



**Northern Village of
Kangihsualujjuaq**

**VULNERABILITY ANALYSIS OF
THE DRINKING WATER
SOURCE**

WATER INTAKE N°X2114288 OF
KANGIHSUALUJJUAQ

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Project 21-0053

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NOTICE TO THE READER

This document has been produced using data collected from Kativik Regional Government (KRG), the Northern Village and the Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC), as well as from other stakeholders involved in the protection of water resources in Northern Quebec. No data has been collected on the field by our professionals due to the SRAS-CoV-2 pandemic. All the analysis presented in this document are based on the interpretation of various provincial regulations.

The analysis presented in this report are given for general guidance and benefit of the client only. Any final decision regarding an eventual intervention on site should be made along with the consultation of the MELCC. Consequently, Nuna Ressources cannot be held responsible for interventions on site conducted before the obtention of the required environmental and governmental authorizations.

REFERENCE TO CITE

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ABSTRACT

The environmental firm Nuna Ressources was mandated by the Northern Village (NV) of Kangiqsualujjuaq to conduct a vulnerability analysis of their drinking water source in compliance with Section 75 of the Water Withdrawal and Protection Regulation (WWPR) and following the guidelines provided in the '*guide de réalisation des analyses de vulnérabilité des sources destinées à l'alimentation en eau potable du Québec*' (MELCC, 2018).

The Northern Village of Kangiqsualujjuaq is located on the shore of the River George estuary, 25 km from its mouth in Ungava Bay, in the Quebec/ Labrador Peninsula. The village is part of the Regional Kativik Government (KRG). Because the area is characterized by a polar climate (Tundra) and a discontinuous and abundant permafrost, the stakes of the drinking water source protection are particularly important. At these latitudes, the presence of permafrost as well as the hazards of such climate conditions indeed imply unique land use challenges.

The drinking water source of NV Kangiqsualujjuaq is a small mountaintop lake, located on higher grounds and outside the village (138 m of elevation above sea level whereas the mean elevation in the village is under 20 m). Water withdrawn from the lake is treated in the village at the water treatment and distribution plant, by UV light and chlorine disinfection and then distributed to the community using water trucks.

The three drinking water source protection areas, determined using a cartographic approach, are as follows: the inner protection zone encompasses the lake waters comprised in a 300 m radius circle around the location of the withdrawal site, plus a 10 m riparian buffer. The intermediate protection zone encompasses the lake waters (and up-stream tributaries) comprised in a 3 km radius circle around the withdrawal site, plus a 120 m riparian buffer. At last, the outer protection zone covers the watershed of the lake.

The evaluation of the vulnerability indicators highlights that two of the six indicators have been put to a “**medium**” level (physical integrity and vulnerability to turbidity) due to the natural characteristics of the watershed and the pressure related to climate conditions exerted on the water withdrawal installations (water intake, manhole). The rating of the other five vulnerability indicators is “**low**”.

Due to the remote nature of the village and its pristine surroundings territories, NV Kangiqsualujjuaq drinking water source is not really exposed to biological/ chemical risks of contamination from human activities. This helps to explain the vulnerability analysis' results.

The heart of the village of Kangiqsualujjuaq is indeed located apart and at a lower elevation compared to the lake in which the water is withdrawn. For this reason, very few human activities are taking place in its vicinity. No human activities or potential events likely to affect the quality or the quantity of the water used for the withdrawal has been listed within the different protection zones. Furthermore, regarding the land use planning, the lake's shores belong to the "Conservation" zone, whereas the remaining surface of the protection areas are all comprised in the "Nuna" zone, which is mainly dedicated to recreational and traditional uses and where no activity/ development susceptible to pollute the municipal water source is authorized. Snow fences and similar uses are the only land uses permitted in the "Conservation" zone. The classification of all the protection areas of the water source in these two land use zones is thus contributing to the water source protection.

Finally, it should be noted that if NV Kangiqsualujjuaq continues to grow with the same rate as observed for the last past years and if the population grow continues to follow the same trend, the water withdrawal in the lake may not be sufficient anymore to provide the entire community with drinking water. A new water source has already been identified for the northern village. A careful study would nevertheless be necessary in order to precise the village's need in term of water quantity, when in the future the water shortage scenario could occur, and which adjustments should be made to the current drinking water system in order to connect this new water source.

Overall, this study highlights the fact that NV Kangiqsualujjuaq drinking water source provides the community with a water of quality that is little affected by human activities as yet. The Nordic climate conditions are the main factors that have the potential to seriously damage the installations related to the drinking water withdrawal/ treatment. In order to consolidate the monitoring and protection of the water source even better, the following recommendations are formulated :

- Install a functional turbidimeter and hold a register to keep a record of the turbidity values of the raw water on a regular basis, particularly during the melting season or after heavy rains when turbidity may rise significantly;
- A complete evaluation should be made by a professional within 5 years in order to assess the conditions of the drinking water withdrawal/ treatment infrastructures. Following this evaluation, make modifications/ improvements to the system if necessary;
- Hold a written register to keep a record of every event (even a minor one) that impacts the drinking water production chain from its withdrawal in the lake to its distribution and keep this register for interannual monitoring. An example of such a register is given at **Appendix 5**;
- Install a thigh fitting lid equipped with a lock on top of the chamber for the air traps and electricity supply for the heating cables located on the shore of the lake;
- When conducting the Colilert test each week, also test the raw water at least once a month during winter and every two weeks during summer.

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1 INTRODUCTION

1.1 MANDATE AND OBJECTIVES

The environmental firm Nuna Ressources received the mandate to conduct a vulnerability analysis of the drinking water source for the Northern Village (NV) of Kangiqsualujjuaq. As the village is providing drinking water for more than 500 people and is thus responsible for a category 1 surface water withdrawal, NV Kangiqsualujjuaq must submit to the Minister a vulnerability report before April, 1st 2021, pursuant to Section 75 of the Water Withdrawal and Protection Regulation (WWPR). Such a report is to be updated every 5 years.

Again, according to WWPR, Section 75, this report regroups the following information :

- The location of the withdrawal site and a description of the associated installations;
- A location plan of the inner, intermediate and outer protection zones of the drinking water source;
- The water vulnerability ratings assessed according to section 69 and Schedule IV of the WWPR;
- An inventory of all human activities, land uses and potential events likely to affect the quality or the quantity of the water used for the withdrawal within the different protection zones;
- An assessment of the threats posed by the human activities, land uses and potential events listed for the quality or the quantity of the water used for the withdrawal;
- The identification of the causes that may explain a “high” or “medium” vulnerability rating regarding the six indicators mentioned in the WWPR, Section 69 and Schedule IV.

This report presents a synthesis of all the information required by the Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC), when available, for the Northern Village of Kangiqsualujjuaq in accordance to the *guide de réalisation des analyses de vulnérabilité des sources destinées à l'alimentation en eau potable du Québec* (MELCC, 2018). Section 5.2 presents missing information or information that could not be obtained at the time this report was written. If pivotal information is missing, this report offers recommendations sorted by priority that may be considered by the municipality to remedy to the missing data before the next report term in 2026.

1.2 GENERAL BACKGROUND OF THE STUDY AREA

The Northern Village of Kangiqsualujjuaq (58°41'36.4"N, 65°57'15.2"O) is located on the shore of the River George estuary, 25 km from its mouth in Ungava Bay, in the Quebec/ Labrador Peninsula and about a hundred kilometers from the Torngat Mountains (Aubé-Michaud et al. 2020). The village is part of the Regional Kativik Government (KRG), in the administrative region Nord-du-Québec (10).

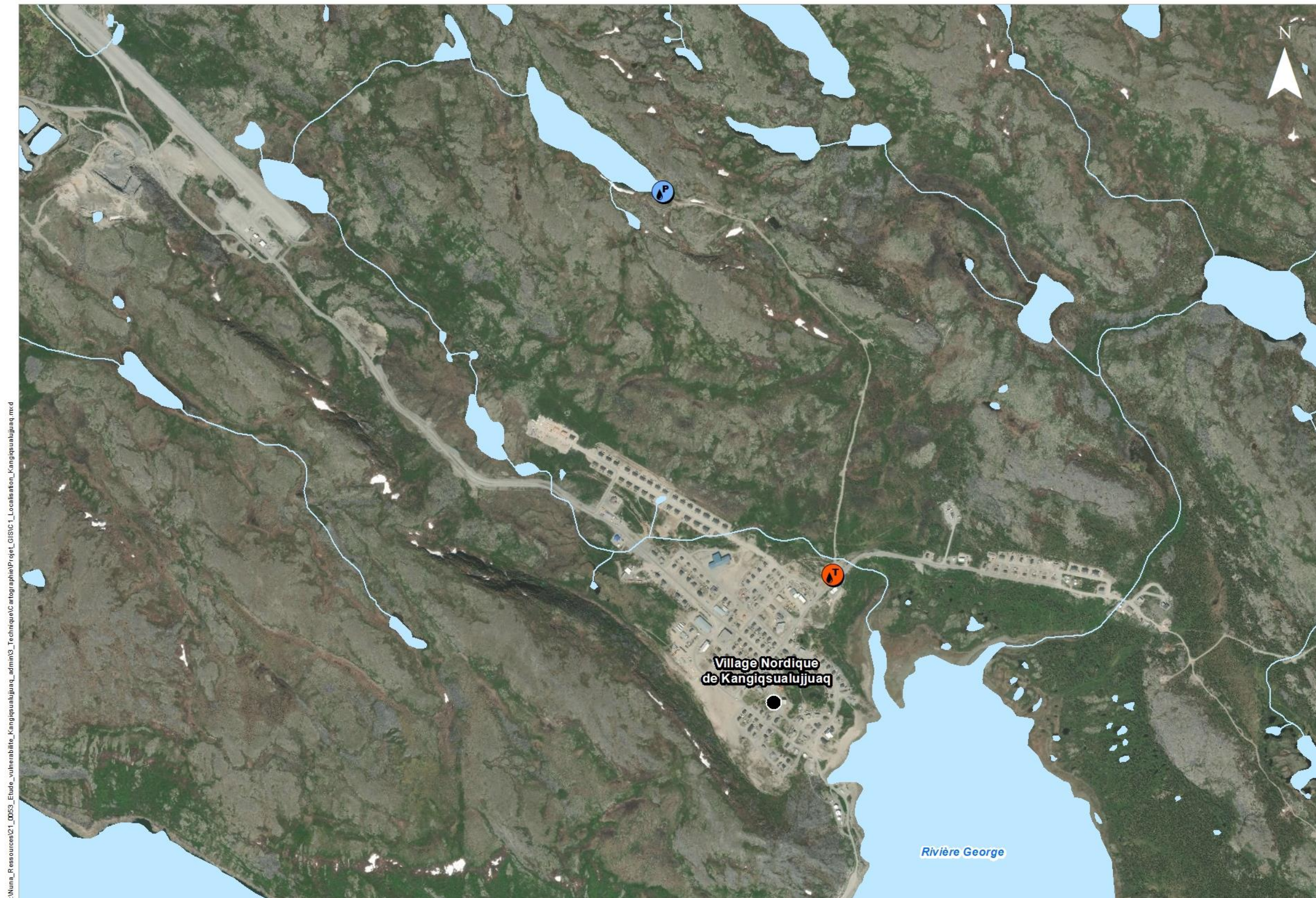
Located at the North-East 150 km away from Kuujjuaq, it has a population of 1028 inhabitants on a territory of 33.9 km² (Affaires municipales et Habitation Québec, 2020).

The NV of Kangiqsualujjuaq is located in an area of discontinuous and abundant permafrost (Appendix 1) in which the temperature at 20m depth has risen from -2.2°C to -1.1°C between 1989 and 2006 (KRG, 2011). The area is characterized by a polar climate (Tundra) and a mix of different vegetation types: shrub tundra, forest tundra as well as boreal forest located in deep valleys. Annual precipitations are about 834 mm per year. Mean annual temperature fluctuates around -3.43°C whereas the freezing season lasts approximately 197 days (2004-2017 mean value from Aubé-Michaud et al. 2020).

The NV of Kangiqsualujjuaq is mainly built on thick surface deposits composed of glaciofluvial sand and gravel, and sandy shoreline deposits (Appendix 1) which are relatively stable during permafrost thawing periods. The main geological units characterizing the area are gneisses from Churchill province, and more precisely tonalitic gneisses, granodioritic granitic gneisses, and dioritic gneisses (Appendix 1).

Outside NV Kangiqsualujjuaq are located :

- To the East : Kuururjuaq National Park, protected area 7 778 of 4 460.8 km²;
- To the South-East : Ulittaniujalik National Park of 5 293 km²;
- To the South-East : Quest Rare Earth Mine at 216 km from the border with Labrador province;
- To the West: Torngat Mountains approx. 100 km away.



CARTE 1
Localisation de l'aire d'étude

- Prise d'eau
 - Usine de traitement des eaux
- Hydrographie**
- Cours d'eau
 - Plan d'eau



1:15 000
0 250 500 1 000 m

Système de projection cartographique: NAD83 (CSRS) MTM 8

Source des données:
Fond de carte, cinquième inventaire écoforestier du Québec méridional
Géobase du réseau hydrographique du Québec (GRHQ) (MERN, 2019);
Cartographie des milieux humides potentiels du Québec (CMHPQ) (MELCC, 2019);
Base de données des bassins hydrographiques (MELCC, 2019a)

2 CHARACTERIZATION OF WATER WITHDRAWAL

The determination of the three protection zones of the drinking water source, as well as the determination of the vulnerability levels of the six indicators respectively presented at sections 2.3 and 2.4 (WWPR Section 69 and Schedule IV) were conducted by compiling various data provided by KRG and the municipality. Open-source data were also used when available for the study areas. The main open-source data used for this report are thus listed below:

- Geobase of Quebec Hydrographic System / *Géobase du réseau hydrographique du Québec* (GRHQ) (MERN, 2019);
- Hydrographic Basins Data base / *Base de données des bassins hydrographiques* (MELCC, 2019);
- Topographic Data of Canada – CanVec Series (Natural Resources Canada, 2020);
- Image Library of the Northern Villages/ *Imagerie des villages autochtones du Nord* (<https://mern.gouv.qc.ca/repertoire-geographique/imagerie-villages-autochtones-nord/>);
- Cartography of the Northern Villages at a 1 : 2 000 scale/ *Cartographie des villages autochtones à l'échelle 1/ 2000* (<https://www.donneesquebec.ca/recherche/dataset/cartes-topographiques-des-villages-autochtones-du-nord-a-l-echelle-de-1-2-000>);
- Satellite imagery from Google Earth Pro©.

2.1 RAW WATER WITHDRAWAL SITE

The water withdrawal site of the Northern Village of Kangiqsualujjuaq is located in a mountaintop lake. The latter has no tributary and a surface area of approximately 64 302 m² for a perimeter of 1583 m. The lake possesses a small outlet which flows only during springtime (melting season). Located on higher grounds compared to the village's heart (138.2 m above sea level, also see profiles in Appendix 2), the lake is enclosed by the surrounding hills (pictures 1 and 2). The actual withdrawal installations (as well as the treatment plant) were initially constructed in 1986.

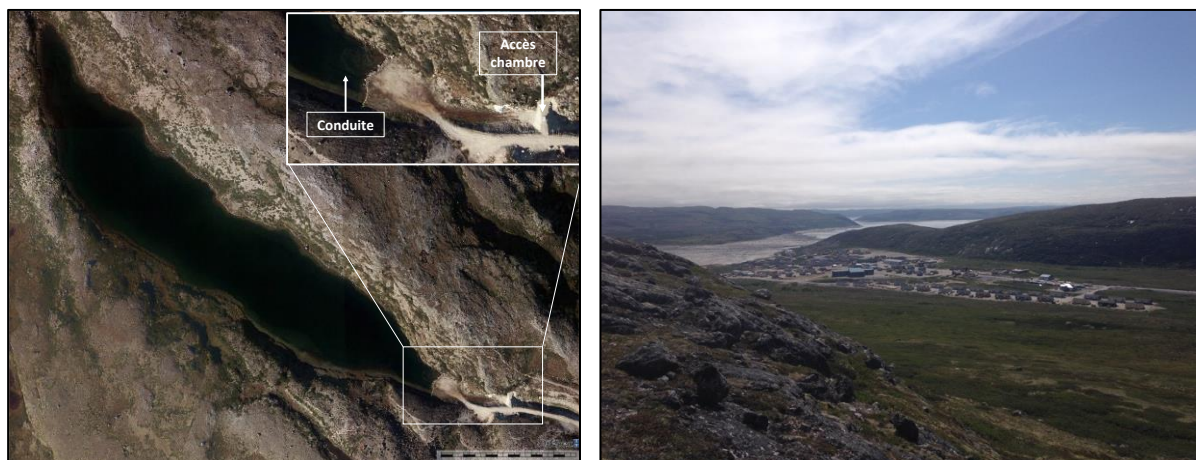


Photo 1. Aerial photography adapted from the images library of the indigenous Northern Villages (MERN). The lake is the drinking water source for the Northern Village of Kangiqsualujjuaq

Photo 2. View of the Kangiqsualujjuaq from higher grounds near the lake from which the village's drinking water is withdrawn (2017, KRG)

Schematics presented in Appendix 2 are describing in details the installations associated to the water withdrawal site in the lake.

The installations at the water withdrawal site are as follows: the water intake in the lake is a polyethylene pipe ending with a strainer. It was initially (see plans in Appendix 2) positioned at approximately 4.5 m depth and the pipe was installed at the bottom of the lake (total length of 25 m). However, the pipe location in the lake was adjusted in 2009/2010 following damages due to repetitive freezing/ melting cycles over the years and a complete obstruction due to mud accumulation¹. Adjustments made at the time permitted to elevate the pipe in order to prevent freezing related damages and sediments accumulation. A 45° bend was made at the end of the pipe in the lake so the strainer is now installed vertically at approximately 1.2 m (4 feet) from the lake's bottom.

Just after the strainer, the pipe splits between a recirculation pipe and another polyethylene pipe; both equipped with heating cables and connected to the air traps and electricity supply chamber on the shore (picture 1). This chamber is a manhole accessible from its top with a ladder (pictures 3 and 4). It is closed with a wooden lid that does not seem to be hermetic or adapted to the structure (picture 4). It should be noted that the water in the recirculation pipe is warmed by an oil furnace coupled with a heat exchanger system. This furnace is not located in the water source watershed. The heating cables are a back-up for the heat exchanger system only².

¹ Personal communication with Mr James Stewart, manager of the northern village of Kangiqsualujjuaq

² Hydro Quebec does not allow electricity as a primary heat source at this latitude

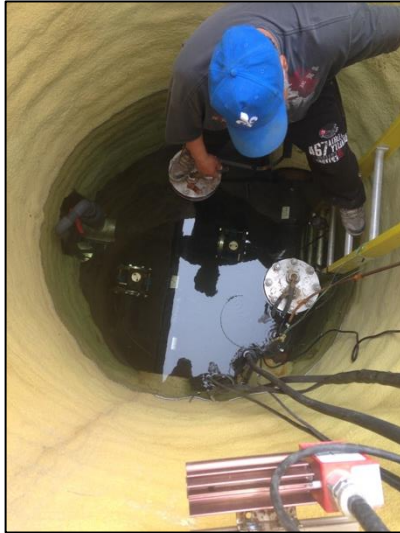


Photo 3. Inside view of the chamber for the air traps and electricity supply for the heating cables (2017, source KRG)

Photo 4. Outside view of chamber for the air traps and electricity supply for the heating cables (2017, KRG)

Table 1. Summary of the surface water withdrawal of the Northern Village of Kangiqsualujjuaq main characteristics

Élément du site de prélèvement	Description et détails
Water intake name	Kangiqsualujjuaq - Approvisionnement
Water intake number	X2114288
Geographical coordinates	58° 42'33.71"N ; 65° 57'43.66"W
Type of consumption	Permanent
Type of withdrawal	In the lake using an underwater strainer
Depth of withdrawal	1.2 m from the bottom of the lake
Population served	1028 inhabitants
Daily withdrawal flow rate	46 000 L
Critical water level	Unknown
Number of the latest authorization delivered by the Ministry	Unknown

The recirculation and the supply pipes (diameter of 10 cm each) leaving from the manhole follow the access road from the lake during 1.7 km to the treatment plant in the village (Map 1). the recirculation pipe allows the raw water to be constantly moving in the pipes in order to prevent freezing.

2.2 DRINKING WATER TREATMENT PLANT

The water treatment and distribution plant for the Northern Village of Kangiqsualujjuaq is located at an elevation inferior to 20 m above sea level, which is contrasting with the water withdrawal location in the lake, at 138 m above sea level. The water intake is connected to the treatment plant by a steep access road (slopes between 8 and 12 %, see profiles in Appendix 2). The water treatment plant is located in the village at the following coordinates (Map 1) :

58°41'48.88" N et 65°57'4.36"W



Photo 5. Filling of a water truck at the water treatment plant for distribution in the village (2014, KRG)

Photo 6. Drinking water tank newly installed in 2014 (KRG, 2014)

Built in 1987, the treatment plant was upgraded in 2014, with, among other things, the construction of a new water tank outside the plant and the dismantling of the previous one, which was installed inside the plant. Some of the installations dedicated to the raw water treatment have also been upgraded in 2017/2018.

In the water plant, the different treatment steps of the raw water are as follows :

- Disinfection using UV light (eight Trojan UV reactors);
- Additional disinfection by injection of chlorine (12 %);
- Water is stored in the water tank;
- Residual addition of chlorine when the water is transferred in the trucks for distribution.

Once the raw water is treated, it is thus distributed daily to the different infrastructures and residences in the village, each one of them having their own water tank. However, the construction of a distribution network by aqueduct is a project that will be conducted within 5 years.

2.3 WATER SOURCE PROTECTION ZONES

In accordance to the WWPR, sections 70, 72 and 74, surface water withdrawals are surrounded by three protection zones: the inner zone, the intermediate zone and the outer zone. In case the surface water withdrawal is located in a lake, the delimitations of each of the respective zones are as follows :

Table 2. Water source protection zones in case the intake is located in a lake

Type of setting	Protection zone		
	Inner	Intermediate	Outer
Lake	300 m around withdrawal site + a 10 m riparian buffer	3 km around withdrawal site + a 120 m riparian buffer	Withdrawal site's watershed + the portion of the intermediate protection zone located downstream if relevant

General methodology:

Watershed delimitations were determined using the hydrographic cutting units (HCU) as well as the linear (rivers) and polygon (lakes) geometric networks available from the Geobase of the Quebec Hydrographic System (GQHS or GRHQ in French, 2019). For reference, HCU represent a portion of a bigger watershed or a group of small watersheds delimited by the "Centre d'expertise hydrique du Québec" (CEHQ; now incorporated into the MELCC).

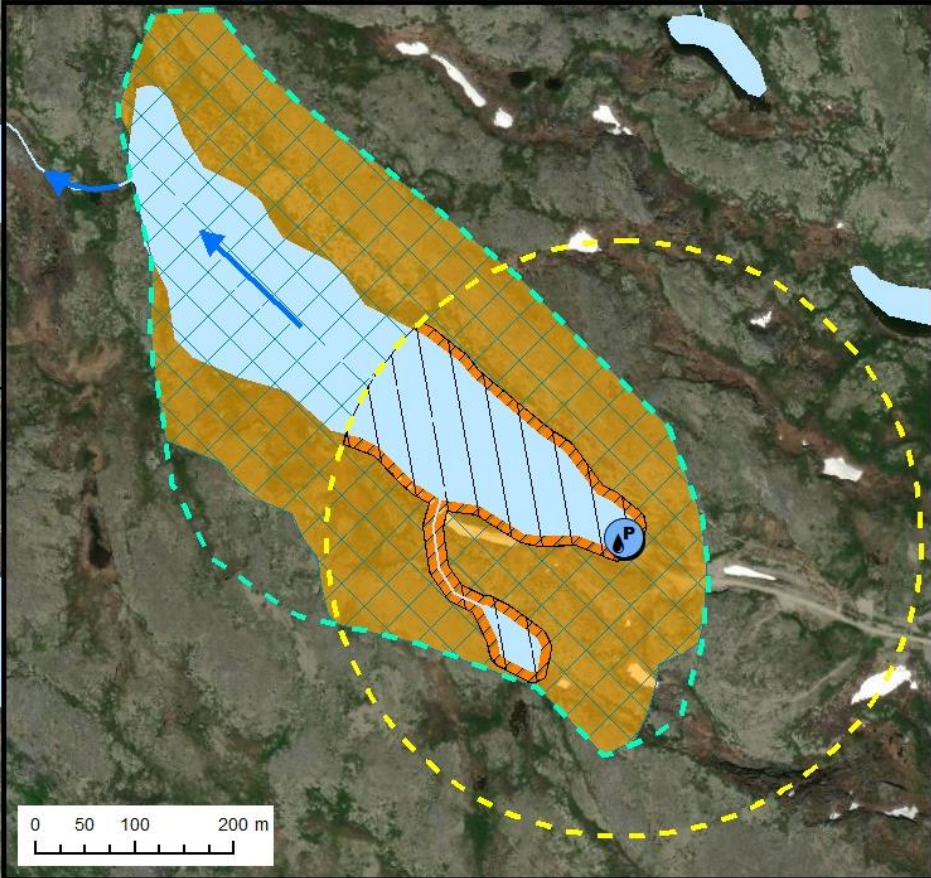
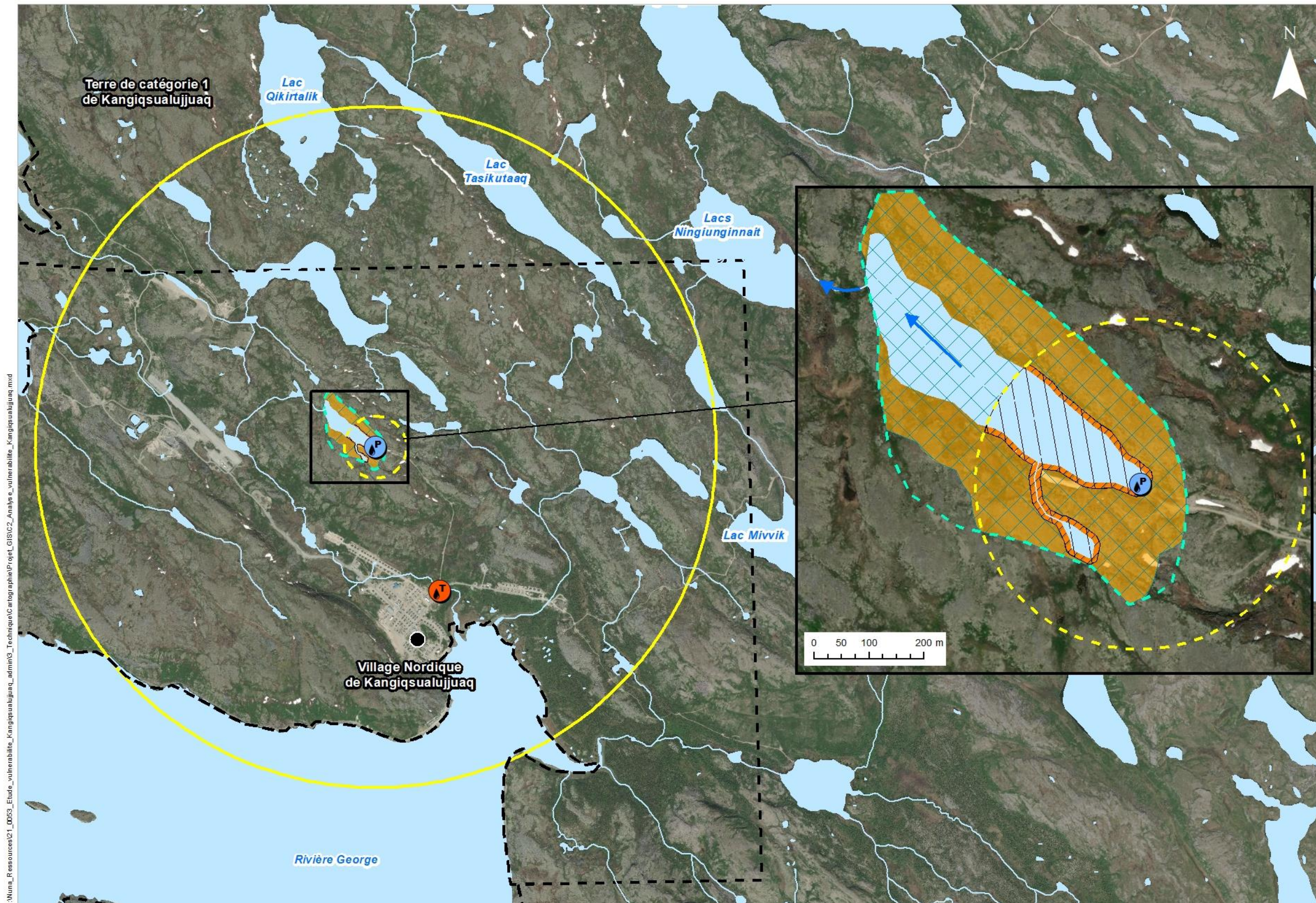
On the one hand, the maximum extension for the water source watershed was determined using the linear (rivers) and polygon (lakes) geometric networks, in particular by the validation of the direction of the water flow and the classification of the linear features according to the Strahler stream order. This operation allows to validate the interconnectivity of the hydrographic system at the HCU limits.

On the other hand, the watershed portion that was downstream the water withdrawal location had to be removed from the lake/ river global watershed when relevant i.e., the portion of the global watershed that has no influence on the exploited waters. The portion upstream the water withdrawal location (watershed delineation) was delimited using level curves at a 1: 50 000 scale available from the topographic data of Canada (CanVec Series, 2020) as well as the linear (rivers) and polygon (lakes) geometric networks available from GQHS. Finally, this whole operation permitted us to properly delimit the water source watershed.

The case of Kangiqsualujjuaq :

For the NV of Kangiqsualujjuaq, the watershed of the mountain top lake is quite small and on higher grounds compared to the village location, bringing the necessity of some cartographic adjustments regarding the delimitation of the protection zones. The lake outlet, which is intermittent and located outside the water source watershed, was thus excluded from the intermediate protection zone as the latter is not influencing, in any case, the exploited waters (strong topographical difference). The portions of the 120m riparian buffer located outside the watershed were excluded as well.

The three protection zones of the drinking water source for the Northern Village of Kangiqsualujjuaq are presented on map 2. As the high-water mark for the presented hydrographic network was not available, rivers delimitations were established using the delimitation available on the hydrographic geobase for the study site.



CARTE 2
Aires de protection de la prise d'eau

- Prise d'eau
- Usine de traitement des eaux
- Limite des municipalités
- Zone de protection**
- Rayon de 300m autour de la prise d'eau
- Rayon de 3km autour de la prise d'eau
- Bande riveraine de 10m
- Bande riveraine de 120m
- Zone de protection immédiate
- Zone de protection intermédiaire
- Zone de protection éloignée (bassin versant de la prise d'eau)
- Hydrographie**
- Cours d'eau
- Plan d'eau
- Sens d'écoulement



1:40 000
0 750 1500 3000 m

Système de projection cartographique: NAD83 (CSRS) MTM 8

Source des données:
Fond de carte, cinquième inventaire écoforestier du Québec méridional
Géobase du réseau hydrographique du Québec (GRHQ) (MERN, 2019);
Cartographie des milieux humides potentiels du Québec (CMHPQ) (MELCC, 2019);
Base de données des bassins hydrographiques (MELCC, 2019a)

2.4 VULNERABILITY INDICATORS

According to WWPR Section 69 and Schedule IV, the surface water source vulnerability has to be evaluated for six indicators. A vulnerability rating “low”, “medium” or “high” has to be attributed to each of the six indicators. These ratings are attributed following the analysis methods presented in the *guide de réalisation des analyses de vulnérabilité des sources destinées à l'alimentation en eau potable du Québec* (MELCC, 2018). The following sections are presenting the results of these analysis for each indicator, as well as the method(s) applied in function of the data sets that were available for this evaluation.

2.4.1 Physical integrity of the withdrawal site

Method 1 : Historical review of all events recorded. Since August, 14th 2014, a person responsible for a category 1 surface water withdrawal must keep an up-to-date record listing all the events that have affected or may have affected the condition of the withdrawal site (Section 22.0.4 of the Regulation respecting the quality of drinking water). Such a record did not seem to be available for the drinking water system of NV Kangiqsualujuaq. However, after consulting members of the municipal council, it appears that no major event would have affected the quantity or the quality of the exploited water in the past years.

In the absence of a written historical review, the second method was applied.

Method 2 : Professional evaluation of the infrastructures related to the water withdrawal.

In the context of the global pandemic linked to the COVID-19 since the beginning of 2020, our professionals could not make a visit in the village in order to meet the local stakeholders, see the drinking water related infrastructures and evaluate their condition since their last upgrade. We thus rely on data provided by some researchers' teams (Center for Northern Studies, Laval University) and information exchanged with members of the local community and the Kativik Regional Government in order to provide a professional judgement regarding the status of the infrastructures and the damage risks associated with the climate conditions. However, we recommend to validate the physical vulnerability rating assigned in this evaluation by going on site as soon as the situation will allow it.

Infrastructures conditions

After consultation of the documentation provided by KRG, it appears that the installations for the withdrawal and treatment of the drinking water of NV Kangiqsualujuaq have regularly been updated since their initial construction. A new drinking water tank was installed outside the treatment plant in 2014, the plant heating system was renovated, a room dedicated to the chlorine storage was added and several building's electrical systems were also upgraded.

Regarding the installations related to the water intake in the lake: the installations related to the water withdrawal in the lake were updated in 2009/2010 after damages caused by ice and the obstruction of the water pipe by mud (sediments accumulation). The water pipeline in the lake was also covered by gravel in order to prevent its displacement by ice. Its end was also elevated at a 1.2 m distance from the bottom of the lake. These infrastructures should be inspected again, with an underwater camera for example, in order to assess 1) if the sediments accumulation since 2009 is important and 2) if ice made new damages to the installations in the lake since 2009.

Regarding the manhole located immediately on the shore of the lake (pictures 1 to 4), the latter was also upgraded a decade ago following melting water infiltrations and the electrocution hazards that ensued every spring (600 volts electrical installations in the ground near the manhole). Finally, we noticed that the top of the manhole is closed only by a wooden lid that does not fit the opening (picture 4). We advise to replace this wooden lid by a cover that fits the manhole and isolates the interior of the chamber from any infiltration (rain, snow, dusts or organic debris) or intrusion by the fauna living in the area. Moreover, as the withdrawal site is a public one, it could be pertinent to install a lock on the new cover in order to provide access to the manhole to the relevant personal only.

Natural hazards regarding the infrastructures

As the village of Kangiqsualujjuaq is located in an area of discontinuous and abundant permafrost, the infrastructures are subject to ground movements linked to the freezing and thawing of the active layer of the permafrost. They are also subject to the meteorological conditions related to the polar climate. An analysis made by the Center for Northern Studies (Aubé-Michaud et al. 2020) presents the permafrost conditions depending on the surface deposits on which are built the village's infrastructures (Appendix 1). The water withdrawal infrastructures (manhole) near the lake are located on glacial deposits (tills) in thin layers on the bedrock. These types of deposits are evaluated to be unstable during permafrost thawing episodes, however their thin layering limits the associated creep behaviour and differential settlement. Thus, permafrost movements in this area should not represent a serious risk for the installations at the water intake location. An inspection of these installations still remains pertinent considering their age and the problems encountered in 2009 and the years before.

As for the installations related to the treatment, storage and distribution of the drinking water, they are located in an area with stratified sand and gravel deposits with a thickness superior to 2 m. This type of deposit is stable during permafrost thawing. These installations are thus not exposed to damages related to the permafrost movements/ the changing conditions of the permafrost.

Finally, still from Aubé-Michaud and co-authors, neither the area hosting the treatment plant in the village nor the location of the water intake infrastructures near the shore of the lake is subject to

natural and apprehended hazards inventoried by the scientists in the context of their research (Appendix 1).

In the light of this information, the location of the water intake infrastructures is deemed vulnerable. Consequently, and by a measure of precaution, the physical vulnerability of the site is thus rated at a “**medium**” level.

Because we could not go to the northern village ourselves for this vulnerability report, a validation on site by a professional is still necessary to validate this rating. Furthermore, knowing the population growth rate (+7.8% between 2011 and 2016, Statistics Canada), it will become essential to reevaluate the situation when updating the present report in 5 years in order to determine if the quantity of drinking water provided by the intake in the lake will still be sufficient to respond to the village’s need or if alternative solutions should be explored (an alternative water source has already been identified for the northern village).

2.4.2 Vulnerability to microorganisms

The Northern Villages, because they are located north of the 55th parallel (Section 22.0.3 of the regulation respecting the quality of the drinking water – RRQDW), do not have the obligation to follow the requirements stated in Section 22.0.1 of the RRQDW, that is the obligation to test one raw water sample per month for *E. Coli* detection when the distribution system provides drinking water for 1 001 to 5 000 persons. Moreover, at the time of the population census in 2016 (Statistics Canada), they were 942 inhabitants in the NV of Kangiqsualujjuaq. The available data suggest that the population passed the 1000 persons threshold only in 2020 (Affaires municipales et Habitation Québec).

Raw water sampling for microorganism’s detection aims to detect the potential presence of pathogenic microorganisms, particularly the bacteria *E. Coli*, known for causing gastroenteritis with the following main symptoms: diarrhoea, abdominal cramping, nausea, vomiting (<https://www.quebec.ca/en/agriculture-environment-and-natural-resources/drinking-water/contaminants-in-drinking-water/escherichia-coli-e-coli-fecal-coliforms-or-enterococci/>).

Surface water sources are more sensitive to contamination by coliforms (total, fecal) compared to underground water sources because of local wildlife and human activities taking place in the surroundings.

In NV Kangiqsualujjuaq’s case, no dataset relative to fecal coliforms in the raw water is available³. Being located north of the 55th parallel, it should be reminded that the village is not in the obligation to monitor this parameter on a regular basis. In order to determine the vulnerability rating of the water source to microorganisms, we thus apply the **second method**.

³ The municipality does however control the coliforms in the treated water on a weekly basis

The latter is to determine if, in the area of the water source watershed, there is neither an agglomeration served by a combined sewer system or by a pseudo separate sewer system, nor an activity or an industry susceptible to contaminate the water with pathogenic microorganisms. The water source watershed being restrained by the surrounding high terrain and the lake being located high up compared to the village, there is no such industry/ human activity in the totality of all the protection zones (map 2 and Appendix 3).

Furthermore, analysis conducted during summer 2019 by a team of researchers from Laval University (Guilherme and Rodriguez, 2020) show that of all the 7 samples analyzed, none contained *E. Coli* bacteria. Although no other data is available to our knowledge, these results are encouraging. Naturally, surface water sources remain particularly sensitive to contamination by the local fauna. For this reason, it is still pertinent to monitor the raw water quality in terms of pathogenic microorganisms.

With all these elements in hand, the vulnerability rating of the water source to microorganisms is fixed at “**low**”.

2.4.3 Vulnerability to fertilizers

Once again, the Northern Villages, because they are located north of the 55th parallel (Section 22.0.3 of the RRQDW) are not subject to the regulations stated in Section 22.0.2 of the RRQDW, that is the obligation, for a municipal drinking water distribution system deserving at least 500 persons and one residence, to sample surface raw water to quantify total phosphorus concentration once a month between May and October of every year.

Methods 2 and 3 will thus be applied for this parameter (method 1 implies the analysis of a concentration dataset of five year and the latter does not exist in this situation). The highest vulnerability rating obtained between methods 2 and 3 will be selected as the final rating.

Method 2 : it consists of inventorying all events related to algal proliferation or cyanobacteria in the exploited water as well as suspected or measured augmentations of ammoniacal nitrogen.

No such event was reported by the NV of Kangiqsualujjuaq. The application of this method allows us to attribute a “**low**” vulnerability rating to fertilizers.

Method 3 : a professional must evaluate all the activities that represent a potential source of phosphorus or ammoniacal nitrogen in all the protection zones and assess if the latter constitute a hazard.

No such activity has been listed in the entire outer protection zone. Moreover, a measure of total phosphorus is available for the lake’s water in August 2019 from a team of researchers of Laval University. This analysis shows that the measured concentration was low (1.6 µg/L) (Guilherme

and Rodriguez, 2020). The criteria for aquatic life quality is fixed at 30 µg/L of total phosphorus in surface waters. It aims to restrict an excessive and harmful algal proliferation (surface water quality criteria, MELCC).

The vulnerability rating of the water source to fertilizers is thus set at “**low**”.

2.4.4 Vulnerability to turbidity

The Northern Villages, because they are located north of the 55th parallel (Section 22.0.3 of the RRQDW), do not have the obligation to follow the requirements stated in Section 22.0.2 of the RRQDW, that is the obligation to monitor the turbidity variations of the raw water at least each 4 hours and log the values in a register.

As no dataset for the turbidity values of the exploited waters is available for the NV of Kangiqsualujjuaq, method 2 is applied in order to assign a vulnerability rating to the water source. This method consists to provide a professional opinion following the evaluation of potential impacts arising from the natural characteristics of the watershed or from the human activities that are taking place in its area.

Eight turbidity values were measured between August and September in 2019 by a team of researchers from Laval University (Guilherme and Rodriguez, 2020). The results were all comprised between 0.2 and 0.6 NTU. So the baseline value for the turbidity in the lake (flood periods excluded) appears to be low and under the value of 5 NTU prescribed in the RRQDW, Section 5.

Following the master plan of the NV of Kangiqsualujjuaq (Appendix 3), the lake shores are designated as a “conservation” zone and the rest of the water source protection zones belong to the “Nuna” zone, which is mainly dedicated to recreational and traditional activities (see also at section 3 for further information about land uses). Considering these elements, human activities in the entire area of the water source outer protection zone (watershed) are not likely to have an impact on the exploited waters’ turbidity.

The lake has a narrow watershed (27.72 ha). It is surrounded by rocky outcrops and undifferentiated till deposits (sands, silt and blocs with traces of gravel, mainly in thin and discontinued layers on the rocks; Aubé-Michaud et al. 2020). Mobile sand deposits originating from the permafrost, as well as the low thickness of the deposits on top of the rocks, could both promote runoff, especially during the melting season in spring or after heavy rains. The moderate to steep slopes around the lake (15 to 40%) also promote runoff to the lake as well as thin layers deposits remobilization. The detailed analysis provided by the firm in hydrogeology LNA, consulted in order to have an additional opinion regarding the evaluation of this parameter, is presented in Appendix 4.

In the light of this information, the water source vulnerability rating to the turbidity is assigned to “**medium**”. For the future, it is advised to log in a register the values of raw water turbidity at the drinking water treatment plant, especially during the melting season or after heavy rains that are likely to wash out sediments to the lake. These records could thus be used when it will be the time to produce the next vulnerability report (2026) in order to validate the present rating with a complete data set. Frequent high turbidity values can lead to equipment failures at the drinking water treatment plant.

2.4.5 Vulnerability to inorganic substances

The 11 inorganic substances which concentrations are to be monitored on an annual basis in accordance to Section 14 of the RRQDW are as follows: antimony, arsenic, barium, boron, cadmium, chromium, cyanide, fluoride, mercury, selenium, uranium. Nitrates and nitrites must also be monitored on a quarterly basis.

As the available dataset concerning these parameters for the NV of Kangiqsualujjuaq does not include five continuous years of results and following the recommendations provided in the guide, we privileged the **second method**. However, the available values were still included in our analysis as a complement to the method used.

Method 2 aims to determine if any industrial, commercial or agricultural activity sector is located in the 120m riparian buffer zone of the water source and what percentage of this terrestrial surface they are occupying. The vulnerability rating is low if this percentage is inferior or equal to 20%. None of these activity sectors was located in the 120 riparian buffer zone of the water source.

Moreover, the concentrations of the 11 inorganic substances, available for 2015, 2016 and 2020, as well as the concentrations of nitrates and nitrites, partially available for 2015, 2016, 2019 and 2020, are all well below the applicable standards. Following this information, the vulnerability rating of the water source to inorganic substances is set at “**low**”.

2.4.6 Vulnerability to organic substances

As the drinking water system in NV Kangiqsualujjuaq is not serving a population of more than 5000 persons, it is not mandatory for the village to control the 16 pesticides and 16 other organic substances in accordance to Section 19 of the RRQDW. **Method 2** was thus applied in order to assign a vulnerability rating for this indicator. This method is identical the method 2 employed in the previous section (2.4.5) for inorganic substances.

The vulnerability rating of the water source to organic substances is thus set at “**low**”.

2.4.7 Summary of vulnerabilities

Table 3. Synthesis of the methods that were used to determine the ratings of the six vulnerability indicators and the resulting ratings

Indicator	Methods	Vulnerability rating
A (physical)	Methods 1 and 2	Medium
B (microorganisms)	Method 2	Low
C (fertilizers)	Method 2 and 3	Low
D (turbidity)	Method 2	Medium
E (inorganic substances)	Method 2	Low
F (organic substances)	Method 2	Low

3 INVENTORY OF THE FACTORS LIKELY TO AFFECT THE DRINKING WATER SOURCE

3.1 HUMAN ACTIVITIES

Due to the context related to Covid-19 pandemic, our professionals could not visit by themselves the Northern Village of Kangiqsualujjuaq in order to inventory the human activities on the field. The following sections have thus been written using information from the master plan and the land use planning of NV Kangiqsualujjuaq and the consultation of the members of the municipal council when precisions were needed. Satellite images from Google Earth and the Image Library of the Northern Villages (MERN) were consulted as well.

The Northern Village of Kangiqsualujjuaq being located approximately 100m lower than the water intake in the lake, the water source is isolated from the village's infrastructures and activities. For this reason, practically no activity is taking place in its watershed.

3.1.1 Human activities Inventory

The human activities to inventory are the ones that, during their usual operations, are prone to discharge contaminants affecting the quality or the quantity of the exploited waters.

No such activity emerges from our inventory.

3.1.2 Threats associated to human activities

As no human activity has been reported at section 3.1.1, there is no associated threat to report here.

3.2 POTENTIAL EVENTS

The potential events linked to human activities correspond to exceptional events caused by accidents or extreme meteorological event and which are susceptible to release contaminants in the exploited surface waters or affect the quantity of the water available for the drinking water system.

3.2.1 Potential events Inventory

As no human activity potentially affecting the quantity or the quality of the exploited waters is taking place in the entire water source watershed, no potential event has been listed in this section.

3.2.2 Threats associated to potential events

As no potential event has been reported at section 3.1.1, there is no associated threat to report here.

3.3 LAND USES

3.3.1 Land uses inventory inside the protection zones

As observed on the zoning map (Appendix 3), the protection zones of the water source are spread over two land use zones:

- The “conservation” zone
- The “Nuna” zone

Snow fences or similar installations are the only developments permitted in the **conservation zones**.

The remaining parts of the inner and intermediate protection zones overlap the land use **zone “Nuna”**. These territories are mainly used for recreational and traditional activities but can also host infrastructures that are usually built away from the heart of the village, as described in the zoning by-law adopted by the municipal council in 2015.

3.3.2 Threats associated with the land uses for the drinking water source

In theory, some of the land uses permitted in the “Nuna” zone could potentially affect the drinking water source such as resource exploration, solid waste disposal site, sewage lagoons, cemeteries. However, it should be noted that the actual infrastructures for wastes disposal are currently located outside the water source watershed. In the present, they pose no threat to the drinking water source. If new infrastructures were to be developed in the “Nuna” zone in the future, regulations from the Zoning By-Law would prevent the implantation of such activities at locations where they would likely be a threat to the water source. Although marginal, threats associated to the uses permitted in the “Nuna” zone are listed in Table 5, Appendix 3. It must be emphasized that the use of these “Nuna” territories by the local population for recreational and traditional purposes (hunting, fishing, berries picking, camping, ...) is a factor that contributes to the water source protection.

4 IDENTIFICATION OF PROBLEMS AND THEIR PROBABLE CAUSES

Due to the remote nature of the northern villages and their pristine surroundings territories, drinking water sources there are not really exposed to biological/ chemical risks of contamination from human activities.

According to the WWPR Section 75, this step of the evaluation is trying to identify the natural or anthropogenic causes that may explain a “high” or a “medium” vulnerability rating for the six indicators analyzed in section 2.4 of this report.

Table 4. Identification of the problems linked to a vulnerability indicator possessing a “medium” or “high” rating

Problem identification	Associated vulnerability indicator	Identification of the causes	Type of causes	Causes description	Associated protection zone
Risks of damages at the water intake in the lake and at the manhole near the shore	Physical integrity	Freezing events, snow melting and sediment accumulation	Natural	Seasonal thawing/ freezing cycle over the years and sediments accumulation in the lake make the water intake’s installations vulnerable	Inner and intermediate
Risk of occasional turbidity increases	Turbidity	Watershed Characteristics	Natural	Surface deposits, their low thickness and the slopes around the lake (15-40%) make the water source vulnerable to turbidity	All zones

Indicator of physical integrity

As discussed at section 2.4.1/ Method 2, pressures on the water intake originating from natural factors and the absence of a recent evaluation of these infrastructures led us to assign a “medium” vulnerability rating to the physical integrity of the withdrawal site. We did so as a precautionary measure. Indeed, knowing the problematics at the water intake site related to freezing events (until 2009) and obstruction by sediments (in 2009) and knowing that some work was done at the time to resolve these problematics, a new evaluation should be undertaken in order to assess the sediments accumulation rate around the strainer in the lake since 2009. Gravel around the water pipeline should also be inspected in order to determine if it is still sufficiently in place to protect the conduct from ice related damages.

The on-site evaluation by a professional should also assess the condition of the manhole near the shore and in particular if it needs some adjustments (other than the tight-fitting lid) in order to 1) prevent melt water infiltrations and 2) guarantee the security of the personal working there at all times.

Furthermore, resources should be allocated to train more personal capable of operating/ maintaining the drinking water system. The professional evaluation of the infrastructures should determine if the drinking water system is adapted to the local reality and offer alternatives/ system upgrades if necessary. It should be noted that a new drinking water source has been identified for the northern village. The evaluation and the potential system up-grades or modifications have to be undertaken with this element in mind.

Vulnerability to turbidity

Considering the lack of data relative to the turbidity of raw waters and considering the natural characteristics of the watershed as well, the vulnerability rating of the water source to turbidity was set at “**medium**” and this as a precautionary measure. No human activity is likely to affect this parameter in the present.

As a consequence, it is rather the natural characteristics of the watershed that are likely to influence the turbidity of the exploited waters. A detailed analysis conducted by the hydrogeological firm LNA (Appendix 4) highlighted that the moderate to steep slopes of the surrounding landscape, the type of deposits around the lake and their low thickness on the basement rock were all factors contributing to increase runoff to the lake and thus increasing the turbidity in the water as well. The vegetation cover and the permitted uses inside the “Nuna” zone are elements that are weakly affecting the turbidity (Appendix 4).

It should also be noted that the turbidimeter available on site is not functional. The instrument cannot withstand the pressure of the water circulating in the pipes. An instrument or system upgrade should be made in order to resolve this issue.

It is thus highly recommended to log the turbidity values of the raw water before it goes into treatment inside the drinking water plant in a written or a numerical register and to do so on a regular basis. This will allow to validate if the watershed characteristics have a significant impact on raw water turbidity and then take measures to cope with this potential problematic when producing the next vulnerability report in 2026.

5 CONCLUSION

5.1 GENERAL CONCLUSION

The Northern Village of Kangiqsualujjuaq, as for the other Northern Villages, is located in a remote environment where few industrial or commercial activities are taking places. For this reason and because the water source watershed is located on higher grounds outside the village, the drinking water source provides the village with quality water. The biggest threat faced by the whole drinking water system is related to the climate conditions: freezing temperatures, variation of permafrost conditions, the latter being in profound mutation due to global climate change.

The evaluation of the vulnerability indicators highlights that two of the six indicators has been fixed to a “**medium**” level (physical integrity and vulnerability to turbidity) due to the natural characteristics of the watershed and the pressure related to climate conditions exerted on the water withdrawal installations (water intake, manhole). The rating of the other four vulnerability indicators is “**low**”. Moreover, no human activity/ potential event is likely to affect the quality or the quantity of the drinking water available for the population. Regarding the land use planning, the zones overlapping the water source protection zones (“conservation” and “Nuna”) are contributing to the protection of the water source rather than threatening it.

Finally, it should be noted that if NV Kangiqsualujjuaq continues to grow with the same rate as observed for the last past years and if the population grow continues to follow the same trend, the water withdrawal in the lake may not be sufficient to provide the entire community with drinking water. A new water source has already been identified for the northern village. A careful study would nevertheless be necessary in order to precise the village’s need in term of water quantity, when in the future the water shortage scenario could occur, and which adjustments should be made to the current drinking water system in order to connect this new water source.

In order to consolidate the monitoring and protection of the water source even better, recommendations are formulated in section 5.3.

5.2 MISSING INFORMATION

No data about high- and low-water levels were available for the study site. Riparian buffer zones were determined using the cartographic delineations available for the hydrographic system from the open data bases used for this evaluation. The best available resolution has been used.

There is no Events Register relative to the water source and its associated infrastructures.

The critical water level, as well as the number of the most recent authorization delivered by the Ministry are also missing information.

A request for access to water quality data had been made to the regional office of the MELCC for Nord-du-Québec on January 6, 2021 concerning drinking water quality for the northern village of Kangiqsualujjuaq. However, no data had been provided to us at the time of writing this report.

Some data about the inorganic substances monitoring were missing.

5.3 RECOMMANDATIONS

Following the drinking water source vulnerability analysis for the Northern Village of Kangiqsualujjuaq, provided here is a list of recommendations sorted by priority in order to 1) validate some of the key elements discussed in the report and 2) guarantee the best possible protection of the drinking water source.

- Install a functional turbidimeter and hold a register to keep a record of the turbidity values of the raw water on a regular basis, particularly during the melting season or after heavy rains when turbidity may rise significantly;
- A complete evaluation should be made by a professional within 5 years in order to assess the conditions of the drinking water withdrawal/ treatment infrastructures. Following this evaluation, make modifications/ improvements to the system if necessary;
- Hold a written register to keep a record of every event (even a minor one) that impacts the drinking water production chain from its withdrawal in the lake to its distribution and keep this register for interannual monitoring. An example of such a register is given at **Appendix 5**;
- Install a thigh fitting lid equipped with a lock on top of the chamber for the air traps and electricity supply for the heating cables located on the shore of the lake;
- When conducting the Colilert test each week, also test the raw water at least once a month during winter and every two weeks during summer.

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APPENDIX 1. GEOLOGY AND PERMAFROST

- A1.1 Geological map of Quebec
- A1.2 Permafrost conditions map (from : Aubé-Michaud et al. 2020)
- A1.3 Natural hazards map (from : Aubé-Michaud et al. 2020)

Résumé

Cette carte présente les conditions de pergélisol de la région de Kangiqsualujjuaq. Ce village est situé au littoral, à 100 km au nord-est de Kuujuaq (58.09° N, 65.97° W).

Note

Cette carte a été compilée principalement par photointerprétation et validée avec un nombre limité d'observations de terrain, de sondages et de forages dans le pergélisol. Toute information trouvée en amont de la projection devra être à jour aux applications.

Abstract

This map shows the permafrost conditions of the Kangiqsualujjuaq region. This Inuvialut village is located on the west coast of the Ungava Bay, 100 km northeast of Kuujuaq (58.09° N, 65.97° W).

Note

This map was compiled mostly by air photo interpretation and validated by a limited number of terrain observations, probing and soil holes in the permafrost. Any information leading to an improvement of permafrost data available on a scale of the map will be received with thanks.



Système national de référence cartographique
NAD83, datum géodésique de 1983, projection conique conique, déformations de forme et d'aire faibles.

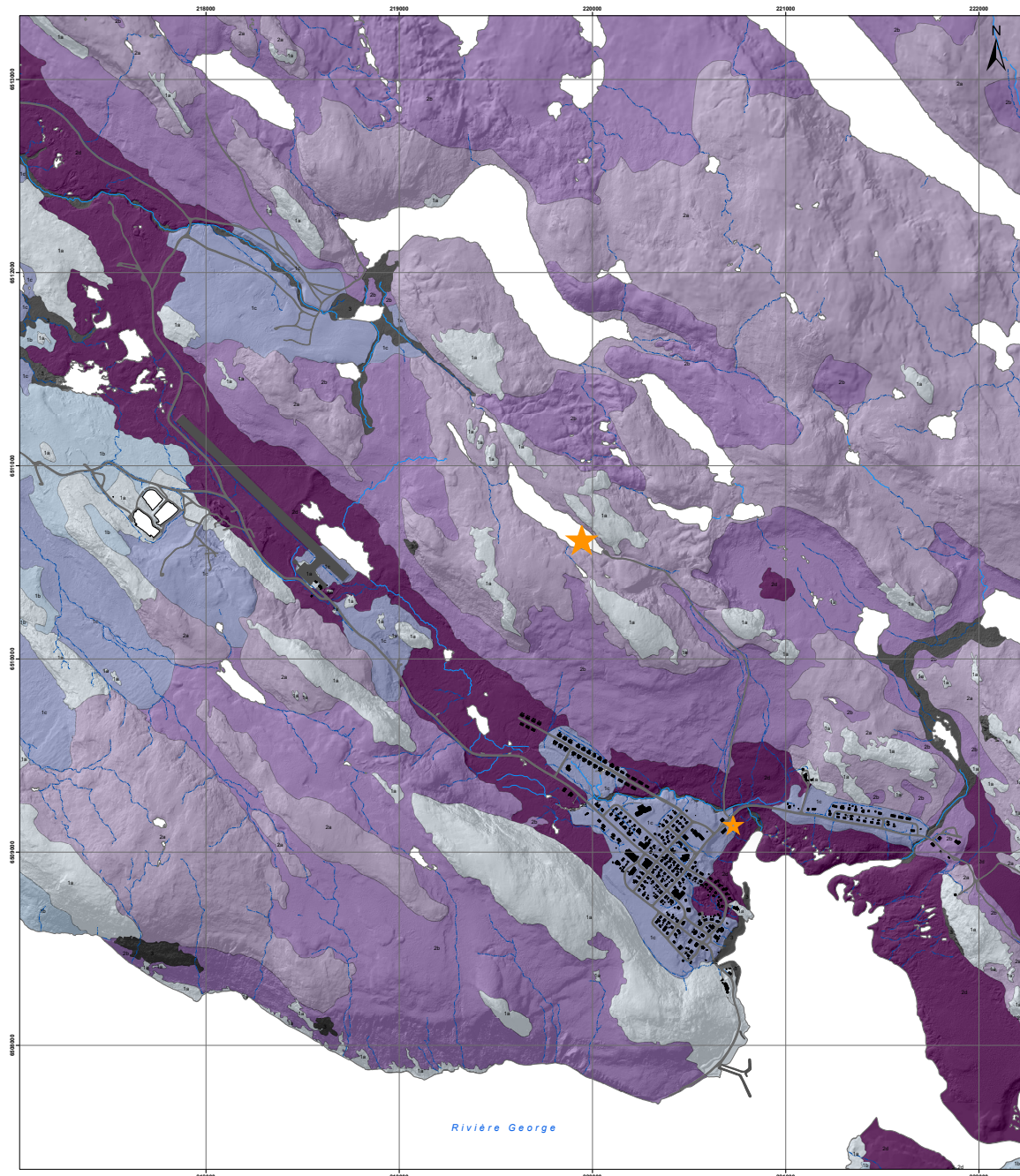
Illustration de couverture :
Kangiqsualujjuaq, Nunavut, Québec.
Photographie par Sarah-Julie Michaud.

Centre d'études nordiques, Québec, 2018

**CONDITIONS DE PERGÉLISOL
KANGIQSUALUJJUAQ**

Québec, Nunavik

1 : 10 000



Dépôts stables au dégel : roc et dépôts meubles contenant très peu ou pas de glace

- 1a** Solde rocheux.
La couche active atteint une épaisseur comprise entre 4,5 et 6 m. Seule sa structure de joints et de diaclases est susceptible de contenir une faible quantité de glace.
- 1b** Dépôt de sable et gravier en couverture mince (< 2 m) sur solde rocheux.
La couche active atteint une épaisseur comprise entre 1,5 et 2,5 m. Contient de la glace interstitielle ponctuelle dont le contenu volumique en glace est généralement inférieur à 10 %.
- 1c** Dépôt de sable et gravier stratifié épais (> 2 m).
La couche active atteint une épaisseur comprise entre 1,5 et 2,5 m. Contient de la glace interstitielle et ponctuellement de la glace sous forme de lentilles dans les couches de matériau à granulométrie fine. Présence probable de réseaux de polygones à coins de glace bien développés.

Dépôts instables au dégel : dépôts meubles contenant beaucoup de glace

- 2a** Dépôt glaciaire (fil) en couverture mince (< 2 m) sur solde rocheux.
La couche active atteint une épaisseur comprise entre 2,5 et 3 m. Contient de la glace interstitielle et sous forme de lentilles dans les couches de matériau à granulométrie fine. Le contenu volumique en glace est généralement inférieur à 30 %. Présence d'ostioles et de coulées de gelification sur les versants. Matériau sujet au fluage et à des tassements différentiels limités lors de sa fonte en raison de sa faible épaisseur.
- 2b** Dépôt glaciaire (fil) en couverture épaisse (> 2 m) sur solde rocheux.
La couche active atteint une épaisseur comprise entre 2,5 et 3 m. Contient de la glace interstitielle et sous forme de lentilles dans les couches de matériau à granulométrie fine. Le contenu volumique en glace est généralement inférieur à 30 %. Présence d'ostioles et de coulées de gelification sur les versants. Matériau sujet au fluage et au tassement différentiel lors de sa fonte.
- 2c** Dépôt à granulométrie fine d'origine marine en couverture mince (< 2 m) sur solde rocheux ou dépôt de sable et gravier épais.
La couche active atteint une épaisseur comprise entre 0,5 et 1,5 m. Contient beaucoup de glace de ségrégation dont le contenu volumique dépasse régulièrement 30 % et peut atteindre près de 100 %. Surface fréquemment recouverte d'ostioles. Matériau sujet à des tassements différentiels limités lors de sa fonte en raison de sa faible épaisseur. Matériau sujet à des ruptures de pente sur les versants.
- 2d** Dépôt à granulométrie fine d'origine marine.
La couche active atteint une épaisseur comprise entre 0,5 et 1,5 m. Contient beaucoup de glace de ségrégation dont le contenu volumique dépasse régulièrement 30 % et peut atteindre près de 100 %. Surface fréquemment recouverte d'ostioles. Matériau sujet à des tassements différentiels importants et à des ruptures de pente sur les versants lors de sa fonte.

Contraintes sévères : processus périglaciaires et de versants dynamiquement, littoraux et plaines alluviales actuelles

- 3** Contraintes sévères : processus périglaciaires et de versants dynamiquement, littoraux et plaines alluviales actuelles.
- BÂTIMENTS**
- INFRASTRUCTURES DE TRANSPORT**
- RÉSEAU DE DRAINAGE** - ruisseaux permanents
- RÉSEAU DE DRAINAGE** - ruisseaux intermittents

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Centre d'études nordiques, Université Laval, juillet 2020

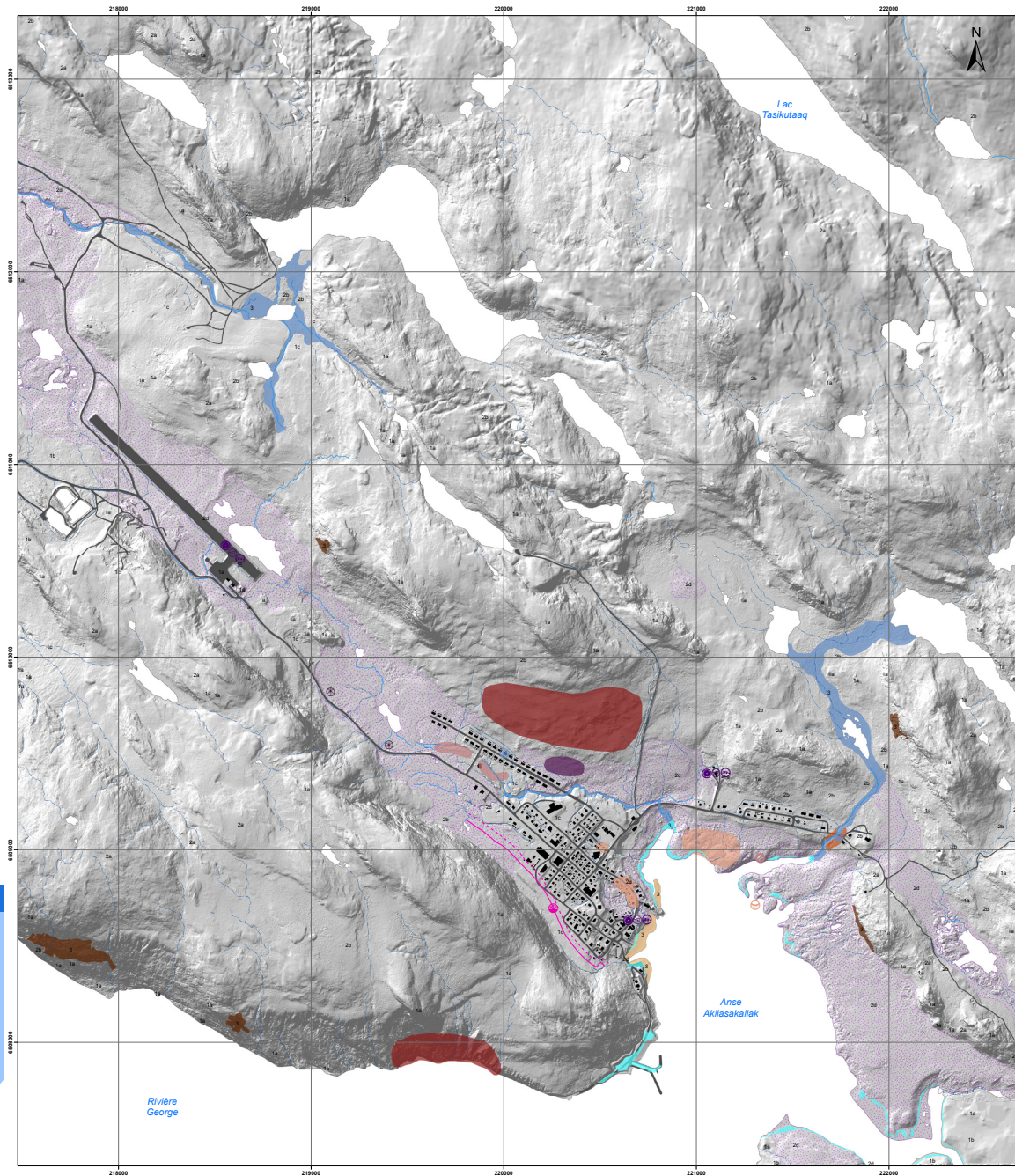
Citation recommandée :
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**CONDITIONS DE PERGÉLISOL
KANGIQSUALUJJUAQ**

Québec, Nunavik

1 : 10 000





MOUVEMENT DE MASSE / MASS WASTING

- AVALANCHE DE NEIGE / SNOW AVALANCHE
 - 1:100
 - 1:1000
- GLISSEMENT DE TERRAIN / LANDSLIDE
- GÉLIFLUXION / GELIFLUCTION
- COULÉE / FLOW
- ÉBOULIS / FALLS

ÉROSION / EROSION

- ÉROSION CÔTIÈRE ET FLUVIALE / COASTAL AND FLUVIAL EROSION
- ÉROSION PAR LE VENT / WIND EROSION

CLIMATIQUE / CLIMATIC

- FEU / WILDFIRE
- TEMPÊTE DE VENT / WIND STORM
- BLIZZARD / BLIZZARD
- VERGLAS / ICE STORM

PROCESSUS PÉRIGLACIAIRES / PERIGLACIAL PROCESSES

- PERIGÉLOSOL RICHE EN GLACE / ICE-RICH PERMAFROST
- GLAÇAGE / ICING
- BUTTE SAISONNIÈRE À NOYAU DE GLACE / FROST BRISTLER

PROCESSUS LIÉS AU DÉGEL / THAW-RELATED PROCESSES

- AFFAISSEMENT THERMOKARSTIQUE / THERMOKARST SUCSIDENCE
- ÉROSION THERMIQUE / THERMAL EROSION

PROCESSUS HYDROLOGIQUES / HYDROLOGICAL PROCESSES

- DRAINAGE D'UN LAC / LAKE DRAINAGE
- SURCOTE / STORM SURGE
- CRUE SOUDAINNE ET INONDATION / FLASH FLOOD AND FLOOD
- EMBÂCLE ET DÉBÂCLE GLACIÈRES / ICE-JAM AND BREAK-UP
- POUSSEE GLACIÈRE / ICE-PUSH

TREMBLEMENT DE TERRE / EARTHQUAKE

- TREMBLEMENT DE TERRE / EARTHQUAKE

HYDROLOGIE / HYDROLOGY

- RÉSEAU DE DRAINAGE - ruisseaux permanents
RILLS AND WATERTRACKS - running throughout all arctic summer
- RÉSEAU DE DRAINAGE - ruisseaux intermittents
RILLS AND WATERTRACKS - running occasionally during spring melt

INFRASTRUCTURES / INFRASTRUCTURE

- BÂTIMENTS / BUILDING
- INFRASTRUCTURES DE TRANSPORT / TRANSPORT INFRASTRUCTURE

Auteurs : S. Aubé-Michaud, M. Allard et E. L'Hérault, Centre d'études nordiques, Université Laval, décembre 2016.
 Authors: S. Aubé-Michaud, M. Allard et E. L'Hérault, Centre d'études nordiques, Université Laval, December 2016.

Citation recommandée :
 Aubé-Michaud, S., Allard, M. et L'Hérault, E., 2016. Aléas naturels actuels et appréhendés, Kangiqsualujjuaq, Québec, Nunavik, Centre d'études nordiques, échelle 1 : 10 000.
 Recommended citation:
 Aubé-Michaud, S., Allard, M. et L'Hérault, E., 2016. Actual and potential natural hazards, Kangiqsualujjuaq, Québec, Nunavik, Centre d'études nordiques, scale 1 : 10 000.

Résumé
 Cette carte présente les risques naturels actuels et appréhendés de la région de Kangiqsualujjuaq. Ce village se situe au Nunavik, sur la côte est de la baie d'Umanav, à 160 km au nord-est de Repulse (66 07' N, 62 07' O).

Abstract
 This map shows the actual and potential natural hazards of the Kangiqsualujjuaq region. This Nunavik village is located on the east coast of the Ungava Bay, 160 km northeast of Repulse (66 07' N, 62 07' W).

Note
 Cette carte a été compilée principalement par photo-interprétation et validée avec un nombre limité d'observations de terrain de montagne et de l'équipe carté. Toute information pouvant améliorer la précision et l'exactitude sera la production d'une mise à jour sera appréciée.

Note
 This map was compiled mainly by air photo interpretation and validated by a limited number of terrain observations, mostly snow and rocks in the mountains. Any information leading to an improvement of precision and accuracy in updates of the map will be received with thanks.

Les risques naturels sont représentés par un symbole graphique, illustré ou coté, en fonction de leur échelle et de leur géométrie.

Natural hazards are presented according to their scale and geometry polygons, lines or points.

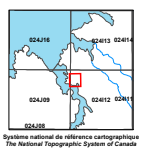


Illustration de couverture / Cover illustration:
 Kangiqsualujjuaq, Nunavik, Québec.
 Photographie par Sarah Aubé-Michaud / Photographed by Sarah Aubé-Michaud

Centre d'études nordiques, Québec, 2016

**ALÉAS NATURELS ACTUELS ET APPRÉHENDÉS
 ACTUAL AND POTENTIAL NATURAL HAZARDS
 KANGIQSUALUJJUAQ**
 Québec, Nunavik
 1 : 10 000

Image en relief ombragé dérivée des données LIDAR 2010 (MRNF 2010, gouvernement du Québec) préparée par L'Hérault, E.
 Illustration: azimuth 315°, altitude 45°, exagération verticale 1x

Hazard created by L'Hérault, E. from LIDAR data (MRNF 2010, gouvernement du Québec).
 Illustration: azimuth 315°, altitude 45°, vertical exaggeration 1x

Projection : MTM zone 5, NAD83

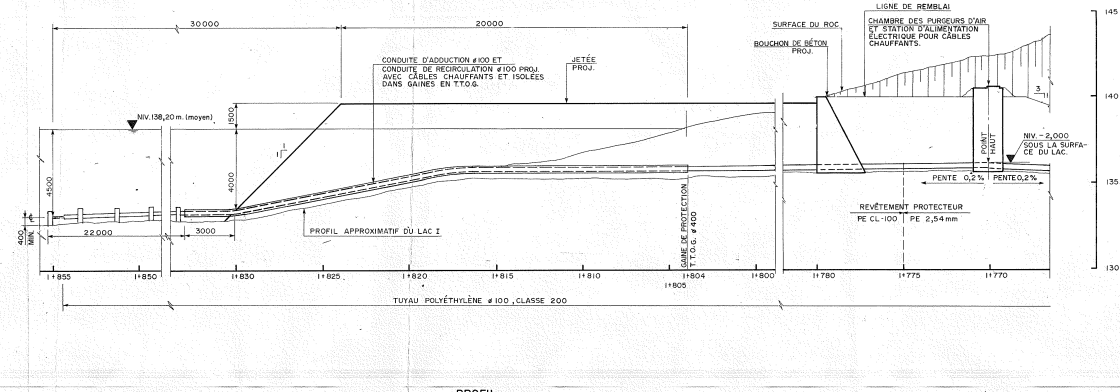
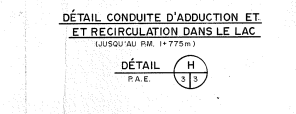
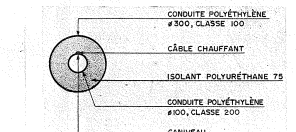
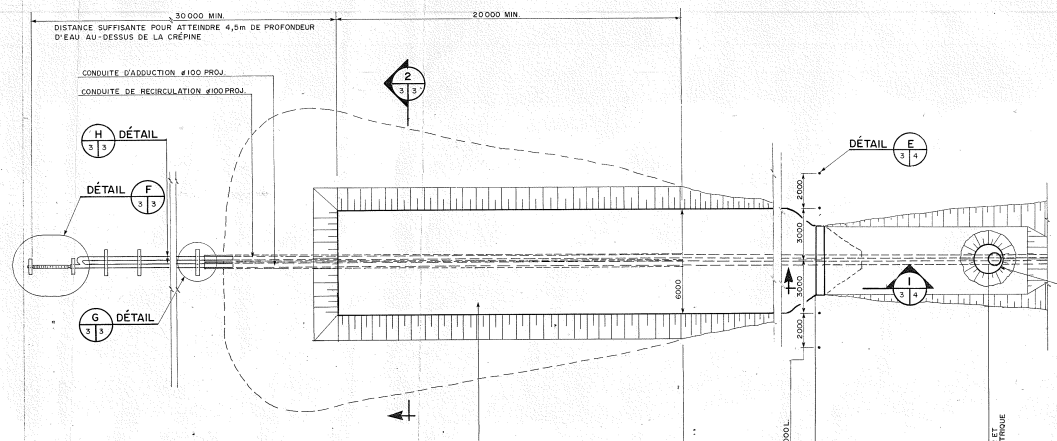
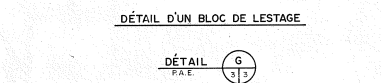
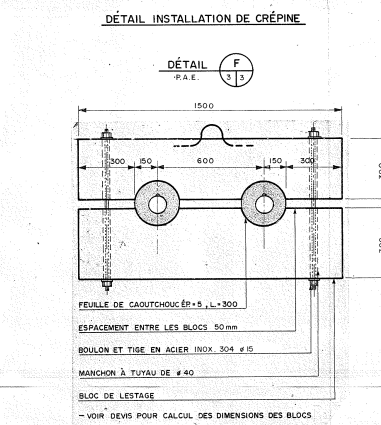
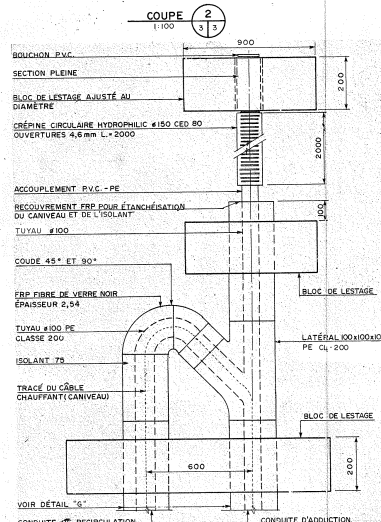
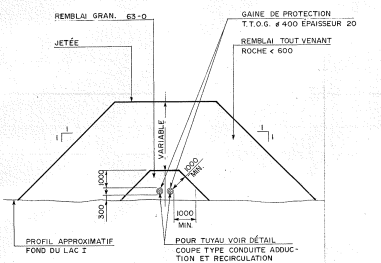
**ALÉAS NATURELS ACTUELS ET APPRÉHENDÉS
 ACTUAL AND POTENTIAL NATURAL HAZARDS
 KANGIQSUALUJJUAQ**
 Québec, Nunavik
 1 : 10 000



cen.ulaval.ca

APPENDIX 2. CONSTRUCTION SCHEMATICS OF THE INSTALLATIONS AT THE WITHDRAWAL SITE

- A2.1, A2.2, and A2.3 Schematics of the installations destined to the withdrawal and treatment of the Northern Village of Kangiqsualujjuaq drinking water.



No.	Date	Modifications	Dessiné	Approuvé
1	86-03-14	ÉMIS POUR APPROBATION		
2	86-04-26	ÉMIS POUR SOUMISSION		
3	86-06-08	ÉMIS POUR CONSTRUCTION (CANULÉE)		
4	87-03-23	RÉVISION GÉNÉRALE ÉMIS POUR SOUMISSION		

No.	Notes
1	LES NIVEAUX NE SONT PAS GÉODÉSIAQUES
2	LE NIVEAU DU LAC PROVIENT DU PLAN DE AÉRO PHOTO
3	LES NIVEAUX DU DESSUS DU BOUCHON DE LA JETÉE ET DES CONDUITES SONT ÉTABLIS EN FONCTION DU NIVEAU DU LAC

SI

Administration Régionale
KATIVIK

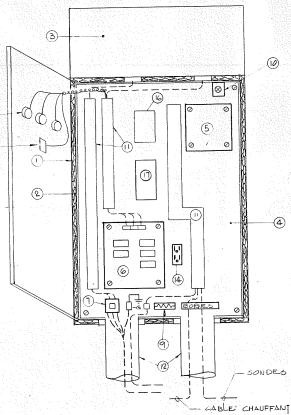
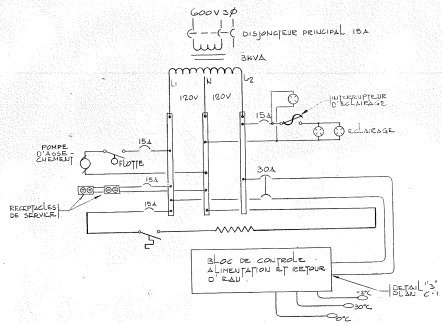
VEZINA, FORTIER ET ASSOCIÉS
CONSULTANTS
MEMBRE DU GROUPE VFA

VILLAGE DE
KANGIOSUALUJUAQ
ALIMENTATION EN EAU POTABLE

Dessiné: *André Lefebvre* Date: 87-03-23 AFFAIRE: 4-2456.1
Vérifié: A.B. Échelle: SOUMISSION Dessiné par: 3
Approuvé: C.V. Échelle: 1:100

PLAN ET PROFIL
DÉTAILS DE LA JETÉE

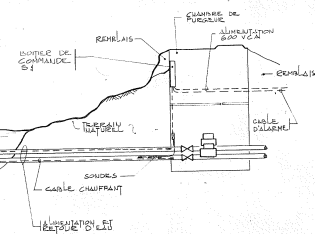
CHAMBRE DE PURGEURS D'AIR



3 BOÎTIER DE COMMANDE TYPE S1

LISTE DES COMPOSANTES DU BOÎTIER DE COMMANDE

1. BOÎTIER EN SOUPEL POLYURE.
2. ISOLANT RIGIDE.
3. TRANSFORMATEUR POUR USAGE EXTERIEUR, 600 V/120-240 V.
4. PLAQUE DE MONTAGE EN ACIER PEINT.
5. BLOC DE CONTRÔLE POUR CABLE CHAUFFANT.
6. PANNEAU D'ALIMENTATION ELECTRIQUE.
7. DISJONCTEUR PRINCIPAL 3 PHASES.
8. LIBRE.
9. ELEMENT CHAUFFANT DU BOÎTIER.
10. THERMOSTAT.
11. CARNEAU DE FILIERE EN PLASTIQUE.
12. CONDUITS RIGIDES EN ACIER 50 MM.
13. LINCERES MONTÉES SUR PORTE.
14. RECEPTACLE LEVISON 91/200.
15. INTERRUPTEUR D'ÉCLAIRAGE MONTÉ SUR LA PORTE DU BOÎTIER MODÈLE 1500.
16. THERMOSTAT À BULBE CHROMAUX À ADJUSTAGE (REGLE) MODÈLE 1151.
17. CONTRÔLEUR DE TEMPÉRATURE DU CABLE CHAUFFANT DE LA DÉCHARGE DE LA POMPE À PURGAGE.

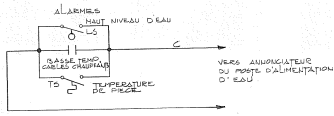


4 DETAIL D'ALIMENTATION DES CABLES CHAUFFANTS CHAMBRE DES PURGEURS D'AIR TYPE S1

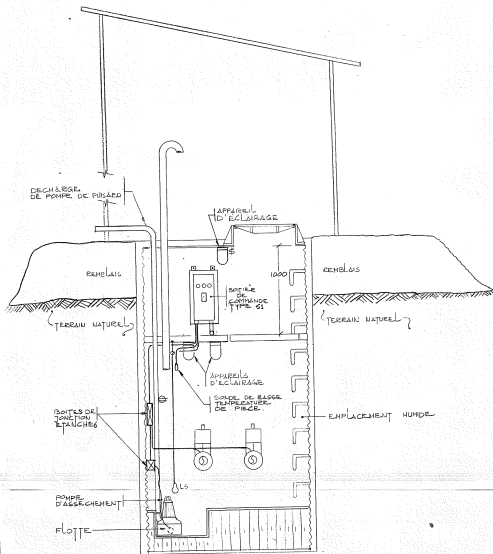
AUTRES COMPOSANTES

- U APPAREILS D'ÉCLAIRAGE HUBBELL ADF-11110, 120 VOLTS INCANDESCENTS AVEC LAMPE A15, 150 WATTS
- LS FLOTTE DE NIVEAU 300 MM AU-DESSUS DU PLANCHER FLOTTANT S22
- ⊕ PRISE DE COURANT MONTÉE AU PNR, 15 A, 120 V, DUPLEX
- CABLE CHAUFFANT DU NIVEAU DE DÉCHARGE DE LA POMPE TYPE AUTOPURGE & 6 MÈTRES ENROULÉ AVEC UN ESPACEMENT DE 25 MM AUTOUR DU TUYAU.

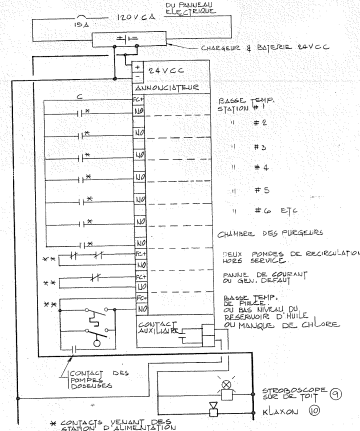
1 DIAGRAMME DE CONTRÔLE TYPE S1



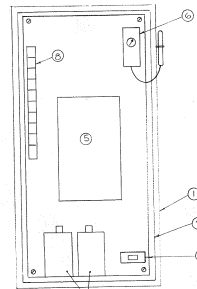
2 CHAMBRE DE PURGEUR D'AIR



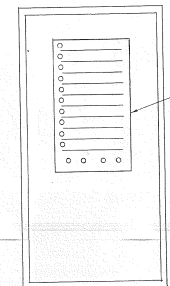
POSTE D'ALIMENTATION D'EAU



5 SCHEMA DE COMMANDE PANNEAU D'ALARME

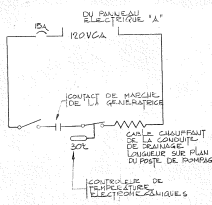


6 VUE INTERIEURE DU PANNEAU D'ALARME



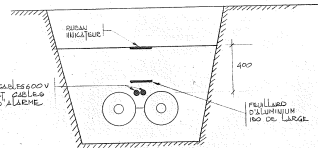
7 VUE DE FACE DU PANNEAU D'ALARME

8 SCHEMA DE CONTRÔLE CABLE CHAUFFANT DE LA CONDUITE DE DRAINAGE TYPE S2



LISTE DES COMPOSANTES

1. BOÎTIER EN ACIER PEINT AVEC PORTE A CHARNIERE, CALIBRE 12.
2. PLAQUE DE MONTAGE EN ACIER, CALIBRE 10.
3. AMPLIFICATEUR PANALAM, SERIE 910, 24V CC POUR MONTAGE DANS UN PANNEAU COMPLET AVEC KLAXON, BOUTON D'ÉCARTIEMENT, BILAS AVEC LIAISE D'ALARME COMUNE. SOURCE DE TENSION FOURNIE PAR L'ANNEXE INTERIEUR POUR LES CONTACTS D'ALARME.
4. BATTERIES ALLIÉES LS-12-25 POUR 24 VOLTS CC.
5. CHARGEUR A TENSION CONSTANTE 24 VOLTS CC, C & D BATTERIES SERIE RAT, 10 AMPÈRES.
6. THERMOSTAT DE PIÈCE À BULBE CHROMAUX À ADJUSTAGE (REGLE) MODÈLE 1151.
7. DISJONCTEUR PRINCIPAL.
8. SONNERIE.
9. PHARE STEREOSCOPIQUE EDWARDS 1172-1-01.
10. KLAXON 24 VCC POUR EXTERIEUR.



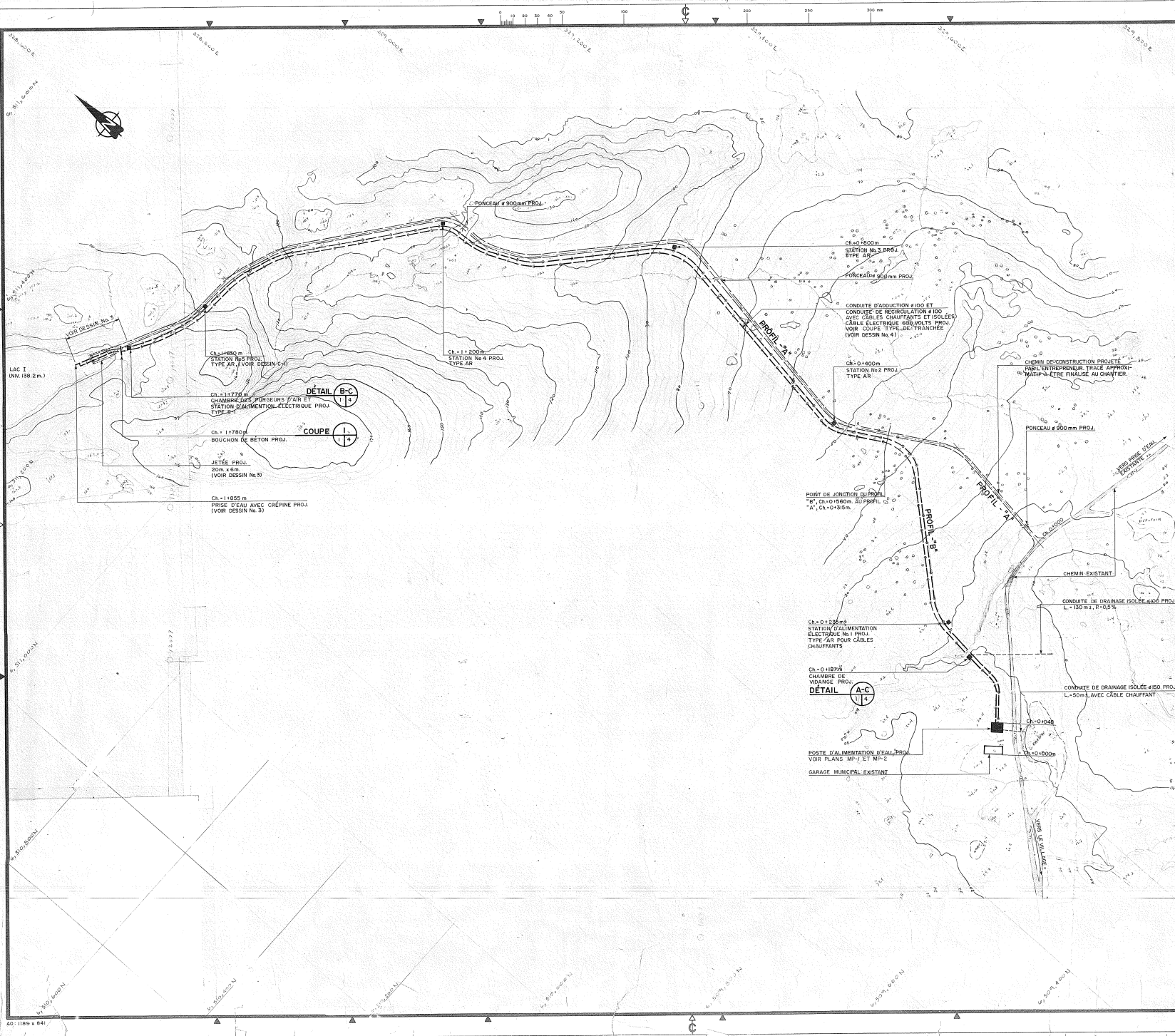
8 TRANCHEE TYPE

No.	Date	Modifications	Dessiné	Approuvé
1	86-03-14	ÉMIS POUR APPROBATION		
2	86-04-26	ÉMIS POUR SOUMISSION		
3	86-05-07	ADDENDA N° 2		
4	86-06-06	ÉMIS POUR CONSTRUCTION		
5	87-03-23	REV. GEN. ÉMIS POUR SOUMISSION		DR

Notes	
QUANTITES POUR LE VILLAGE DE KANGIUSUALJUJUAQ	
DESIGNATION	QUANTITE
TYPE S1	1
TYPE S2	1
PANNEAU D'ALARME	1

AGENCIÉRIE	
SI	
20760	
QUEBEC	
HÉRIFF-DUBOUCHÉ	
INGÉNIEUR	

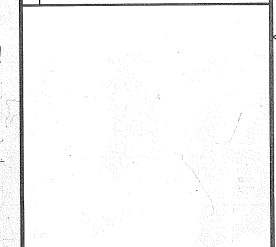
ADMINISTRATION REGIONALE KATIVIK					
MEYMA FORTIER ET ASSOCIÉS CONSULTANTS					
BUREAU DE QUÉBEC 1054					
1500, Boulevard Comptoir, 3ème Étage Montréal (Québec) Canada H3B 2S9					
(514) 482-3810 Téléc. (514) 482-3820					
VILLAGE DE KANGIUSUALJUJUAQ					
ALIMENTATION EN EAU POTABLE					
Dessiné	U.P.A.	Date	86-06-06	Approuvé	4-2456.1
Vérifié	V.N.	Émission		Titulaire	
Approuvé	V.N.	Échelle	D.S.E.	Projet	C-2
DÉTAILS					
CHAMBRE DES PURGEURS D'AIR					
POSTE D'ALIMENTATION D'EAU					



No.	Date	Modifications	Devisé	Approuvé
1	86-03-14	EMIS POUR APPROBATION		
2	86-05-26	EMIS POUR SOUMISSION		
3	86-06-06	EMIS POUR CONSTRUCTION (ANNULEE)		
4	87-03-23	REVISION GENERALE EMIS POUR SOUMISSION		

Notes

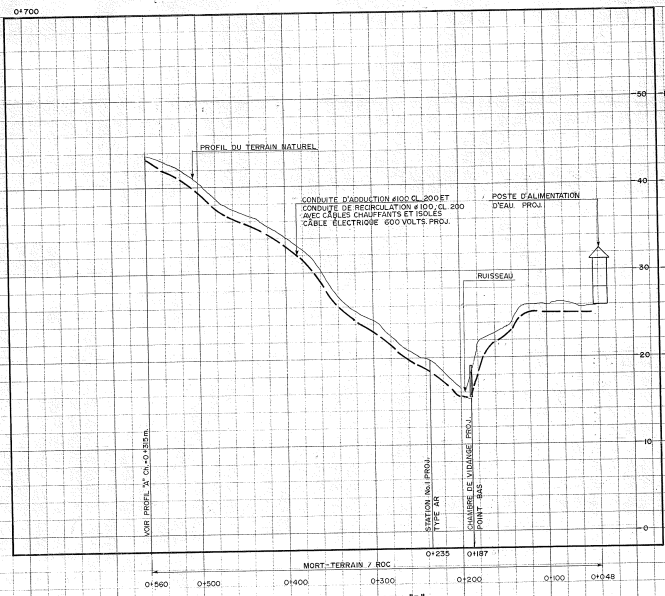
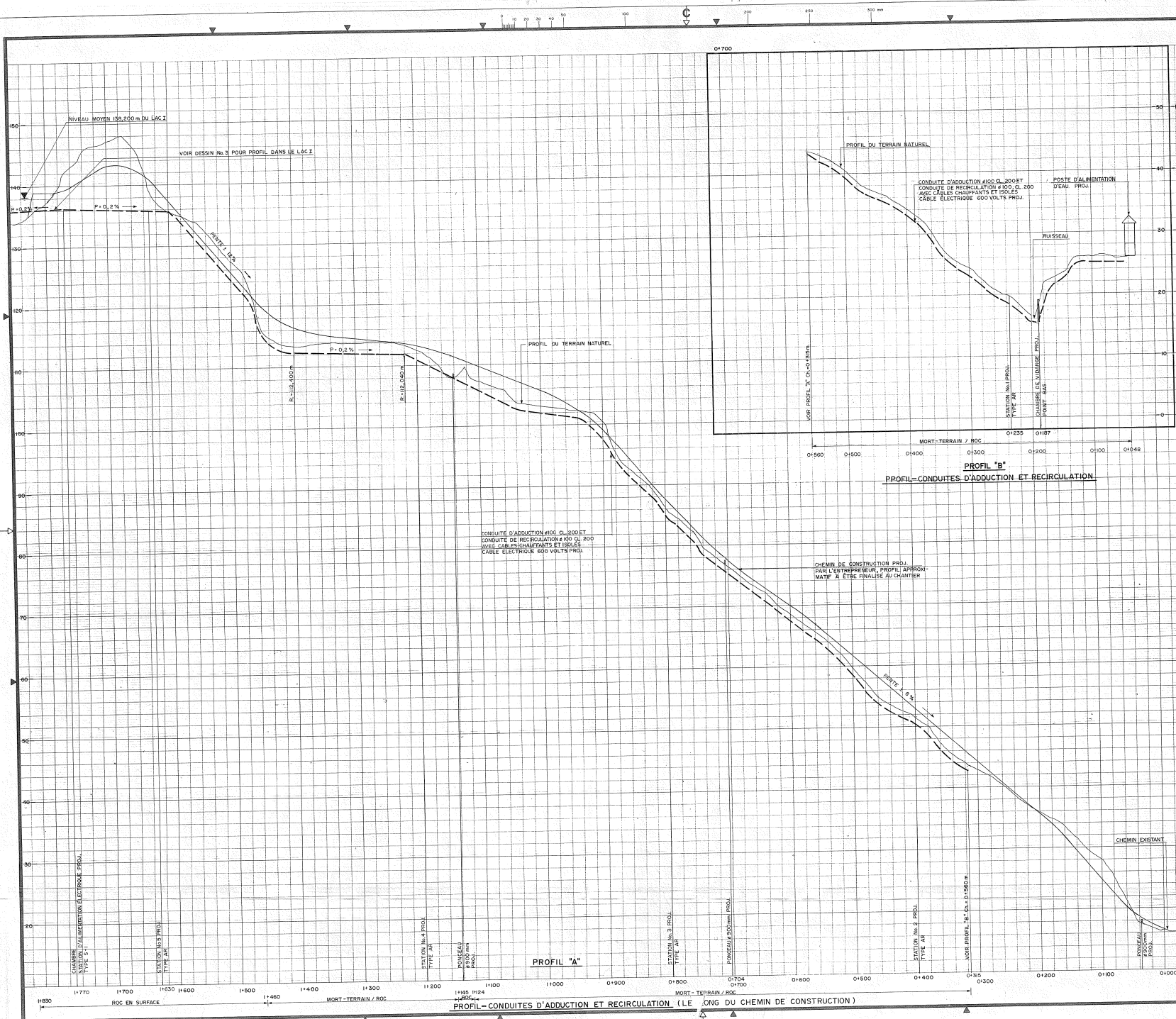
1 LES COURBES DE NOUVEAU PROVIENNENT D'INTERPRETATIONS A PARTIR DE PHOTOGRAPHIES AERIENNES ET NE SONT PAS GEODESIQUES.



**ADMINISTRATION REGIONALE
KATIVIK**

**VILLAGE DE
KANGISUALUJUAQ**

ALIMENTATION EN EAU POTABLE	
DESSIN VEZINA, FORTIER ET ASSOCIES CONSULTANTS MEMBRE DU GROUPE VFA <small>2500 Boulevard Carrière, Bureau 305, Miramichi (Québec) Canada J4B 2A9 (514) 463-3010 Téléc. (514) 463-3010 FAX (514) 463-3010</small>	DATE 87-03-23 AFFAIRE 4-2456.1
VERIFIÉ A. D. SOUMISSION	DESSIN No. 1
APPROUVE C.V. 1:2000	PLAN CONDUITES ET ROUTE



No.	Date	Modifications	Approuvé
1	86-03-14	EMIS POUR APPROBATION	
2	86-04-26	EMIS POUR SOUMISSION	
3	86-05-05	EMIS POUR CONSTRUCTION (ANNULEE)	
4	87-03-23	REVISION GENERALE EMIS POUR SOUMISSION	

Notes	
1	LES NIVEAUX NE SONT PAS GEODESIQUES
2	LES CONDUITES D'ADDUCTION ET DE RECIRCULATION DEVRONT SUIVRE UN PROFIL REGULIER SANS CREER DE POINT HAUT OU BAS SAUF CEUX INDIGUES SUR LES PLANS.



ADMINISTRATION REGIONALE
KATIVIK

VEZINA, FORTIER ET ASSOCIES
CONSULTEURS
MEMBRE DU GROUPE VFA

VILLAGE DE
KANGISQUALUJJUAO
ALIMENTATION EN EAU POTABLE

Dessiné: <i>André Gauthier</i>	Date: 87-03-23	Affaire: 4-2456.1
Approuvé: C.V.	Échelle: 1:2000	Dessin No: 2

PROFILS
CONDUITES ET ROUTE

APPENDIX 3. LAND USES

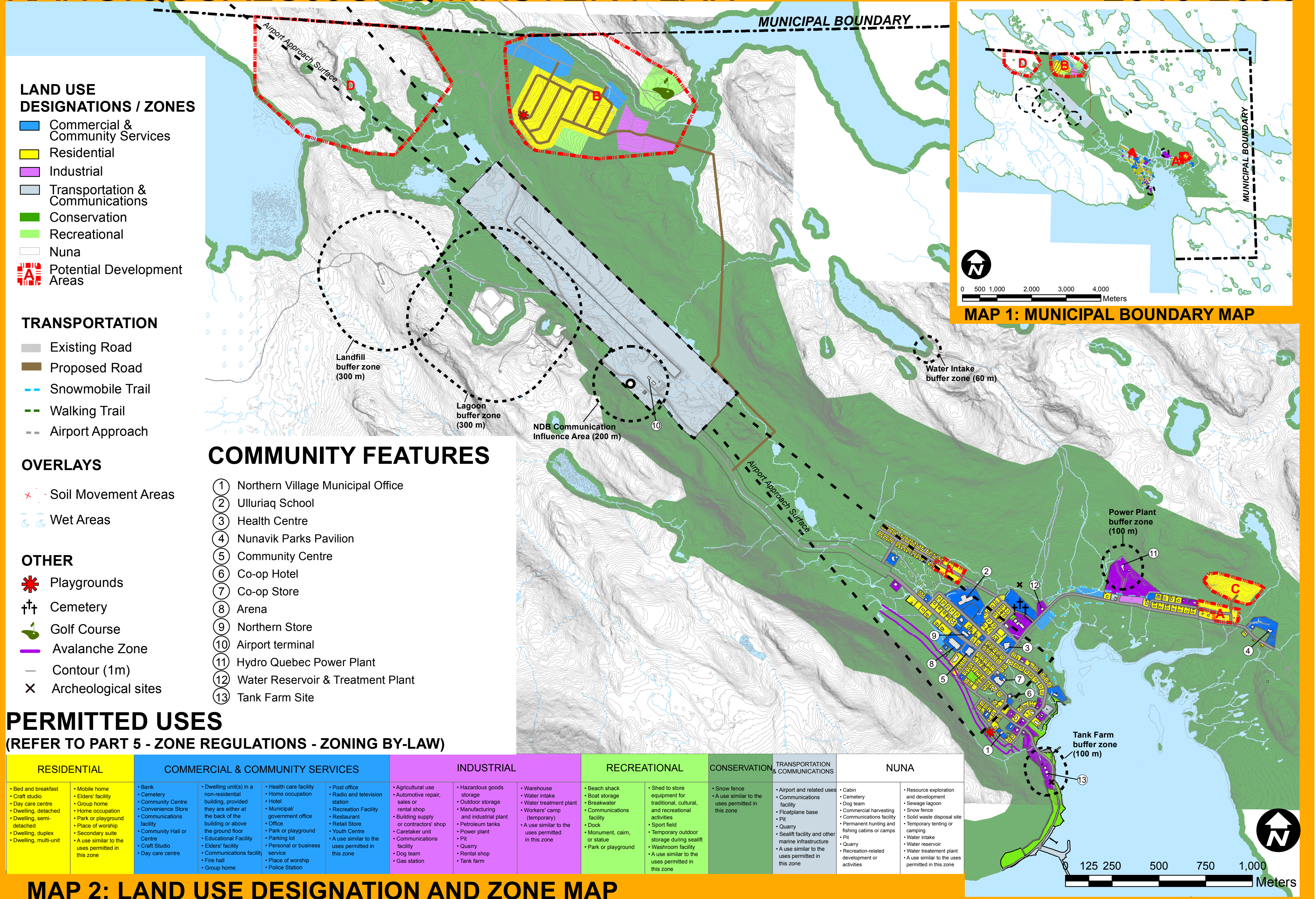
Table 5. Inventory of land uses likely to impact in a positive or in a negative way the drinking water source

Name of the zone	Protection zone	Threat/protection represented by the land use	Land use associated to a threat/ a protection	Potential contaminants and associated risks
Nuna	All zones	Threat	Mining exploration	Inorganic substances and sediments Risk is negligible
Nuna	All zones	Threat	Cemetery	Organic substances, microorganisms Risk is negligible
Nuna	All zones	Threat	Sewage lagoon	Organic substances, microorganisms Risk is negligible
Nuna	All zones	Threat	Solid waste disposal site	Organic and inorganic substances, microorganisms Risk is negligible
Nuna	All zones	Protection	Hunting and fishing	-
Nuna	All zones	Protection	Berry picking	-
Nuna	All zones	Protection	Camping and outdoors activities	-

- A3.1 Zoning map of the Northern Village of Kangiqsualujjuaq (From: KRG)
- A3.2 Kangiqsualujjuaq Land Categories (From: Nunavik Landholding Corporation Association)

KANGIQSUALUJJUAQ MASTER PLAN

2016-2036



LAND USE DESIGNATIONS / ZONES

- Commercial & Community Services
- Residential
- Industrial
- Transportation & Communications
- Conservation
- Recreational
- Nuna
- Ⓜ Potential Development Areas

TRANSPORTATION

- Existing Road
- Proposed Road
- - Snowmobile Trail
- - Walking Trail
- - Airport Approach

OVERLAYS

- ✖ Soil Movement Areas
- ☁ Wet Areas

OTHER

- ✳ Playgrounds
- †† Cemetery
- 🌳 Golf Course
- Avalanche Zone
- Contour (1m)
- ✕ Archeological sites

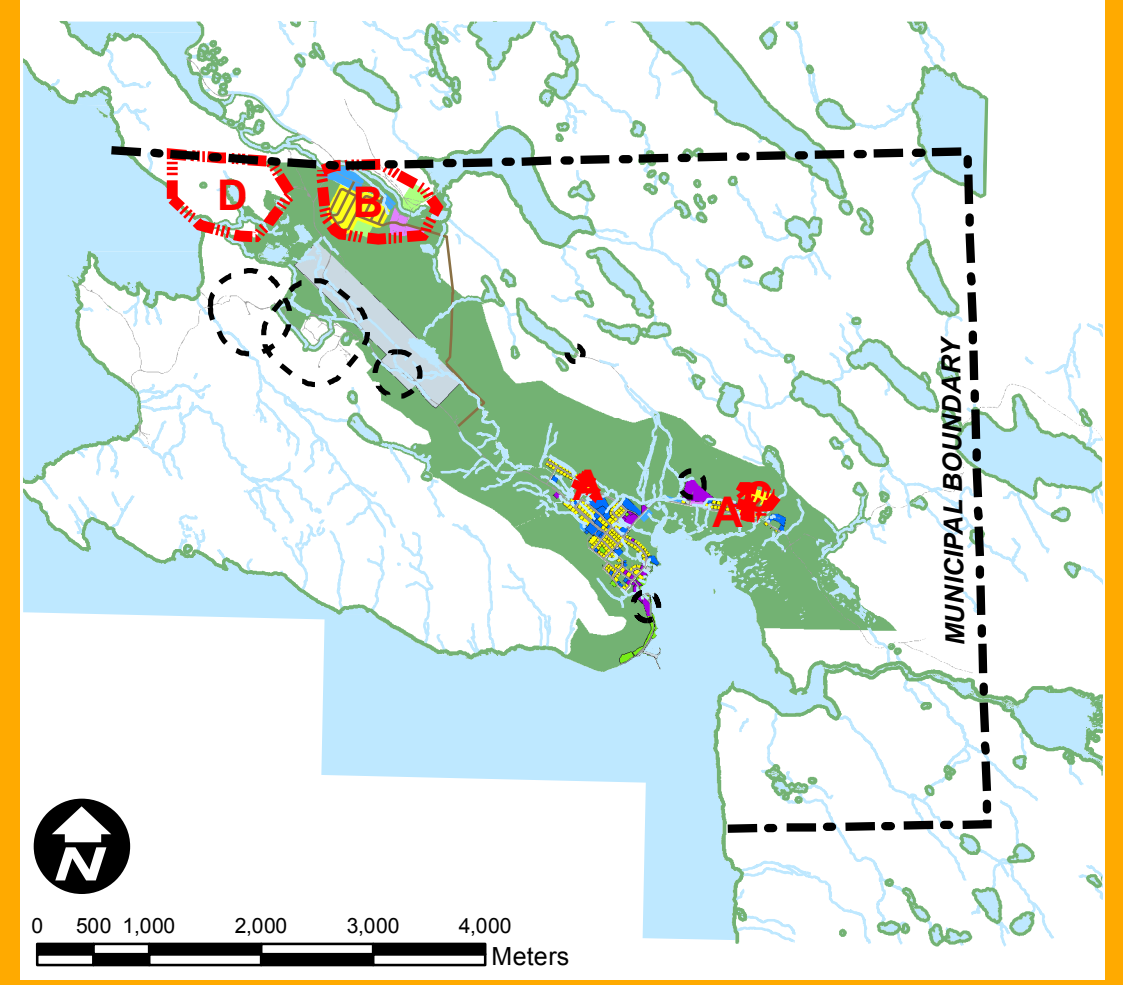
COMMUNITY FEATURES

- ① Northern Village Municipal Office
- ② Ulluriaq School
- ③ Health Centre
- ④ Nunavik Parks Pavilion
- ⑤ Community Centre
- ⑥ Co-op Hotel
- ⑦ Co-op Store
- ⑧ Arena
- ⑨ Northern Store
- ⑩ Airport terminal
- ⑪ Hydro Quebec Power Plant
- ⑫ Water Reservoir & Treatment Plant
- ⑬ Tank Farm Site

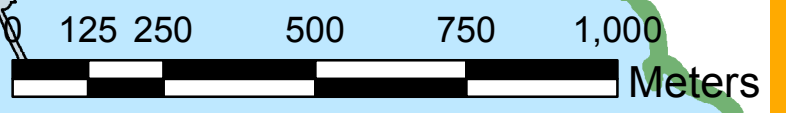
PERMITTED USES

(REFER TO PART 5 - ZONE REGULATIONS - ZONING BY-LAW)

RESIDENTIAL	COMMERCIAL & COMMUNITY SERVICES	INDUSTRIAL	RECREATIONAL	CONSERVATION	TRANSPORTATION & COMMUNICATIONS	NUNA
<ul style="list-style-type: none"> • Bed and breakfast • Craft studio • Day care centre • Dwelling, detached • Dwelling, semi-detached • Dwelling, duplex • Dwelling, multi-unit • Mobile home • Elders' facility • Group home • Home occupation • Park or playground • Place of worship • Secondary suite • A use similar to the uses permitted in this zone 	<ul style="list-style-type: none"> • Bank • Cemetery • Community Centre • Convenience Store • Communications • Community Hall or Centre • Craft Studio • Day care centre • Dwelling unit(s) in a non-residential building, provided they are either at the back of the building or above the ground floor • Educational Facility • Elders' facility • Communications facility • Fire hall • Group home • Health care facility • Home occupation • Hotel • Municipal/ government office • Office • Park or playground • Parking lot • Personal or business service • Place of worship • Police Station • Post office • Radio and television station • Recreation Facility • Restaurant • Retail Store • Youth Centre • A use similar to the uses permitted in this zone 	<ul style="list-style-type: none"> • Agricultural use • Automotive repair, sales or rental shop • Building supply or contractors' shop • Caretaker unit • Communications facility • Dog team • Gas station • Hazardous goods storage • Outdoor storage • Manufacturing and industrial plant • Petroleum tanks • Power plant • Pit • Quarry • Rental shop • Tank farm • Warehouse • Water intake • Water treatment plant • Workers' camp (temporary) • A use similar to the uses permitted in this zone 	<ul style="list-style-type: none"> • Beach shack • Boat storage • Breakwater • Communications facility • Dock • Monument, cairn, or statue • Park or playground • Shed to store equipment for traditional, cultural, and recreational activities • Sport field • Temporary outdoor storage during sealift • Washroom facility • A use similar to the uses permitted in this zone 	<ul style="list-style-type: none"> • Snow fence • A use similar to the uses permitted in this zone 	<ul style="list-style-type: none"> • Airport and related uses • Communications facility • Floatplane base • Pit • Quarry • Sealift facility and other marine infrastructure • A use similar to the uses permitted in this zone 	<ul style="list-style-type: none"> • Cabin • Cemetery • Dog team • Commercial harvesting • Communications facility • Permanent hunting and fishing cabins or camps • Pit • Quarry • Recreation-related development or activities • Resource exploration and development • Sewage lagoon • Snow fence • Solid waste disposal site • Temporary tenting or camping • Water intake • Water reservoir • Water treatment plant • A use similar to the uses permitted in this zone



MAP 1: MUNICIPAL BOUNDARY MAP



MAP 2: LAND USE DESIGNATION AND ZONE MAP

APPENDIX 4. PRECISIONS ABOUT THE VULNERABILITY TO TURBIDITY

- A4.1 Pdf from LNA (4 pages : 1 table and 3 maps)
- A4.2 Email from LNA

Tableau 1 : Détermination de la vulnérabilité des eaux exploitées à la turbidité

Client : Groupe Synergis

Projet : Accompagnement technique pour l'analyse de vulnérabilité des sources d'eau potable du village

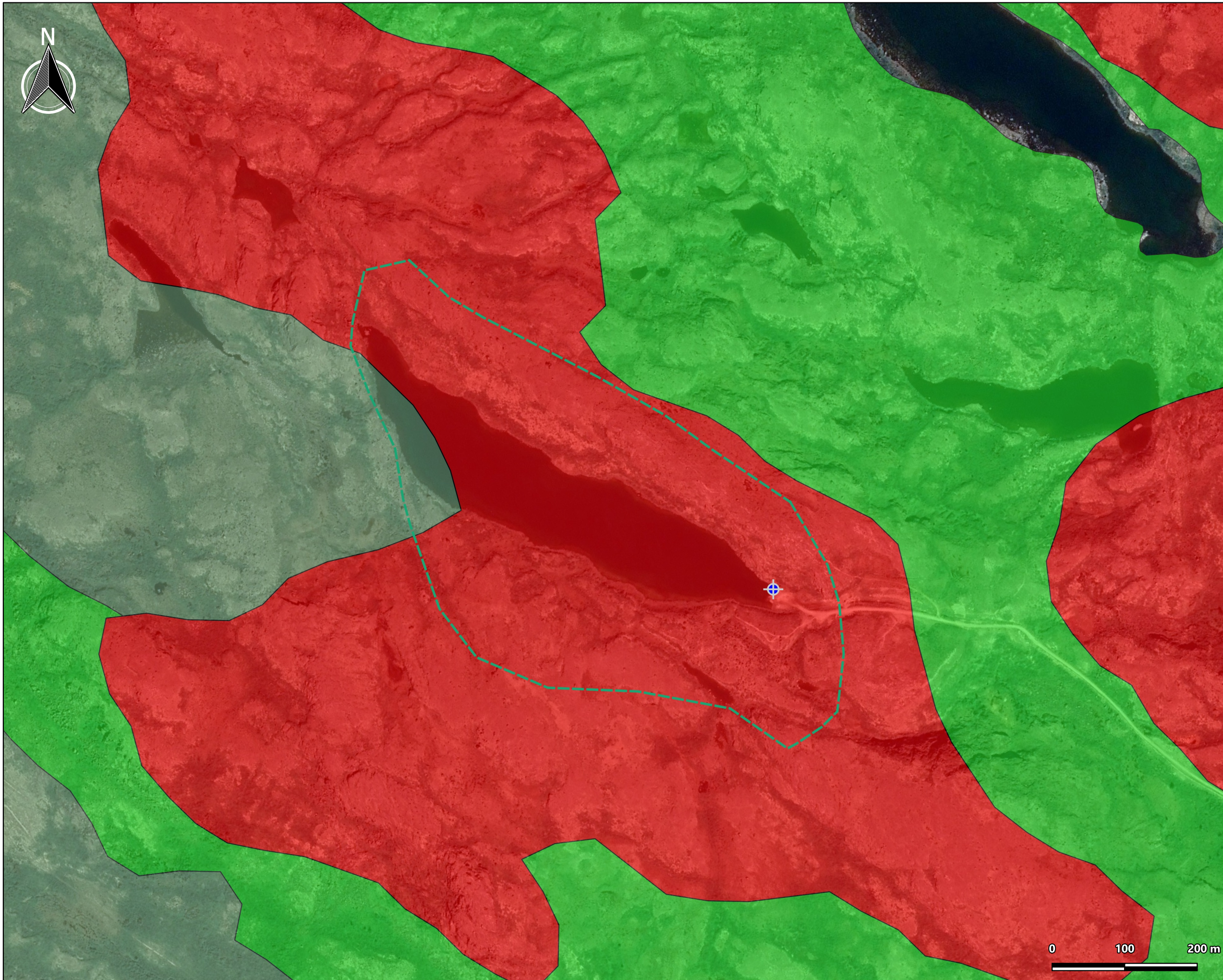
nordique de Kangiqsualujjuaq

N/Ref. : 20-6867-4663

Caractéristique du milieu	Description	Source des données	Risque associé pour la turbidité
Pédologie	Pergélisol. Pas d'information sur la nature précise de ce dernier sur toute la surface. Mais les forages réalisés dans le cadre de l'étude intitulée "Caractérisation géotechnique et cartographie améliorée du pergélisol dans les communautés nordiques du Nunavik" montre que majoritairement la surface du pergélisol est constituée de matière organique ou de sable. Le sable peut facilement être remobilisé et ainsi se retrouver dans les cours d'eau.	Rapport "Caractérisation géotechnique et cartographie améliorée du pergélisol dans les communautés nordiques du Nunavik - Kangiqsualujjuaq"	Moyen
Géologie	Le bassin versant est restreint et entouré très majoritairement (environ 95%) par des affleurements rocheux. La faible épaisseur de sol favorise le ruissellement	Ministère des Forêts, de la Faune et des Parcs	Élevé
Relief	Utilisation du MNT pour calculer les pentes dans un logiciel SIG. Le lac est entouré par des pentes modérées à fortes (15 à 40%). Ces fortes pentes favorisent le ruissellement et la mise en mouvement des particules notamment lors de fortes précipitations.	MNT (MERN)	Moyen
Couvert végétal	La végétation de la partie terrestre du bassin versant de la prise d'eau est désignée comme de la toundra à arbustes dressés. Cette végétation contribue à diminuer le ruissellement.	Ministère des Forêts, de la Faune et des Parcs	Faible
Affectation du territoire	Affectations du territoire du village nordique de Kangiqsualujjuaq, les bordures du lac sont classées comme « zones de conservation » et le reste des aires de protection de la source d'eau appartient à la zone « Nuna », laquelle est principalement dédiée aux activités traditionnelles et récréatives	Affectations du territoire de Kangiqsualujjuaq	Faible

Vulnérabilité retenue pour l'indicateur D

Moyen








Groupe Synergis

Accompagnement technique pour l'analyse de vulnérabilité des sources d'eau potable du village nordique de Kangiqsualujuaq

Géologie des dépôts de surface

LÉGENDE

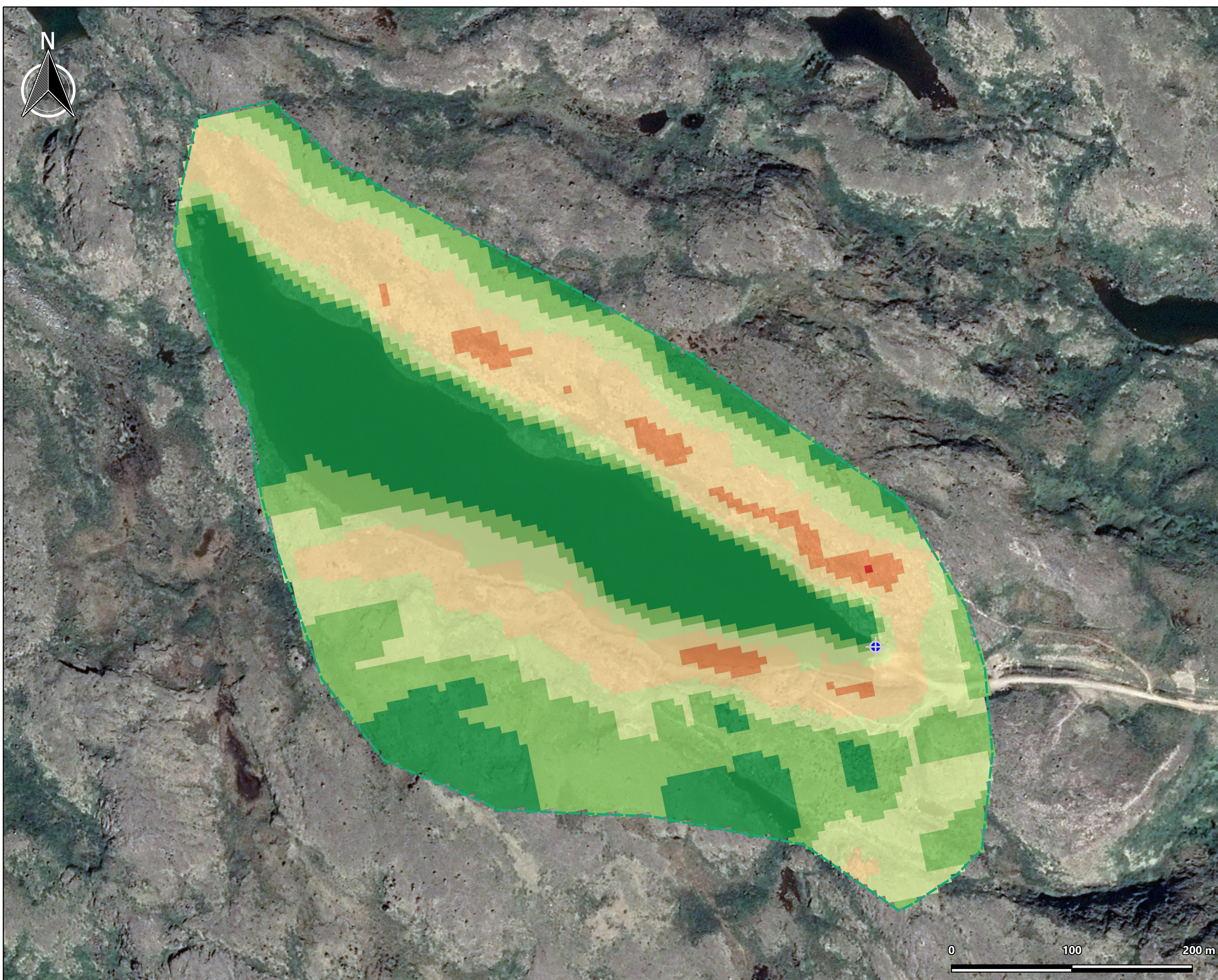
-  Prise d'eau
-  Aire de protection éloignée
- Dépôts de surface**
-  Till indifférenciés
-  Littoral - Faciès d'eau peu profonde
-  Roc

Nom du fichier :
20-6867-4663_fig1_depots_surface_Kangiq
Fond cartographique : Google satellite
Projection NAD83 UTM20

Échelle :	1 : 5 000	Date :	2021-02-12
Figure :	1	Dossier :	20-6867-4663
Approuvé par : Jean-Philippe Tremblay, géo., hydrogéologue			
Préparé par : Jérémie Targosz, chargé de projet			
Dessiné par : Jérémie Targosz, chargé de projet			



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





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Accompagnement technique pour l'analyse de vulnérabilité des sources d'eau potable du village nordique de Kangiqsualujuaq

Carte des pentes au sein des aires de protection

LÉGENDE

-  Prise d'eau
 -  Aire de protection éloignée
- Classes de pente
-  Pente nulle 0 à 3%
 -  Pente faible 4 à 8%
 -  Pente douce 9 à 15%
 -  Pente modérée 16 à 30%
 -  Pente forte 31 à 40%
 -  Pente excessive 41% et plus

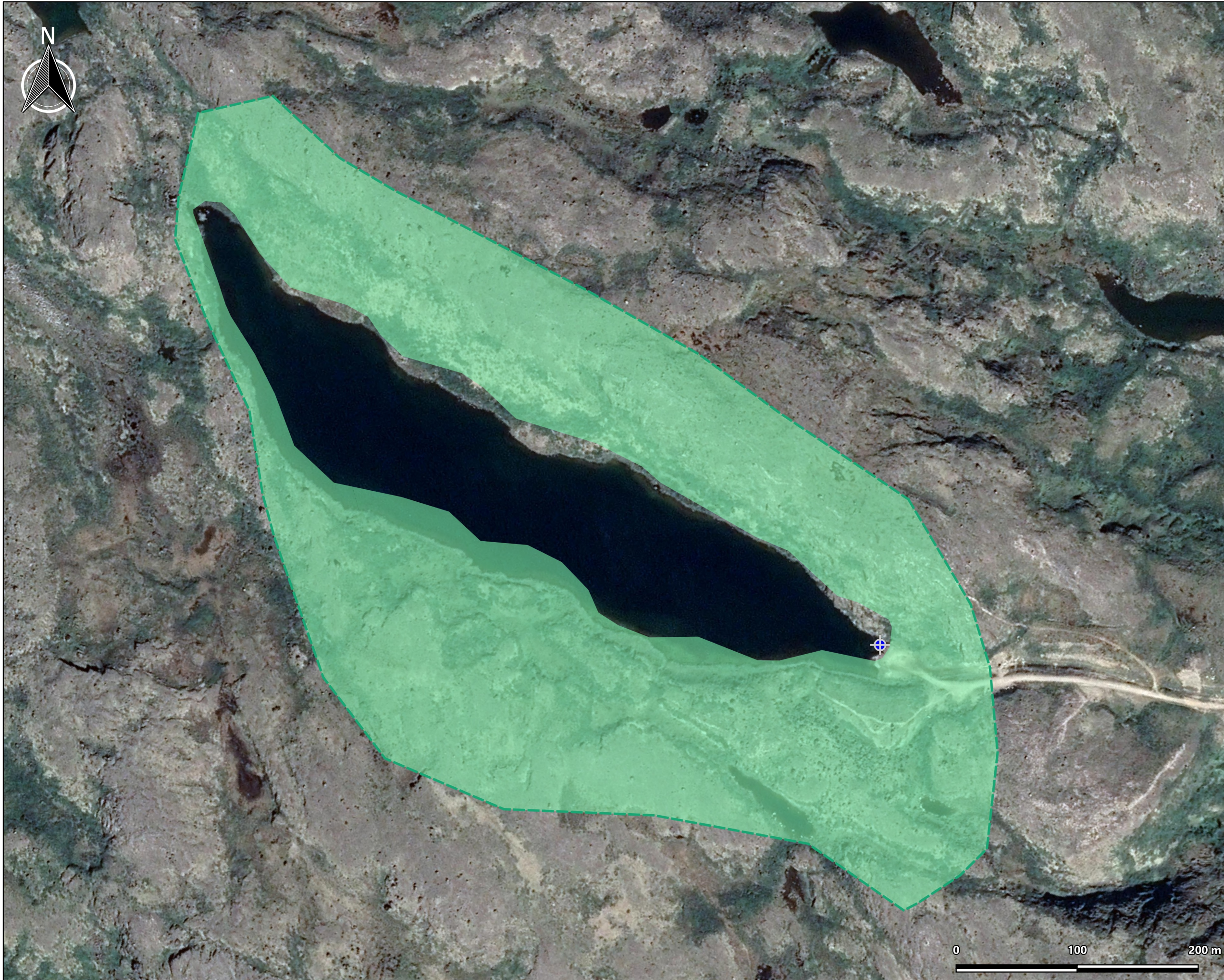
Nom du fichier : 20-6867-4663_fig2_pentes_Kangiq
 Fond cartographique : Google satellite
 Projection NAD83 UTM20

Échelle :	1 : 3 000	Date :	2021-02-12
Figure :	2	Dossier :	20-6867-4663
Approuvé par : Jean-Philippe Tremblay, géo., hydrogéologue			
Préparé par : Jérémy Targosz, chargé de projet			
Dessiné par : Jérémy Targosz, chargé de projet			



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


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Accompagnement technique pour l'analyse de vulnérabilité des sources d'eau potable du village nordique de Kangiqsualujuaq

Cartographie du couvert végétal au sein des aires de protection

LÉGENDE

-  Prise d'eau
-  Aire de protection éloignée
- Végétation cartographiée**
-  Toundra à arbustes dressés

Nom du fichier :
20-6867-4663_fig3_vegetation_Kangiq
Fond cartographique : Google satellite
Projection NAD83 UTM20

Échelle :	1 : 3 000	Date :	2021-02-12
Figure :	3	Dossier :	20-6867-4663
Approuvé par : Jean-Philippe Tremblay, géo., hydrogéologue			
Préparé par : Jérémy Targosz, chargé de projet			
Dessiné par : Jérémy Targosz, chargé de projet			



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Demande d'avis externe - Études de vulnérabilité Villages de l'eau potable - Villages Nordique

J.Targosz | LNA <jtargosz@lnaqua.com>

Lun 2021-02-15 14:59

À : Rachel Hussherr <rachel.hussherr@nunaressources.ca>

Cc : Jean-Philippe Tremblay <jptremblay@lnaqua.com>; lguillemette@synergis.ca <lguillemette@synergis.ca>

 2 pièces jointes (24 Mo)

20-6867-4663_Indicateur_D_Kagiq.pdf; 20-6867-4663_Indicateur_D_Salluit.pdf;

Bonjour Rachel,

Vous trouverez ci-joint notre avis concernant la vulnérabilité des eaux exploitées à la turbidité pour les prises d'eau Kangiqsualujjuaq et Salluit.

À partir des informations disponibles, nous avons attribué un niveau de risque (faible, moyen ou élevé) aux principales caractéristiques du milieu pouvant impacter la turbidité des eaux exploitées. Grâce au niveau obtenu pour chacun des paramètres, nous avons pu déterminer le niveau de vulnérabilité de l'indicateur D.

En l'absence de données abondantes et précises, nous avons choisi de définir les niveaux de vulnérabilité de façon sécuritaire.

En espérant le tout conforme à vos attentes, je demeure disponible pour toute interrogation.

Au plaisir,

APPENDIX 5. EXAMPLE OF AN EVENT REGISTER

Identification of the withdrawal site

Location of the potable water production facility: [Northern Village of Kangiqsualujjuaq](#)

Identification of the withdrawal site:

Name : [Kangiqsualujjuaq – Approv.](#)

Number : [X2114288](#)

Event details

Description of event: _____

Start date: _____ End date: _____

Types of problem encountered:

- Water shortage (strictly linked to a drying up of the water source)
- Obstruction or breakage at the withdrawal site
- Malfunction of the screening, filtration, disinfection system or the entire treatment (validate whether MELCC must be advised in accordance to Article 35.1)
- Other: _____

Affected equipments or processes :

- Equipment: Strainer Water pipes Pumping system
- Processes: Screening Filtration Disinfection
- Entire treatment system
- Others: _____
- None

Location of occurrence (note if necessary): _____

Categories of events to which the observations refer:

- Natural or anthropogenic events that affected the physical integrity of the withdrawal site
- Algae, cyanobacteria or aquatic plants proliferation
- Suspected or measured increases in ammoniacal nitrogen
- Others

Observations made by (name) :

Position :

Signature :

Date :

***Reminders:**

- A separate register must be kept for each withdrawal site, ie for each separate water withdrawal installation;
- Each event must be listed separately (one event per page), even if two events occur simultaneously;
- An event whose effect extends over several consecutive days should be recorded as a single event. However, a similar event that occurs periodically must be recorded separately at each occurrence.

Details of some of the information to be entered in the register

Event information

Types of problem encountered: Check all types of applicable problems according to the classification established in section 22.0.4 of RRQDW.

Types of problems encountered	Examples
Water shortage (strictly linked to a drying up of the water source)	Low flow leading to an exposure of the water intake
	Drainage due to the breaking of a retention dam
Obstruction of the withdrawal site	Silting up
	Frazil
	Proliferation of aquatic plants or zebra mussels
	Accumulation of coarse debris
Breakdown of the withdrawal site	Damages caused by ice
	Subsidence of a retaining wall
	Tearing off / removing of the supply line
Malfunction of the screening, coagulation, settling, filtration, disinfection system or of the entire treatment system	Overgrowth of algae, cyanobacteria or other microorganisms causing taste and odor problems in treated water
	Proliferation of aquatic plants or zebra mussels causing problems with the screening system
	Presence of a contaminant in raw water (for example, ammoniacal nitrogen) which increases the consumption of chemicals (eg. chlorine) and prevents the achievement of treatment goals
Others (any other problem that does not belong to one of the three previous types of problems)	Presence of a contaminant in the raw water which does not affect the operation of existing treatment processes, but which cannot be treated by these processes (eg. chlorides in high concentrations or hydrocarbons).
	<u>Note:</u> Depending on the nature of the contaminant and the risks it represents for human health, its presence could lead to the temporary closure of the water intake.

Place where the event occurred: in some cases, it may be relevant to note the location of the event (eg. the location of the cyanobacteria bloom or the location of a spill).

Categories of events to which the observations refer/relate: Check all the categories concerned.

- Natural or anthropogenic events that have affected the physical integrity of the withdrawal site include events associated with a water shortage, an obstruction or breakage of the sampling site.

The "other" category includes all events that do not correspond to one of the first three categories.