manifold,
- Reuse of the existing pipe connection manifold,

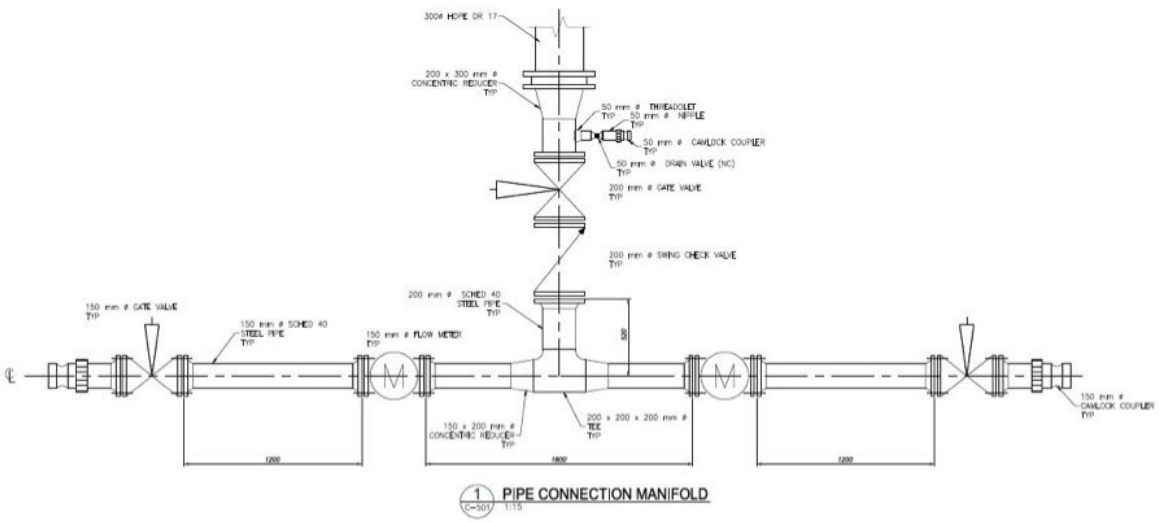


Figure 2-2: Ex pipe connection manifold

- Total watermain length of 1160 m. However, analysis indicates that gravity flow occurs from the high point at station 3+29 to the discharge into the lake. Therefore, potential pumps are reviewed based on achieving the design flow rate through only 1160 – 329 = 831 m up to the watermain high point,
- High point at station 3+29 of 130.0 m,
- Watermain consisting of 300ø HDPE DR17 pipe.

The two-pump pipe layout used in the model is represented in **Figure 2-2**. The end of the pipe connection manifold is at J19. The jagged alignment to the right of J19 represents the watermain from the pipe connection manifold to the high point at station 3+29. The different colours represent the pressure at that point in the system, with red indicating greater than 80 psi, and each subsequent colour dropping by approximately 20 psi. The flow through each segment is indicated in L/s by the value “Q.”

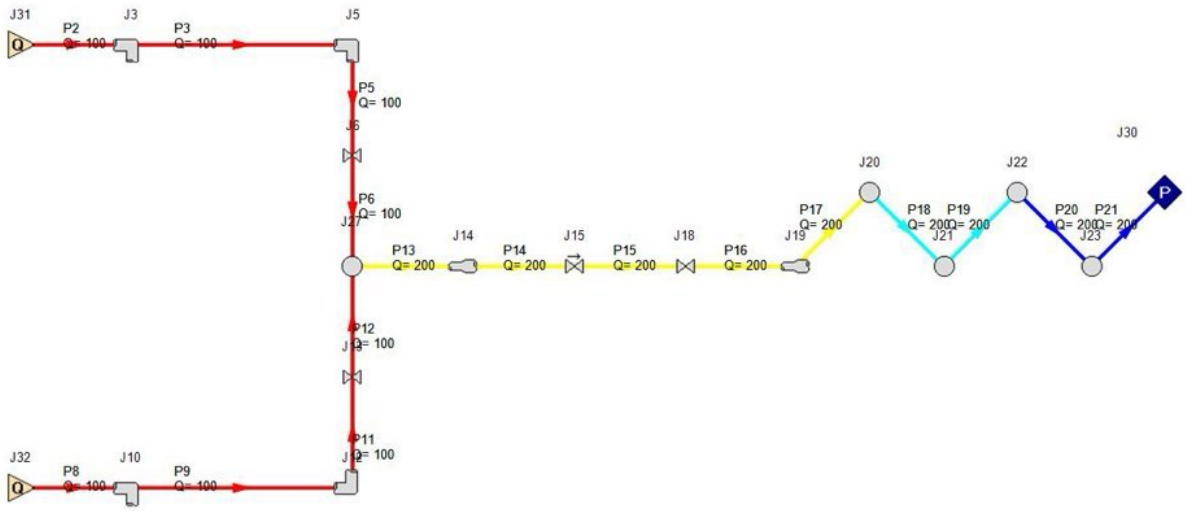


Figure 2-3: Model representation of pump system and watermain

The flow velocity of 100 L/s through the existing 150ø pipe is 5.9 m/s. The flow velocity of 200 L/s through the existing 200ø pipe is 6.2 m/s. These velocities are higher than is typically recommended and will be discussed further in the section, Options for Dry Land Pump Setups. The flow velocity through the 300ø pipe is 3.2 m/s, which is on par with the upper limits of typical design parameters.

Hydraulic analysis using the model described above results in a pump duty point of:

- 100 L/s @ 58.5 m TDH (1585 USGPM @ 83.2 psi) for two pumps operating simultaneously.
- 67 L/s @ 58.5 m TDH (1062 USGPM @ 83.2 psi) for three pumps operating simultaneously.
- 50 L/s @ 58.5 m TDH (793 USGPM @ 83.2 psi) for four pumps operating simultaneously.

This total system head of 58.5 m is used for all pumping alternatives discussed because the combined flow through common pipe makes up almost 95% of the friction loss in the system. Therefore, changes to individual pump discharges upstream of the common pipe will have only a small effect on pump performance, from a purely hydraulics perspective.

2.3 Pumps Installation

All pump alternatives discussed in this report are end suction and capable of priming automatically. During preliminary discussions with the City, it was assumed that the new pumps would be located on the river shore nearest the lake. The road access and diesel engine providing power for the pumps is on the opposite shore. In terms of hydraulic analysis, which shore the new pumps are located on is mostly irrelevant for the same reasons the individual pump discharge pipe changes have negligible relative effect, as described above. Which side of the river the pumps are installed on will be determined during

detailed design. Depending on the decision made, there will either be a watermain crossing the river or electrical power and control cables.

Each pump will require a dedicated suction pipe matching the diameter of the pump's inlet flange. This suction pipe should be long enough to draw water from a deep part of the river and include a fish screen. Whether all suction pipes converge on a single fish screen structure or have separate small fish screens will be determined during detailed design.

Each pump's discharge will be connected to the pipe connection manifold. For the three and four pump options, additional connection(s) will be required on the manifold since it currently only has two connections.

The pumps are mounted on frames that allow them to be relatively easily disconnected and transported for off-site storage over the winter months. Another option is to trailer-mount the pumps and control panel. Stantec has confirmed that the recommended supplier has the capability to custom fabricate a trailer and pump package that meets Canadian transportation regulations.

3 MODIFICATIONS AND DRY LAND PUMP SETUPS

3.1 Pipe Connection Manifold

Regardless of the new pump option that is installed, we recommend that the pipe connection manifold be modified. The recommended modifications will reduce the required head capacity of the pumps, thereby reducing the required discharge pressure and power consumption. These recommendations are made without knowledge of the specific make, model, or condition of the existing piping and valves, and hence may be subject to change during detailed design. For the feasibility report, we assumed the most hydraulically conservative scenario of reusing the existing pipe connection manifold without changes, but it is imperative that the manifold be modified.

- At the design flow rate of 200 L/s the flow velocity through 200ø pipe is approximately 6.2 m/s. This far exceeds maximum recommended pipe velocity and using such a high velocity will significantly shorten the service life of the valves, damage the pipe, and increases risk of water hammer causing damage to the installation. Stantec recommends the following modifications for each potential pump setup:
    - Two pumps: remove the existing check valve. Increase each individual pump connection branch to 250ø and install a 250ø check valve and isolation valve on each branch. The flow velocity through each check valve will drop to approximately 2.0 m/s. The 150ø flow meters can be reused to reduce capital costs, but it is recommended to keep the associated 150ø pipe lengths to the minimum required for the flow meter to provide accurate results,
    - Three pumps: install a third pump connection complete with isolation valve. Increase each individual pump connection branch to 200ø and install a 200ø check valve on each branch. The flow velocity through each check valve will drop to approximately 2.1 m/s. The 150ø flow meters can be reused to reduce capital costs. It is recommended that a third flow meter be installed on the third pump discharge. The 150ø flow meters should have the associated 150ø pipe lengths minimized based on flow meter requirements,
    - Four pumps: install a third and a fourth pump connection complete with an isolation valve for each individual pump. Install a check valve on each individual pump discharge. Assuming 200ø check valves, flow velocity is reduced to 1.5 m/s. To reduce capital costs, each existing 150ø flow meter can be made to measure flow from a pair of pumps. Once again, we recommend that the length of 150ø pipe be kept to a minimum.

In each of the above cases, the pumps have a check valve on their individual discharge lines. This should reduce risk of damage to a pump when it is called to start against a watermain that is already pressurized by another pump or pumps.

3.2 Variable Flow

The City has requested a flow range from 40 L/s to 200 L/s to accommodate varying river water level. Regardless of the number of pumps installed, to reach down to 40 L/s for a pump system designed to accommodate 200 L/s, at least one pump will require a variable frequency drive (VFD). We recommend that one or more pumps, depending on the total number of installed pumps, be constant speed to reduce capital costs compared to multiple VFDs. This setup will provide the ability to pump as low as 40 L/s (or possibly lower), all the way up to 200 L/s.

3.3 New Pump Installation Options

3.3.1 TWO SELF-PRIMING PUMPS

This option consists of two land-based self-priming pumps capable of pumping approximately 100 L/s each when operating simultaneously. One pump would be driven by VFD to allow operation at the minimum flow rate. Each pump would be connected to one end of the modified pipe connection manifold as described above. There are two options for this setup:

1. Cornell 5HH-RP-F18DBK:
    a. Note that to achieve continuously variable flow from the single pump minimum VFD flow up to 200 L/s with both pumps operating, both pumps must be driven by VFD. If only one pump has VFD in dual pump operation, the flow range of approximately 130 L/s to 160 L/s would likely not be achievable.
    b. 125 HP, 575 V / 3 phase / 60 Hz, TEFC enclosure motor
    c. 200ø suction and 150ø discharge
    d. Duty point of approximately 100 L/s @ 61.9 m TDH when both pumps are operating (200 L/s total flow)
    e. Duty point of approximately 130 L/s @ 51.1 m TDH when only one pump is operating.
    f. Capable of turning down to 40 L/s with single pump operation by VFD
    g. Operating from 95% to 124% of best efficiency point (BEP) at full speed, depending on dual or single pump operation

h.

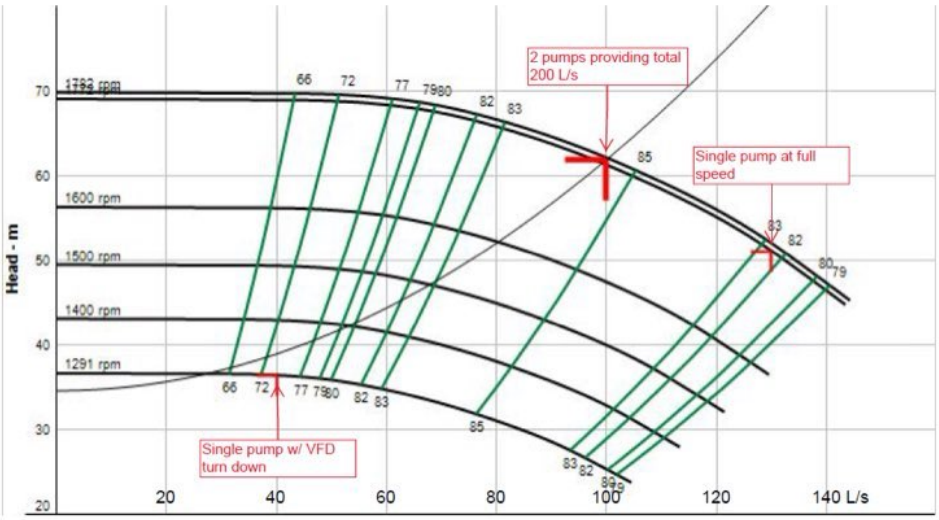


Figure 3-1: Cornell 5HH pump expected operating points

2. Gorman-Rupp PAH4A60C:

    a. Note that this option does not technically achieve the full 200 L/s duty point, nor turn down to 40 L/s with a single pump. However, it is possible that with further review, a pump meeting the full desired flow range from this manufacturer may be found.

    b. 125 HP, 575 V / 3 phase / 60 Hz, TEFC enclosure motor

    c. 150ø suction and 100ø discharge

    d. Duty point of approximately 91.7 L/s @ 57.0 m TDH when both pumps are operating (total of 183.4 L/s; this performance achieved with standard 1800 rpm; the pump can be operated slightly above its nominal rated speed to close the gap at least partially to 100 L/s)

    e. Duty point of approximately 119 L/s @ 48.5 m TDH when only one pump is operating.

    f. Capable of turning down to 55 L/s with single pump operation by VFD

    g. Operating from 108% to 129% of best efficiency point (BEP) at full speed, depending on dual or single pump operation

h.

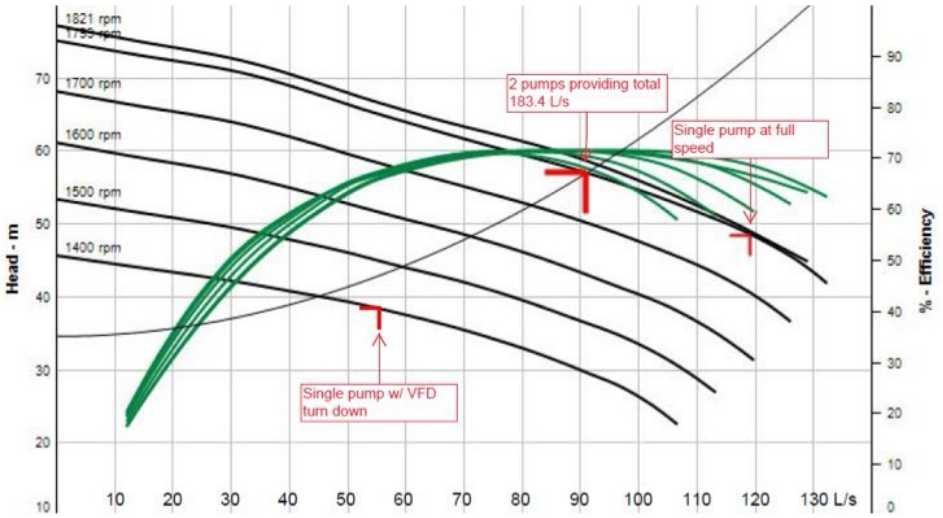


Figure 3-2: Gorman-Rupp PAH 4 pump expected operating points

3.3.2 THREE SELF-PRIMING PUMPS

This option consists of three land-based self-priming pumps capable of pumping 67 L/s each when operating simultaneously. One pump would be driven by VFD to allow operation down to 40 L/s and below. Each pump would be connected to the modified pipe connection manifold as described above. There is only one pump manufacturer for this option because through discussions with Gorman-Rupp, it was determined that they did not have a pump selection to recommend for this flow and pressure range.

1. Cornell 4HH-RP-F18DBK:

    a. Note that to achieve continuously variable flow from the single pump minimum VFD flow up to 200 L/s with all three pumps operating, a minimum of two of these pumps must be driven by VFD. If only one pump has VFD in dual pump operation, the constant speed pump could operate outside of its recommended range.

    b. 75 HP, 575 V / 3 phase / 60 Hz, TEFC enclosure motor.

    c. 150ø suction and 100ø discharge.

    d. Duty point of approximately 68.6 L/s @ 62.0 m TDH when all pumps are operating (205.8 L/s total flow).

    e. Duty point of approximately 82.9 L/s @ 55.5 m TDH when two pumps are operating (165.8 L/s total flow). At this operating point, the pump motor is expected to operate slightly beyond its rated capacity, but the motor can accommodate, and this is considered a reasonable compromise rather than upgrading to 100 hp motors.

f. This pump should not operate at full speed as a single pump when connected to the existing pipe system. The expected duty point for a single pump is approximately 97 L/s. However, the NPSHr at this flow rate is over 9 m, and the pump would suffer from cavitation and premature damage. In addition, the motor would have to be upgraded to 100 hp to accommodate the higher flow. A single pump can operate using a VFD from below 40 L/s up to approximately 85 L/s using the 75 hp motor.

g. Operating from 94% to 114% of best efficiency point (BEP) at full speed, depending on triple or dual pump operation (single pump operation via VFD does not have a full speed operating point).

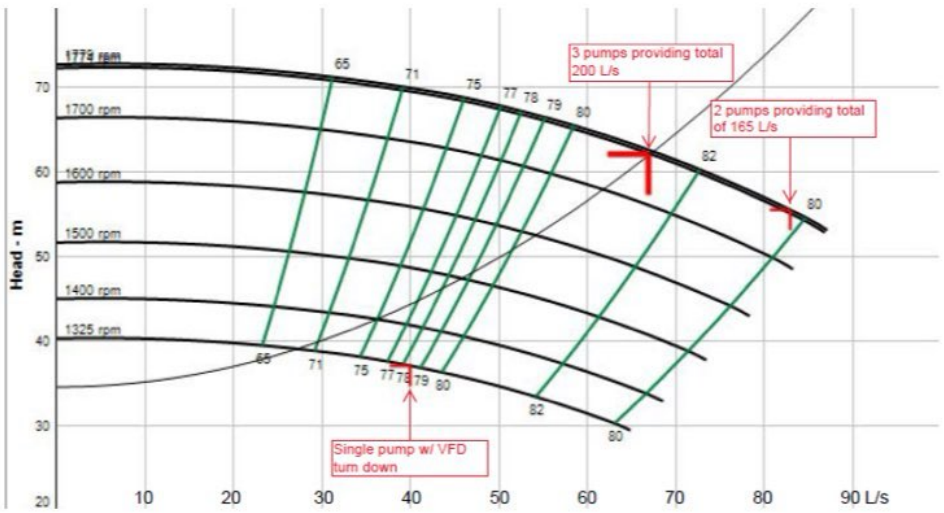


Figure 2-3: Cornell 4HH pump expected operating points (376 mm impeller)

3.3.3 FOUR SELF-PRIMING PUMPS

This option consists of four land-based self-priming pumps capable of pumping 50 L/s each when operating simultaneously. A minimum of one pump would be driven by VFD to allow operation down to 40 L/s. Each pump would be connected to the modified pipe connection manifold as described above. There is only one pump manufacturer for this option because through discussions with Gorman-Rupp, it was determined that they did not have a pump selection to recommend for this flow and pressure range.

2. Cornell 4HH-RP-F18DBK:

a. Note that to achieve continuously variable flow from the single pump minimum VFD flow up to 200 L/s with all four pumps operating, a minimum of two of these pumps must be driven by VFD. If only one pump has VFD in dual pump operation, the constant speed pump would operate outside of its recommended range.

b. 75 HP, 575 V / 3 phase / 60 Hz, TEFC enclosure motor.

c. 150ø suction and 100ø discharge.

d. Duty point of approximately 53.1 L/s @ 62.1 m TDH when all pumps are operating (212 L/s total flow).

e. Duty point of approximately 63.8 L/s @ 58.5 m TDH when three pumps are operating (191 L/s total flow).

f. Duty point of approximately 77.0 L/s @ 52.8 m TDH when two pumps are operating (154 L/s total flow).

g. Although this pump can operate singly at full speed, we recommend using VFD to limit single pump operation to approximately 80 L/s. This pump should not operate at full speed as a single pump when connected to the existing pipe system. However, a single pump can operate using a VFD from below 40 L/s up to approximately 80 L/s.

h. Operating from 75% to 110% of best efficiency point (BEP) at full speed, depending on quadruple, triple, or dual pump operation (single pump operation via VFD does not have a full speed operating point).

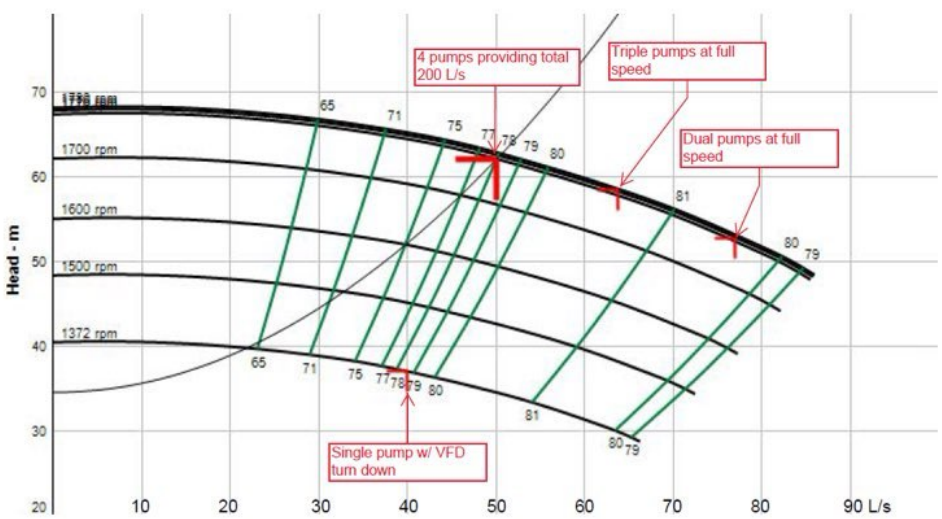


Figure 3-4: Cornell 4HH pump expected operating points (364 mm impeller)

4 EVALUATION OF DRY LAND PUMP OPTIONS

4.1 General

This feasibility report assumes that the City will be addressing the AHJ's concerns via installation of new pumps installed on shore and drawing water from the river. Modifications to the existing submersible pump installation to make it acceptable are not considered. As described in Section 3 – Modifications and Dry Land Pump Setups, we recommend that the pipe connection manifold be upgraded to a larger diameter as appropriate to match the number of connections and individual pump capacity for each option. In the following sections, each of the options is discussed in detail including their relative technical advantages and disadvantages, Stantec's opinion of probable construction cost for the pumps and control panel excluding elements common to all options (mobilization, demobilization, engineering fees, contingency, insurance, bonding, etc), and pump delivery lead time. The cost of modifying the existing pipe connection manifold, fabricating a new manifold, or providing fish screens is not significant compared to the cost of new pumps and control panel, and is not included in the OPC figures.

All pump options in this report are capable of starting from an unprimed condition and either automatically self-priming or running a prime assist system to start pumping water from the river to the lake without operator intervention.

4.1.1 OPTION 1: TWO PUMPS

Regardless of the pump model selected, the two-pump option includes the following general scope:

- Install a total of two 125 hp electric motor driven pumps on shore (one on either side of the pipe connection manifold).
- Install a base of compacted crushed rock or concrete at each pump location.
- Install pump control panel c/w 2 VFDs and data input from flow meters.
- Connect new pump panel to existing diesel generator.
- Install suction pipes from pumps' inlets to deeper areas of river:
    - 200ø is recommended, but 150ø would be acceptable only for the Gorman-Rupp PAH4A60C option.
    - Install fish screen(s).
- Install discharge pipes from pumps' discharges to pipe connection manifold:
    - 250ø is recommended to keep flow velocity below 3 m/s.
- Install new pipe connection manifold to accommodate higher individual pump and total flow rates:

- Change from cam-lock end connections to flanged connections to better accommodate higher operating pressure and larger pipe.
- Increase gate valves' size to match connected pipe size Install reducers to accommodate reuse of existing 150ø flow meter on each pump branch. Total length of 150ø pipe per pump shall be 1.2 m.
- Install increaser and 250ø check valve on each pump branch.
- Install increasers, 300ø tee and gate valve on combined flow portion of pipe connection manifold.
- Install 50ø stub connection complete with drain valve and cam-lock connection to allow draining of watermain.
- Connect to existing 300ø HDPE DR 17 watermain.

Table 4.1 - Advantages and Disadvantages of Option 1: Two Cornell 5HH-RP-F18DBK Pumps

OPC: $360,000	
Advantages	**Disadvantages**
Fewer pumps leading to lower expected capital cost and simpler operation, and less winter storage space required	Both pumps require VFD to achieve capability of continuous flow range up to 200 L/s
Able to achieve full flow range from 40 L/s up to 200 L/s if both pumps are driven by VFD	Due to larger individual pump flows than options with more pumps, requires larger piping and valves.
Pumps operate at high efficiency (over 80%) when operated at full speed in both single and dual pump operation	14-week delivery from approved shop drawings
Pump continues to operate at a very respectable approximately 74% efficiency when operating at 40 L/s	

Table 4.2 - Advantages and Disadvantages of Option 1: Two Gorman-Rupp PAH4A60C Pumps

OPC: $360,000	
Advantages	**Disadvantages**
Fewer pumps leading to lower expected capital cost and simpler operation, and less winter storage space required	Has a reduced operational range of approximately 55 L/s to 183 L/s
Potentially benefit from cost savings of smaller pipe and valve sizes compared to Cornell two-pump option	Although pump efficiency is respectable at over 65% throughout the expected operating range, it is lower than the Cornell two-pump option
	Both pumps require VFD to achieve capability of continuous flow range up to maximum flow
	18-week delivery from approved shop drawings

4.1.2 OPTION 2: THREE PUMPS

The three-pump option includes the following general scope:

- Install a total of three 75 hp electric motor driven pumps on shore.
- Install a base of compacted crushed rock or concrete at each pump location.
- Install pump control panel c/w 2 VFDs, 1 soft starter, and data input from flow meters.
- Connect new pump panel to existing diesel generator.
- Install suction pipes from pumps' inlets to deeper areas of river:
    - 200ø is recommended.
    - Install fish screen(s).
- Install discharge pipes from pumps' discharges to pipe connection manifold:
    - 200ø is recommended to keep flow velocity below 3 m/s.
- Install new pipe connection manifold to accommodate higher individual pump and total flow rates:
    - Change from cam-lock end connections to flanged connections to better accommodate higher operating pressure and larger pipe.
    - Increase gate valves' size to match connected pipe size (may repurpose 200ø gate valve from existing manifold).
    - Install 200ø check valve on each pump branch (may repurpose 200ø check valve from existing manifold).
    - Install new 150ø flow meter and repurpose two existing flow meters, one for each pump discharge branch.
    - Install reducers to accommodate 150ø flow meter on each pump branch. Total length of 150ø pipe per pump shall be 1.2 m.
    - Install increaser and 300ø gate valve on combined flow portion of pipe connection manifold.
    - Install 50ø stub connection complete with drain valve and cam-lock connection to allow draining of watermain.
    - Connect to existing 300ø HDPE DR 17 watermain.

Table 4.3 - Advantages and Disadvantages of Option 2: Three Cornell 4HH-RP-F18DBK Pumps c/w 376 mm Impeller

OPC: $400,000	
Advantages	**Disadvantages**
Smaller pumps than two-pump option, resulting in the pumps operating in a more preferred range than the two-pump option	Two of three pumps require VFD to achieve capability of continuous flow range up to 200 L/s
Able to achieve full flow range from 40 L/s up to 200 L/s if two pumps are driven by VFD	Requires more winter storage space than two-pump option
Able to operate, with VFD, below 40 L/s more effectively than two-pump option	With increasing number of pumps, comes increasing size and cost of pump control panel
Pumps operate at high efficiency (over 80%) when operated at full speed in both dual and triple pump operation	Single pump is not able to operate at full speed without exceeding manufacturer recommended limits
Pump continues to operate at a high efficiency of approximately 78% when operating at 40 L/s	
More pumps results in improved redundancy. Failure of a single pump has a smaller negative impact on the overall maximum system performance than Option 1	
With 200ø pipe being appropriate for individual pump discharge branches, able to repurpose more existing valves and reduce capital cost	
Lowest total motor power requirement	
Shortest delivery time of 12 weeks from approved shop drawings	

4.1.3 OPTION 3: FOUR PUMPS

The four-pump option includes the following general scope:

- Install a total of four 75 hp electric motor driven pumps on shore.
- Install a base of compacted crushed rock or concrete at each pump location.
- Install pump control panel c/w 2 VFDs, 2 soft starters, and data input from flow meters.
- Connect new pump panel to existing diesel generator.
- Install suction pipes from pumps' inlets to deeper areas of river:
    - 200ø is recommended.
    - Install fish screen(s).

- Install discharge pipes from pumps' discharges to pipe connection manifold:
    - 200ø is recommended.
- Install new pipe connection manifold to accommodate higher flow rates:
    - Change from cam-lock end connections to flanged connections to better accommodate higher operating pressure.
    - Increase gate valves' size to match connected pipe size as required (may repurpose 200ø gate valves from existing manifold).
    - Install check valve on each pump branch (may repurpose 200ø check valve from existing manifold).
    - Install two new 150ø flow meters and repurpose two existing flow meters, one for each pump discharge branch.
    - Install reducers as required to accommodate 150ø flow meter on each pump branch.
    - Install increaser and 300ø gate valve on combined flow portion of pipe connection manifold.
    - Install 50ø stub connection complete with drain valve and cam-lock connection to allow draining of watermain.
    - Connect to existing 300ø HDPE DR 17 watermain.

Table 4.4 - Advantages and Disadvantages of Option 3: Four Cornell 4HH-RP-F18DBK Pumps c/w 364 mm Impeller

OPC: $500,000	
Advantages	**Disadvantages**
Smaller pumps than two-pump option, resulting in the pumps operating in a more preferred range than the two-pump option	Two of four pumps require VFD to achieve capability of continuous flow range up to 200 L/s
Able to achieve full flow range from 40 L/s up to 200 L/s if two pumps are driven by VFD	Highest winter storage space requirement
Able to operate, with VFD, below 40 L/s more effectively than two-pump option	With increasing number of pumps, comes increasing size and cost of pump control panel
Pumps operate at high efficiency (over 78%) throughout the range of 40 L/s to 200 L/s	Highest total motor power requirement
With 200ø pipe being appropriate for individual pump discharge branches, able to repurpose more existing valves and reduce capital cost	Uses same pumps and motors as three-pump option, albeit with smaller impeller. Therefore, there is little benefit to the increased capital and operating cost of the fourth pump
Shortest delivery time of 12 weeks from approved shop drawings	Single pump is not able to operate at full speed without exceeding manufacturer recommended limits
More pumps results in improved redundancy. Failure of a single pump has the smallest negative impact of all options on the overall maximum system performance	

5 RECOMMENDATION

Stantec recommends proceeding with Option 1: the installation of two pumps, each rated for 100 L/s during simultaneous operation, with 125 hp motors, control panel, and new pipe connection manifold. Of the two types of pumps within this option, the Cornell 5HH-RP-F18DBK pumps are preferred. A brief summary of the options is presented in the following table.

	Option 1: Cornell 2 Pumps	Option 1: Gorman-Rupp 2 Pumps	Option 2: Cornell 3 Pumps	Option 3: Cornell 4 Pumps
Capital Cost	$375,000	$375,000	$400,000	$500,000
Delivery Schedule	14	18	12	12
Covers Full Design Flow Range	Yes	No	Yes	Yes
Operating Efficiency	74% - 85%	65% - 71%	78% - 82%	78% - 81%
Full Speed Single Pump Operation	Yes	Yes	No	No
Max Flow With 1 Failed Pump	130 L/s	119 L/s	165 L/s	191 L/s

- Option 1 Cornell pump meets or exceeds the Option 1 Gorman-Rupp pump in all of the above categories, so it is preferred out of these two options.
- The Cornell 3 pumps option is preferred over the Cornell 4 pumps option because it is significantly less expensive and requires less physical space for operation and storage.
- The primary reason the Cornell 2 pumps option is preferred over the Cornell 3 pumps option is because a single pump can be operated over its full range. The 3-pump option would require either built in control logic limiting pump run speed during single pump operation or observance by local operators to prevent operating the pump outside of its recommended range. The risk to the 3-pump setup is increased by the potential for actual conditions on site to vary from what was modelled.

Appendix A Opinion of Probable Cost

Opinion of Probable Cost					
City of Iqaluit Temporary Raw Water Pumping System Option 1 – Dual Cornell 5HH-RP-F18DBK Pumps					
Item	**Description**	**Unit**	**Quantity**	**Unit Price**	**Total**
1	**General Requirements**				
a)	Mobilization & Demobilization	L.S.	1	$ 157,000.00	$ 157,000.00
	Subtotal				**$ 157,000.00**
2	**Site Works**				
a)	Pump Bases Preparation	L.S.	1	$ 10,000.00	$ 10,000.00
b)	Pump Intakes & Fish Screens	Ea.	3	$ 1,500.00	$ 4,500.00
	Subtotal				**$ 14,500.00**
3	**Pumps Installation**				
a)	Pumps	Ea.	2	$ 90,000.00	$ 180,000.00
b)	Pump Control Panel	L.S.	1	$ 180,000.00	$ 180,000.00
c)	Discharge Pipe & Pipe Connection Manifold	L.S.	1	$ 34,000.00	$ 34,000.00
d)	Field Wiring	L.S.	1	$ 25,000.00	$ 25,000.00
f)	Commissioning, Demonstration & Training	L.S.	1	$ 15,000.00	$ 15,000.00
	Subtotal				**$ 434,000.00**
5	**Allowances**				
a)	Estimating Allowance	L.S.	30%	$ 605,500.00	$ 181,650.00
b)	Engineering	L.S.	8%	$ 787,000.00	$ 62,960.00
	Subtotal				**$ 244,610.00**
	Grand Total (rounded)				**$ 851,000.00**

APPENDIX C

Daily Withdrawals from the Apex River and Daily Flow Recorded at WSC Station 10UH015

Table A Summary of Pumping Activities and Average Daily Flow at WSC Station 10UH015

Date	Daily Average Flow WSC 10UH015 (m^3/s)	10% of Daily Flow at WSC 10UH015 (m^3/s)	Average Daily Pumping Rate (m^3/s)	Average Percent Flow Taken
6/26/2023	3.45	0.345	0.135	4%
6/27/2023	2.45	0.245	0.141	6%
6/28/2023	2.25	0.225	0.167	7%
6/29/2023	2.02	0.202	0.166	8%
6/30/2023	1.97	0.197	0.168	9%
7/1/2023	2.48	0.248	0.166	7%
7/2/2023	6.49	0.649	0.169	3%
7/3/2023	3.15	0.315	0.166	5%
7/4/2023	3.66	0.366	0.174	5%
7/5/2023	3.83	0.383	0.175	5%
7/6/2023	3.14	0.314	0.166	5%
7/7/2023	2.53	0.253	0.167	7%
7/8/2023	1.81	0.181	0.167	9%
7/9/2023	1.40	0.140	0.164	12%
7/10/2023	1.21	0.121	0.138	11%
7/11/2023	1.20	0.120	0.132	11%
7/12/2023	1.10	0.110	0.107	10%
7/13/2023	2.00	0.200	0.063	3%

APPENDIX D

Apex Pumping 2023

Substantial Completion,

Demobilization, &

Equipment Manifest

November 1, 2022

NUNAMI STANTEC LIMITED

Substantial Completion

To:	Shane Turner Superintendent of Public Works/Water Works City of Iqaluit Eric Jacobsen President Tower Arctic Ltd.	From:	Matt Follett, M.A.Sc., P.Eng. Associate Civil Engineer Nunami Stantec Ltd.
File:	144903395	Date:	November 1, 2023

Reference: Apex Pumping 2023 _ Substantial Completion, Demobilization, & Equipment Manifest

The following list summarizes a list of equipment that is to be returned to the City of Iqaluit (City) by Tower Arctic Ltd. (TAL) following the Apex River 2024 pumping season. The intention of this manifest is assure items are documented as returned and received by the City. Pumps must be stored in a heated storage area by the City. The City advised TAL to store these in the Apex Warehouse.

On September 14, 2023 the City confirmed that the site could be demobilized based upon the water levels in Lake Geraldine and overflow conditions at the spillway. The 2023 pumping program consisted of one pumping period from June 26 – July 13. As such, the project operations were substantially completed by July 14. TAL requested substantial completion on August 8 as Lake Geraldine water levels remained high at that time, suggesting that an additional pumping period would not be required. Since this date, it is understood that the Equipment Manifest (below) is accurate and accepted by the City.

As the work has now been concluded for the 2023 pumping season, including demobilization, Nunami Stantec accepts that substantial completion can be backdated to the original request of August 8, 2023. We recommend that all holdback amounts can be released at this time.

Item	Description	Signoff (Initials)		Notes
		City of Iqaluit	TAL	
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	SP	City to advise on delivery location. City to ensure pumps are stored in a heated, indoor space throughout the winter. Update: Apex Warehouse
Apex Fish Screens	Stored with the pumps above.	S.t	SP	Apex Warehouse
Operator Shack	Operator shack/seacan is at the Waste Transfer Station.	S.t	SP	At the pit in front of the waste transfer facility

Reference: **Apex Pumping 2023 _ Substantial Completion, Demobilization, & Equipment Manifest**

Pump Control Seacan	Green shack/seacan is at the Waste Transfer Station.	S.T	SP	At the pit in front of the waste transfer facility
Manifolds	1 x pipe manifold with valves, flanges, etc.	S.T.	SP	At the City's coke plant outside.
Flow Meters	3 x Apex -including cabling for Lecomte flow meters	S.T.	SP	Inside green sea can at the pit in front of Waste Transfer Facility. Additional flowmeter cables inside sea can.
Hoses	Flexible hoses used for connection from pumps to manifold.	S.T.	SP	Inside green sea can at pit in front of Waste Transfer Station
Electrical Cable and Equipment (Panels, Soft Starts)	Container for generator and pump panels has been delivered to the Waste Transfer Station	S.T.	SP	Inside green sea can at pin in front of Waste Transfer Station
CAT Generators	This has been modified in accordance with the Government of Nunavut Chief Electrical Inspector (2023, pre-pumping startup). Front and rear seals repaired on 600V generator.	S.T.	SP	Doors shut and stored outside. 480V – Waste Transfer Facility 600V – Coke Plant
Fuel Tanks	External fuel tanks are empty and stored together at the waste transfer station.	S.T.	SP	Outside at the pit in front of Waste Transfer Station
Fuel Pipe and Valve	Piping drained and delivered.	S.T.	SP	Outside in pit at Waste Transfer Station.
Outhouse				N/A

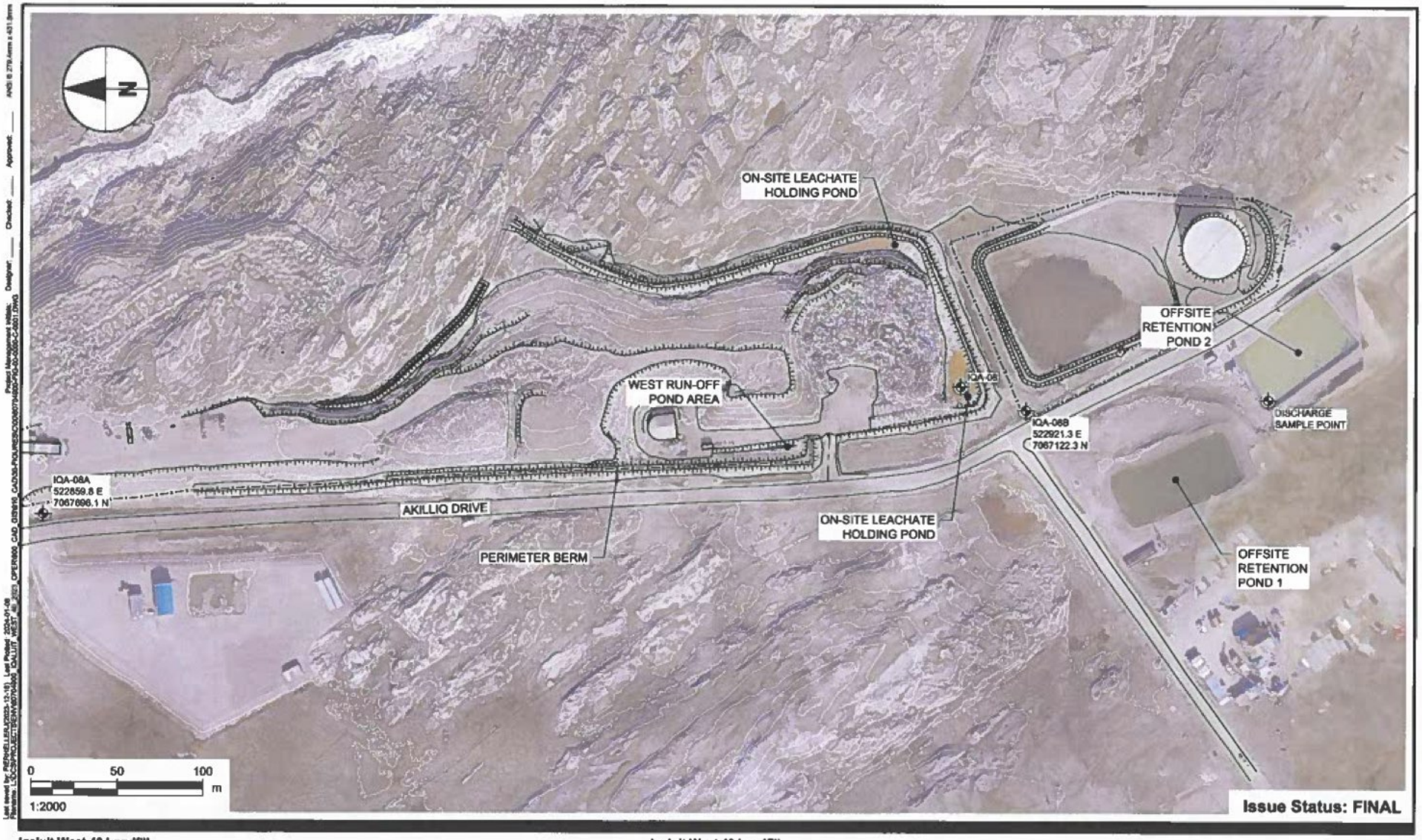
We understand that the City of Iqaluit (Shane Turner) accepts the details provided above on the successful return and storage of equipment for the Apex Pumping Project.

Nunami Stantec Ltd.

Matt Follett, M.A.Sc., P.Eng.
Associate, Civil Engineering Lead, Nunavut

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

APPENDIX C – Sampling Points for the West 40 Landfill



Iqaluit West 40 Landfill
Operations and Maintenance Plan
City of Iqaluit
Project No.: 60704900 Date: 2024-01-08

Iqaluit West 40 Landfill
Monitoring Locations
Plan

AECOM

Figure: 1