



City of Iqaluit

Sewage Lagoon Operation and Maintenance Manual

July 21, 2026

Rev 9



Annual Updates Page

The annual update pages are to be completed on an approximately annual basis. The update description should contain a brief and concise summary of any additions to the O&M Manual since the last update. Typically, this would include any repairs/maintenance activities performed, updates to the Permanent Log Book, new construction, alterations, supplementary historical documents, changes to the Water Licence or the list of responsible personnel, etc.

Rev	Date	Comments	Author
0	Sept 2004	No additions to Permanent Record File (PRF).	Allan Murray (Concentric)
1	Sept 2005	2004 DSI added to appendix.	Allan Murray (Concentric)
2	Feb 2005	2005 DSI added to appendix.	Allan Murray (Concentric)
3	Aug 2006	2006 DSI added to appendix. Lagoon was taken offline June 2006; all effluent to new sewage treatment plant, lagoon now on back-up status. Repairs/alterations to west berm completed Aug 2006.	Allan Murray (Concentric)
4	Oct 2009	2009 DSI added to appendix.	Allan Murray (Concentric)
5	Sep 2011	2011 DSI added to appendix.	Allan Murray (Concentric)
6	Jun 2012	2012 DSR added to appendix.	Allan Murray (Concentric)
7	March 2020	PRF was updated and Permanent Log Book added to individual appendices. Latest DSI included in Appendix F. Facility history and background updated with information on WWTP redesign upgrades.	Zach Paquin (Stantec)
8	July 21, 2026	Updated to support the water licence renewal and amendment.	Richard Cook (Knight Piésold Ltd.)
9	July 22, 2026	Clarified use of sewage lagoon, clarified when effluent is sampled, and updated guidance regarding dam safety inspections.	Richard Cook (Knight Piésold Ltd.)



Executive Summary

Wastewater that is bypassed from the City of Iqaluit wastewater treatment plant (WWTP) is discharged into a single-celled anaerobic lagoon system; the volume of which is estimated to be 25,000 m³. The available piping systems to the lagoon incorporate a combination septage dump station and diversion chamber, which allows both the septage and gravity flow from the City's system to be directed to the lagoon on a provisional basis.

The outlet from the lagoon, based on 1991 as-builts, consists of a piped discharge controlled by a valve chamber. The elevation of the discharge is 5.6 metres, which is approximately 2 metres above the bottom of the lagoon. The lagoon is not lined and several features such as a French drain, and an overflow spillway, were incorporated into the design of the lagoon to maintain the geotechnical stability of the system. The discharge point of the outlet directs the flow to the same channel in which the current WWTP outfall discharges.

This manual consists of the operation and maintenance procedures for the Iqaluit WWTP Sewage Lagoon. The manual is developed to ensure the operation and maintenance of the sewage lagoon meets the mandatory requirements as per Type A Water Licence 3AM-IQA1626, issued by the Nunavut Water Board and approved by the Minister of Crown-Indigenous Relations and Northern Affairs Canada.

Operation and maintenance checklists for weekly, and monthly review have been provided in this manual and should be followed. The inspections and maintenance that takes place for the sewage lagoon should be recorded; a site inspection template has been included in Appendix D to record such information.

The Sewage Lagoon O&M Manual shall act as a permanent record file for all aspects relating to the Iqaluit WWTP Sewage Lagoon. Changes or additions to the manual shall be logged to ensure the history and operation of the facility has been maintained.



Table of Contents

Executive Summary	i
1.0 Introduction	1
2.0 Responsible Personnel	2
2.1 Emergency Planning & Contact	2
3.0 Background	3
3.1 Wastewater Collection	3
3.2 Iqaluit WWTP	3
3.3 Sewage Lagoon	4
3.3.1 Overview	4
3.3.2 History	6
4.0 Monitoring and Inspections	9
4.1 Weekly Inspection Program	9
4.1.1 Inlet Structure Monitoring	9
4.1.2 Berm Inspections	11
4.1.3 Outlet Structure Monitoring	13
4.1.4 Colour Observations	14
4.1.5 Weekly Checklist	14
4.2 Monthly Inspection Program	15
4.2.1 Floating Material Removal	15
4.2.2 Effluent and Drainage	15
4.2.3 Signage	15
4.2.4 Monthly Checklist	15
4.3 Annual Inspection	15
4.4 Nuisance Control	16
4.4.1 Odours	16
4.4.2 Vegetation Control	16
4.4.3 Insects	17
5.0 Sludge Management	18
5.1.1 Sludge Survey	18
5.1.2 Sludge Removal and Frequency	20
5.1.3 Sludge Disposal	22
5.1.4 Health and Safety	22
6.0 Sampling and Water Quality	23
6.1 Wastewater Sampling	23
6.2 Quality Assurance/Quality Control Plan	24



7.0	Dam Safety Inspections and Guidelines	25
8.0	References	26

Tables

Table 1	List of Responsible Personnel for Iqaluit WWTP Sewage Lagoon	2
Table 2	Lagoon Colour Identification.....	14
Table 3	Sample Point 1 Characteristics	23
Table 4	Effluent Quality Requirements	24

Figures

Figure 1	Truck Dump Station.....	3
Figure 2	Layout of Sewage Lagoon and WWTP	5
Figure 3	Sewage Lagoon - Facing South Toward Koojesse Inlet	6
Figure 4	Truck Dump Station Section.....	10
Figure 5	Lagoon Depths from Infrared Sludge Survey Completed in 2019.....	20
Figure 6	Mixing of Lagoon Supernatant and Settled Sludge during Desludging.....	21
Figure 7	Desludging of Sewage Lagoon using Geotubes placed on Containment Pad	21
Figure 8	Sewage Lagoon Sampling Location	23

Appendices

Appendix A	Sewage Lagoon Drawings
Appendix B	Current Water Licence
Appendix C	INAC Sampling Guide
Appendix D	Permanent Log Book
Appendix E	Laboratory Sampling Requirements
Appendix F	Dam Safety Reviews & Inspections



1.0 INTRODUCTION

This manual provides procedures for the safe and compliant operation and maintenance (O&M) of the City of Iqaluit's Sewage Lagoon. The sewage lagoon must be operated in accordance with this manual, so that adverse impacts to public health and safety, and compliance with the Water Licence 3AM-IQA1626 (attached in Appendix B), are both met.

The Nunavut Water Board's mandate is to regulate the use of land and waters and the disposal of waste to provide conservation, development and utilization of land and water resources.

Details provided in this Manual include information on the licensee and the operations staff for the sewage lagoon, detailed history and information on the sewage lagoon, fundamentals of sewage lagoon operation and operational requirements/checklists.

This O&M manual should be reviewed at each annual update, to ensure all relevant information has been added to the manual. If significant changes/alterations have occurred during the previous year, it is recommended to have the O&M manual properly updated/revised to reflect the changes as appropriate. Updates to the manual should be filed as part of the City's water licence annual report submitted to the Nunavut Water Board by March 31 of each year.

A separate O&M manual governs the operation of the wastewater treatment plant (WWTP).



2.0 RESPONSIBLE PERSONNEL

The personnel responsible for the sewage lagoon facility are, in ascending order:

- Iqaluit WWTP Operator
- Utilidor Foreman
- Public Works Operations Superintendent
- Director of Public Works
- Chief Administrative Officer

The Iqaluit WWTP Operators, Utilidor Foreman, and Public Works Superintendent are responsible for regularly scheduled inspections other than DSI's. Contact information for the applicable personnel are provided in Table 1. The table should be updated regularly to reflect any changes to personnel or designated roles.

Table 1 List of Responsible Personnel for Iqaluit WWTP Sewage Lagoon

Role	Name	Contact Information
Director of Public Works	Adrian Blanchard	Phone: 867-222-2966 Email: A.Blanchard@iqaluit.ca
Superintendent of Water and Sewer Services	Shane Turner	Phone: 867-222-2165 Email: S.Turner@iqaluit.ca
Iqaluit WWTP Operator	Pat Wolfe	Phone: 867-222-2424 Email: P.Wolfe@iqaluit.nu.ca
Iqaluit WWTP Operator	Emmanuel Kayode	Phone: Email: E.Kayode@iqaluit.nu.ca

2.1 EMERGENCY PLANNING & CONTACT

In the event an accidental/unauthorized discharge of wastewater occurs or if such a discharge is foreseeable, the Spill Contingency Plan for the City of Iqaluit shall be employed.

1. The first contact shall be to the WWTP Superintendent (867) 979-5636.
2. If contact cannot be made with the WWTP Superintendent and the situation is deemed an emergency, the City's Dispatch should be contacted at (867) 979-5650.
3. The incident shall be reported to the NWT/NU 24-Hour Spill Report Hotline at (867) 920-8130; and to the Inspector at (867) 975-4295.
4. A report regarding the incident shall be submitted to the Crown-Indigenous Affairs and Northern Development Canada (CIRNAC) Inspector within 30 days of reporting the incident.

3.0 BACKGROUND

3.1 WASTEWATER COLLECTION

Wastewater from the City of Iqaluit is received at the WWTP via 2 methods: The incoming sewer lines and by truck, which discharges the hauled sewage into the dump station manhole upstream of the WWTP. Wastewater received at the WWTP can be bypassed to the sewage lagoon via the upstream dump station manhole (Figure 1).



Figure 1 Truck Dump Station

3.2 IQALUIT WWTP

The City of Iqaluit WWTP was originally designed and constructed by a design-builder in 1998 to achieve a higher level of treatment than the existing primary sewage lagoon. The initial WWTP, constructed in 1999-2000, consisted of two aerobic tanks, two anoxic tanks, aeration blowers, cassette filters, and a Fournier press. Concerns arose in 2000 regarding the structural integrity of the aerobic tanks. A consultant (CH2M Gore & Storrie Ltd) was retained by the City to complete investigations and provide recommendations on the structural integrity. The City completed the recommended shotcrete application to all wall sections in the tanks. Ultimately, the WWTP was never commissioned because the design-builder abandoned the project.

In 2002, significant deficiencies were found in both the design and construction during a subsequent investigation. The deficiencies included code violations, inappropriate process selection and poor engineering practices such as not sizing the plant to include future population growth.



Following the 2002 facility assessment, AECOM was retained to complete the detailed design of a new WWTP incorporating the existing structure as much as possible. The design was advanced for both a primary and secondary treatment system. Phase 1 of the design, which consisted of a primary treatment system, proceeded to construction and was completed in 2006. The treatment processes consisted of influent pumps, auger screens and a primary filter (Salsnes Filter). The Salsnes Filter was selected as a substitute for ‘traditional’ primary clarification as a simple, low-cost and robust alternative considered appropriate for Iqaluit. Phase 2 of the WWTP (secondary treatment), which was planned to include bioreactors, a dissolved air flotation (DAF) unit, and a belt filter press, was put on hold during detailed design, pending the availability of capital funding for the project. Secondary treatment was never put in operation.

In March 2013, the City received an Inspector’s direction from Aboriginal Affairs and Northern Development Canada and Environment Canada that required the City to complete upgrades to the WWTP to bring the quality of effluent into compliance with applicable standards by December 2018.

Nunami Stantec was selected to perform the upgrades to the WWTP facility in 2016. Upon completion of detailed design, it was determined that the associated costs with the proposed upgrades to the WWTP would exceed the available government funds. To determine the feasibility of the design and reduce the overall upgrade costs, a value engineering session was held in July 2017, which resulted in several recommendations to help cut project costs.

Nunami Stantec was retained to perform the redesign of the WWTP based on the results of the value engineering session, in September 2017. The redesign consisted of the replacement of the existing primary treatment system and the installation of a new secondary treatment system, all within the existing footprint of the original WWTP. The primary treatment process consists of influent pumps, auger screens, and a primary filter (Salsnes Filter), similar to the existing primary treatment setup. The secondary treatment process consists of two trains of moving bed biofilm reactors (MBBR), which is preceded by two dissolved air flotation (DAF) units. The overall process was selected to ensure a low cost, robust system that could be installed within the limited space of the existing building.

A process-mechanical O&M manual was published when the current WWTP was commissioned in 2020 (City of Iqaluit, 2020).

3.3 SEWAGE LAGOON

3.3.1 OVERVIEW

The sewage lagoon is located to the west of the City adjacent to the Iqaluit WWTP. It is a single-celled, naturally aerobic lagoon which has a current handling capacity of 25,000 m³.

The outlet from the lagoon, based on 1991 as-builts, consists of a piped discharge controlled by a valve chamber. The elevation of the discharge is 5.6 metres, which is approximately 2 metres above the bottom of the lagoon. The lagoon is not lined and several features such as a French drain, and an overflow spillway, were incorporated into the design of the lagoon to maintain the geotechnical stability of the system. The discharge point of the outlet directs the flow to the same channel in which the current WWTP outfall discharges.

The effluent from the lagoon flows into a low-lying area, which eventually discharges to Koojesse Inlet approximately 1.1 km away. A layout of the site is shown in Figure 2.



Figure 2 Layout of Sewage Lagoon and WWTP

Currently, all sewage flows are being directed to the WWTP, described in Section 3.2. The purpose of the sewage lagoon is to act as a bypass/overflow system for the WWTP, should the plant experience an unexpected shutdown where it must divert away from the plant. The sewage lagoon is considered an intermittent discharge lagoon, as the lagoon is in operation only while the WWTP is unavailable.

In late 2025 into 2026, the belt filter press in the WWTP stopped functioning, and a protracted repair ensued. The sewage lagoon has been used to store un-thickened sewage sludge that would have otherwise been taken to the landfill.

The sewage lagoon will continue to be used as a bypass/overflow system for untreated sewage from the WWTP as well as for sewage sludge should the sludge dewatering system malfunction.

Flow can be diverted to the sewage lagoon by closing the upstream isolation gate located within the truck discharge manhole and opening the isolation gate to the sewage lagoon within the same manhole.

When the sewage lagoon is required to be in operation, it will be operated in one of two methods:

1. Filling the lagoon and intermittently discharging effluent. The lagoon is discharged at a semi-constant rate through an effluent pipe located within a coarse rip-rap section of the west berm. Effluent quality will need to be tested prior to releasing through the lagoon outfall for regulatory reporting purposes.

2. Overland pumping from the lagoon back to the WWTP, via the truck dump station upstream of the WWTP wet well. This method is subject to the WWTP coming back into operation prior to the sewage lagoon completely filling.

The sewage lagoon facility has no operable controls, systems and/or components, apart from the outlet control valve and structure near the west berm. The outlet control valve may be used to regulate the level in the lagoon. The lagoon is an older retaining structure built on “leaky dam” technology, which signifies that there is no liner for the lagoon and no significant operating controls or components; The pervious nature of the berms allows for percolation through the berm section.

3.3.2 HISTORY

The sewage lagoon was constructed in 1978 and was formed by two berms that connected the shoreline to a natural island formation. The man-made structures form the east and west boundaries of the lagoon; the north and south boundaries therefore utilize the natural topography (see Figure 3).



Figure 3 Sewage Lagoon - Facing South Toward Koojesse Inlet

At the time of construction, the original sewage lagoon had an area and capacity of approximately 17,000 m² and 32,000 m³ respectively.

In 1981, a partial wash out occurred during high tide, which was subsequently repaired. The repair washed out again that same year. Subsequent upgrades in 1983 increased the capacity of the lagoon to approximately 56,000 m³.



The lagoon was the subject of investigative studies in 1983 and 1984, which proposed various upgrades, including the following:

- Lining of exterior slopes with filter cloth and riprap
- Construction of an overflow (spillway) in the west berm
- Construction of a positive outlet control
- Installation of an impermeable liner on the interior slopes

In June 1991, a breach of the west berm caused a major effluent spill into Koojesse Inlet.

A preliminary engineering report from July 1991 indicated that the spillway and impermeable liner upgrades had not been done, and that as-built drawings for any upgrades could not be located. The 1991 report recommended specific repairs and improvements for the berm reconstruction area. These included erosion protection (filter cloth and riprap) on the upstream and downstream sides, section conformity (2H:1V and 3H:1V on the upstream and downstream sides respectively), and construction of an overflow spillway section.

In a December 1991 supplementary report, concerns over material suitability prompted the recommendation to further flatten slopes to 3H: 1V and 4H: 1V on the upstream and downstream sides, respectively, of the west berm.

In December 1997, significant seepage developed on the west berm. Recommendations were made in a February 1998 engineering report to increase monitoring, to develop a spill preparedness plan, and to maintain the lagoon at its lowest possible level. In June 1998, a Spill Contingency Plan was prepared which included a Sewage Lagoon Preparedness Plan. In that document, it is stated that the potential existed for further uncontrolled sewage releases due to berm failure.

A Dam Safety Review (DSR) for the Lake Geraldine Dam and Sewage Lagoon was prepared in 2001, which was followed up by a Dam Safety Inspection (DSI), which was conducted in October 2002. The DSI noted no significant changes since the 2001 DSR but highlighted the seepage concerns of the east berm and the threat of overtopping in the spring. The DSI reiterated the recommendations of the 2001 DSR, as follows:

- There is inadequate information concerning the as-built conditions of the berms
- The berms are not considered safe in their current condition and are non-compliant with the design and performance standards of the DSG
- Remedial measures included three (3) options - an impermeable liner; buttressing the berms; and building a new lagoon



No DSI was conducted in 2003, based on previous documentation searches. However, a geotechnical investigation was conducted in 2003. The scope of the geotechnical investigation was to undertake a topographic survey of the lagoon and conduct a slope stability analysis of the berms. A separate hydrologic report is referenced but has not been located. It appeared that the geotechnical investigation was attempting to address some of the as-built issues discussed in the 2002 DSI. Conclusions from the geotechnical investigation included:

- Adequate (satisfying the Dam Safety Guidelines) factors of safety exist for steady state seepage and rapid drawdown scenarios
- The west berm should remain stable, provided it is protected against overtopping and adequate erosion protection is installed on the downstream face

A DSI was conducted in 2004. The report indicated that catastrophic failure is unlikely with the above provisos, however, localized failures or seeps were to be expected until such time as the lagoon was lined with an impervious material or rebuilt. The recommendations from the 2004 DSI are consolidated as follows:

- Preparation of the Permanent Record File (PRF) remains outstanding
- Undertake the next DSI prior to October 2005
- The safety/stability recommendations from the 2003 geotechnical report (discussed above) should be implemented in 2005

In August 2006, the west berm was upgraded to address the recommendations contained in past reports, and a DSI was completed, which took into consideration the upgraded west berm, and acknowledged the preparation of a PRF.

A sludge survey was completed for the lagoon in 2018, which indicated that approximately 1600 m³ of dry sludge was being held within the lagoon. Desludging of the lagoon was recommended and occurred in October 2019. Inaccuracy in the estimate of percent solids in the lagoon resulted in a total of 475 m³ of dry sludge being removed to complete the desludging process.

With the completion of the Iqaluit WWTP upgrades, the sewage lagoon shall remain as an emergency storage facility, should the WWTP require to be bypassed.



4.0 MONITORING AND INSPECTIONS

Records of all inspections, preventive maintenance, repairs, and operational procedures should be meticulously kept. The records should be kept for the lifetime of the facility. Site Inspection Templates are provided for record keeping in Appendix D. Copies of these reports should be kept in an organized and convenient location.

The checklists in the following sections provide detailed inspection requirements.

4.1 WEEKLY INSPECTION PROGRAM

Once a week, a walk-around inspection of the lagoon should be undertaken to observe if there are any obvious concerns. Action needs to be taken immediately if major problems such as significant erosion are apparent. A Site Inspection Template is attached in Appendix D. This form is to be completed upon each weekly, monthly, and annual site inspection visit undertaken by City of Iqaluit Employees.

During weekly inspections, all the major components of the sewage lagoon system should be checked to see if they are operating properly. If they are not, a repair work order should be generated, and the repairs made immediately. Once identified, repairs to lagoon systems cannot wait, as the consequences of failure can be very costly.

The sewage lagoon itself has four main areas to inspect:

- Inlet Structures (Truck Dump Station and Lagoon Influent Line)
- Berms
- Outfall Structure
- Colour of lagoon liquid

4.1.1 INLET STRUCTURE MONITORING

4.1.1.1 TRUCK DUMP STATION

The truck dump station is a 2.0m x 2.0m concrete chamber, which receives the gravity flows from the City, as well as the trucked sewage. A schematic of the truck dump station is presented as Figure 4. The truck sewage is discharged to the dump station through several discharge connections at the top of the chamber. At the bottom of the chamber, a 300mm diameter HDPE line receives gravity sewage, and the sewage exits either through the 300mm diameter HDPE line to the WWTP, or through the 250mm diameter HDPE line to the sewage lagoon. As flows are mainly directed to the WWTP, the flow to the sewage lagoon is blocked with a series 20 Fontaine Sluice Gate. The dump station was modified in 2019 to include a 250mm diameter HDPE overflow to the sewage lagoon, which ties into the existing HDPE line to the sewage lagoon. Refer to drawings in Appendix A for truck dump station details.

At the truck dump station manhole, major problems can occur as a result of freezing within the manhole, snow accumulation, uncontrolled spillage, and waste accumulation in the discharge line.

Polyethylene

Freezing within the manhole could result in the inability to open/close the bypass valve to the lagoon (i.e. inability to control discharge to lagoon). Allowing snow to accumulate around the truck dump station could result in an inability to access the site, which could result in the trucks being unable to discharge wastewater at this location or actuate the bypass gate to the lagoon if necessary.

Uncontrolled spillage at the truck dump station would result in notification to regulatory bodies. Waste accumulation would result in an inability to discharge to the lagoon.

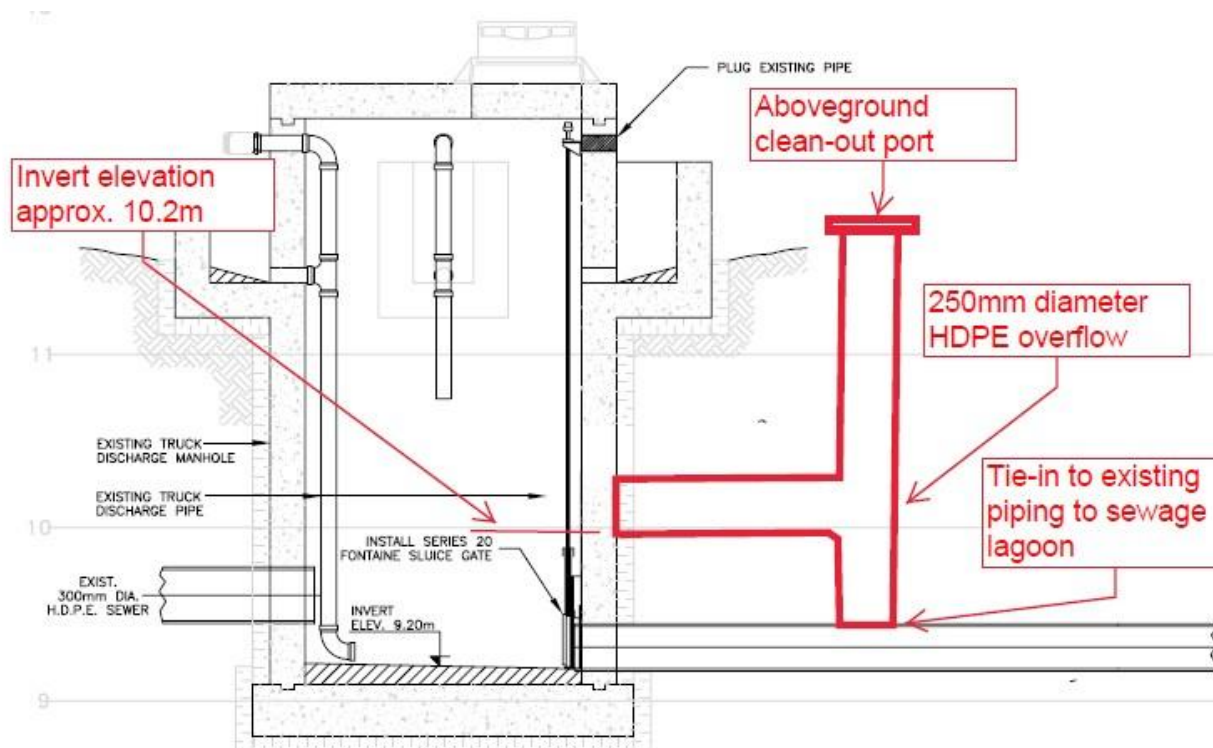


Figure 4 Truck Dump Station Section

Snow accumulation at the dump station can be mitigated by clearing the snow periodically. This should occur each time the road access to the WWTP is cleared.

If spillage is to occur from one of the sewage trucks at or around the truck dump station, all spilled material should be removed and disposed to the lagoon, along with any snow or ice which becomes contaminated by the spill.

Waste accumulation within the dump station can be mitigated by regularly inspecting the manhole and checking if any build-up is occurring within the manhole. Any build-up should be broken up to allow proper discharge to the lagoon.



4.1.1.2 INFLUENT LINE

Freezing of the dump station lagoon influent line has been previously noted to occur at the discharge point into the lagoon. This can have severe consequences if not monitored, as the lagoon influent is a last line of defence to protect overflows from occurring at the WWTP and the upstream manholes. Freezing of lagoon influent line occurs due to snow accumulation around the discharge point, or obstruction from ice heaving up from the lagoon. The discharge point for the lagoon influent line should be monitored and maintained regularly in the winter to remove any build-up of snow and ice that occurs. It is also recommended to keep the level in the lagoon below the influent discharge to the lagoon to minimize the development of ice blockage.

4.1.2 BERM INSPECTIONS

There are three main functions of the lagoon berms:

1. To form part of a storage container for the retention of the wastewater for treatment
2. To provide access to all parts of the lagoon
3. To provide a system for flow rate control

The objective of a berm inspection is to make sure that failure does not result from undue leakage. Wastewater leakages through the berms mean that there is not proper containment of the wastewater within the lagoon, which is a source of contamination and needs to be addressed immediately. The two major concerns, and visual evidence of potential berm issues, are excessive growth of vegetation, which may hide developing problems, and erosion. Erosion of berms can be caused by the occurrence of waves on the inside of the lagoon cells, and surface runoff on the inside or outside of the lagoon cells. Leakage problems in berms can also be further aggravated by animal burrows.

Regular monitoring and maintenance are required to control berm erosion. The most frequent areas are:

1. Around the effluent discharge structure (located in the southwest corner of the lagoon cell)
2. At all corners of the lagoon
3. Along the inside banks, which are downwind
4. Areas with insufficient vegetative cover
5. Areas with insufficient berm compaction

Wind-induced water erosion is usually more serious for large lagoons, particularly with surface areas over 50,000 m² (5 hectares). The sewage lagoon is much smaller (approximately 17,605 m² or 1.76 hectares), and therefore wind-induced erosion is not a primary concern. If it is found that excessive erosion is occurring, additional riprap can be placed to reduce its effects.

Another method of berm protection uses grass or other vegetative cover. Vegetation may not be present directly following construction of the lagoon, however once vegetation begins to establish, it is important that regular cutting of grass or vegetative cover is carried out. A well-maintained berm is less likely to be the target for burrowing animals.



4.1.2.1 VEGETATION

Plants around the outside slope of the lagoon berm are good and necessary. Small-sized vegetation on the outside slopes of the berms is beneficial, however large weeds and shrubs can cause deep root-related problems and must be removed. Proper maintenance on the outside slopes, including regular cutting and removal, must be addressed on a routine basis.

Riprap protection should not be covered with vegetation, as the vegetation will be difficult and dangerous to control. Similarly, vegetation should not be allowed to grow on the inside slope of the lagoon berms.

A number of surface weeds can develop in lagoons. The problem with these weeds is that they block out the sunlight, which is needed to produce oxygen. A second problem is that when floating plants die, they begin to decompose, using up oxygen, which is needed by the bacteria and lowering the dissolved oxygen.

Duckweed is one of the most common of the problem weeds. It is a three-leaved plant, and develops long hair-like roots which harden in the water. It varies in colour from light green during normal growth to brownish yellow in its death phase.

The ways to control surface weeds are to skim them off the lagoon (often difficult and requires repeating). The removed weeds should be taken to the landfill and buried, where possible, to prevent odour and insect problems.

General guidelines for regular vegetation control are to:

1. Remove all shrubs from the lagoon area
2. Allow, plant, or maintain shallow-dense rooted, perennial grasses such as Perennial Ryegrass, on the outside slopes of the berms
3. Cut grass regularly during warm weather. Mowing equipment should have a low centre of gravity to minimize the potential of overturning the tractor when mowing along the berm slopes. The slopes are constructed at a 3:1 ratio

4.1.2.2 RUNOFF AND DRAINAGE

The outside cell berms are gradually sloped away, at a 3:1 to 4:1 slope, depending on the berm in question. The sloped berms allow any accumulated precipitation to drain to the perimeter ditches that surround the site. The lagoon influent, which is conveyed from the sewage truck discharge station, is received along the Northeast side of the lagoon. The sewage truck discharge station is constructed of a precast concrete manhole which connects to a 250mm diameter HDPE that drains into the lagoon. Precipitation that falls on the discharge area which could be contaminated by any spilled sewage is drained down the inside cell berm (which is sloped 3:1), into the cell and is processed through the lagoon system.

Surface runoff is prevented from entering the lagoon through sloping of the berms and interceptor ditches at the bottom of the outer berm slope. The ditches must be properly maintained to prevent the blockage of drainage.

The berms and drainage ditches should be visually checked on a regular basis. This should be recorded weekly as shown in Appendix D.



4.1.2.3 FREEBOARD MONITORING

The sewage lagoon has been designed to have a minimum of one (1) metre of freeboard along the containment berms, which is the distance between the water surface and the top of the berm, when the lagoon is full (reached the design high water level). This is to protect the berm from erosion and overtopping. The sewage lagoon has a minimum of 0.8 metres of freeboard along the overflow spillway portion of the lagoon, which allows a controlled release through a specific area of the lagoon berm should the lagoon be overtopped.

It is important to ensure that the sewage lagoon level does not exceed the design high water level mark of 6.50 metres (21 feet) as indicated on the lagoon as-built drawings. Exceeding the design high-level mark will create unwanted pressure along the west berm and potentially cause flooding to other areas beyond the lagoon.

4.1.3 OUTLET STRUCTURE MONITORING

Two types of outlet structures exist at the sewage lagoon:

1. Effluent outlet structure
2. Emergency overflow section

The effluent outlet structure consists of an insulated, 200mm HDPE pipe which passes through the west dyke and is connected to a control vault, which allows the lagoon effluent discharge and lagoon water levels to be controlled. The control vault consists of two, 200 CWP Crane knife gate valves, which are spaced by a blind flanged tee in the middle. The valves are used to isolate the flow of the lagoon outfall and typically remain closed unless a release from the lagoon is required.

The outlet structure is designed to allow continuous discharge of the lagoon effluent, which should have the valve in the control vault remain open while the lagoon is in operation and receiving flows. A section of the dyke adjacent to the outlet structure contains a French drain to provide greater stability to the berm structure. The outlet has an elevation of 5.60 m, which is 0.9 m below the max high level of the lagoon (6.50 m).

An emergency overflow section is designed to allow for a controlled discharge from the lagoon over a section of the west berm, in the case where the lagoon cannot properly discharge through the outlet structure. The emergency overflow prevents the lagoon from overtopping and/or failing at any of the berms, which would have serious implications. The overflow consists of a recessed section of the berm, which was designed to be 0.2 m lower than the remaining berms, allowing for the overflow to discharge adjacent to the existing lagoon outlet structure. Maintenance inspections should be completed routinely to detect any settling, blockage, or damage to the overflow structure. The overflow section should always be kept open and well maintained. Refer to drawings in Appendix A for details on overflow.

The sewage lagoon system is designed to minimize any short-circuiting of the wastewater. The inlet is located approximately opposite to the outlet location, maximizing the effective use of the designed cell volume and retention time.



4.1.4 COLOUR OBSERVATIONS

The colour of the liquid in a lagoon is an indicator of how well it is working. The colour identification for the lagoon is presented in Table 2.

If the lagoon is operating well, it is usually bright green. If the contents of the lagoons are any other colour, there may be something wrong with the treatment process of the lagoon. The City of Iqaluit WWTP Operators should be contacted to determine the problem, and an engineer should be contacted to assess the condition of the lagoon.

Table 2 Lagoon Colour Identification

Colour	Lagoon Health	Comments
Green	Great	Good treatment conditions; neutral pH and high dissolved oxygen.
Dull Green - Yellow	Okay	pH and dissolved oxygen generally dropping.
Tan - Brown	Poor	Dissolved oxygen level and pH may be dropping; may also indicated physical issues with the lagoon or collection system.
Grey - Black	Very Poor	Possibly full anaerobic conditions (no dissolved oxygen); lagoon is not treating wastewater well. Odours are most likely present.

4.1.5 WEEKLY CHECKLIST

1. Walk around the lagoon site and conduct a visual inspection
2. Determine the colour of the liquid in the lagoon cells during the open water season. If the water is a very dark black, contact the City of Iqaluit Superintendent (see Section 2.0)
3. Check berms and drainage ditches for damage caused by animals, vegetation, or any type of erosion. If damage is observed, repair the problem immediately to eliminate further damage and expenses
4. Verify a one-meter freeboard is always maintained at all berms. Contact the City of Iqaluit Superintendent if considerably different elevations exist, as this may be an indication that settlement is occurring, or discharge structures are not operating correctly
5. Inspect major components:
 - a. Operation of the sluice gate in the inlet structure
 - b. Operation of knife gate valves in the outlet structure



4.2 MONTHLY INSPECTION PROGRAM

4.2.1 FLOATING MATERIAL REMOVAL

The City of Iqaluit Sewage Lagoon is not fenced, which can allow windblown garbage to enter the facility. Any debris that is observed on the surface of the cell should be removed at the first opportunity using a skimming device and taken to the landfill. Algae growth on the surface of the lagoon does not need to be removed.

4.2.2 EFFLUENT AND DRAINAGE

Effluent is sampled prior to discharge, once during discharge, and once prior to completion of discharge. See Section 6 for details on sampling procedures.

Drainage contaminated by effluent will be contained using temporary dykes/berms and pumped or trucked to the lagoon area as per the Government of Nunavut's *Environmental Guideline for the General Management of Hazardous Waste*.

4.2.3 SIGNAGE

As per Water Licence requirement B.5, warning signs must surround the lagoon and be located near the high traffic locations. All lost or damaged signs must be replaced. All signs shall include warnings in all official languages of Nunavut to coincide with the languages of the area. Lagoon signage was installed as part of the WWTP upgrades in October 2019.

Due to the history of finding large debris (mattresses, bikes, etc.) in the sewage lagoon by the public, it is recommended to add "No Dumping" signs to the existing warning signs placed around the perimeter of the sewage lagoon.

4.2.4 MONTHLY CHECKLIST

1. Inspect signage; repair as required
2. Visual inspection of sewage lagoon area to ensure run-off or seepage is not occurring
3. Sample effluent and record pH/colour as required by Water Licence (see Section 6.0)
4. Remove excess floating debris and any vegetation

4.3 ANNUAL INSPECTION

1. Determine sludge levels in lagoon cells and remove sludge as required (see Section 5.0).
2. Clear drainage ditches and culverts of excess snow/ice and repair any damage from erosion
3. Assess berms and site for erosion and repair as necessary



4.4 NUISANCE CONTROL

4.4.1 ODOURS

Under normal operating conditions, the lagoon will not experience or cause serious odour problems. However, at certain times, significant odours may occur.

The most troublesome odour conditions occur:

1. During the period immediately following ice break-up; this problem will normally be of short duration. It is also likely to occur annually.
2. At the end of an extensive period of cloud cover (in spring to fall when there is no ice cover), resulting in reduced sunlight and therefore reduced algae activity and low oxygen production. The problem will decrease as sunlight returns or ice-cover forms.
3. Extensive floating sludge mats. In this case, floating scum, septic sludge and algae mats need to be broken up and dispersed using manual mechanical means such as a rake.
4. If insufficient water level is maintained in the lagoon. A minimum of 1 meter of standing water will help cap the lagoon sludge, which will reduce the amount of odours experienced.

4.4.2 VEGETATION CONTROL

Plants around the outside slope of the lagoon berm are good and necessary. Small-size vegetation on the outside slopes of the berms are beneficial, however large weeds and shrubs can cause deep root-related problems and must be removed. Proper maintenance on the outside slopes, including regular cutting and removal, must be addressed on a routine basis.

Riprap protection should not be covered with vegetation as the vegetation will be difficult and dangerous to control. Similarly, vegetation should not be allowed to grow on the inside slope of the lagoon berms.

A number of surface weeds can develop in lagoons. The problem with these weeds is that they block out the sunlight, which is needed to produce oxygen. A second problem is that when floating plants die, they begin to decompose, using up oxygen which is needed by the bacteria and lowering the dissolved oxygen.

Duckweed is one of the most common of the problem weeds. It is a three-leaved plant. It develops long hair-like roots which harden in the water. It varies in colour from light green during normal growth to brownish yellow in its death phase.

The ways to control surface weeds are to skim them off the lagoon (often difficult and requires repeating). The removed weeds should be taken to the landfill and buried, where possible, to prevent odour and insect problems.



General guidelines for regular vegetation control are to:

1. Remove all shrubs from the lagoon area.
2. Allow, plant, or maintain shallow-dense rooted, perennial grasses such as Perennial Ryegrass, on the outside slopes of the berms.
3. Cut grass regularly during warm weather. Mowing equipment should have a low centre of gravity to minimize the potential of overturning the tractor when mowing along the berm slopes. The slopes are constructed at a 3:1 ratio.

4.4.3 INSECTS

Flies and mosquitoes create the most common insect problems. Most mosquitoes breed in sheltered, calm water containing vegetation and floating materials to which the female can attach the eggs. The egg clusters are fragile and easily damaged by turbulent action caused by wind and currents. Poor weed control and the accumulation of scum layer will make insect problems worse.

Puddles of water outside the lagoon will also harbour insects. Berm maintenance and the filling of potholes and puddles will reduce the opportunity for insect reproduction.



5.0 SLUDGE MANAGEMENT

Sludge is the non-liquid portion of waste that accumulates on the bottom of the lagoon cell. General sludge management activities are required very infrequently. Sludge removal will likely be required every 10 to 15 years. Sludge volumes are to be measured and recorded every 2 to 5 years to determine when an actual sludge removal is required.

5.1.1 SLUDGE SURVEY

A sludge survey involves two steps: locating the top of the sludge layer and measuring the sludge thickness at several locations in a lagoon. The basic sludge survey approach is to measure the depth from the liquid surface to the top of the sludge layer and then measure the depth from the liquid surface to the lagoon bottom (soil contact); calculate the difference to obtain the thickness of the sludge layer. The following approach has been provided for information only, as it is recommended that a sludge survey be performed by an expert contractor that has the necessary experience and tools required for the work.

5.1.1.1 SAFETY REQUIREMENTS

The sludge survey should be conducted from a boat on the lagoon. Special care should be taken when going on to the lagoon in a boat. For safety reasons, at least three people should be present: two in the boat and one on the lagoon bank. The extra person(s) on shore may be needed as a rescuer(s), should anything go awry. The extra person on the boat assists with getting in and out of the boat and anchoring the boat at the measurement locations. Also, it is more efficient if one person in the boat uses the measuring instruments and the other records the data. Flat-bottom or johnboats are preferred over canoes or V-bottom boats, as they are more stable. All persons working within the inner slopes of the lagoon, and especially those in the boat, should wear appropriate flotation devices.

5.1.1.2 SAMPLING STRATEGY

The sludge layer is generally a "mobile" fluid, but it may form peaks and valleys within the lagoon. Small lagoons, such as the City of Iqaluit Sewage Lagoon, seem to have more variation in sludge layer thickness. For this reason, at least 25 depth measurements should be taken for the lagoon. The locations for measurements should be determined by a uniform grid, if possible. Avoid measuring over the slope of the lagoon embankments. All measurements from the various locations on the grid should be averaged to produce an average sludge layer thickness to calculate the volume of sludge.

5.1.1.3 DISK -ON-ROPE METHOD

The basic sludge survey approach is to measure the depth from the liquid surface to the top of the sludge layer, and then measure the depth from the liquid surface to the lagoon bottom (soil contact); calculate the difference to obtain the thickness of the sludge layer. The following approach has been provided for information only, as it is recommended that a sludge survey be performed by an expert contractor that has the necessary experience and tools required for the work.



A disk-on-rope can be used for detecting the top of the sludge layer using a disk or plate that sinks through the liquid and settles on the sludge. When used carefully, this method generally agrees within 22mm (1 inch) with infrared detectors. A PVC disk 1/4-inch thick and about 8 to 12 inches in diameter or of square shape (specific gravity = 1.4) has shown results consistent with the infrared detectors. The size (area) of the disk should make little difference because the pressure exerted on the sludge is constant per O&M Checklist unit area. Disks of Lexan (specific gravity = 1.2) give similar results. Materials that are heavier than PVC could exert more pressure and penetrate the sludge.

The wire, rope, or string by which the infrared detectors or disks are lowered into the lagoon should be marked using metric measurements of 10cm. This line should not be elastic because stretching will cause variations in readings. The disk should be lowered slowly to keep it from swaying off vertical line. Holes should be drilled in the disk to allow liquid to pass through and reduce swaying. The rope or string can be attached to the disk at the center or at 2 to 4 symmetrically placed locations to keep the disk more stable. The depth to the sludge layer should be measured with the disk before using a pole to measure depth to the lagoon bottom because the pole may disturb the sludge layer. The following is a list of instructions to perform a sludge survey:

1. Gather the necessary personnel and equipment, including the following: boat, life jackets, paddles, map or sketch of lagoon, clipboard and pencils, sludge detection device such as a disk-on-rope with interval markings to determine the top of the sludge layer, and a solid rod or pole with interval markings to determine the depth to the lagoon bottom. A small johnboat is recommended. There should be a minimum of two people in the boat and one on the bank.
2. Measure sludge at a minimum of 25 points over the area of the lagoon. Set up a uniform grid on a lagoon sketch to show the location of each point.
3. Measure the depth from the surface of the liquid to the top of the sludge. Record this depth. Insert a pole vertically at the same location until the lagoon bottom (soil contact) is felt. Record this depth. The sludge thickness is the difference between the two readings.
4. Proceed to all other sample points and record measurements similarly.
5. To determine the average sludge layer thickness in the lagoon, add all sludge layer thickness determinations and divide by the number of readings taken. This average, along with the difference from the top of berm to the water level in each cell should be recorded.

5.1.1.4 INFRARED DETECTOR METHOD

For a more detailed measurement of the lagoon profile, an infrared sludge interface detector and acoustic reflectors can be used to measure the bottom profile and the depth of the sludge blanket. The infrared measurements can be further correlated with the use of a sludge judge. Sludge samples are also collected throughout the lagoon and measured for total solids and total volatile solids to approximate dry material volumes in the lagoon.

In 2018, Lambourne Environmental was selected to perform a sludge survey of the lagoon. The survey was completed using infrared sludge detectors, and a sludge judge, as listed above. The estimated dry sludge volume of the lagoon was estimated at 1,597 m³ with a percent solids of 30% for the settled sludge. Figure 5 shows the lagoon depth measurements obtained as a result of the sludge survey completed in 2019.

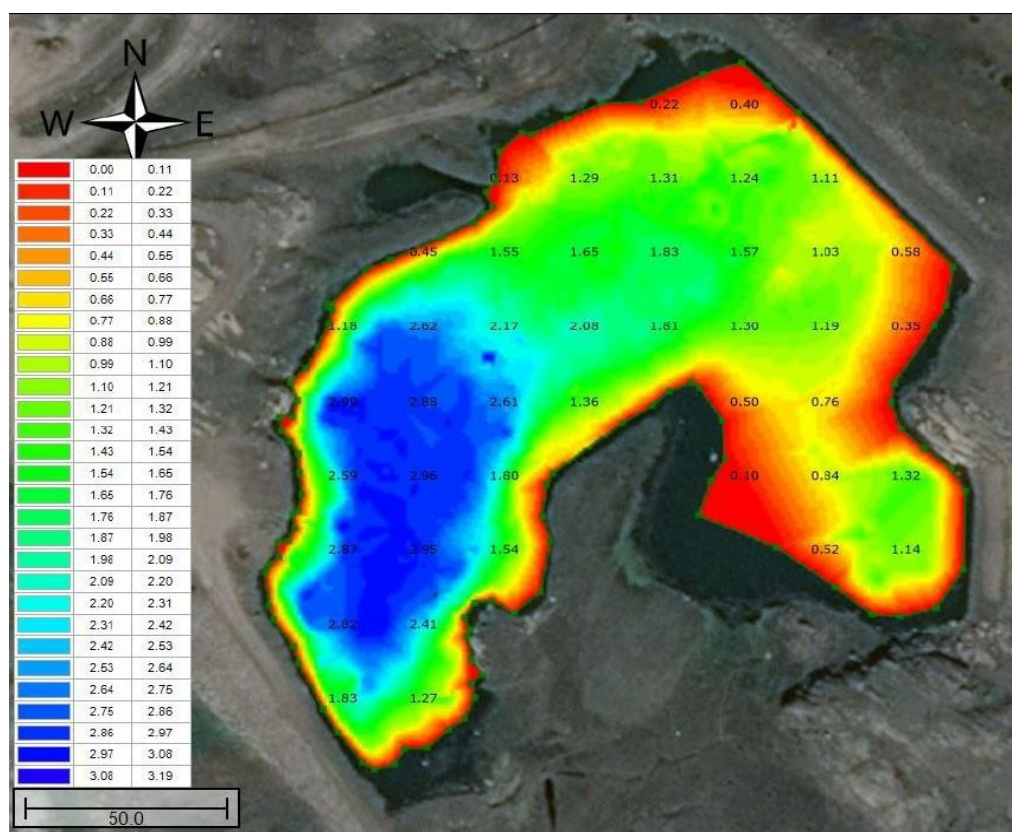


Figure 5 Lagoon Depths from Infrared Sludge Survey Completed in 2019

5.1.2 SLUDGE REMOVAL AND FREQUENCY

When a sludge survey determines that excessive sludge has accumulated in any one of the cells, sludge removal should be completed. In the case where more than 1/3 of the designed water storage depth is accumulated sludge, the sludge should be planned to be removed.

After draining or pumping free water, the solids can be removed using an excavator. To protect the bottom of the lagoon, do not try to remove the bottom 250mm of sludge. Refer to the facility drawings to determine lagoon elevations.

Care must be taken to prevent damage to the berm surfaces during this method of cleaning. It is important to have a skilled operator doing this work to reduce the potential for surface damage.

Sludge removal can also be completed by dewatering the lagoon and pumping into geotube containment vessels. One method to perform the desludging is to use lagoon pumps, which are connected to a piece of mechanical equipment, such as a tractor (see Figure 6 below). Lagoon supernatant is mixed with settled sludge via the lagoon pumps, which is conveyed to a polymerization unit. Polymer is dosed into the pumped sludge before entering the geotubes to increase dewaterability of the sludge. The geotubes then slowly dewater and dry the sludge, which can be removed from the geotubes via an excavator and disposed of at the

landfill. The geotubes should be placed on a containment pad, which ensure the proper stability of the tubes when being filled (see Figures 6 and 7). It is beneficial to have the containment pad for the geotubes located adjacent to the sewage lagoon, so that the water which drains from the geotubes can be gravity drained back to the lagoon. This reduces the need for additional dewatering pumps to return the water back to the lagoon.



Figure 6 Mixing of Lagoon Supernatant and Settled Sludge during Desludging

Sampling should be performed prior to dewatering to determine the approximate solids content of the water in the sewage lagoon, which assists in determining appropriate polymer dosage required during pumping, as well as provide a more defined quantity of anticipate solids removed per unit of water pumped from the lagoon. Anticipated dry solids content, combined with flow totalization during the desludging process, will help monitor the quantity of sludge removed with the expected quantities.



Figure 7 Desludging of Sewage Lagoon using Geotubes placed on Containment Pad



5.1.3 SLUDGE DISPOSAL

Removed sewage sludge will be allowed to accumulate, treat naturally, and dewater in a future specified location. This location and its characteristics will be chosen with approvals from the NWB. Currently, the City is developing a solids management plan which will determine the ultimate disposal option. Potential exists to utilize the dried sludge as organic cover/mix material for the landfill.

During the winter, freezing will encourage consolidation of the sludge and, upon thawing, further dewatering. Any liquid accumulating with the removed sewage sludge will be pumped back into the sewage lagoon, if it was unable to gravity drain back to the lagoon.

5.1.4 HEALTH AND SAFETY

Prior to undertaking any sludge survey, removal or disposal, operators should be well aware of safety and health considerations. All operations conducted at the lagoon facility shall adhere to the applicable Workers Safety and Compensation Commission policies and legislations.

A minimum of two people shall be on site when working in and around the wastewater filled lagoon cell. Safety belts and lanyards shall be used when a worker is required to work on the sloped surfaces of the lagoon cells. Proper flotation devices shall be on site to prevent drowning in the event that someone falls in. Protective masks should also be worn by operators when working around the lagoon to protect against pathogens and odours. Refer to City Safety policies and procedures for full safety requirements

Raw untreated sludge may contain pathogens harmful to human health. When working with raw untreated sludge, proper clothing shall be worn to eliminate skin contact such as gloves and appropriate boots. Immediately upon completion of work, the hands and face of those working with the sludge should be washed with soapy warm water to prevent any contamination.

It is recommended to maintain a minimum level of standing water in the lagoon after completion of desludging. Full removal of the lagoon sludge is not recommended if the lagoon is to continue operating as an emergency overflow and treatment option for the WWTP. It is recommended to maintain some settled sludge as seed sludge, which will help maintain anaerobic conditions in the lagoon for treatment during emergency overflows. The standing water will also help cap the lagoon sludge and reduce the occurrence of any odors that are generated from the sludge.

6.0 SAMPLING AND WATER QUALITY

6.1 WASTEWATER SAMPLING

The following effluent sample station for the Iqaluit WWTP Sewage Lagoon shall be prior to discharge, once during discharge, and once prior to completion of discharge. The effluent will be analyzed for the following parameters listed in Table 3. Locations of the sample station are shown in Figure 8.

Table 3 Sample Point 1 Characteristics

SNP ID: IQA-02 (SP-1): Lagoon Effluent		Description: <i>At the lagoon site effluent discharge piping.</i> Rationale: To monitor lagoon final effluent water quality to determine the quality of treatment being provided by the sewage lagoon, along with the quality of effluent discharging into the Koojesse Inlet.
UTM Coordinates: 7068682m N 522821m E		
1		BOD ₅
2		Fecal Coliform (FC)
3		Total Suspended Solids (TSS)
4		pH
5		Temperature
6		Conductivity
7		ICP- Metal Scans

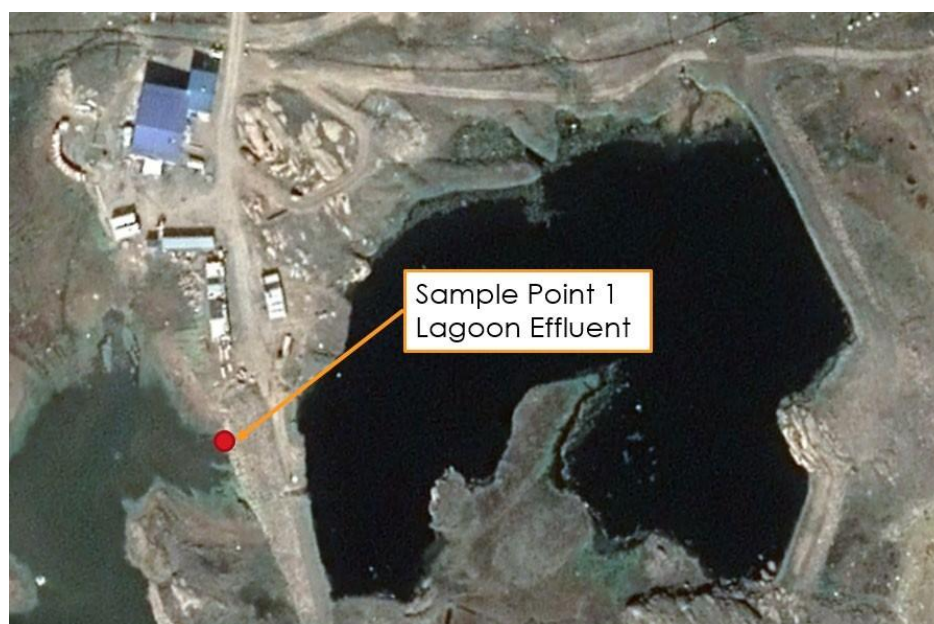


Figure 8 Sewage Lagoon Sampling Location



As per the Water Licence requirements, effluent from the lagoon shall meet the following effluent quality requirements at IQA-02 identified in Table 4.

Table 4 Effluent Quality Requirements

Parameter	Maximum Average Concentration	Maximum Concentration of Any Grab Sample
Total Suspended Solids (TSS)	50.0 mg/L	100.0 mg/L
pH	Between 6 and 9	

pH measurements are valuable because pH is one of the environmental factors that affect the activity and health of the microorganisms. Sudden changes, or abnormal values, indicate that the process has been upset in some way, usually from a toxic waste. Once the lagoon is completely thawed, pH measurements should be taken monthly during effluent sampling.

6.2 QUALITY ASSURANCE/QUALITY CONTROL PLAN

The Surveillance Network Program (SNP) sampling is completed in accordance with the City of Iqaluit's Monitoring and Quality Assurance / Quality Control Plan (CIRNAC, 1996), along with Information on sampling of effluents and receiving waters; a copy of this guideline is attached in Appendix C for reference.

The purpose of taking samples is threefold: one, to measure, determine, or quantify how well the lagoon is working; two, to determine if the effluent meets the regulatory requirements; and three, to adhere to the requirements stated in the governing Water Licence.

There are six important parts to the process of sampling:

1. Taking the sample at the time called for
2. Using the correct sample container
3. Taking the sample from the correct location
4. Careful and correct labelling of the sample container
5. Using proper sampling procedures
6. Shipping the sample in proper containers so it arrives on time at the laboratory for testing

Sample analysis will be conducted by a laboratory accredited by the Canadian Association of Environmental Analytical Laboratories (CAEAL) as a testing laboratory for specific tests registered with CAEAL. The laboratory shall also be accredited according to ISO/IEC Standard 17025. Routine methods of sampling and analysis are based on recognized procedures such as Standard Methods for the Examination of Water and Wastewater APHA, AWWA, WEF, Environmental Canada, USEPA.

Follow all quality control and quality assurance procedures required by the laboratory conducting the analysis. Chemical testing shall use appropriate analytical methods as contained in the most recent edition of Standard Methods for the Examination of Water and Wastewater or other recognized testing methods. A copy of the laboratory sampling requirements will be included in Appendix E of this manual. Detailed sampling procedures are discussed in the Environmental Monitoring Program and QA/QC Plan.



7.0 DAM SAFETY INSPECTIONS AND GUIDELINES

The Canadian Dam Safety Guidelines (DSG) applies to structures exceeding both 7.5 m height and 10,000 m³ storage capacity. The City's sewage lagoon exceeds these thresholds. The DSG's stipulate that a Permanent Record File (PRF), suitable for transfer to the regulatory agency, (in this case the Nunavut Water Board), should be maintained as an ongoing historical reference. The file is required to contain the following:

- History and Background
- Operations, Maintenance & Surveillance Requirements
- Permanent Logbook (PLB)
- Records of all DSR's and DSI's
- As-Built Drawings (and Design Data)

In 2012, Concentric Associates reviewed the classification of the sewage lagoon and determined that the sewage lagoon is classified as a low-risk dam structure, as there is very minimal risk for loss of life, or any socio-economic impacts if a dam failure were to occur (Concentric, 2012; Appendix F). Therefore, the sewage lagoon does not require DSR's to be completed. Regular reviews of the DSG's and sewage lagoon should still be completed to monitor revisions to the guidelines, and if any changes are made to the structure of the sewage lagoon. The CDA (2019) guidelines state that for low consequence category dams, dam safety inspections (DSIs) on can be extended to once every two years, depending on the overall risk that the dam poses.



8.0 REFERENCES

Canadian Dam Association (CDA). (2019). *Dam Safety Guidelines*.

City of Iqaluit. (2020). *Process - Mechanical Operation & Maintenance Manual for the Iqaluit Wastewater Treatment Plant, Iqaluit, Nunavut*. April 24.

Concentric Associates International Inc. (2012). Letter: *Iqaluit Sewage lagoon - DSR Requirements Investigation*. June 29, 2012. Ref. No. 12-4487.

Government of Nunavut. (2010, October). *Environmental Guideline for the General Management of Hazardous Waste*. NU, Canada.

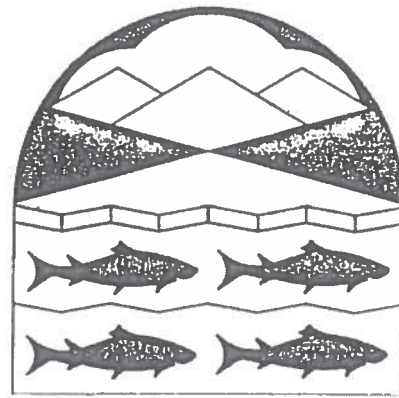
Indian and Northern Affairs Canada. (1996). *Quality Assurance (QA) and Quality Control (QC) Guidelines For Use By Class "A" Licensees in Meeting SNP Requirements and For Submission of A QA/QC Plan*. NWT, Canada.

Nunavut Water Board. (2016, June 17). *Type "A" Water Licence No: 3AM-IQA1626*. Iqaluit, NU, Canada.



APPENDIX A

Sewage Lagoon Drawings



TOWN OF IQALUIT

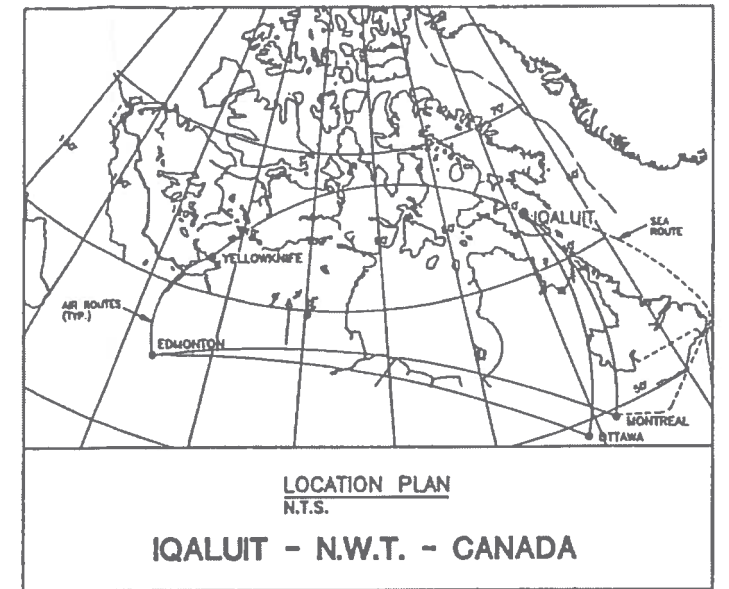
ᐃᐱᐸᐸᐸ ᐸᐸᐸᐸᐸ ᐸᐸᐸᐸᐸ

LAGOON RECONSTRUCTION AND DRAINAGE IMPROVEMENTS

RECORD DRAWINGS

CONTRACT No.

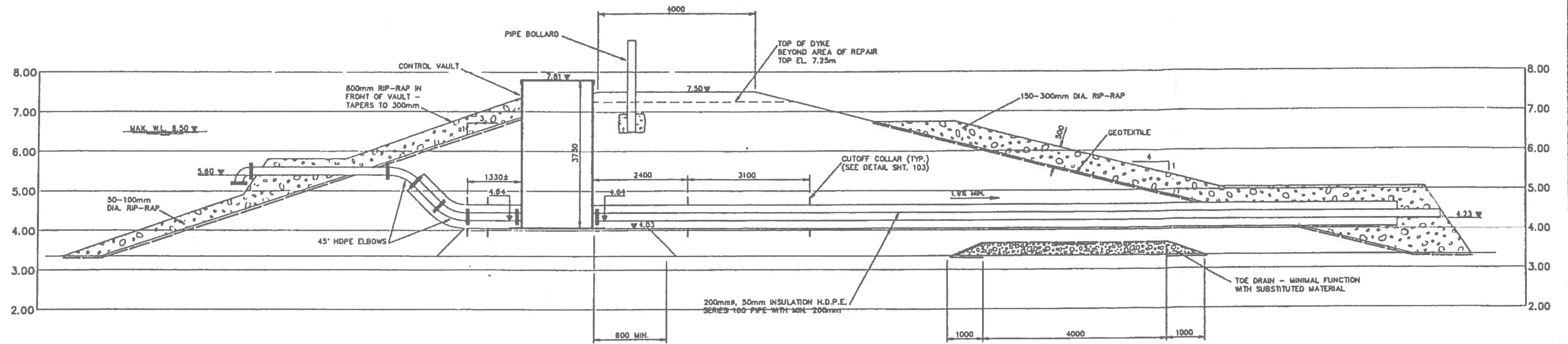
Kenneth R. Johnson
M.A.Sc., MCIP, P.Eng.
Planner & Engineer
www.cryofront.com



THIS IS A
PHOTO-REDUCTION
DO NOT SCALE

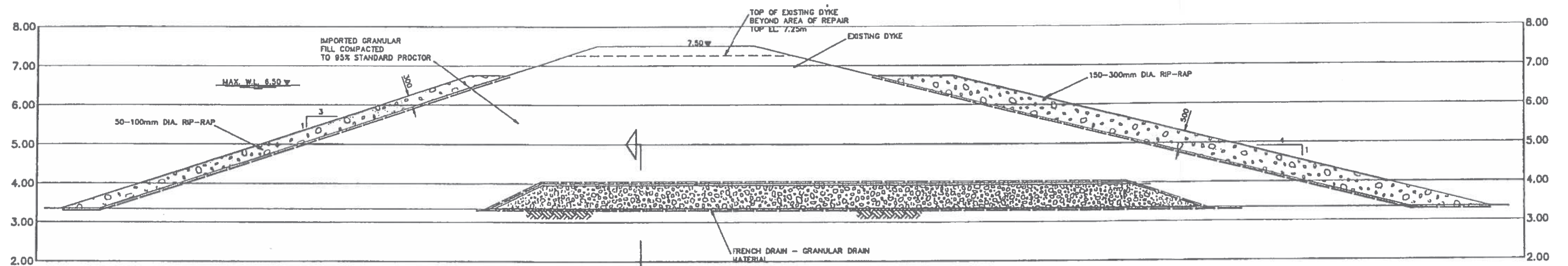


UMA Engineering Ltd.
Engineers, Planners & Surveyors



DYKE RECONSTRUCTION

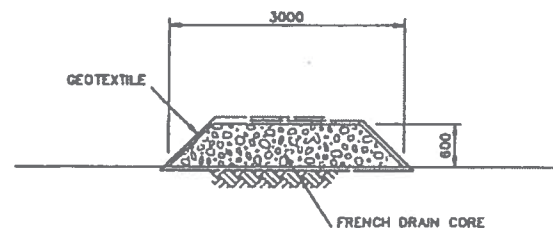
SCALE 1:50



FRENCH DRAIN (MINIMAL FUNCTION WITH SUBSTITUTED MATERIAL)

SCALE 1:50

NOTE: IMPORTED GRANULAR FILL CLASS D2 NOT UTILIZED ABOVE ELEVATION OF FRENCH DRAIN. MATERIAL WITH LARGER FINES COMPONENT SUBSTITUTED BY TOWN OF IQALUIT. DESIGN SLOPES OF 4:1 (EXTERIOR) AND 3:1 (INTERIOR) ACCOMMODATE THIS MATERIAL.



SECTION A

SCALE 1:50

**THIS IS A
PHOTO-REDUCTION
DO NOT SCALE**

TOWN OF IQALUIT, N.W.T.

LAGOON RECONSTRUCTION
AND DRAINAGE IMPROVEMENTS

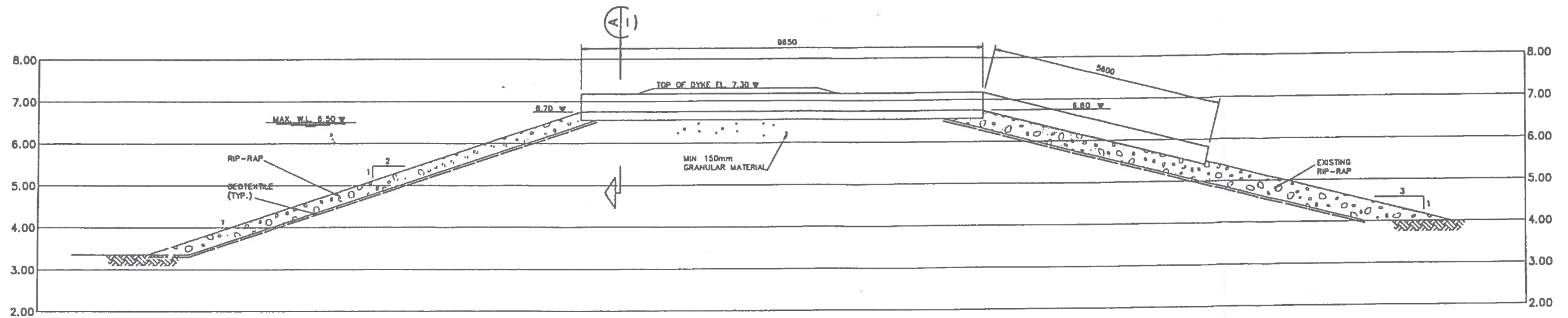
SECTIONS & DETAILS

THE ASSOCIATION IN
PROFESSIONAL ENGINEERS
AND SURVEYORS
PERMIT NUMBER
P.007
UMA ENGINEERING
LTD.

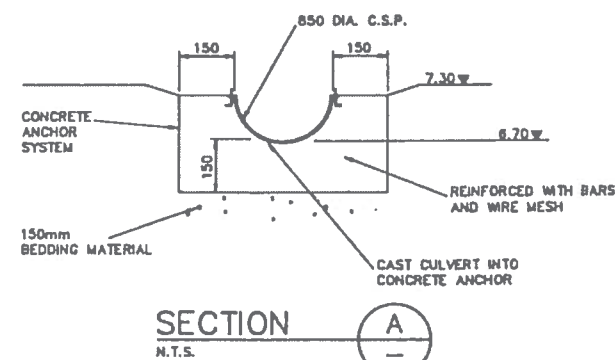
2	91	12	10	RECORD DRAWING	ME	KRJ	KRJ	KRJ
1	91	08	08	FOR CONSTRUCTION	ME	KRJ	JVA	BCO

UMA Engineering Ltd.
Engineers, Planners & Surveyors
British Columbia Alberta Saskatchewan
Manitoba Ontario Yukon Territory
Northwest Territories

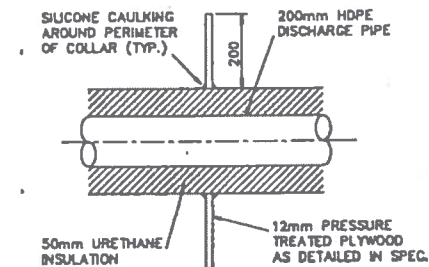




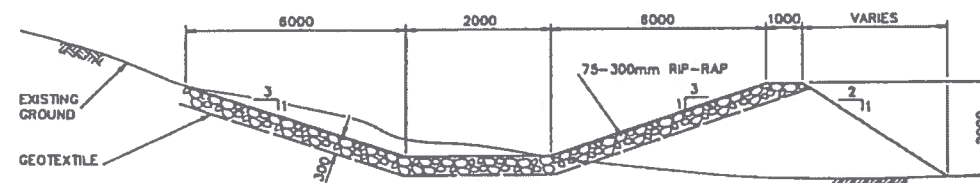
SECTION THROUGH OVERFLOW SPILLWAY
SCALE 1:50



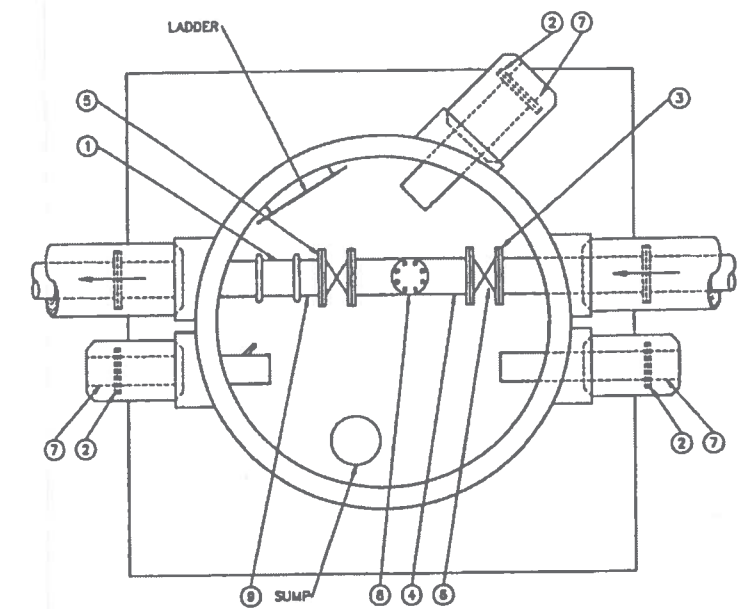
SECTION A-A
N.T.S.



CUTOFF COLLAR DETAIL
N.T.S.



DITCH X-SECTION DETAIL
N.T.S.



REFERENCE

- | | |
|---|---|
| 1. VICTAULIC SPOOL PIECE | 5. PINCH VALVE |
| 2. BLIND FLANGE - GALVANIZED | 6. 200 KNIFE GATE VALVE (200 CWP CRANE) |
| 3. VICTAULIC STYLE #741 FLANGE - GALVANIZED | 7. MASTIC COATED P.U. INSUL. PLUG |
| 4. FLANGE SPOOL PIECE - GALVANIZED | 8. TEE WITH BLIND FLANGE |
| | 9. FLANGE BY VICTAULIC SPOOL PIECE |

CONTROL VAULT

N.T.S. THIS IS A
PHOTO-REDUCTION
DO NOT SCALE

TOWN OF IQALUIT, N.W.T.

LAGOON RECONSTRUCTION
AND DRAINAGE IMPROVEMENTS

SECTIONS AND DETAILS

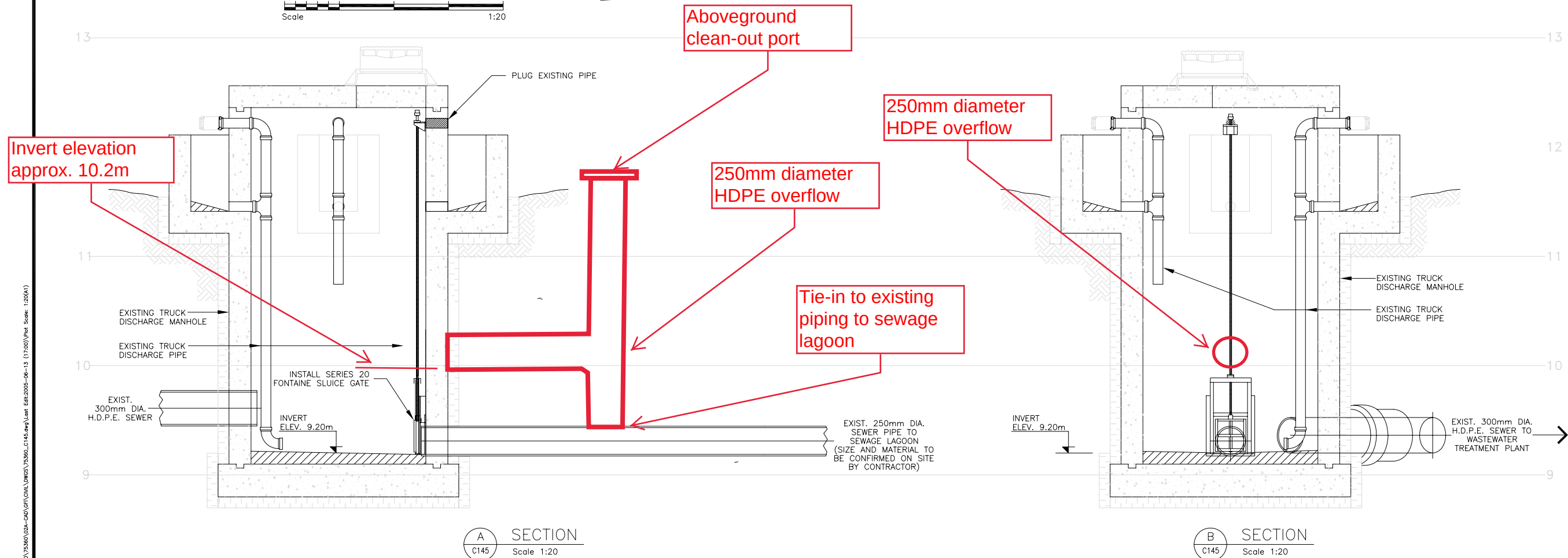
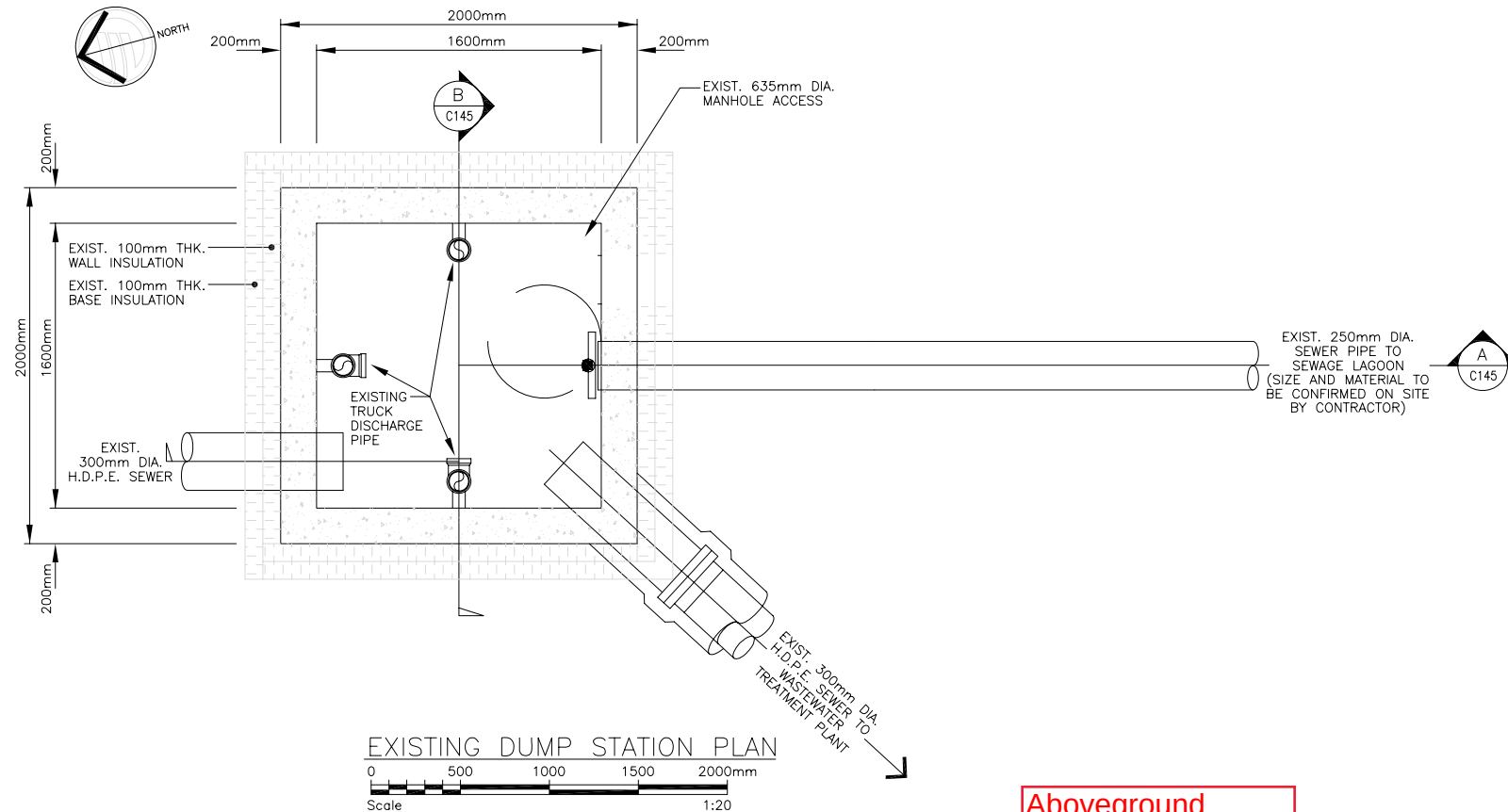
THE ASSOCIATION OF
PROFESSIONAL ENGINEERS
AND SURVEYORS OF
THE NORTHWEST TERRITORIES
PERMIT NUMBER
P 007
UMA ENGINEERING
LTD.

2	01	12	10	RECORD DRAWING	ME	KRJ	KRJ	KRJ
1	01	08	08	FOR CONSTRUCTION	ME	KRJ	JVA	BCO

UMA Engineering Ltd.
Engineers, Planners & Surveyors
British Columbia Alberta Saskatchewan
Manitoba Ontario Yukon Territory
Northwest Territories



1100	00	00	47	A1	102	2
------	----	----	----	----	-----	---



RECORD DRAWING
INFORMATION CONTAINED IN THESE DRAWINGS IS AS SUPPLIED BY:
KUDLIK CONSTRUCTION LTD.
THE COMPLETENESS AND ACCURACY OF THIS RECORD DRAWING IS NOT GUARANTEED.
INFORMATION SHOULD BE VERIFIED AT THE ACTUAL LOCATION BEFORE USE.

No.	Date	Description
2	2006 05/11	RECORD DRAWING
1	2005 6/13	ISSUED FOR CONSTRUCTION
0	2005 3/14	ISSUED FOR TENDER

REVISIONS

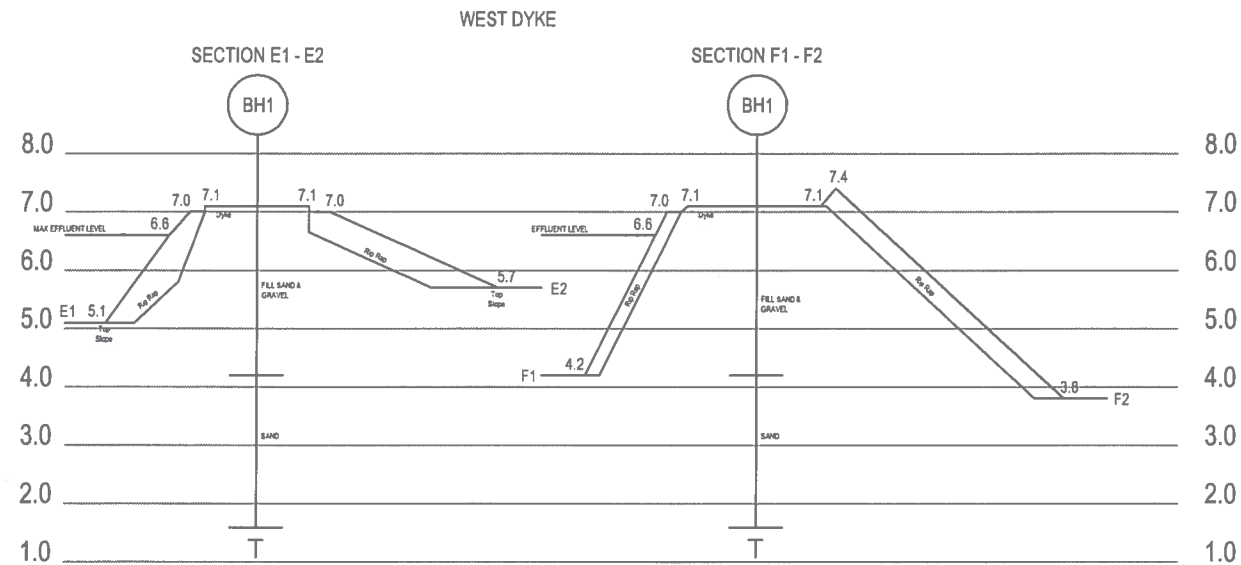


Design	R.H.B./G.A.P.
Drawn	R.J.H.
Approved	
Checked	

Project Title
**CITY OF IQALUIT
WASTEWATER
TREATMENT PLANT
PHASE 1**

Drawing Title
**EXISTING
DUMP STATION
MODIFICATIONS**

Scale AS NOTED	Date
Project No. 75360	2005-03-09
Drawing No. C145	Revision 2



WEST DYKE ELEVATION

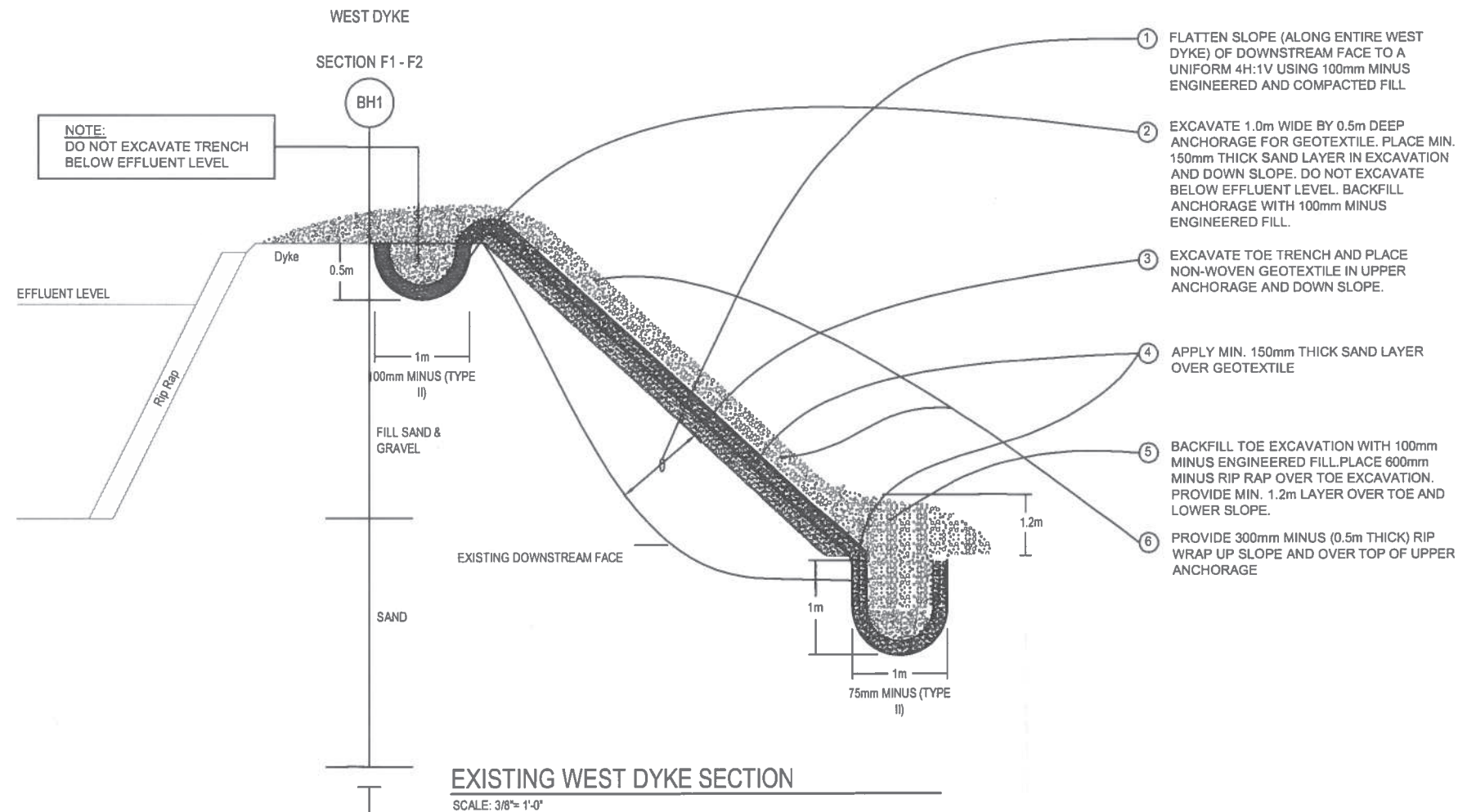
SCALE: 3/8"= 1'-0"
 *AS PER TROW'S GEOTECHNICAL REPORT
 (OTGE00D16794A) DATED OCT 8/2003

GENERAL NOTES:

- BIDDERS/CONTRACTORS SHALL CAREFULLY EXAMINE AND STUDY THE DRAWING AND THE SITE OF THE WORK IN ORDER TO SATISFY THEMSELVES BY EXAMINATION AS TO ALL CONDITIONS AFFECTING THE CONTRACT, THE DETAILED REQUIREMENTS OF THE CONSTRUCTION AND EXTENT OF WORK INVOLVED.
- ALL BIDDERS/CONTRACTORS SHALL CONFIRM OVERALL DIMENSIONS AND QUANTITY OF WORK AND NOTIFY CONSULTANT OF ANY DISCREPANCIES NOTED. NO CONSIDERATION SHALL BE GIVEN FOR CLAIMS FOR EXTRA COMPENSATIONS BEYOND THAT SHOWN ON THE DRAWINGS.
- NO CLAIM SHALL BE MADE AT ANY TIME AFTER SUBMISSION OF A QUOTATION THAT THERE WAS ANY MISUNDERSTANDING OF THE TERMS AND CONDITIONS OF THE CONTRACT RELATING TO THE SITE CONDITIONS.
- OBSERVE AND ENFORCE ALL CONSTRUCTION SAFETY MEASURES REQUIRED BY THE OCCUPATIONAL HEALTH AND SAFETY ACT, WCB, MUNICIPAL REGULATIONS, AND OTHER REGULATIONS GOVERNING CONSTRUCTION WORK. THE MOST STRINGENT REQUIREMENTS WILL APPLY.
- ANY DAMAGES TO EXISTING SERVICES INCURRED BY THE CONTRACTOR DURING THE WORK SHALL BE REPAIRED AND/OR REPLACED TO THE ENTIRE SATISFACTION OF THE PARTIES CONCERNED AT THE CONTRACTORS EXPENSE.
- BACKFILL SHALL NOT BE PLACED UNLESS SUBGRADE IS COMPLETELY FREE OF FROST. DO NOT USE ANY MATERIAL WITHOUT APPROVAL FROM THE CONSULTANT.
- MATERIALS SHALL BE PLACED IN LIFTS BY APPROVED EQUIPMENT, FOR FULL WIDTH OF THE EXCAVATION AS SHOWN ON THE DRAWINGS, AND COMPACTED TO 98% STANDARD PROCTOR DRY DENSITY.
- MATERIAL SHALL BE MOISTENED OR DRIED AS REQUIRED FOR MAXIMUM DENSITY AND THOROUGHLY COMPACTED BY MECHANICAL VIBRATORS CAPABLE OF PRODUCING REQUIRED COMPACTION.

TECHNICAL NOTES:

- THE DESIGN DETAILS PRESENTED ARE INTENDED TO PROVIDE ENHANCED EROSION PROTECTION FOR THE DOWNSTREAM FACE OF THE WEST DYKE, AS PER RECOMMENDATIONS MADE IN THE TROW GEOTECHNICAL REPORT (OTGE00D16794A) DATED OCT 8/2003.
- THE EROSION CONTROL MEASURES ARE CONSIDERED TEMPORARY. LAGOON TO BE INSPECTED ANNUALLY.
- PREVENTION OF OVERTOPPING OF THE LAGOON IS REQUIRED TO ENSURE CONTINUED SLOPE STABILITY. CONTINUING TO OPERATE THE LAGOON AT MINIMAL LEVELS AND CONTROLLING THE AMOUNT OF DISCHARGE USING THE CONTROL STRUCTURE CAN PREVENT OVERTOPPING.



- FLATTEN SLOPE (ALONG ENTIRE WEST DYKE) OF DOWNSTREAM FACE TO A UNIFORM 4H:1V USING 100mm MINUS ENGINEERED AND COMPACTED FILL
- EXCAVATE 1.0m WIDE BY 0.5m DEEP ANCHORAGE FOR GEOTEXTILE. PLACE MIN. 150mm THICK SAND LAYER IN EXCAVATION AND DOWN SLOPE. DO NOT EXCAVATE BELOW EFFLUENT LEVEL. BACKFILL ANCHORAGE WITH 100mm MINUS ENGINEERED FILL.
- EXCAVATE TOE TRENCH AND PLACE NON-WOVEN GEOTEXTILE IN UPPER ANCHORAGE AND DOWN SLOPE.
- APPLY MIN. 150mm THICK SAND LAYER OVER GEOTEXTILE
- BACKFILL TOE EXCAVATION WITH 100mm MINUS ENGINEERED FILL. PLACE 600mm MINUS RIP RAP OVER TOE EXCAVATION. PROVIDE MIN. 1.2m LAYER OVER TOE AND LOWER SLOPE.
- PROVIDE 300mm MINUS (0.5m THICK) RIP WRAP UP SLOPE AND OVER TOP OF UPPER ANCHORAGE

EXISTING WEST DYKE SECTION

SCALE: 3/8"= 1'-0"



700 Richmond St., Suite 104
 London, ON, N6A 5C7
 Tel. 519 452-7700
 Fax 519 452-1712

1428 Blair Plaza, Suite 104
 Ottawa, ON, K1J 8L8
 Tel. 613 824-8900
 Fax 613 824-8901

SUBMIT NAME:

CITY OF IQALUIT

PROJECT ADDRESS:

CITY OF IQALUIT NUNAVUT

DRAWING TITLE:

EXISTING WEST DYKE
 ELEVATION

PROJECT NAME:

SEWAGE LAGOON WEST DYKE
 UPGRADES

DESIGN R.A.H.

DESIGN C.Y.

APPROV A.D.M.

SCALE AS NOTED

DATE OCT/2005

PROJECT NO 05-1292

DWG. NO.

SK2

1 OF 1

3	ISSUED FOR TENDER	JUNE, 22/06
2	ISSUED FOR TENDER	JUNE, 15/06
1	ISSUED FOR CLIENT REVIEW	JUNE, 2/06
NO	REVISION / ISSUED TO	DATE



APPENDIX B

Current Water Licence



NUNAVUT WATER BOARD

TYPE "A" WATER LICENCE NO. 3AM-IQA1626



TABLE OF CONTENTS

PART A:	SCOPE, DEFINITIONS, AND ENFORCEMENT.....	4
1.	SCOPE	4
2.	DEFINITIONS.....	5
3.	ENFORCEMENT	5
PART B:	GENERAL CONDITIONS	5
PART C:	CONDITIONS APPLYING TO SECURITY	7
PART D:	CONDITIONS APPLYING TO THE USE OF WATERS AND WATER MANAGEMENT PLANS	7
PART E:	CONDITIONS APPLYING TO THE DEPOSIT OF WASTE AND WASTE MANAGEMENT PLANS	8
PART F:	CONDITIONS APPLYING TO CONSTRUCTION	11
PART G:	CONDITIONS APPLYING TO MODIFICATIONS	12
PART H:	CONDITIONS APPLYING TO SPILL CONTINGENCY PLANNING.....	12
PART I:	CONDITIONS APPLYING TO MONITORING	13
PART J:	CONDITIONS APPLYING TO CLOSURE AND RECLAMATION	14
SCHEDULES		15
Schedule A:	Definitions	16
Schedule B:	Annual Reporting Requirements	20
Schedule I:	Condition Applying to Monitoring	21



Licence No. 3AM-IQA1626

Pursuant to the Nunavut Waters and Nunavut Surface Rights Tribunal Act and the Agreement Between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in Right of Canada, the Nunavut Water Board, hereinafter referred to as the Board, hereby grants to the

CITY OF IQALUIT

(Licensee)

P.O. BOX 460 IQALUIT, NU X0A 0H0

(Mailing Address)

hereinafter called the Licensee, the right to alter, divert or otherwise use Water or deposit Waste for a period subject to restrictions and conditions contained within this Licence:

Licence Number / Type: **3AM-IQA1626 / TYPE "A"**

Water Management Area: **FROBISHER BAY WATERSHED (53)**

Location: **WITHIN CITY OF IQALUIT'S MUNICIPAL BOUNDARIES, QIKIQTANI REGION, NUNAVUT**

Classification: **MUNICIPAL UNDERTAKING**

Purpose: **USE OF WATERS AND DEPOSIT OF WASTE**

Quantity of Water not to be Exceeded: **1,100,000 CUBIC METRES ANNUALLY**

Date Licence Issuance: **JUNE 17, 2016**

Expiry of Licence: **JUNE 16, 2026**

This Licence issued (**Motion Number: 2016-02-P6-14**) and recorded at Goji Haven, Nunavut, includes and is subject to the annexed conditions.

Norman Mike
Nunavut Water Board,
Hearing Chair

APPROVED
BY: Minister of Indigenous and
Northern Affairs Canada

APPROVAL
DATE: _____



PART A: **SCOPE, DEFINITIONS, AND ENFORCEMENT**

1. **SCOPE**

We need to add the new water reservoir and pipeline to the table in (a) to account for the physical boundaries of these new features.

- a. This Type “A” Water Licence No. 3AM-IQA1626 (“Replacement and Amended Licence” or “Licence”) authorizes the City of Iqaluit (“Licensee” or the “City”) to use Water and deposit Waste in support of a Municipal undertaking, as classified under Schedule 1 of the *Regulations*, within the City’s municipal boundaries at the following approximate geographic coordinates:

Undertaking	Latitude	Longitude
Overall Extents	63° 50' 56.31" N	68° 39' 49.87" W
	63° 50' 57.30" N	68° 33' 41.94" W
	63° 43' 48.91" N	68° 18' 12.53" W
	63° 41' 06.60" N	68° 18' 18.82" W
	63° 41' 04.08" N	68° 32' 44.20" W
	63° 44' 46.02" N	68° 39' 43.1 0" W
West 40 Landfill	63° 43' 58.15" N	68° 32' 08.54" W
Water Treatment Plant	63° 45' 12.24" N	68° 30' 22.79" W
Wastewater Treatment Plant	63° 44' 45.15" N	68° 32' 19.80" W

The scope of activities, works, and undertakings authorized in accordance with the terms and conditions of this Replacement and Amended Licence is as follows:

- Use, management, and protection of the Lake Geraldine drainage basin;
- Management and protection of Waters surrounding the West 40 Landfill site;
- Management, collection, and monitoring of leachate from the West 40 Landfill site and adjacent Sludge Management Facility;
- Management of improved drainage works at the West 40 Landfill site;
- Management, operation, and eventual closure and reclamation of the current West 40 Landfill site and associated solid waste disposal facilities;
- Upgrades, operation, maintenance, monitoring, and eventual closure and reclamation of a Wastewater Treatment Plant (WWTP);
- Operation, maintenance, monitoring, and eventual closure and reclamation of a Sludge Management Facility;
- Operation, maintenance, monitoring and eventual closure and reclamation of a Sewage Lagoon Facility;
- Implementation of contingency measures for the Wastewater and Landfill management facilities; and
- Implementation of changes to the monitoring requirements including frequency, parameters, and stations being monitored.

- b. This Licence is issued subject to conditions contained herein with respect to the taking of Waters and the depositing of Waste of any type in any Waters or in any place under any



conditions where such Waste or any other Waste that results from the deposits of such Waste may enter any Waters. Whenever new Regulations are made or existing Regulations are amended by the Governor in Council under the Act, or other statutes imposing more stringent conditions relating to the quantity, type or manner under which any such Waste may be so deposited, this Licence shall be deemed to be subject to such requirements; and

- c. Compliance with the terms and conditions of this Licence does not absolve the Licensee from the responsibility for compliance with all applicable legislation, guidelines, and directives.

2. DEFINITIONS

- a. The Licensee shall refer to [Schedule A](#) for definitions of terms used in this Licence.

3. ENFORCEMENT

- a. Failure to comply with this Licence shall be a violation of the Act, subjecting the Licensee to the enforcement measures and the penalties provided for in the Act.
- b. All inspection and enforcement services regarding this Licence will be provided by Inspectors appointed under the Act.
- c. For the purpose of enforcing the terms and conditions of this Licence with respect to the use of Water and deposit or Discharge of Waste in Waters, Inspectors appointed under the Act, hold all powers, privileges, and protections that are conferred upon them by the Act or by other applicable laws.

PART B: GENERAL CONDITIONS

- 1. The Licensee shall file, with the Board for review, no later than the 31st of March of the year following the calendar year being reported, an Annual Report formulated in accordance with the requirements under [Schedule B](#) of this Licence.
- 2. The Licensee shall maintain a copy of this Licence at the Municipal Office, potable Water Treatment Facility, and the Waste Treatment Facilities at all times.
- 3. The Licensee shall file an application for renewal of this Licence at least one (1) year prior to the Licence expiry.
- 4. The Licensee shall, to the satisfaction of an Inspector, install, operate, and maintain metres, devices or other appropriate methods for measuring the volumes of Water used and Waste Discharged or deposited.



Nunavut Water Board | Type "A" Water Licence No: 3AM-IQA1626

5. The Licensee shall post the necessary signs to identify the stations of the Monitoring Program included under [Schedule I](#) of this Licence. All signage shall be in the Official Languages of Nunavut.
6. The Licensee shall, for all Plans submitted under this Licence, include a proposed timetable for implementation. Plans submitted cannot be undertaken without subsequent written approval and/or directions from the Board. The Board may alter or modify a Plan if necessary to achieve legislative objectives and will notify the Licensee in writing of acceptance, rejection, or alteration of the Plan.
7. The Licensee shall, for all Plans submitted under this Licence, implement the Plan as approved by the Board in writing.
8. The Licensee shall, within thirty (30) days of notification or within the timeframe specified by the Board, submit for review and/or Board's approval revisions for any plan found to be unacceptable to the Board.
9. Every Plan to be carried out pursuant to the terms and conditions of this Licence shall become a part of the Licence, and any additional terms and conditions imposed upon approval of a Plan by the Board shall also become part of the Licence. All relevant terms and conditions of the Licence should be contemplated in the development of a Plan where appropriate.
10. The Licensee shall review the Plans referred to in this Licence as required by changes in operation and/or technology and modify the Plans accordingly. Revisions to any Plan shall be submitted in the form of an addendum to be included within the Annual Report required under Part B, Item 1, complete with the lists of revisions detailing where significant content changes are made.
11. The Licensee shall immediately report to the NWT/NU 24-Hour Spill Report Line (867-920-8130) any spills of Waste associated with the Undertakings under this Licence including the potable Water Treatment Facility and Waste Treatment Facilities, which are reported to or observed by the Licensee.
12. Any communication with respect to this Licence shall be made in writing to the attention of:

Manager of Licensing
Nunavut Water Board
P. O. Box 119
Goji Haven, NU X0B 1J0
Telephone: (867) 360-6338
Fax: (867) 360-6369
Email: licensing@nwb-oen.ca
13. Any notice made to an Inspector shall be made in writing to the attention of:



Nunavut Water Board | Type "A" Water Licence No: 3AM-IQA1626

Water Resources Officer
Nunavut District, Nunavut Region
P.O. Box 100
Iqaluit, NU X0A 0H0
Telephone: (867) 975-4295
Fax: (867) 979-6445

14. The Licensee shall submit, to the Board for information or as otherwise directed, one (1) paper copy and one (1) electronic copy of all reports, studies, and Plans generated for the works, activities, and undertakings under this Licence. All Reports, studies or Plans submitted to the Board by the Licensee shall include an executive summary in English, Inuktitut, and French.
15. The Licensee shall ensure that any document(s) or correspondence submitted by the Licensee to the Board is received by the Board and maintain on file a copy of the acknowledgment of receipt issued by the Manager of Licensing or his/her designate.
16. This Licence is assignable as provided for in section 44 of the Act.
17. The expiry or cancellation of this Licence does not relieve the Licensee from any obligation imposed by the Licence, or any other regulatory requirement.

PART C: **CONDITIONS APPLYING TO SECURITY**

1. The Licensee is not required to post reclamation security for the activities, works, and undertakings authorized under this Licence.

PART D: **CONDITIONS APPLYING TO THE USE OF WATERS AND WATER MANAGEMENT PLANS**

1. The Licensee is authorized to withdraw, from the Lake Geraldine Reservoir at Monitoring Station No. IQA-01, up to 1,100,000 cubic metres of Water annually for the relevant activities, works, and undertakings authorized under the scope of this Licence.
2. The Licensee shall submit to the Board for approval, within sixty (60) days of the Effective Date of the Licence, an updated manual for the potable Water Treatment Facility. The Manual shall be prepared in accordance with relevant aspects of the format outlined in the *Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories* (GNWT, 1996). The manual shall, address among other items, the following:
 - a. Purpose of facility;
 - b. Site setting;



- c. Operational procedures for storage, treatment and distribution of potable Water; Waste generated and hazardous substances associated with the facility; site inspections; and personnel training;
 - d. Maintenance procedures including equipment servicing;
 - e. Sampling and monitoring requirements; and
 - f. Emergency response measures.
3. The Licensee shall equip all freshwater intake structures with screens of appropriate mesh size that meet the requirements of Fisheries and Oceans (DFO) Canada's *Freshwater Intake End-of-Pipe Fish Screen Guidelines* (1995 or the most current) so as to prevent the entrainment of fish and control Water withdrawal rates such that fish do not become impinged within the screens.
4. The Licensee shall undertake Dam Safety Inspections (DSI) and/or Dam Safety Reviews (DSR) of the Lake Geraldine water supply facility in accordance with requirements of the Canadian Dam Association (CDA), *Dam Safety Guidelines* (2007, or the most current version). The Licensee shall submit for the Board's review, within the Annual Report required under Part B, Item 1, the report generated for the DSIs or DSRs along with the Licensee's recommended actions to address any deficiencies identified in the inspections and/or reviews.
5. The Licensee shall not remove any material from below the ordinary High Water Mark of any Water body unless otherwise approved by the Board in writing.
6. The Licensee shall not cause erosion to the banks of any body of Water and shall provide the necessary controls to prevent such erosion.
7. The Licensee shall implement necessary measures to control sediment and erosion prior to and during operations to prevent entry of sediments into Water.
8. The Licensee shall maintain the potable Water Treatment Facility in accordance with applicable guidelines, procedures, and regulations and to the satisfaction of an Inspector.
9. The Licensee shall, as part of any proposal to supplement the Lake Geraldine Reservoir, evaluate the potential impact on freshwater resources, including fish and fish habitat. The results of the evaluation must be included as part of any application to augment the Lake Geraldine Reservoir with Water from proximal water bodies.

PART E: **CONDITIONS APPLYING TO THE DEPOSIT OF WASTE AND WASTE MANAGEMENT PLANS**

1. The Licensee is authorized to use the Sewage Lagoon Facility and the Wastewater Treatment Plant to treat and dispose of Wastewater generated by the Undertaking authorized under this Licence until such time that the Upgraded Wastewater Treatment Plant authorized by the



Licensee is constructed and commissioned, or as otherwise approved by the Board in writing.

2. The Licensee shall provide written notice to an Inspector and the Board at least ten (10) days prior to any planned Discharges from the Solid Waste Facility, Sewage Lagoon Facility, Wastewater Treatment Plant, and the Upgraded Wastewater Treatment Plant once commissioned.
3. The Licensee shall establish the relevant monitoring stations for the facilities authorized under this Licence in accordance with [Schedule I](#).
4. The Licensee shall ensure that Surface Drainage or surface Water runoff associated with site activities or generated during the construction of any facility designed to withhold, divert, or retain Water or Waste, does not exceed the following Effluent criteria:

Parameter	Maximum Average Concentration	Maximum concentration of Any Grab Sample
Total Suspended Solids (TSS)	50.0 mg/L	100.0 mg/L
pH	Between 6 and 9.	

5. Upon commissioning of the Upgraded Wastewater Treatment Plant, the Sewage Lagoon Facility shall be used as a back-up facility or closed and reclaimed in accordance in Part J, Item 4.
6. The Licensee shall submit to the Board for approval in writing, within four (4) months of the Effective Date of the Licence, an Operation and Maintenance Manual for the Sewage Lagoon Facility that addresses requirements for both the Sewage Lagoon and Sludge Management Facilities. The manual shall be prepared in accordance with the *Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories* (GNWT, 1996).
7. The Licence shall submit to the Board for approval in writing, by December 21, 2018 or as otherwise directed by the Board in writing, an Operations and Maintenance Manual for the Upgraded Wastewater Treatment Plant that incorporates the requirements of Part E, Item 6. The manual shall be prepared in accordance with the *Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories* (GNWT, 1996).
8. The manual referred to in Part E, Item 7 shall supersede the manual referenced in Part E, Item 6, following approval by the Board in writing.
9. The Licensee shall submit to the Board for approval in writing, by December 31, 2018, an updated version of the plan entitled *City of Iqaluit Solid Waste Management Plan*, dated January 2014 that addresses relevant intervener's comments and recommendations made during the licensing process, such as inclusion of details related to future uses of the landfill, timeframe for closure, and ongoing activities within the scope of this Licence.



10. The Licensee shall undertake Dam Safety Inspections (DSI) and/or Dam Safety Reviews (DSR) of the Wastewater Treatment Facilities in accordance with requirements of the Canadian Dam Association (CDA), *Dam Safety Guidelines* (2007, or most current version). The Licensee shall submit for the Board's review, within the Annual Report required under Part B, Item 1, the report generated for the DSIs or DSRs along with the Licensee's recommended actions to address any deficiencies identified in the inspections and/or reviews.
11. The Licensee shall dispose of and contain all municipal solid waste generated by the City at the West 40 Landfill as associated site(s) authorized under this licence or as otherwise approved by the Board in writing.
12. The Licensee shall submit to the Board for approval, within sixty (60) days of the Effective Date of the Licence, an updated Landfill Operation and Maintenance Manual that addresses concerns raised by intervening parties during the licensing process including the following:
 - a. Management of Leachate from the facility;
 - b. Updated sampling and monitoring requirements; and
 - c. Open burning practices.
 - d. Ongoing activities within
13. The Licensee shall collect and contain all leachate generated by the West 40 Landfill within the Landfill.
14. The Licensee shall submit to the Board for review, by December 31, 2017, an updated version of the document entitled *West 40 Landfill Drainage Management Review*, dated September 16, 2011, that addresses the concerns raised by intervening parties including information on the absence of permafrost related data.
15. The Inspector may authorize an emergency Discharge ,following the Licensee's written submission to the Inspector and to the Board, at least fifteen (15) days prior to discharge or as instructed by the Inspector, that includes the following information:
 - a. Proposed quantity of discharge;
 - b. Reason for discharge;
 - c. Identification of the Final Discharge Location;
 - d. Proposed sampling and analysis to be conducted; and
 - e. Proposed mitigation measures to implemented.
16. The Licensee shall submit to the Board and the Inspector for review, within sixty (60) days following any emergency Discharge authorized by the Inspector, a report that includes, among other items, an analysis of results for the emergency Discharge.
17. The Licensee shall maintain the Licensed Facilities to the satisfaction of an Inspector.



18. The Licensee shall remove from the site associated with the undertaking, all Hazardous Wastes, waste oil and non-combustible waste generated through the course of the operation, for disposal at a licensed waste disposal facility.
19. The Licensee shall maintain records of all Waste removed from site and records of confirmation of proper disposal of removed Waste. These records shall be made available to an Inspector or the Board upon request.

PART F: **CONDITIONS APPLYING TO CONSTRUCTION**

1. The Licensee shall, submit to the Board for review, within thirty (30) days prior to commencing construction of any facilities or infrastructure authorized under this Licence, for-construction designs and drawings, signed and stamped by an Engineer.
2. The Licensee shall ensure that all relevant approved facilities are designed and constructed to engineering standards such that, at a minimum, they comply with the most current version of the *Canadian Dam Safety Guidelines*.
3. The Licensee shall implement measures to ensure that all materials used in the construction of relevant facilities or infrastructure included under the scope of this Licence are free of contaminants, to the extent that they do not cause harmful or significant effects to Water.
4. The Licensee shall maintain shoreline stability during construction.
5. The Licensee shall ensure that all final designs and drawings are qualified by an Engineer confirming that:
 - a. Works are designed under sound engineering principles;
 - b. Design limitations are understood and communicated within the report; and
 - c. Measures are implemented to minimize impact to Water.
6. The Licensee shall, submit to the Board for review, within ninety (90) days of completion of any structure authorized under this licence, to contain, withhold, divert or retain Water or Wastes; a construction summary report prepared by an Engineer that includes, among other relevant information, as-built drawings, documentation of field decisions that deviated from original plans, and any data used to support these decisions.
7. The Licensee shall, if contamination of surface and/or ground water is encountered during construction and excavation, notify the Inspector immediately and implement the Spill Contingency Plan.
8. The Licensee shall develop and implement measures necessary to prevent and mitigate erosion and/or the release of sediment into Water during the construction of the Upgraded Wastewater Treatment Plant or during any construction activities associated with the Undertaking.



PART G: CONDITIONS APPLYING TO MODIFICATIONS

1. The Licensee may, without written consent from the Board, carry out Modifications to the potable Water Treatment Facility and Waste Treatment Facilities provided that such Modifications are consistent with the terms of this Licence and the following requirements are met:
 - a. the Licensee has notified the Board in writing of such proposed Modifications at least sixty (60) days prior to beginning the Modifications;
 - b. Such Modifications are consistent with the NPC Land Use Planning (NPC) Conformity Determination and the NIRB Screening Decision;
 - c. such Modifications do not place the Licensee in contravention of the Licence or the Act;
 - d. the Board has not, during the sixty (60) days following notification of the proposed Modifications, informed the Licensee that review of the proposal will require more than sixty (60) days; and
 - e. The Board has not rejected the proposed Modifications.
2. Modifications for which all of the conditions referred to in Part G, Item 1 have not been met can be carried out only with written approval from the Board.
3. The Licensee shall provide as-built plans and drawings of the Modifications referred to in this Licence within ninety (90) days of completion of the Modifications. These plans and drawings shall be stamped by an Engineer.

PART H: CONDITIONS APPLYING TO SPILL CONTINGENCY PLANNING

1. The Licensee shall, submit to the Board for approval in writing, within thirty (30) days of the Effective Date of this Licence, an amalgamated and updated Spill Contingency Plan. The Plan shall address spill contingency planning requirements for all relevant aspects of works, activities, and undertakings associated with the scope of this Licence including the Sewage Lift Station.
2. The Licensee shall, subject to section 16 of the Regulations, report any unauthorized deposits of Waste or foreseeable unauthorized deposits of waste and/or Discharges of Effluent, and:
 - a. Employ, as required, the approved Spill Contingency Plan;
 - b. Report the incident immediately via the NWT/NU 24-Hour Spill Reporting Line (867) 920-8130 and to the Inspector at (867) 975-4295; and
 - c. For each spill occurrence, submit a detailed report to the Inspector, no later than thirty (30) days after initially reporting the event. The report shall include the amount and



type of spilled product, the GPS location of the spill, and the measures taken to contain, clean up and restore the spill site.

3. The Licensee shall, in addition to Part H, Item 2, regardless of the quantity of release of a harmful substance, report to the NWT/NU Spill Line if the release is near or into a Water body.

PART I: CONDITIONS APPLYING TO MONITORING

1. The Licensee shall monitor the relevant potable Water Treatment Facility and Waste Treatment Facilities authorized under this Licence in accordance with requirements included under [Schedule I](#).
2. The Licensee shall, submit Board for approval in writing, within sixty (60) days of the Effective Date of this Licence, an updated Monitoring Program that addresses monitoring requirements for the Water Treatment Facility and Waste Treatment Facilities. The Monitoring Program shall address, among other items, the requirements outlined in [Schedule I](#).
3. All analyses required under [Schedule I](#) shall be conducted using methods as described in the most recent edition of “*Standard Methods for the Examination of Water and Wastewater*”, or by such other methods as approved by the Board in writing.
4. All laboratory analyses shall be performed at a laboratory accredited according to ISO/IEC Standard 17025. The accreditation shall be current and in good standing.
5. The Licensee shall, submit to the Board for review, within sixty (60) days of the Effective Date of the Licence, an updated Quality Assurance/Quality Control (QA/QC) Plan prepared in accordance with *Quality Assurance (QA) and Quality Control (QC) Guidelines for Use by Class “A” Licensees in Meeting SNP Requirements and for Submission of a QA/QC Plan* (INAC, 1996 or most current version). The updated plan shall be accompanied by a letter from an Analyst of an accredited laboratory confirming acceptability of the Plan.
6. The Licensee shall measure by instrument and record in cubic metres, the monthly quantities of freshwater extracted from the Lake Geraldine Reservoir, at Monitoring Program Station No. IQA-01, used for all purposes under this Licence.
7. The Licensee shall measure, by instrument and record in cubic metres, the quantities of Effluent released from the Sewage Lagoon Facility at Monitoring Station No. IQA-02, Wastewater Treatment Plant and/or Upgraded Wastewater Treatment Plant at Monitoring Station No. IQA-04 and the West 40 Landfill at Monitoring Station No. IQA-08.
8. The Licensee shall measure and record in cubic metres, the monthly and annual volumes of sludge removed from the Wastewater Treatment Facilities.



9. The Licensee shall provide the GPS co-ordinates (in degrees, minutes and seconds of latitude and longitude) of all locations of sources of Water utilized and Waste deposited under this Licence.
10. The Licensee shall include all of the data and information required by the Monitoring Program under [Schedule I](#) within the Annual Report required under Part B, Item 1 of the Licence or as otherwise requested by an Inspector and/or the Board.
11. Additional Monitoring may be requested by the Board and/or the Inspector.
12. The Monitoring Program and compliance dates specified in the Licence may be modified at the discretion of the Board in writing and do not constitute an application for Amendment as defined in the *Act*.

PART J: CONDITIONS APPLYING TO CLOSURE AND RECLAMATION

1. The Board has accepted the document entitled *Iqaluit Solid Waste Management Plan West 40 Landfill Decommissioning Technical Memorandum*, dated January 2014, submitted as additional information with the Application.
2. The Licensee shall submit to the Board for approval in writing, at least one (1) year prior to commencing the decommissioning of the West 40 Landfill, a Final Closure and Reclamation Plan prepared by an Engineer in accordance with industry’s best practices and relevant guidelines.
3. The Licensee shall, for the Plan required under Part J, Item 2, include a presentation of data and a discussion of environmental conditions existing before the use of the site by the Licensee as a municipal landfill, as well as remediation objectives.
4. The Licensee shall notify the Board in writing, at least one year prior to the implementation of final closure, of its intentions to proceed with final closure of any Water use or Waste disposal facilities included within the scope of this Licence, excluding the Facility under Part J, Item 2.



SCHEDULES

[Schedule A:](#) Scope, Definitions, and Enforcement

[Schedule B:](#) General Conditions

Schedule C: No Schedule for Security

Schedule D: No Schedule for Use of Water and Water Management Plans

Schedule E: No Schedule Waste Disposal and Waste Management Plans

Schedule F: No Schedule for Construction

Schedule G: No Schedule for Modifications

Schedule H: No Schedule for Spill Contingency Planning

[Schedule I:](#) Monitoring

Schedule J: No Schedule for Closure and Reclamation



Schedule A: Definitions

In this Licence, 3AM-IQA1626:

“**Act**” means the *Nunavut Waters and Nunavut Surface Rights Tribunal Act*;

“**Addendum**” means the supplemental text that is added to a full plan, manual, or report, usually included at the end of the document and is not intended to require a full resubmission of the revised report. It may also be considered as an appendix or supplement;

“**Amendment**” means a change to any terms and conditions of this Licence through application to the NWB, requiring a change, addition, or deletion of specific terms and conditions of the Licence not considered as a modification;

“**Analyst**” means an Analyst designated by the Minister under section 85 (1) of the *Act*;

“**Annually**” means, in the context of monitoring frequency, one sampling event occurring every 365 days with a minimum of 200 days between sampling events;

“**Application**” means, for the purposes of this License, the totality of the NWB Public Register opened as a result of the filing of the application to replace and amend expired Water Licence 3AM-IQA0611(3AM-IQA0612);

“**Biannually**” means, in the context of the monitoring frequency, two sampling events occurring per calendar year, with a minimum of 150 days and a maximum of 210 days between sampling events;

“**Board**” means the Nunavut Water Board established under Article 13 of the *Nunavut Land Claims Agreement* and under section 14 of the *Act*;

“**Discharge**” means the release of any Water or Waste to the receiving environment;

“**Effective Date**” means the date on which the Minister of Indigenous and Northern Affairs Canada approves the Licence;

“**Effluent**” means treated or untreated liquid Waste material that is Discharged into the environment from the site water management facilities such as a settling pond or a treatment plant;

“**Engineer**” means a professional engineer registered to practice in Nunavut in accordance with the *Consolidation of Engineers and Geoscientists Act S. Nu 2008, c.2* and the *Engineering and Geoscience Professions Act S.N.W.T. 2006, c.16 Amended by S.N.W.T. 2009, c.12*;

“**Engineered Structure**” means any facility, designed and approved by a Professional Engineer who is registered with the Association of Professional Engineers, Geologists and Geophysicists of Nunavut;



“**Grab Sample**” means an undiluted quantity of material collected at a particular time and place that may be representative of the total substance being sampled at the time and place it was collected;

“**Greywater**” means the component of Effluent produced from domestic use (i.e. washing, bathing, food preparation and laundering), excluding Sewage;

“**Hazardous Waste**” means materials or contaminants categorized as dangerous goods under the *Transportation of Dangerous Good Act* (1992), no longer used for their original purpose and intended for recycling, treatment, disposal or storage at appropriate facilities;

“**High Water Mark**” means the usual or average level to which a body of water rises at its highest point and remains for sufficient time so as to change the characteristics of the land (ref. *Department of Fisheries and Oceans Canada, Operational Statement: Mineral Exploration Activities*);

“**Inspector**” means an Inspector designated by the Minister under section 85 (1) of the Act;

“**Licence**” means this Type “A” Water Licence No. 3AM-IQA1626, issued by the Nunavut Water Board to the City of Iqaluit in accordance with the Act;

“**Licensee**” means the entity to whom Licence No. 3AM-IQA1626 is issued or assigned;

“**Minister**” means the Minister of Indigenous and Northern Affairs Canada (INAC);

“**Modification**” means an alteration to a physical work that may introduce a new structure or eliminates an existing structure and does not alter the purpose or function of the work;

“**Monitoring Program**” means the program to collect data on surface water and groundwater quality to assess impacts to the environment of an appurtenant undertaking;

“**Monthly**” means, in the context of monitoring frequency, one sampling event occurring within calendar month with a minimum of twenty-one (21) days between sampling events;

“**Nunavut Land Claims Agreement**” (NLCA) means the “*Agreement Between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in Right of Canada*,” including its preamble and schedules, and any Amendments to that agreement made pursuant to it;

“**Quality Assurance / Quality Control (QA/QC)**” Quality Assurance means the system of activities designed to better ensure that quality control is done effectively; Quality Control means the use of established procedures to achieve standards of measurement for the three principle components of quality: precision, accuracy and reliability;



“**Quarterly**” means divisions of the calendar year, comprised of three month intervals from January to December, inclusive (January – March, April – June, July – September and October – December);

“**Regulations**” means the *Nunavut Waters Regulations* (SOR/2013/669 18th April, 2013);

“**Sewage**” means all toilet wastes and greywater;

“**Sewage Lagoon Facility**” refers to the waste disposal facility and associated structures designed and constructed to treat Sewage in the City of Iqaluit since 1978, which has also been upgraded in subsequent years;

“**Sludge Management Facility**” means the facility located within the West 40 Landfill that is used for the disposal and treatment of sludge generated by the Wastewater Treatment Plant;

“**Solid Waste Facility**” means the West 40 Landfill, Sludge Management Facility and all other facilities identified in the Application that are designed and constructed to manage solid waste generated by the City of Iqaluit;

“**Surface Drainage**” means all surface waters resulting from the flow over, through or out of an operations area and is collected by means of Engineered structures;

“**Undertaking or Undertakings**” means an undertaking or undertakings in respect of which Water is to be used or Waste is to be deposited, as classified in Schedule 1 of the *Regulations*;

“**Upgraded Wastewater Treatment Plant (UWWTP)**” means the current Wastewater Treatment Plant, which was designed, constructed, and commissioned under Phase 1, for the preliminary treatment of Wastewater, in addition to the infrastructure scheduled for construction and commissioning by December 2018, under Phase 2, for the secondary treatment of Wastewater as described in the Application;

“**Use**” means use as defined in section 4 of the Act;

“**Waste**” means Water as defined in section 4 of the Act;

“**Waste Treatment Facilities**” refers to all facilities constructed and operated by the City of Iqaluit to manage solid and liquid Waste associated with this licence.

“**Wastewater**” means the water generated by site activities or originates on-site that requires treatment or any other water management activity;

“**Wastewater Treatment Facilities**” means the Sewage Lagoon, Wastewater Treatment Plant, Upgraded Wastewater Treatment Plant and associated facilities authorized under this Licence;



“**Wastewater Treatment Plant**” means the engineered system, located adjacent to the Sewage Lagoon Facility that is designed for the containment and preliminary treatment of Sewage generated by the City of Iqaluit as described in the Application;

“**Water or Waters**” means water as defined in section 4 of the *Act*;

“**Water Treatment Facility**” means the engineered facilities and appurtenances designed and constructed for the withdrawal storage treatment and distribution of fresh water for domestic purposes, described in the Application; and

“**West 40 Landfill**” means the Solid Waste Facility or original landfill facility along with its Northern Expansion and Sludge Management Facility that is designed to manage solid waste generated by the City of Iqaluit.



Schedule B: Annual Reporting Requirements

The Annual Report referred to in Part B, Item 1, shall include the following:

- a. The monthly and annual quantities in cubic metres of fresh Water withdrawn from the Lake Geraldine Reservoir at Monitoring Station No. IQA-01;
- b. The monthly and annual quantities in cubic metres of any Discharges from the Wastewater Treatment Facilities at Monitoring Stations IQA-02, IQA-04, and IQA-08;
- c. Copy of reports generated from Dam Safety Inspections and Dam Safety Reviews along with the Licensee’s proposed actions to address issues identified and/or updates on continuing actions to address issues;
- d. The monthly and annual quantities in cubic metres of sludge removed from the Wastewater Treatment Facilities;
- e. The monthly and annual quantities of Wastes disposed of at the West 40 landfill;
- f. A summary report which includes all data and information generated under the Monitoring Program, including the QA/QC program, in electronic and printed formats acceptable to the Board;
- g. A summary of all construction activities carried out for facilities under the Licence;
- h. A summary of modifications and/or major maintenance work carried out on the potable Water Treatment and Waste Treatment Facilities, including all associated structures;
- i. A progress report and revisions (if applicable) to any studies requested by the Board that relate to Waste management, Water use or reclamation and a brief description of any future studies planned by the Licensee including, a non-technical executive summary for the general public, translated into Inuktitut;
- j. Any revisions required, in the form of addenda, to Plans, Manuals and Reports approved under the Licence;
- k. 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;
- l. A summary of any closure and reclamation work undertaken and an outline of any work anticipated for the next year, including any changes to implementation and scheduling;
- m. A summary of actions taken to address concerns or deficiencies listed in the inspection reports and/or compliance reports filed by an Inspector;
- n. 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;
- o. A summary of any studies, reports and plans requested by the Board that relate to Waste disposal, Water use or reclamation and a brief description of any future studies planned; and
- p. Any other details on the use of Water or Waste disposal requested by the Board by November 1st of the year being reported.



Schedule I: Condition Applying to Monitoring

Table 1 – Water Quality Parameters		
Test Groups	Analytical Parameters	Units
Routine (R)	Alkalinity, Acidity, Chloride, Carbonate, Bicarbonate, Total Hardness, Hydroxide, Sulphate, Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Total Organic Carbon (TOC), Total Inorganic Carbon (TIC)	mg/L
	pH (field and lab)	pH units
	Oxidation-Reduction Potential (ORP) (field)	mV
	Conductivity (field and lab)	uS/cm
	Temperature (field)	°C
	Turbidity	NTU
Effluent (E)	Total Suspended Solids (TSS)	mg/L
	Temperature (field)	°C
	Conductivity (field and lab)	uS/cm
	pH (field and lab)	pH units
Acute Lethality (AL)	Based on Environment Canada’s <i>Procedure for pH Stabilization During the Testing of Acute Lethality of Wastewater Effluent to Rainbow Trout</i> (EPS 1/RM/50, March 2008), if single concentration test fails and unionized ammonia concentration is less than or equal to 1.25 mg/L	“Pass” / “Fail”
ICP- Metals Scan (Total)	Al, Sb, As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Mo, Ni, Se, Sn, Ag, Sr, Tl, Ti, U, V, Zn, Hg	mg/L
Nutrients (N)	Ammonia-N, Nitrate-N, Nitrite-N	mg N/L
	Total Phosphorus, Orthophosphate	mg/L
Biological (B)	Biochemical Oxygen Demand	mg/L
	Total and Fecal Coliform	CFU/100 mL
Potable Water (PW)	Fecal Coliform	CFU/100 mL
	ICP Metals (Total and dissolved)	mg/L
	Total Suspended Solids –TSS	mg/L
Flow (F)	Volume	m ³
Landfill Specific (LS)	Polychlorinated Biphenyls (PCBs) Benzene, Toluene, Ethylbenzene and Xylene (BTEX)	mg/L



Table 2¹ - Water Quality Monitoring Criteria

Station ID	Description	Status	Parameter	Testing / Measurement Frequency	Reporting Frequency
IQA-01	Lake Geraldine Reservoir – Raw Water	Active	R, PW	Monthly	Biannually
			F	Monthly	
IQA-01(#)	Based on Part I, Item 4 of Expired Licence	Inactive	N/A	N/A	N/A
IQA-02	Sewage Lagoon – Effluent Discharge Point	Active	B, N, E, ICP	Once prior to discharge; once during discharge; and once prior to the completion of discharge	Annually
			F	During decant	
IQA-03	Sewage Lagoon – Influent	Inactive	N/A	N/A	N/A
IQA-04	Wastewater Treatment Plant - Effluent	Active	B, N, E, ICP	Quarterly – Prior to commissioning of the WWTP	Annually
			B, N, E, ICP	Monthly – Following commissioning of the WWTP	
			AL	Annually – following commissioning of the WWTP	
			F	During Discharge	
IQA-05	Wastewater Treatment Plant - Influent	Active	B, E, N, ICP	Biannually – Prior to commissioning of the WWTP	Annually
				No testing requirements following commissioning of the WWTP	N/A
IQA-06	Sludge – From WWTP	Active	B, E, N, ICP	Quarterly	Annually
IQA-07	Surface Water entering West 40 Landfill – Based on Part E, Item 4 of the Expired Licence	Inactive	N/A	N/A	N/A



Station ID	Description	Status	Parameter	Testing / Measurement Frequency	Reporting Frequency
IQA-08	West 40 Landfill – Effluent Discharge Point, Based on Part E, Item 4 of the Expired Licence	Active	B, E, N, ICP, F, LS	Once prior to discharge; once during discharge; and once prior to the completion of discharge	Annually
			F	During Discharge	
IQA-08(#)	Based on E, Item 17, Part F, Item 10 & Part I, Item 4 of the Expired Licence	Inactive	N/A ²	N/A	N/A
IQA-08A	Station situated up-gradient of West 40 Landfill	Active	B, E, N, ICP, F, LS	Annually	Annually
IQA-08B	Station situated down-gradient of West 40 Landfill	Active			
IQA-09	Contaminated soil accepted at the West 40 Landfill	Inactive	NA	N/A	N/A

¹ Table 2 may be modified by the Board and re-issued where necessary. Re-issuance is not considered an Amendment to the application or Licence as defined in the *Act*.

² Means not applicable



APPENDIX C

INAC Sampling Guide

QUALITY ASSURANCE (QA) AND QUALITY CONTROL (QC)

GUIDELINES

**FOR USE BY CLASS "A" LICENSEES
IN MEETING SNP REQUIREMENTS**

AND FOR SUBMISSION OF A QA/QC PLAN

JULY 1996

**DEPARTMENT OF INDIAN AND NORTHERN AFFAIRS CANADA
WATER RESOURCES DIVISION
AND THE
NORTHWEST TERRITORIES WATER BOARD**

Table of Contents

1.0	Introduction and Definitions	1
2.0	Field Sampling.....	1
2.1	Sample Collection.....	1
2.1.1	Location	1
2.1.2	Sampling Equipment.....	2
2.1.3	Sampling Methods	3
2.2	Sample Handling.....	4
2.2.1	Preservation	4
2.2.2	Sample Identification.....	5
2.2.3	Transportation.....	5
3.0	Lab Analysis	6
3.1	Outside Laboratories.....	6
3.1.1	Lab Accreditation	6
3.1.2	Detection Limits.....	6
3.1.3	Methodology	6
3.2	In-House Laboratories.....	6
3.2.1	Identification of Analytical Laboratory/Detection Limits	7
3.2.2	For Overall Analytical Methods, Precision and Accuracy	7
3.2.3	Accuracy Requirements	7
3.2.4	Precision Requirements	8
3.2.5	Methodology	8
4.0	Reporting Requirements	9
4.1	General Submissions	9
4.2	Outside Laboratories.....	9
4.3	In-House Laboratories	9
Appendixes		
	Appendix 1.....	11
	Table 1 - Summary of Preservation Requirements	
	Appendix 2.....	12
	References	

1.0 Introduction and Definitions

In order to assist Licensees in completing their Quality Assurance and Quality Control (QA/QC) Plan, the following guidelines are provided, which indicates the minimum information that should be included.

These Guidelines are divided into three sections:

- 1) Field Sampling
- 2) Lab Analysis
- 3) Reporting Requirements

It is recognized that there may be different interpretations as to what is covered by "Quality Assurance/Control" due to the fact that certain Licensees have their own laboratories, while others only use commercial laboratories. For licence purposes, "Quality Assurance" and "Quality Control" refer to the following:

Quality Assurance: is the system of activities designed to better ensure that quality control is done effectively; while

Quality Control: is the use of established procedures to achieve standards of measurement for the three principal components of quality: precision, accuracy and reliability.

2.0 Field Sampling

2.1 Sample Collection

2.1.1 Location

A QA/QC plan must identify the locations of all sampling stations and the markers used to identify the stations. If the Surveillance Network Program (SNP) of the Water Licence does not specify sampling locations, locations should be chosen with help from an Inspector.

Buoys and landmarks identify sampling stations in tailings ponds and lakes, while sign post positioning usually marks stream sample stations. Stations should be used repeatedly, with the same personnel and techniques to reduce operational error. The use of Global Positioning System (GPS) to identify Latitude and Longitude for sampling stations is recommended.

2.1.2 Sampling Equipment

The Plan must include a detailed section on the equipment used for sampling, the rationale behind the choices of equipment, and descriptions of how the equipment is maintained and calibrated. Equipment and bottles should be selected so that they do not contaminate or otherwise alter the concentrations of parameters of interest.

Sampling devices, sample bottles and filtration devices should be constructed of non-metallic material. Most samples are now collected in containers constructed of high density polyethylene plastic. However, there are some exceptions, when testing for oil and grease or phenols glass containers are to be used. When conducting a fish bioassay, plastic drums are used while hydrocarbon based containers are not to be used for the collection of organic samples.

This section should also identify whether new or used bottles are used for each sample analysis. New bottles are preferred,

but sample containers may be used repeatedly with proper handling measures.

If old bottles are used, a detailed description should be included, noting how they are maintained, stored and cleaned. Usually, this will closely resemble the product manufacturer's instructions. An example of how bottles should be cleaned is outlined below:

- Rinse well with hot tap water for one minute or more.
- Empty bottle and add 30% HNO₃ to approximately 1/3 container capacity. Shake well for three to four minutes.
- Rinse vigorously with hot tap water for two minutes.
- Rinse thoroughly three times with tap water and three times with distilled water.
- Store with 0.2% HNO₃ for a minimum of one week.
- Rinse again with distilled water at least three times.

Bottles that are to be used for bacteria testing should be acid washed or autoclaved if possible.

Note: Additional information on bottle washing is also available from Water Resources Division.

2.1.3 Sampling Methods

This Section will include details on methods for sample collection and the equipment that is to be used for each station.

In lakes and ponds, regular sample bottles are used the majority of the time, but Van Dorn samples are often utilized. The sample or the sample bottle is usually lowered to mid

depth and washed three times before collecting the sample on the fourth submersion. Approximately 2% of the sample container capacity should remain to provide for mixing, preservative addition and thermal expansion.

Stream water sampling is usually done by plunging a sample bottle toward the current and allowing it to fill. Once again, the bottle should be rinsed three times before filling and room should be left for preservative addition and mixing.

A glass bottle should be used when sampling for oil and grease with the sample being collected during the first submersion and not rinsed three times first.

This section should also describe how often field blanks and replicate samples will be collected. Field blanks are samples of distilled/deionized water that are to be treated in exactly the same manner as the other samples. Blanks should therefore be taken to the field and handled and preserved as part of the sample program. They indicate when a sample may be contaminated and are indicative of general sample integrity. Replicate samples (duplicates and triplicates) are two or three samples collected from the same station at the same time. They help to ensure sample precision at the laboratory.

2.2 Sample Handling

2.2.1 Preservation

After collection, most samples must be preserved in order to prevent chemical or biochemical changes to the sample. The QA/QC plan must describe how samples from each station are to be preserved.

Preservation is generally done by the addition of certain chemicals into the bottle immediately after the sample is collected. **Table 1** is a general guide to preservatives and their appropriate concentrations. The QA/QC plan should contain more detailed information on the concentrations and amount of preservatives that will be used.

2.2.2 Sample Identification

The plan should include a description of the system used to identify samples. The system must provide positive sample identification and ensure that the identification is maintained. It is advisable to keep a logbook of samples that have already been delivered.

The identification can be maintained by marking the bottle itself or a label, with a water resistant, non-smear felt pen. The information should be clear to persons uninvolved in the sampling and may include such details as company name, sample area, SNP number, time and date.

2.2.3 Transportation

The section on transportation will describe how sample integrity will be ensured from the time of collection to completion of delivery. Delivery to the lab should be done as soon as possible after the samples have been collected.

Usually, samples are sealed and stored upright in a box with other samples to provide a snug, immobile storage space during transfer. Any samples that require refrigeration for preservation should be kept cool during transport.

3.0 Lab Analysis

Because certain Class "A" Licensees have their own analytical laboratory and others rely on commercial laboratories, this section of the Guidelines is divided accordingly.

3.1 Outside Laboratories

3.1.1 Lab Accreditation

The Licensee will identify in the plan the name of the commercial laboratory that will be conducting the analyses. A letter must be provided from the commercial lab indicating that they are accredited to conduct analyses on each of the required sampling parameters. Ideally, the lab should be accredited by the Canadian Association for Environmental Analytical Laboratories (C.A.E.A.L.) and should provide a certificate stating parameters for which they are accredited.

3.1.2 Detection Limits

Detection limits for the commercial lab should be identified for all parameters and should be reported when any SNP data is submitted.

3.1.3 Methodology

Descriptions should be included for any methods of analysis used that are not outlined in "Standard Methods for the Examination of Water and Wastewater".

3.2 In House Laboratories

3.2.1 Identification of Analytical Laboratory/Detection Limits

Licensees using in-house labs shall identify their detection limits for all parameters and report them when any SNP data is submitted. The Licensee shall also identify the commercial lab they use to check for quality control.

3.2.2 For Overall Analytical Methods, Precision and Accuracy

The plan must describe how the Licensee will ensure precision and accuracy in their analytical methods. This includes what action will be taken if any sample results are found to be outside the appropriate ranges.

All analyses should be conducted in accordance with methods prescribed in the current edition of "Standard Methods for the Examination of Water and Wastewater" or by other approved methods. In addition, the lab should analyze standard reference material for each parameter measured. For each parameter (group) to be measured, a complete description of the sampling procedure must be documented and adhered to.

If any sample results are outside the appropriate QA/QC ranges, attempts should be made to correct the problem and the sample shall be immediately re-analyzed. If any analysis indicates a violation of a licence condition, an Inspector shall be notified of the violation, any corrective action taken, and the results of retests.

3.2.3 Accuracy Requirements

The plan should document how the Licensee will go about

ensuring accuracy in the laboratory. Accuracy is the measurement of how closely a value approximates a standard, or true value. The Licensee should identify the frequency at which certified or reference standards will be analyzed during each sampling period.

3.2.4 Precision Requirements

Precision is a measure of the closeness or repeatability of a set of values. This section will describe how and when replicate samples are taken to ensure lab precision. It is recommended that the Licensee take triplicates at one SNP station during each sampling period. If daily sampling is required at only one station, a duplicate sample should be taken each time, with a triplicate sample taken one a week.

3.2.5 Methodology

Descriptions should be included of any methods of analysis that are not taken from "Standard Methods for the Examination of Waste and Wastewater." Standard methods should be referenced.

4.0 Reporting Requirements

4.1 General Submission

The QA/QC plan will contain a section outlining what information will be reported in the monthly SNP reports. Any control charts or graphs which display the precision and accuracy of the methods used to analyze the samples should be submitted with the report. This includes warning and control limits used to determine acceptability of the data.

4.2 Outside Laboratories

The Licensee shall outline the number of replicate samples that will be collected and submitted with each SNP report. It is recommended that one set of duplicates or triplicates from an assigned SNP site, as well as the results from field blanks, be submitted with each required SNP report. This would serve as an internal/external check for the Licensee and the commercial lab.

4.3 In-House Laboratories

The Licensee shall outline the number of results from replicate samples that will be included with each required SNP report. It is recommended that two duplicate sets be collected per month at an assigned SNP site, with one set being sent to a commercial lab while the other is to be analyzed by the Licensee's lab. Analytical results from both labs should be submitted with each required SNP report. This would serve as an external check for the lab. Any results from a commercial lab should be presented on the lab's letterhead.

**FOR FURTHER INFORMATION, CONTACT THE WATER
RESOURCES DIVISION AT:**

**Box 1500
Yellowknife, NWT
X1A 2R3
(867) 669-2654 Phone
(867) 669-2716 Fax**

Appendix 1**Table 1: General Summary of Special Sampling or Handling Techniques**

Determination	Container	Minimum Sample Size (ml)	Preservation	Maximum Storage Recommended
BOD	Sterile polyethylene	1000	Refrigerate 4°C	24 hours
Conductivity	Polyethylene	500	Refrigerate 4°C	28 days
Total Cyanide	Polyethylene	500	Add NaOH to raise pH>12 refrigerate in dark	24 hours
Hardness	Polyethylene	100	Add Conc. HNO ₃ to lower pH<2 OR (*) unpreserved	6 months
Metals, General	Polyethylene	250	For dissolved metals filter immediately, add Conc. HNO ₃ to pH<2	6 months
Mercury	Glass (rinsed with 1 + 1 HNO ₃)	500	Add Conc. HNO ₃ or pH<2 or H ₂ SO ₄ + 1 ml of 5% K ₂ Cr ₂ O ₇ , refrigerate 4°C	28 days
Nitrogen:				
Ammonia	Polyethylene	500	Analyze as soon as possible or add H ₂ SO ₄ to pH<2, refrigerate OR (*) unpreserved	7 days
Nitrate	Polyethylene	100	Analyze as soon as possible or refrigerate	48 hours
Oil and Grease	Glass or wide-mouth calibrated	1000	Add H ₂ SO ₄ to pH<2, refrigerate	28 days
pH	Polyethylene	--	Analyze immediately	2 hours
Suspended Solids	Polyethylene	--	Refrigerate	7 days
Temperature	Polyethylene	--	Analyze immediately	0
Turbidity	Polyethylene	--	Analyze same day; store in dark up to 24 hours, refrigerate	24 hours
Bacteria	Polyethylene (sterilized)	--	None: Keep cool	6 - 48 hours

(*) Unpreserved = check with lab that will be analyzing the samples

Appendix 2

References:

Gilbert, Andrew (1993). “Echo Bay Mines Ltd. Environmental Laboratory Quality Assurance Plan”.

Soniassy, R. (1980). “A Guide for the Collection of Water and Effluent Samples”; pp 1-16; INAC

“Standard Methods for the Examination of Water and Wastewater” (1989); AHPA, AWWA and WPCF, 17th edition.

Water Resources Division, Indian and Northern Affairs Canada (1990). “Generic Quality Assurance (QA) Plan Guidelines for Use by the Licensees in Meeting SNP Requirements for Submission of a QA Plan”; INAC.



APPENDIX D

Permanent Log Book



APPENDIX D

PERMANENT LOG BOOK

A Permanent Log Book (PLB) shall be provided for every dam structure that meets the requirements set forth by the Dam Safety Guidelines (DSG). The log book shall contain notations or records of the following items:

- Changes to normal operation
- Unusual events or conditions
- Inspection activity
- Weather conditions and trends
- Unusual maintenance activity
- Test of any control equipment

The PLB is to be updated in accordance with these instructions. All updates should be completed either on the same day as the event noted or within 24 hours of the event. The PLB should be updated by the person that undertakes the particular inspection.

For the Iqaluit WWTP Sewage Lagoon, the only control equipment is the control valve and access structure at the outlet to the lagoon. These components should be inspected for proper operation during the regularly scheduled inspections on a bi-annual basis. All site inspection checklists completed shall be contained in this section and maintained in chronological order.

Table D.1 Permanent Log Book Entries

Date	Updated Description	Action Required	Name & Signature
Feb 10 2005	DSI Conducted by Concentric	Nothing Immediate; report will be added to the PRF in Tab 6	
Jun 30 2005	Regular Inspection by Plant Foreman	None	
Aug 06 2005	Unscheduled Inspection by Plant Foreman due to unusual amount of rainfall over the previous 24 hours	No obvious problems. Continue to monitor, another inspection will be done tomorrow.	



Monitoring and Maintenance Checklist

A) Weekly Inspection:

1. Visual Inspection of berms
2. Visual inspection of accompanying drainage ditches
3. Visual inspection of truck discharge structures
4. Visual inspection of outlet structures (sluice gate at inlet structure, and knife gate valves in the outlet structure)
5. Verify lagoon water levels & 1-meter freeboard
6. Colour of lagoon: _____

Concerns:

No	Yes
No	Yes
No	Yes
No	Yes
No	Yes
No	Yes

Concerns: _____

A) Monthly Inspection:

1. Visual inspection of lagoon signage
2. Sample and record effluents during periods of flow
3. Remove floating debris and vegetation

Concerns:

No	Yes
No	Yes
No	Yes

Concerns: _____

A) Annual Inspection:

1. Complete a sludge survey (as required)
2. Clear drainage ditches and culverts and repair as necessary
3. Assess berms and site for erosion and repair as necessary

Concerns:

No	Yes
No	Yes
No	Yes

Concerns: _____

Signature of Inspector _____

Name of Inspector: _____

Weekly Monthly Annually

Date of Inspection: _____



APPENDIX E

Laboratory Sampling Requirements



City of Iqaluit – Sewage Lagoon Laboratory Sampling Requirements

Created: Jan 2020

Version 1.0

A list of the minimum testing requirements for the Iqaluit WWTP Sewage Lagoon are provided below. All test samples should be sent to and evaluated by an accredited and approved laboratory. Testing results should be reported every year.

The testing requirements below should be reviewed and updated at each update/renewal of the City's Water License. The table below shall log when each update was completed to ensure that the most current Water License testing requirements are being executed. Confirmation that the testing requirements meet the most current Water license shall be completed prior to any sampling/testing being completed.

Sampling Requirement Log Book

Date	Current Water License	Updates to Testing	Name & Signature
Jan 2020	3AM-IQA1626/TYPE – A (June 17, 2016 – June 16, 2026)	None	Nunami Stantec





City of Iqaluit – Sewage Lagoon Laboratory Sampling Requirements

Created: Jan 2020

Version 1.0

The following tables are taken directly from the current Water license, which illustrate the required testing parameters and frequency for the Iqaluit WWTP Sewage Lagoon. If further clarification is required, consult the complete Water License in Appendix B (ensure that Water License is up-to-date).

Sampling requirements for the Iqaluit WWTP Sewage Lagoon are identified in yellow in Table 1 and Table 2 below:

Table 1 – Water Quality Parameters		
Test Groups	Analytical Parameters	Units
Routine (R)	Alkalinity, Acidity, Chloride, Carbonate, Bicarbonate, Total Hardness, Hydroxide, Sulphate, Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Total Organic Carbon (TOC), Total Inorganic Carbon (TIC)	mg/L
	pH (field and lab)	pH units
	Oxidation-Reduction Potential (ORP) (field)	mV
	Conductivity (field and lab)	uS/cm
	Temperature (field)	°C
	Turbidity	NTU
Effluent (E)	Total Suspended Solids (TSS)	mg/L
	Temperature (field)	°C
	Conductivity (field and lab)	uS/cm
	pH (field and lab)	pH units
Acute Lethality (AL)	Based on Environment Canada's <i>Procedure for pH Stabilization During the Testing of Acute Lethality of Wastewater Effluent to Rainbow Trout</i> (EPS 1/RM/50, March 2008), if single concentration test fails and un-ionized ammonia concentration is less than or equal to 1.25 mg/L	"Pass" / "Fail"
ICP- Metals Scan (Total)	Al, Sb, As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Mo, Ni, Se, Sn, Ag, Sr, Tl, Ti, U, V, Zn, Hg	mg/L
Nutrients (N)	Ammonia-N, Nitrate-N, Nitrite-N	mg N/L
	Total Phosphorus, Orthophosphate	mg/L
Biological (B)	Biochemical Oxygen Demand	mg/L
	Total and Fecal Coliform	CFU/100 mL
Potable Water (PW)	Fecal Coliform	CFU/100 mL
	ICP Metals (Total and dissolved)	mg/L
	Total Suspended Solids –TSS	mg/L
Flow (F)	Volume	m ³
Landfill Specific (LS)	Polychlorinated Biphenyls (PCBs) Benzene, Toluene, Ethylbenzene and Xylene (BTEX)	mg/L





City of Iqaluit – Sewage Lagoon Laboratory Sampling Requirements

Created: Jan 2020
Version 1.0

Table 2¹ - Water Quality Monitoring Criteria

Station ID	Description	Status	Parameter	Testing / Measurement Frequency	Reporting Frequency
IQA-01	Lake Geraldine Reservoir – Raw Water	Active	R, PW	Monthly	Biannually
			F	Monthly	
IQA-01(#)	Based on Part I, Item 4 of Expired Licence	Inactive	N/A	N/A	N/A
IQA-02	Sewage Lagoon – Effluent Discharge Point	Active	B, N, E, ICP	Once prior to discharge; once during discharge; and once prior to the completion of discharge	Annually
			F	During decant	
IQA-03	Sewage Lagoon – Influent	Inactive	N/A	N/A	N/A
IQA-04	Wastewater Treatment Plant - Effluent	Active	B, N, E, ICP	Quarterly – Prior to commissioning of the WWTP	Annually
			B, N, E, ICP	Monthly – Following commissioning of the WWTP	
			AL	Annually – following commissioning of the WWTP	
			F	During Discharge	
IQA-05	Wastewater Treatment Plant - Influent	Active	B, E, N, ICP	Biannually – Prior to commissioning of the WWTP	Annually
				No testing requirements following commissioning of the WWTP	N/A
IQA-06	Sludge – From WWTP	Active	B, E, N, ICP	Quarterly	Annually
IQA-07	Surface Water entering West 40 Landfill – Based on Part E, Item 4 of the Expired Licence	Inactive	N/A	N/A	N/A





APPENDIX F

Dam Safety Reviews & Inspections



APPENDIX F

DAM SAFETY REVIEWS & INSPECTIONS

Copies of all Dam Safety Inspections (DSIs) and Dam Safety Reviews (DSRs) conducted on the Iqaluit Sewage Lagoon shall be contained in this section. The documents should be placed in chronological order for ease of reference.

New documents that are added to this section should be noted in the annual updates page at the beginning of the O&M manual, in the Permanent Log Book for the associated site inspection, and in the DSR/DSI register listed below.

Date	Document	Completed By
Feb 2002	Dam Safety Review	Trow
Oct 2002	Dam Safety Inspection	Trow
Feb 2005	Dam Safety Inspection	Concentric
Aug 2006	Dam Safety Inspection	Concentric
Oct 2009	Dam Safety Inspection	Concentric
Sep 2011	Dam Safety Inspection	Concentric
Jun 2012	Dam Safety Review Investigation	Concentric



Our file # 12-4487

June 29, 2012

City of Iqaluit
Department of Engineering
P.O. Box 460
Iqaluit, Nunavut
X0A 0H0

via email

Attention: Mr. Paul Clow, Project Officer

**Re: Iqaluit Sewage Lagoon
DSR Requirement Investigation**

Dear Paul:

Concentric Associates International Incorporated (Concentric) was retained to determine if and how often Dam Safety Reviews (DRS's) are required for the Sewage Lagoon in Iqaluit, Nunavut.

Background and Description

The Iqaluit Sewage Lagoon was constructed south of the FOL barracks, on the tidal plain at the head of Koojesse Inlet circa 1978. The lagoon is formed by 2 man-made berms (east and west) and the natural topography to the north and south.

The sewage lagoon has not been in use for several years, the water treatment plant constructed circa 2006 removes the need for the lagoon. However the lagoon is required as an emergency back-up in the event of a failure at the water treatment plant.

Observations

The Canadian Dam Safety Guidelines (DSG) were originally published in 1999. That document formed the basis for the Dam Safety Review (DSR) conducted by Trow (now exp) in 2001/2002. The Trow (now exp) DSR recommended a new DSR every ten (10) years.

The DSG's have since undergone significant revisions, with a new issue published in 2007.

Concentric suggested that, prior to a new DSR being conducted, a review of the classification criteria, and thus the DSR requirements of the 2007 DSG be conducted.

SASKATOON
220 3rd Avenue South,
Suite 413,
Saskatoon, Saskatchewan
S7K 1M1
T: 306.343.5500
TF: 1.866.919.8899
F: 306.343.3601

REGINA
369 Park Street,
Regina, Saskatchewan
S4N 5B2
T: 306.522.6100
F: 306.522.6101

WINNIPEG
300 - 1600 Ness Avenue,
Madison Square
Winnipeg, Manitoba
R3J 3W7
T: 204.783.1276
TF: 1.866.919.4531
F: 204.478.4940

LONDON
700 Richmond Street,
Suite 307,
London, Ontario
N6A 5C7
T: 519.452.7700
TF: 1.866.919.4531
F: 519.452.1712

OTTAWA
5310 Canotek Road,
Unit 30,
Ottawa, Ontario
K1J 9N5
T: 613.824.8900
TF: 1.866.919.4530
F: 613.824.8901

IQALUIT
Box 957,
Iqaluit, Nunavut
X0A 0H0
T: 867.979.3300
TF: 1.866.919.4533
F: 867.979.3302



According to the 2007 Dam Safety Guidelines, the suggested frequency for DSR's to be performed varies, based on the Dam Classification. For example, with a Significant Class Dam a DSR is required every 10 years.

Section 2.5 of the safety guidelines outlines the consequences to be evaluated for the various classifications.

Consequences for the determination of Dam Classification are as follows:

- Population at Risk (PAR), defined as the number of people who would be exposed to the hazard of a dam failure.
- Loss of Life, defined as the number of people would be exposed to flood waters and would experience consequences that could range from inconvenience and economic losses to loss of life.
- Environmental and Cultural Values: defined as significant environmental losses as assessed in terms of whether restoration of environment is feasible and how long it would take. Cultural losses include damage to irreplaceable historical and cultural features.
- Infrastructure and Economics, defined as economic losses including direct damage to third-party property, facilities, other utilities and infrastructure.

Concentric has determined that there is no PAR in the event of a dam failure. Localized seepage is to be expected with un-lined ("leaky") lagoon technology. In the event of a berm failure or wash out as the immediate surrounding area of the lagoon is unpopulated; no risk to human life is expected.

Loss of Life is determined to be zero for the same reasons stated above.

Environmental and Cultural Values: long term loss is not anticipated; there are no historical sites in the vicinity. The lagoon will continue to have localized seepage, and in the unlikely event of a berm failure or washout, the environmental impact will be minimal and temporary in nature.

Regarding Infrastructure and Economics, the immediate area contains limited infrastructure and services. The drainage path is towards Koojesse Inlet, with no threat to the airport and surrounding infrastructure.

Recommendations

Based on our observations, we believe that the Iqaluit Sewage Lagoon has a Low Risk Dam Classification; therefore, a Dam Safety Review is not required. However, the consequences of failure should be reviewed periodically, and the DSG's reviewed for any amendments or revisions.



Should there be any questions, please contact the undersigned.

Yours sincerely,

Concentric Associates International Incorporated

Lisa Koehler A.Sc.T.
Project Manager

Allan Murray P.Eng.
Partner