



GOVERNMENT OF NUNAVUT

Resolute Bay Solid Waste Site – Business Case for Facility Upgrades





May 12, 2025

Department of Community & Government Services
Government of Nunavut
PO Box 1000 Station 700
Iqaluit, NU
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Attention: Paul Clow
Manager Municipal Planning

Resolute Bay Solid Waste Site – Business Case for Facility Upgrades

Mr. Clow:

Dillon Consulting Limited (Dillon) is pleased to submit to the Government of Nunavut the enclosed report documenting the Business Case for Solid Waste Facility Upgrades for the Resolute Bay Solid Waste Site.

The report summarizes the Business Case for the Resolute Bay Solid Waste Facility, including a review of past work, a summary of observations from the site assessment and discussion with community representatives, climate change considerations, a solid waste site improvement plan, design schematic, cost estimates and recommendations.

If you should have any questions or concerns regarding the contents of this report, please direct them to Rebecca Appleton at rappleton@dillon.ca or calling 902-452-1424.

Sincerely,

DILLON CONSULTING LIMITED

A handwritten signature in blue ink, appearing to read "Rebecca Appleton".

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Executive Summary

The Government of Nunavut (GN), Department of Community and Government Services (CGS) has retained Dillon Consulting Limited (Dillon) to provide consulting services to complete Business Cases for solid waste facility upgrades in 13 communities across Nunavut, including Resolute Bay. The Business Cases are being undertaken to assess the solid waste facilities and to develop and recommend options to upgrade the facilities to improve operations, improve alignment with regulatory conditions, and prolong the useful life of the facilities.

The primary solid waste site (the “facility”) in Resolute Bay is a dump and burning site located southwest of the community. Two additional sites are used for waste management needs in the community: a scrap metals storage site located north of the airport and a drop-off site located in the community. Several previous studies have been completed on the facility, including a feasibility study to construct a new facility with a lined landfill.

A facility visit was completed in September 2022 with Dillon and community staff. Based on previous reports and the September 2022 site visit, numerous deficiencies and concerns were noted, including:

- The location of the MSW dump and burning site is on a beach area in close proximity to historical sites and to the Arctic Ocean;
- Solid waste disposal methods being practiced have the potential to pose hazards to the environment, as well as the health and safety of community members and staff, by way of:
 - Animal interactions;
 - Smoke inhalation from burning waste;
 - Unfenced sites; and
 - Unsanitary waste disposal methods.
- There are currently no leachate management measures in place; and
- No environmental protection measures have been established.

It is Dillon’s understanding that the intent of the project is to upgrade the current site. However, unlike other communities in Nunavut, Resolute Bay does not have a delineated MSW disposal area to upgrade. Rather, the community has been continuously burning waste and burying the burnt waste over a large area of rock beach along the shoreline. The MSW burning area is not delineated and it is in close proximity to both the Ocean and a cultural and historic monument. It is not feasible to upgrade the MSW burning site to a suitable condition for long-term use. A new solid waste facility is recommended to provide the community with a suitable waste site, to significantly improve operations and health and safety, to meet the needs of the community and to bring operations in line with regulatory compliance.

The objective of the facility upgrade is to provide the community with a suitable MSW disposal site that will bring waste management operations in Resolute Bay in line with best practices and create a safer

facility for the community and for the environment. The required facility improvements include the construction of a new waste management site at a new location. The proposed new site is the preferred site (Alternative Site A) identified in the 2021 Resolute Bay Solid Waste Facility Planning Study (Dillon, 2021). The mandatory facility upgrade components include the following:

- Building a new SWMF; and
- Purchasing dedicated equipment for its operation.

In addition, the following optional site upgrade components were considered:

- Closure of the drop-off site; and
- Backhauling stockpiled metals and hazardous waste.

Additionally, a functioning waste incinerator is present in the community at the Polar Continental Shelf Program (PCSP) facility. It is suggested that discussion between the GN and PCSP occur to determine if a partnership could be created to test incineration of municipal solid waste generated in the community using PCSP's incinerator. Problematic waste streams, such as organics and animal carcasses that attract wildlife, would be a priority for waste incineration. The limitations and concerns of incineration in arctic conditions need to be fully understood and vetted before moving forward with the purchase of an incinerator. A pilot study of incineration technologies, in partnership with PCSP and their incinerator, to confirm potential for successful outcomes prior to wide scale implementation is recommended.

With consideration of noted deficiencies, limitations and cost estimates, it is recommended that the following components be implemented:

- Construction of a new SWMF;
- Purchasing dedicated equipment for its operation; and
- Closure of the drop-off site.

The use of the existing MSW dump and burning site and drop-off area will be discontinued and the site will be closed. The new site will meet the waste management needs of the community for a minimum of 20 years and will allow for the consolidation of the existing sites into one fully functioning waste management facility. It is recommended that the scrap metals storage site be closed to the public but remain available to municipal staff to serve the Hamlet for their materials laydown needs.

A Class D cost estimate was prepared by Altus Group for the capital cost items for both the mandatory and optional components of the facility improvement plan, and for backhauling of specific waste types from the community for disposal in other parts of Canada. Altus also prepared a 20-year Class D cost estimate for Operations and Maintenance (O&M) costs.

A summary of recommended facility improvements, and associated Class D cost estimates, are presented in **Table 1**. Costs to close the current dump and burning are not included in this cost estimate.

Table 1: Capital Cost Summary – Recommended Site Upgrade Components

Cost Item	Price
Proposed New Municipal Solid Waste Facility – Mandatory Components	
Access Road to Proposed SWMF Area	\$30,728
Storm Water Management	\$171,990
Attendants Building	\$229,944
Portable Washroom	\$67,046
Berming	\$146,960
Seacan Storage	\$100,000
Waste Cell	\$2,229,641
Leachate Pond including Pump	\$101,935
HHW Depot	\$36,066
Fencing	\$1,037,413
Signage	\$12,500
Uninsulated Vehicle Storage Building	\$330,823
Power to Site and Lighting	\$1,567,868
Other (Heavy Equipment Mobilization)*	\$735,000
Site Grading and Preparation	\$773,367
Sub-Total	\$7,572,000
Other	
Garbage Truck	\$288,750
Loader	\$535,500
Skid Steer with Forklift Attachment	\$110,250
Sub-Total	\$934,500
Optional Recommended Items	
**Closure of the Drop-Off Site	\$397,425
Backhauling Metals for the Closure of the Dropoff Site (est. 47 seacans)	\$753,562
Backhauling ELVs or the Closure of the Dropoff Site (est. 12 seacans)	\$159,600
Backhauling Hazardous Waste for the Closure of the Dropoff Site (est. 5 seacans)	\$183,333
Sub-Total for Optional Items	\$1,494,000
Contingencies and Fees	
General Requirements & Fees	\$3,401,000
Freight & Accommodations	\$2,701,000
Design and Pricing Contingency (10%)	\$1,001,000
Escalation Contingency (12.3%)	\$1,231,000
Market Contingency (40%)	\$4,001,000
Sub-Total for Contingency and Fees	\$12,335,000
Total for Recommended Components	\$22,335,500

Notes:

*Mobilization of heavy equipment (\$735,000) is included under the assumption that there is no availability of local equipment for construction works.

** This line item only includes adding fencing, a gate and signage to the drop-off site. Costs associated with an environmental investigation and closure plan for the drop-off site are not included. Costs to backhaul metals and hazardous waste from the drop-off site are included in the Backhauling line items.

The recommendations presented in **Table 1** are to be considered by the GN, in conjunction with the Business Case Reports being prepared in parallel for the waste sites in other communities, allowing for comparison of the priorities and costs so that the GN can provide the best allocations of funds as needed throughout the Territory.

A Class D Operations and Maintenance cost estimate has been developed for the recommended facility upgrade scenario. The Class D O&M cost estimate is presented in **Appendix E**.

The Business Case has been presented to Resolute Bay council and a motion for approval is included in **Appendix F**.

1.0

Introduction

The Government of Nunavut (GN), Department of Community and Government Services (CGS) has retained Dillon Consulting Limited (Dillon) to provide consulting services to complete Business Cases for solid waste facility upgrades in 13 communities across Nunavut. The Business Cases are being undertaken to assess the solid waste sites and develop and recommend options to upgrade the sites to improve operations, improve alignment with regulatory conditions and prolong the useful life of the sites. The Business Case provided herein is for the solid waste facility in Resolute Bay, Nunavut.

The Municipality of Resolute Bay is located on the southern end of Cornwallis Island, in the Qikiqtaaluk Region of Nunavut Territory. It is the second most northerly community in Canada and is currently the permanent home to approximately 198 people, living in approximately 60 homes, as well as approximately 150 additional seasonal and temporary residents. Cornwallis Island is home to the Polar Continental Shelf Program (PCSP) facility, which is operated by Natural Resources Canada (NRC) and is also a tourist destination for visitors wishing to start expeditions further into Canada's Arctic. The Government of Canada also operates a military base on Cornwallis Island, which is located near the Municipality. These facilities share the Resolute Bay Airport, as well as local roads.

The primary solid waste site (the "facility") is a dump and burning site located southwest of the Municipality, along the southern edge of the road. The facility is located across the road from a historical Thule Site, as well as the Relocation Memorial Site. The facility is situated along the shoreline of Resolute Bay, approximately 40 metres (m) from the high tide line and operates under Resolute Bay Water License 3BM-YRB2126, dated December 22, 2021 (**Appendix A**). Two additional sites are used for waste management needs in the community: a scrap metals storage site and a drop-off site. **Figure 1** (attached) shows an aerial view of the three sites in relation to the community and surrounding area.

This Business Case report presents a review of past work, a detailed account of the facility assessment completed in September 2022, feedback on the facility received during conversations with the GN and Resolute Bay SAO and public works staff, climate change considerations as they relate to the facility, a facility improvement plan, schematic design, Class D cost estimate for capital facility improvements and 20-year Operation and Maintenance (O&M) costs, and recommendations. The cost estimate prepared by Altus Group for the proposed facility upgrades is presented in **Appendix B** and **Appendix C**.

1.1

Project Background

Upgrades to solid waste operations and management are a priority for the community of Resolute Bay and the GN. Several previous studies have been completed on the facility, including a feasibility study to relocate the waste facility and construct a new facility with a lined cell. It is Dillon's understanding that the resources associated with this project is limited; however, given the numerous deficiencies

associated with the current site, the most appropriate solution to bring operations more in line with regulatory compliance is to construct a new solid waste facility by relocating to a new site.

1.2 Objectives of the Business Case

Facility improvements are to be recommended that will support the operational needs of Resolute Bay for as long as possible given the constraints of budget, location, and current compliance issues. The mandatory facility upgrade components, based on the terms of reference for this project, include the following:

- Upgrade on-site/off-site water management;
- Delineate locations for different types of waste to improve segregation of materials; and
- Install new fencing.

In addition, the following optional facility upgrade components will also be considered:

- Improved hazardous waste containment;
- Waste management buildings;
- Hazardous waste and metal backhauling;
- Equipment shelters;
- Attendant structures;
- Equipment to manage the proposed upgraded facility; and
- Lighting.

This project involves determining and identifying upgrades that are the most pertinent for the site, that fall within the budget available to the GN for implementation of the upgrades. The recommendations presented for the Resolute Bay solid waste site are to be considered by the GN, in conjunction with the Business Case reports being prepared in parallel for waste sites in other communities, allowing for comparisons of the priorities and costs so that the GN can provide the best allocations of funds as needed throughout the Territory.

2.0

Review of Past Work

2.1

Background Reports

Several previous studies have been completed for the facility. The following background documents were reviewed:

- 2021 Resolute Bay Solid Waste Management Planning Study, including an Airport Bird Hazard Risk Assessment for the Proposed Solid Waste Management Facility and a Geotechnical Investigation, completed by Dillon Consulting;
- 2021 Resolute Bay Water License 3BM-YRB2126 (current Water License for the facility);
- 2020 Resolute Bay Water License 3BM-RES2025 (previous Water License for the facility);
- 2018 Resolute Bay Solid Waste Audit completed by EXP Services Inc.;
- 2014 Tender Specifications for New Solid Waste Disposal Facility for Resolute Bay, Nunavut completed by Arktis Solutions Inc. and Class A Cost Estimate completed by Hanscomb Ltd.; and
- 2013 Solid Waste Disposal Facility Design Report for Resolute Bay, Nunavut completed by Arktis Solutions Inc.

A summary of relevant information from the documents is provided in the proceeding sections.

2.1.1

2021 Resolute Bay Solid Waste Management Planning Study

The Resolute Bay Solid Waste Management Planning Study (Dillon, 2021) provided a review of the current solid waste management (SWM) system, assessed three new Solid Waste Management Facility (SWMF) site alternatives, and identified a preferred site for future development. The study included an intrusive Geotechnical Site Investigation completed for two of the three sites, as one was inaccessible at the time of drilling.

At the time of the completion of this study, the SWM challenges which were identified by local community members including members of council and the SAO, included:

- Animal interactions, specifically with polar bears scavenging at the dump site;
- Smoke and air quality concerns resulting from burning at the dump site;
- Lack of control over use of the dump site by contractors and non-Municipality staff; and
- Lack of access to recycling options.

The report noted that the location of the MSW dump site and storage sites, and the solid waste disposal methods being practiced, have the potential to pose hazards to the environment, as well as the health and safety of community members and staff, by way of animal interactions, smoke inhalation from burning waste, unsanitary waste disposal methods, and other factors. There are currently no leachate management measures in place, and no environmental protection measures have been established.

2.1.1.1

Solid Waste Management Planning Study Recommendations

The purpose of the Study was to identify and provide a planning review of three different sites, and to determine the most favorable site for the development of a new SWMF.

The Solid Waste Management Planning Study recommended that Site A, located approximately 4 km northwest of the existing solid waste facility, be chosen for the development of a new SWMF. The area around the Municipality of Resolute Bay is very limited for development options by the access constraints to the east, and by the airport setback to the northwest. Based on this understanding, Site A has been shown to meet the setback criteria for most factors and allows for all-season access. Although it is located within the 4000 m radius airport setback, the site is not directly aligned with the runway.

To improve the health and safety of the Municipality the following basic site improvements were recommended to be carried out at the existing SWMF:

- The scrap metal site is suggested for upgrades, as the current waste disposal site is not considered to be in a suitable location for ongoing use, and the scrap metal site has basic infrastructure in place to use as a starting point for a waste diversion area.
- The location of the current waste dump site in Resolute Bay is located in proximity to the shoreline, as well as the proximity to areas of cultural and historical significance. This poses a potential risk to the surrounding environment and community users. The most significant potential risk arises from a lack of a liner for waste materials, specifically HHW, this allows for the migration of hazardous materials to runoff into the surrounding soil and/or ocean.
- The Waste Disposal Site has no attendant or instructions for users, this further leads to unauthorized dumping at the site and in areas reserved for specific material. Ultimately, diversion activities should be moved to a new location and the current Waste Dump Site grounds should be decommissioned.
- Arrangements be made for municipal staff to use the Polar Continental Shelf Program (PCSP) facility at predetermined times for the incineration of municipal waste. It was assumed that all municipal solid waste, residuals and incineration by-products could be managed by the PSCP, and a municipal landfill is not required to meet Resolute Bay's disposal needs.

2.1.1.2

Geotechnical Investigation

A geotechnical investigation, conducted by Canadrill, was included in the 2021 Resolute Bay Solid Waste Facility Planning Study. The investigation was conducted in November 2019. The purpose of the study was to assess the geotechnical suitability of three site alternatives nearby the existing facility for landfill development, therefore the results do not reflect the geotechnical characteristics of the existing waste site but are expected to be similar. The study comprised of six boreholes at Site A, located approximately 4 km northwest of the existing facility and four boreholes at Site B, located approximately 6 km north of the existing facility. The boreholes were analyzed in a laboratory to assess the soil stratigraphy.

Based on the geotechnical findings, both sites appear to consist of coarse-grained sand and gravel down to shallow bedrock. The bedrock surface was within 0.3 to 2.4 metres below grade (mbg) throughout Site A and was either exposed or within 0.6 m throughout the explored areas of Site B. As noted above, some extensive areas of severely fractured bedrock were observed at the borehole locations, resulting in a highly variable depth to sound bedrock at both sites. Some areas of thicker overburden/shattered bedrock may exist within the unexplored extents of the sites. Overall, it appears both sites are similar from a geotechnical perspective, and both do not appear to be in close proximity to a seismic fault, or a low-lying coastal area that could be affected by storm surges or sea level rise.

The maximum active layer thickness throughout the sites was found to be approximately 0.7 m and the current Mean Annual Ground Temperature (MAGT) was found to be -11.9°C . Changes to the active layer thickness and MAGT throughout the life of the structure will be dependent on many variables.

CSA PLUS 4011-19 provides that under a high greenhouse gas scenario the Mean Annual Air Temperature (MAAT) in Resolute Bay is estimated to increase by approximately 2.2°C over the next 30 years (by 2050) compared to the historic temperature trends which were available up to 2010. It is noted however, that recent research infers that greenhouse gas emissions over the next 30 years and beyond may be even higher than previously anticipated and new scenarios continue to be produced by global experts. Therefore, accurately estimating what the active layer thickness and MAGT will be 30 years from now was beyond the scope of the investigation. The historical temperature data was adjusted to incorporate the MAAT increase estimated by CSA PLUS 4011-19 and utilized simplified empirical methods to generate an estimated maximum active layer thickness for design. It was also assumed (conservatively) that the MAGT will rise in step with the MAAT.

Based on the assessment, it was recommended that a design active layer thickness of 1.1 m and design MAGT of -9.7°C be used for design at the sites.

2.1.2 2018 Resolute Bay Solid Waste Audit

The 2018 Resolute Bay Solid Waste Audit was conducted to provide a characterization of the Hamlet's municipal solid waste, projected estimated annual quantities, and estimates of the waste stream. The results were used to estimate the amount of material required for disposal and potentially available for waste diversion.

The results showed that composition by weight, from greatest to least, is organics (50.47%), fibres (13.65%), other garbage (10.45%), plastics (10.29%), diapers (5.19%), and metals (4.79%), respectively. The remaining materials including textiles, glass, and household hazardous waste (HHW) made up the remaining 5.14%.

Total annual waste generation in the community of Resolute Bay estimated from the waste audit is 512 tonnes.

It was found that almost 75% of waste generated could potentially be diverted from the landfill through the following methods, if programs existed:

- Stored/shipped for recycling or safe disposal;
- Composting;
- Source for alternative daily cover; and
- Controlled combustion.

3.0

Facility Assessment

3.1

Facility Visit

A facility assessment was conducted on September 20, 2022, with Dillon and community staff. An overview of the facility was assessed, including waste management practices, waste management services provided, waste management personnel, waste diversion programs, and operational equipment. The facility consists of the following three sites:

- Municipal solid waste (MSW) dump and burning site; and
- Two additional waste storage areas, including:
 - Scrap Metal Storage Site located north of the airport; and
 - Drop-off Site located in the community.

The locations of the three sites are shown on the attached **Figure 1**. The MSW dump and burning site could not be surveyed due to undefined site boundaries and the flat nature of the material and lack of stockpiles, as discussed further in the subsequent section. The existing site conditions at the drop-off site are presented on **Figure 2**. The existing site conditions at the Metal Storage Site are presented on **Figure 3**.

Each of these sites are approximately 4km from one another but managed as part of the entire waste management system.

MSW Dump and Burning Site

The MSW dump and burning site (**Photos 1 to 4**) site is located approximately 4km southwest of the Town site, along the southern edge of the road and situated approximately 40m from the high tide line. The current MSW dump site is in close proximity to a historical Thule site, as well as the Relocation Memorial Site and former Town site. The MSW dump site is located southwest of the Municipality, along the southern edge of the road. The disposal site is flat, and slopes beyond the dump site towards the beach. The surface material at the disposal site is gravel and sand, with no clay observed at surface. The site consists of a non-engineered MSW disposal area, where the waste is open burned daily, then buried. There are no stockpiles of MSW. Material remaining after burning of waste is flattened by a dozer and covered. The site could not be surveyed due to the flat nature of the material and lack of



Photo 1: MSW Dump and Burning Site

stockpiles. There is no infrastructure, and no visible waste piles. The area is sand and gravel with no clay observed.



Photo 2: MSW site with burn area observed on the left



Photo 3: MSW and Burning Site

The current dump site is not fenced, and there is no infrastructure in place (i.e., no scale house, staffed shelter, power supplies, waste bins, or enclosed waste containment areas of any type). The site does not have a large amount of waste accumulated, in part because waste is burned daily. The waste that remains is managed with a dozer operated by Municipal staff. During the summer months, sand and gravel are used as cover on occasion. Once an area has been used for waste and the residue from burning is substantial, the area is flattened with the dozer, and covered with gravel.



Photo 4: MSW and Burning Site

There are currently no leachate management measures in place, and no environmental protection measures have been established.

Scrap Metals Storage Site

The scrap metals storage site is located northwest of the air strip and is approximately 7 km northwest of the Town site. The site is a fully fenced and gated area, along the coastal road. The residents refer to it as 'Canadian Tire' and salvage materials when possible. There are no buildings or lights, the only infrastructure



Photo 5: Metal Storage Site Located north of the Airport (February 2019)

is the fence. This site is large, relatively flat, and has a good access road. The site is used primarily for storage of scrap metal, appliances, bulky waste, fuel and propane tanks, and end-of-life vehicles. Other material has also been disposed at this site, including construction and demolition waste (C&D). Metals are stockpiled at the facility for material re-use. Drums for batteries are also stockpiled in the metals areas. Photos were not collected at this site during the September 2022 site visit. **Photo 5** depicts photographs taken during Dillon's site visit in 2019.

Drop-off Site

The drop-off site is located west of the Municipality, approximately 280m northwest of the nearest residential home (**Photos 6 and 7**). It is commonly used by community members for dropping off large items including white goods, scrap metal, and bulky furniture waste. This drop-off material is intended to be transferred by municipal staff to the fenced scrap metal storage site on an as-needed basis.

The waste is consolidated into the following groups:

- Used oil barrels;
- End of life vehicles;
- Household white goods (primarily fridges, stoves, sinks, bathtubs water heaters, furnaces, washers and dryers);
- End of life snowmobiles; and
- Construction and demolition refuse (C&D).

An old concrete slab is present at the site. It was noted that many of the larger piles of C&D were deposited on the site by a contractor, following large renovation projects in the community. During the site visit in September 2022, additional non-waste materials were being stored at this site, including materials for a future culvert construction project. There is a privately-owned blue garage at the site.



Photo 7: End of life vehicles and other waste materials at the Drop-off Site



Photo 6: Waste barrels at the Drop-off Site

3.2 Waste Operations

Municipal solid waste (MSW) is manually collected daily by Municipal staff using a pick-up truck. Waste is collected from waste storage boxes located at each home (**Photos 8** and **Photo 9**), which are built and provided by the Municipality. There is a total of 75 buildings in the Municipality, 15 of which are municipal buildings and local businesses.



Photo 8: Example 1 of Household Garbage Box (February, 2019)



Photo 9: Example 2 of Household Garbage Box (February, 2019)

The waste collected from homes is separated, with metal and bulky items taken to the scrap metal storage site north of the airport. There is currently no charge for waste disposal to any of the commercial waste generators. Households are charged \$30/month in waste disposal fees. Household waste generation is understood to vary substantially from day-to-day and week-to-week, but less significantly seasonally.

MSW Burning Site

Waste is hauled to the current dump site for disposal and burned daily. There are no visible waste piles at the MSW site. After the accumulation of residue from burning is substantial, the area is flattened with the dozer and covered with local gravel. The Municipal staff burns the waste to reduce organic material as much as possible, primarily to deter polar bears from coming to the site to scavenge for food. Polar bears continue to be attracted to the site and are commonly observed searching through the burned waste material for food.

The equipment used includes one garbage truck, one bulldozer and one dump truck. The hamlet indicated that this equipment was in working condition however, it was noted to be obsolete and needing to be replaced with modern day equipment. The equipment is stored by the hamlet off-site and is operated by community public works staff for other work beyond the solid waste site operations. All three solid waste sites do not have attendants, and management of the waste is minimal. The

community representatives noted that there are no concerns associated with litter and other waste materials from the waste site traveling to the community due to burning practices.

Scrap Metals Storage Site

The site is open to the public, however, most of the waste materials at this site are delivered by municipal staff via municipal trucks. There are no site attendants.

Drop-off Site

The site is commonly used by the community members dropping off large items. Discussion with the community revealed that the public should be using the Scrap Metals Storage yard, however residents prefer the drop-off site because of its proximity, and familiarity with the process. The scrap metal storage site is also further, and it can be difficult to transport materials in the winter from one site to another, namely waste oil barrels. Stockpiles of materials are observed at both sites and empty and full barrels of various fluids remain at the drop-off site and do not get transported to the Scrap Metals Storage Site.

Hazardous waste is stored on both the scrap metals storage site and the drop-off site. Fuel and propane tanks, and barrels of liquid hazardous waste are stored at the scrap metals storage site. The drop-off site has an accumulation of hazardous waste fluid barrels, both full and empty, which are intended to be transferred to the scrap metals yard. Currently the stockpile of barrels needing to be transferred to the scrap metals yard is increasing in size as transfer between sites was noted to be a difficult activity for staff.

3.3 Facility Features

An assessment of facility features was conducted during the facility visit. A summary of observations is presented below.

3.3.1 Access Road

The road conditions from the community to each of the sites are in good condition. The MSW dump and burning site is accessed by a well-maintained gravel road (**Photo 10**).

The roads do not present risk of flooding as no runoff drainage was observed and municipal staff did not indicate flooding as a concern. It was noted that although the road to the Scrap Metals Storage Site was in good condition, snow accumulates at the entrance to the site during the winter and it is not well maintained.



Photo 10: Municipal Solid Waste Dump Site Access Road

3.3.2 Facility Access, Fencing and Security

The MSW dump and burning site and the drop-off site are unfenced. The metals storage site is fenced. All sites are open to residents to drop-off waste at any time. There are no restrictions or site operator oversight to control waste disposal practices in the community. The sites do not have lighting, which is viewed as health and safety and operational concern given the limited amount of available daylight hours in the winter months.

Municipal staff noted that the drop-off site, located near the community, has been purposely left unfenced as a means to prevent residents from throwing materials over the fence or dumping illegally outside of the fence. As noted, locals use this site for the drop-off of their waste and regularly visit the site for salvaging materials.

The metals storage site is fenced, relatively flat and in good condition. The fence was observed to be in good condition, except for the eastern portion where the top bar is lifted. The site gate remains open. The entrance to the site was noted by municipal staff to be not well maintained in the winter months, as snow accumulates at the entrance.

3.3.3 Waste Disposal Area

The extent of the drop-off site and the metals storage site are shown on the attached **Figures 2 and 3**, respectively.

MSW Dump and Burning Site

The MSW dump and burning site could not be surveyed due to undefined site boundaries and the flat nature of the material and lack of stockpiles from burning. It is not possible to determine the extent of

the area utilized for historic and current disposal practices due to the application of cover material. The extent of the area used for burying waste is estimated to be approximately 200,000 m².

Drop-off Site

The extent of the drop-off site is approximately 20,000 m² in size. The volume of the existing waste piles is approximately 3,204 m³. The composition of the waste piles and their volumes are summarized below and depicted in **Photos 11-18**:

- Pile #1 – C&D Waste: 986 m³
- Pile #2 – C&D Waste: 110 m³
- Pile #3 – C&D Waste: 28 m³
- Pile #4 – Barrels (empty and full): 105 m³
- Pile #5 – Metal: 685 m³
- Pile #6 – End-of-life vehicles and metals: 1,201 m³
- Pile #7 – C&D and miscellaneous waste: 89m³



Photo 11: Pile #1 - C&D Waste



Photo 12: Pile #2 - C&D Waste



Photo 13: Pile #6 (north portion) - Metal Waste and End-Of-Life Vehicles



Photo 14: Pile #6 (south portion) Metal Waste



Photo 15: Pile #4 - Empty Barrels



Photo 16: Pile #5 - Metal Waste



Photo 17: Pile #7 - C&D Waste



Photo 18: Metals Storage Site (February, 2019)

Scrap Metals Storage Site

The extent of the fenced scrap metal storage site is approximately 46,500 m² in size, with approximately a quarter of this surface area occupied with waste. The volumes of the existing waste piles are approximately 5,024 m³.

3.3.4

Burning Practices

Current burning practices include open burning at the MSW dump and burning site (**Photo 19**). Household waste and other materials that can be burned are burned daily. The residual material remaining following burning practices is buried. Waste that does not burn easily is disposed of at the Drop-off Site. According to municipal staff, burning is practiced at the facility due to the significant presence of wildlife in the area, specifically polar bears. Waste is burned to mitigate wildlife attraction to the area. The practice of waste burning has been conducted in Resolute Bay for several years.



Photo 19: Open Burning of Municipal Waste at the MSW Dump and Burning Site

Initial discussions with staff operating a waste incinerator in the community at the PCSP facility have been made. The facility is receptive to working with the municipality to process municipal waste in their incinerator. Formal discussions on the logistics between the GN and PCSP are required.

There is no burning at the drop-off site or the scrap metal storage site.

3.3.5 Surface Water

No surface water was observed during the site visits on either waste receiving site.

Pooling water at the scrap metals storage site has been identified in historical inspections and reports, however, no pooled water was observed at the time of the site visit.

3.3.6 Potential Environmental Hazards

Impacts to soil and groundwater may be present at the waste sites due to the lack of environmental controls associated with the operation of the waste site, including the lack of waste containment and berming. Staining near the waste oil barrels was observed at the drop-off site (**Photo 20**). Additionally, open burning of waste creates the potential for environmental hazards from the release of hazardous carcinogenic compounds and other toxic substances from smoke and in the residual ash.



Photo 20: Staining visible near waste oil barrels at the drop-off site

3.3.7 Presence of Wildlife

There is a known presence of polar bears in the area, as reported by municipal staff. To mitigate attraction to the facility, suitable waste is being burned. Polar bears are active at the MSW dump and burning site during the early winter for three to four weeks, and in early spring for three to four weeks.

4.0

Climate Change Considerations

Climate change effects result in potential risks associated with landfills. Hazards associated with each of these effects are listed in **Table 2**.

Table 2: Climate Change Effects and Associated Potential Hazards at Landfills

Climate Change Effects	Potential Hazards at Landfills
Warming temperatures	• Risks associated with degrading permafrost; and • Changed or increased wildlife and pests.
Degrading permafrost	• Increasing risks of ground instability from gradual permafrost thaw, slumping and degradation; and • Changed drainage.
Changes in sea level	• Uncertain risks from either inundation due to seal level rise, or isostatic rebound resulting in decreasing sea levels; • Increased risk of shoreline erosion or instability; and • Accelerated permafrost degradation.
Ice-free seasons	• Increased risks from shoreline erosion, storm due to reduced ice cover; and • Changes to wildlife.
More summer heat events	• Increased risks of abrupt permafrost degradation, thermakarst lakes, land wasting.
Increasing summer precipitation and heavy rainfall events	• Heavy summer rainfall events – more erosion & potential for contamination; • Total summer rainfall amounts increasing – more leachate, increased contamination risks; and • Increased risks of abrupt permafrost degradation, thermakarst lakes, land wasting, landslides.
Increasing snow events and seasonal amounts	• Limits access to site; • More labour, costs to clear snow from landfill sites; • Management of snow piles; • Increased snowmelt-flood risks and contamination potential; • Added erosion risks; and • Increased snow cover - increased permafrost thaw.
Increasing frequency of high wind events and changes to prevailing winds	• Facilities and buildings damage; • More blowing debris; • Staff safety risks and operational constraints on landfill operations (safety); and • Fencing damage.
Blizzards	• Access to site; • Snow drifting on landfill, snow removal and storage; and • Risks to staff and operations (safety).

4.1

Climate Change Considerations for Resolute Bay Solid Waste Facility

The Resolute Bay MSW dump and burning site is located on a beach adjacent to the shoreline of the marine environment, the Parry Channel (Arctic Ocean). Ground instability may be accelerated by permafrost degradation which will have risks for this facility due to its slope towards the Ocean. The site is approximately 130 m from the shoreline. Increased summer heat, longer melting seasons, and increased precipitation due to a changing climate will increase quantities of surface water runoff through the waste site.

The Geotechnical Investigation conducted in 2021 found the current maximum active layer thickness throughout the sites to be approximately 0.7 m and the current MAGT to be -11.9°C . Changes to the active layer thickness and MAGT throughout the life of the structure will be dependent on many variables, possibly including but not limited to actual current values, changes to snow cover, precipitation, surface/groundwater flow, material gradation and in-situ ice content.

It was found that under a high greenhouse gas scenario, the MAAT in Resolute Bay is estimated to increase by approximately 2.2°C by 2050. Recent research infers that greenhouse gas emissions over the next 30 years and beyond may be even higher than previously anticipated and new scenarios continue to be produced by global experts. Therefore, the historical temperature data was adjusted to generate an estimated maximum active layer thickness for design. It was recommended that a design active layer thickness of 1.1 m and design MAGT of -9.7°C be used for design.

5.0

Solid Waste Site Improvement Plan

5.1

Summary of Solid Waste Site Challenges and Deficiencies

Based on the review of available background materials for the sites, the completion of a site visit, best practices for the management of waste in northern Canadian climates, and discussions with GN staff and the Resolute Bay municipal staff, several improvements are required to waste management infrastructure in Resolute Bay. The primary concern with current waste management practices and facilities in Resolute Bay is the lack of a suitable municipal solid waste disposal facility. The current facility, which burns waste daily, poses numerous risks to the environment and health and safety, including the potential for interactions with wildlife, smoke inhalation, unsanitary and unsafe waste disposal methods. As determined during the previous Solid Waste Planning Study (Dillon, 2021) and during this project, the current MSW dump and burning site is not suitable for MSW disposal due to several factors including its close proximity to the Arctic Ocean and to a historical Thule site. Additionally, the MSW burning site is not delineated, making upgrades to the site very challenging, and the site is not fenced.

A summary of deficiencies noted at the three sites, based on operational (compliance) concerns and potential impacts to the environment and/or health and safety, are presented in **Table 3**. Site challenges and deficiencies have been organized into the following categories: water management and site grading, waste segregation and management, and site operations and access.

Table 3: Summary of Solid Waste Site Challenges and Deficiencies – Resolute Bay

Site Feature	Deficiency	Applicable Concern
Water Management and Grading		
Water/run-off management/drainage	There is no ditching or runoff collection systems for run-off at the sites. Except for a small bermed area at the drop-off site, there is no secondary containment of hazardous waste.	Environmental Concern Operational Concern
Waste Segregation and Management		
Segregation of waste	There is insufficient separation of electronic waste, HHW, white goods, tires, batteries and scrap metal.	Environmental Concern Operational Concern
Open Burning of waste	Burning practices include burning household waste up to a frequency of daily, creating smoke inhalation and air quality concerns.	Health and Safety Concern Operational Concern Environmental Concern
Windblown Litter	No controls for windblown litter exist currently, however, since MSW is burned daily and covered, litter was not noted to be a major concern.	Environmental Concern

Site Feature	Deficiency	Applicable Concern
Management of Hazardous Waste	Primary and secondary containment for hazardous waste is lacking.	Environmental Concern Health and Safety Concern
Site Operations and Access		
Site security and access	There is no fencing present at the MSW dump and burning site or the drop-off site.	Operational Concern Health and Safety Concern
Wildlife attractants and presence	Polar bears are present at the MSW dump site. Polar bears are noted to be more frequent in the fall and spring, however, their presence is possible at any time throughout the year.	Health and Safety Concern
Lighting	There is no lighting at the waste sites. Given the limited amount of daylight in the fall and winter months, no lightning is a concern.	Health and Safety Concern Operational Concern
Signage	There is inadequate signage at the sites indicating hours of operation or providing direction on waste segregation and disposal practices.	Operational Concern
Attendant	There is no dedicated attendant working at the waste site, nor is there an attendant shelter.	Operational Concern Health and Safety Concern (extreme temperatures)

5.2 Required Facility Improvements

Proposed facility upgrades have been developed based on the deficiencies noted in **Table 3** which summarizes compliance concerns regarding current practices and conditions at the MSW dump and burning site, operational concerns, health and safety concerns, potential impacts to the environment, and based on previous reports and discussion with the community and the GN. The improvements proposed in the proceeding sections are aimed at rectifying the numerous deficiencies noted, including, primarily, the lack of a suitable MSW disposal facility in the community of Resolute Bay. The improvements centre on the construction of a new solid waste management facility. Due to historic waste burning and burying practices at the MSW dump and burning site, it is not feasible to upgrade the site to a suitable condition for long-term use. The objective of the facility upgrade is to provide the community with a suitable MSW disposal site that will bring waste management operations in Resolute Bay in line with best practices and create a safer facility for the community and for the environment.

The required facility improvements include the construction of a new waste management site at a new location. The new site is the preferred site (Alternative Site A) identified in the 2021 Resolute Bay Solid Waste Facility Planning Study (Dillon, 2021). The use of the existing MSW dump and burning site and

drop-off area will be discontinued and the site will be closed. The new site will meet the waste management needs of the community for a minimum of 20 years and will allow for the consolidation of the existing sites into one fully functioning waste management facility. It is recommended that the scrap metals storage site be closed to the public but remain available to municipal staff to serve the Hamlet for their materials laydown needs.

One design schematic has been developed presenting the required waste management facility components. It is presented and discussed in **Section 6.1**. Optional components, such as backhauling of select materials, have also been included and are discussed in **Section 6.2**.

It is noted that closure plans for the MSW dump and burning site are beyond the scope of this project and are not included in this Business Case. Backhauling hazardous waste and metals from the drop-off site, as well as consolidating and relocating bulky material at the drop-off site to the new SWMF is included in the cost estimate.

6.0

New Waste Management Facility Schematic Design

Unlike other municipalities, existing waste management practices and infrastructure in Resolute Bay do not offer the ability to upgrade the current MSW disposal area. There is no single, delineated waste site where MSW is disposed. The current practice of burning and burying waste at the beach site is not accepted, nor is it recommended to continue for several reasons, including, the close proximity to both a culturally and historically significant tourist site and the shoreline, and poses a potential risk to the surrounding environment, human health and ecological health. To address the waste management requirements of Resolute Bay and concerns associated with current waste management practices and existing infrastructure, a new SWMF is proposed. The acceptance of all waste streams will be directed to the new site.

The review of the 2021 Resolute Bay Solid Waste Facility Planning Study (Dillon, 2021) proposed 'Alternative Site A' as the best of six candidate sites for a new SWMF. This location is located approximately 4 km northwest of the current MSW dump and burning site and is shown on the attached **Figure 1**. There is currently a utility road built near the proposed site, however construction of a portion of road will be required to connect the utility road to the new SWMF.

Quantities of waste materials generated in Resolute Bay were estimated based on previous reports, with the most recent waste audit being the 2018 Resolute Bay Solid Waste Audit Report (EXP Services Inc., 2018). The following assumptions were used when building the anticipated waste generation rates for a 20-year planning timeline:

- Waste generation rate of 1.097 tonnes per capita annually;
- 2023 population of 188 people; and
- Yearly population growth rate of 1%.

Approximately 210 tonnes of solid waste is generated in the community per year (2024 estimate). The anticipated quantities of waste generated in the community over a 20-year lifespan of the new facility are the following:

- 4,600 tonnes of municipal solid waste;
- 360 tonnes of bulky waste;
- 105 tonnes of metals; and
- 55 tonnes of hazardous waste.

The proposed new solid waste management facility is anticipated to fulfill a 20-year lifespan, without waste incineration. This lifespan estimate was based on future waste generated in the community and does not include relocating materials from the current drop-off site to the new site.

6.1 Mandatory Schematic Design Components

The mandatory components of the new solid waste management facility design schematic include the following:

- Construction of a new MSW landfill cell;
- Construction of a new access road to connect to the nearby utility road¹;
- Water management, including construction of ditching, and site grading;
- Waste segregation areas for storage of various materials including clean wood, end of life vehicles and tire storage, household hazardous waste depot, and a seacan storage area;
- Construction of a leachate pond;
- Extending power to the site and adding lighting;
- Installation of fencing and an entrance gate;
- An attendant building and a vehicle storage building; and
- Dedicated equipment for landfill operations.

The mandatory components of the proposed new SWMF are presented on **Figure 4**, with additional details presented on **Figures 5, 6 and 7**. Closure of the existing MSW dump and burning site and the drop-off area is required. It is recommended that the Scrap Metals Storage Site be closed to the public, but remain available to municipal staff to serve the Hamlet for their materials laydown needs.

6.1.1 Water Management and Grading

To prevent surface water from interacting with the waste on site, the new SWMF site will have:

- Ditching on either side of the access road;
- Ditching surrounding the perimeter of the site within the fence line;
- Berms installed around each waste diversion area, including hazardous wastes;
- Berming around the MSW receiving area; and
- A leachate pond.

In addition, the facility will be graded to allow proper collection and drainage of storm water run-off towards the ditching.

6.1.2 Waste Segregation and Management

The new SWMF will address operational, environmental and health and safety concerns related to the management, segregation, storage and disposal of waste materials in Resolute Bay. The following waste segregation and management features are proposed (as presented on **Figure 4**):

¹ Preliminary approval from NAV Canada was received in a letter dated July 16, 2019, for the development of a landfill and waste diversion facility at Proposed Site A and is included in Appendix B of the Resolute Bay, NU Solid Waste Management Planning Study (Dillon, 2021). Another application will be required to be submitted once further design details are available, such as structure heights.

- Containment and management of MSW materials in a MSW cell lined with a HDPE geomembrane²;
- Construction of bermed and fenced material segregation and storage areas;
- Sorting waste from the existing drop-off site by segregating materials of similar waste type and relocating them to the appropriate location at the new SWMF. Waste types include, electronic waste, HHW including batteries, white goods, tires, and scrap metal;
- A designated area for stockpiling clean wood;
- Consolidation of the end of vehicles into a single area; and
- Consolidation and management of hazardous wastes.

Various waste segregation, storage and disposal areas are presented on the proposed site plan (**Figure 4**) and further detailed on **Figures 5, 6** and **7**. The areas for waste receiving will be bermed and individually fenced. The areas include the following:

- Municipal solid waste cell (92m by 102m);
- HHW depot (15m x 21m);
- End of life vehicles storage (15m x 34m);
- Tire storage (15m x 34m);
- Seacan storage (17m x 50m) for metals, hazardous waste, e-waste and white goods; and
- Clean wood diversion area (21m x 23m).

MSW Cell

The MSW cell will be fenced on the east, south, and west sides for control of windblown litter. The entrance for waste drop-off is from the north-west side which is unfenced. The details of the MSW cell are presented on **Figure 5** and include the plan for the final capped landfill cell to be 5 meters in height and an area of 80 m x 90 m at the top of the cell. The cell will be constructed with a liner system consisting of sand bedding, geotextiles, (terrafix 420R and Propex Geotex 2801) and a geomembrane (1.5 mm HDPE). Open waste burning practices will be eliminated. Consideration for a waste incineration pilot test is included as an optional item and is discussed further in **Section 6.2.1**. Daily and weekly cover will be applied to the MSW as the means to reduce wildlife attraction. Leachate will be directed to a leachate pond. The leachate will be managed by site operations staff, with evaporation as the primary treatment method, and recirculating the leachate into the MSW cell as a secondary disposal method when the leachate cell is full. Discharge criteria for releases of leachate must be met prior to pumping liquids from the leachate cell into the surrounding environment.

Self-Directed Divertible Waste Areas

The divertible waste areas are displayed on **Figure 4**. The HHW depot will be a bermed area adjacent to the site entrance that is designed to receive and store the approximate 0.5 tonnes of hazardous waste

² Alternate liner systems may be explored during the detailed design phase. Liner systems are dependent on the availability of local materials. Without sufficient evidence of the availability of clay in the region, an HDPE geomembrane liner has been assumed for this Business Case.

generated per year. If the waste requires further storage needs, the attendant will move materials to a dedicated hazardous waste seacan.

The bermed seacan storage area is intended to be a space for collecting, and storing seacans that are to be shipped for final disposal in Quebec via sea transport. The materials expected to be collected in the seacans include:

- White goods;
- E-waste;
- Metals; and
- Hazardous waste (batteries, paints, used oil containers).

End of life vehicles will have a designated bermed area for storage. A bermed area for the storage of tires will be immediately south of the end-of-life vehicle area. An area for clean wood salvage will be located to the southwest of the leachate pond. The area will be used to temporarily store wood that is in reusable condition. Unused clean wood will be periodically moved to the MSW cell for eventual disposal.

Legacy Waste Management from Existing Waste Management Sites

The new SWMF will accept all new waste generated in the community. The management of the three former sites includes the following recommendations:

- Discontinue accepting waste at the drop-off site. Where practical, moving legacy waste to the new SWMF. A site closure plan for the drop-off site, including backhauling metals and hazardous waste, is included in the optional components in **Section 6.2**;
- Discontinue accepting, burning, and burying of MSW at the MSW dump and burning site. Closure of the site. As part of the closure planning for this site, it is recommended that an environmental investigation be undertaken by the hamlet to determine the location and extent of the impacts of historical waste practices at this site; and
- Segregation of materials at the scrap metal storage site and relocation where practical to the new SWMF. It is proposed that the scrap metal storage site remains operational and be used by the hamlet as needed for material laydown purposes. The site should be closed to the public. Backhauling of metals and hazardous waste is included in the optional components in **Section 6.2**.

Residents are accustomed to dropping waste materials at the drop-off site which is located in close proximity to the community. Public engagement and education will be required to inform residents of the proposed changes to waste management in Resolute Bay, including the closure of the drop-off area site, and the desire for all waste materials to be dropped off at the new SWMF once constructed. Once the new SWMF is operational, the fence at the scrap metals storage site should be closed and locked so that public access is restricted. To formally close the drop-off site and the scrap metals storage site, clear signage should be installed at the gates diverting material to the new site. Proposed site closure of the drop-off site is included as an optional component in **Section 6.2**.

6.1.3 Facility Operations and Access

At the new SWMF, safety and control will be improved with the installation of fencing and an access gate at the entrance. Six-foot (1.8m) chain-link fencing will be erected around the perimeter of the new site. A twelve-foot manual swing gate will be installed at the northwest corner of the site where the entrance meets the access road. The attendant's trailer will be inside of the fence.

Within the site, additional 1.8m chain link perimeter fencing will be installed around the leachate pond, the sea can storage area, the HHW depot, the end-of-life vehicle storage area, the clean wood diversion area and the tire storage area. The MSW cell will be contained on three sides with chain link fencing to allow for more efficient drop-off and movement of vehicles and to reduce litter. The northwest side will not be fenced. Windblown litter in that direction should be collected around the site's perimeter fence.

Additional proposed facility improvements related to facility operations and access include the following:

- Extending the local electrical grid approximately 3 km to provide power to the SWMF;
- Addition of a heated facility attendant shelter and the provision of a part-time dedicated facility attendant. It is proposed that the attendant shelter be a portable, prefabricated trailer with power and heat provided by the extension of the local power grid to the site;
- Installation of lighting throughout the facility and at the entrance to the site at the attendant shelter. The lighting suggested is LED and solar power assisted and would tie into the power grid. Lighting would be installed at the HHW depot, the end-of-life vehicles/tires area, the Seacan storage area, the leachate pond and the municipal solid waste cell; and
- Installation of signage throughout the facility indicating proper waste disposal practices, including hours of operation, proper locations for segregation and storage of waste, and contact information for the facility attendant.

6.1.4 Leachate Pond

The management of leachate will be accomplished through the collection and storage into a leachate pond located to the southwest of the MSW cell. The leachate collection system includes a 10,300m² lined cell with a discharge pump.

Leachate will be managed by site operations personnel, as needed. The proposed system will rely on natural microbial processes and evaporation for the treatment of leachate within the pond. If the leachate pond is full, recirculating within the waste can serve as an immediate method of temporarily reducing the volumes. Discharge criteria for leachate must be established by regulating authorities, and the leachate must be tested and meet the criteria prior to release. Leachate releases should be documented and recorded.

6.1.5 Construction of Access Road and Vehicle Storage Building

The proposed gravel access road is 85.0 m long access road is proposed to be 5.0 m wide. The access road will be constructed from the end of the existing local utility road north of the site to the new SWMF.

A vehicle storage building is proposed for the storage of required equipment. The building will be a 6.0 m by 8.0 m non-insulated metal, vehicle storage garage on a concrete pad. There will be a 4.0 m by 5.0 m overhead door, interior lights, windows, and a man door. The building will provide storage for the equipment proposed in **Section 6.1.6**.

6.1.6 Equipment

Hamlet staff are currently using a pick-up truck for waste collection in the community. A proper garbage truck is recommended to be purchased to reduce windblown litter and to make waste collection efforts more efficient. A waste loader is recommended to provide the new SWMF with the means to move and compact waste, as well as add daily cover so that waste is not exposed to the elements, and to reduce attraction from wildlife. A skid steer with forklift attachment is recommended as a means to move, store, and package collected diverted waste, such as waste oil barrels, scrap metals, white goods, other bulky waste, clean wood, etc. The skid steer would be used on both the new SWMF site and the scrap metals storage laydown site.

Equipment will be stored either in the proposed vehicle storage building, or in the public works garage.

6.2 Optional Design Schematic Components

6.2.1 Waste Incineration Partnership

As noted in **Section 3.3.5** (Burning Practices) and **Table 3** (Summary of Solid Waste Facility Challenges and Deficiencies), the community openly burns household waste daily. The primary drivers for this activity in Resolute Bay are to reduce the amount of waste requiring landfilling, and mitigate wildlife attraction to the area, specifically polar bears. A safer and more compliant alternative to open burning is waste incineration. Types of waste that could benefit from incineration are Styrofoam, plastics, oily rags, plastic bags, and problematic waste streams that attract wildlife such as food waste, including animal and vegetable scraps, and carcasses and organs.

While a waste incinerator does present the benefits listed above regarding managing problematic waste streams, waste incineration in northern Canada presents many challenges and constraints, including:

- Reliability risk associated with the current technologies available;
 - For example, maintenance and repairs will require a specialized, out-of-territory technician, resulting in long down-time when repairs are needed;

- Low throughput waste volumes and cold (frozen) input feedstock create a significant risk of low temperature burn, which is ineffective and will emit air contaminants (e.g., dioxins and furans) if the burn chamber temperature cannot be maintained. Regular air monitoring would be required;
- Uncertain constructability requirements in northern communities (e.g., unknown impacts on the underlying permafrost, cold snow-blowing winds, etc.);
- Large fuel demand to operate an incinerator, which is costly and would impact the overall supply of diesel available in the community. Additional fuel is required to maintain high incineration temperatures during winter conditions; and
- Labour requirements to operate (specialized training and availability of labour).

A waste incinerator already exists in the community at the PCSP facility. The PCSP noted during their discussions with Dillon that the facility is receptive to potentially working with the municipality to process municipal waste in their incinerator. Formal discussions on the logistics between the GN and PCSP are required to determine if the PCSP is a feasible option for handling MSW in the community.

The limitations and concerns noted above regarding waste incineration in Nunavut need to be fully understood and vetted before moving forward with the purchase of an incinerator. Incinerators must be operated to meet the technologies minimum design requirements (e.g., chamber temperature and residence time). The ash from incineration would need to be disposed of in barrels and backhauled. It is recommended that pilot testing of incineration using the PCSP's incinerator occur prior to full scale implementation of waste incineration in Resolute Bay. It is recommended that the GN connect with PCSP personnel to develop an arrangement and agreement to pilot test using their incinerator to process problematic waste in the MSW waste stream.

6.2.2 Site Closure of the Drop-Off Site

The drop-off site is close to the community and remains a tempting option for staff and locals to quickly and conveniently drop-off their waste. It is recommended that this site be closed as a means to reduce illegal dumping and encourage use of the new SWMF. Closing the drop-off site includes the following:

- Relocating the 1,100 m³ of C&D and bulky non-hazardous waste to the MSW cell, or the scrap metals storage site, as applicable (Pile #1 and Pile #3);
- Backhauling the 1,300 m² of metals and end of life vehicles on site to a waste disposal facility in Quebec;
- Backhauling approximately 200 hazardous waste fluid barrels (waste oil barrels);
- Installation of a chain link perimeter fence;
- Installation of a 3.6m (12 foot) gate; and
- A sign indicating site closure and directing users to the new facility.

After the waste materials have been removed from the site, as part of the closure planning for this site, it is recommended that an environmental investigation be undertaken to determine the extent of impacts of historical waste practices at this site, noting that staining was observed on the ground near

the waste oil barrels. The costs associated with an environmental investigation and closure plan are not included in this report.

Due to the proximity to the community, a fence and gate are recommended to be erected at the drop-off site once the material has been removed, to reduce illegal dumping. The site could be repurposed for alternative uses by the Municipality. Council should be involved early in this process, to gauge their preference on re-developing the site.

6.2.3 Backhauling Program

The backhauling of legacy hazardous waste is recommended as a consideration to reduce existing volumes of bulky waste materials and hazardous waste in the community to reduce the potential for environmental impacts, and to help maximize the useful life of waste management facilities in the community. It is anticipated that an ongoing backhauling program would be required to occur at a minimum of once every five years. Materials are to be collected in accordance with the Transportation of Dangerous Goods (TDG) regulations. To accomplish this, it is recommended that the GN hires a qualified TDC consultant to update the O&M procedures to ensure the materials are collected or repackaged with the intent of transport. Seacans containing appropriate secondary containment will then be shipped to Quebec for disposal or management at an approved waste disposal or recycling facility.

Backhauling the accumulated stockpiled bulky waste, including the portion necessary to close the Drop-off Site are outlined in this section. Approximate total volumes suitable for backhauling are a summation of the waste types listed in **Section 3.2** and are summarized below:

- Scrap Metals: 5,610 m³ at the scrap metal storage site, and 1,300 m³ at the drop-off site for a total of 6,910 m³;
- Non-hazardous bulky waste (including C&D Waste): 1,213 m³ at the drop-off site;
- Hazardous waste, comprising of waste fluid barrels at the drop-off site: 200 barrels; and
- End-of-life vehicles at the drop off site: 35 units.

Although the aforementioned volumes represent materials that could be backhauled, it is expected that the proposed new SWMF will have capacity to landfill previously diverted materials that were stockpiled because they were not suitable for burning. Much of the bulky C&D waste can be relocated and/or disposed of in the new landfill. There is no immediate requirement to backhaul scrap metals, hazardous waste and other bulky wastes; however, a regular backhauling program should be implemented as part of the regular O&M for the site as a means to manage quantities of bulky waste materials.

Materials proposed for backhauling as part of the closure of the Drop-off Site were discussed in **Section 6.2.3** and include backhauling 1,300 m² of metals, 35 end of life vehicles and approximately 200 hazardous waste fluid barrels (waste oil barrels).

Many of the end-of-life vehicles are crushed and, in a condition, where transport may be more suitable in a seacan. It is assumed that on average three to four vehicles will fit into one seacan or open tray-style seacan depending on size. The backhauling costs therefore average approximately \$3300 to \$4400 per vehicle. Costs for removing the full quantity of materials, as well as partial amount for the closure of the drop off site only, to a disposal facility in Quebec are presented in the Tables in Section 7 and detailed in **Appendix D**.

Bulky waste materials will accumulate in the new SWMF over time. Developing a once in every five years backhauling program and including associated budget in operations and maintenance costs is recommended. Attention should be paid to items under extended producer responsibility programs (ERP). The inventory of recycling programs (Government of Canada, 2023) available in Nunavut is currently limited to mercury containing products and pharmaceuticals, however these programs are expected to be expanding. Without knowing the generation rates of these diverted materials, a simple estimate for budgeting purposes was set at approximately three seacans per year and is included in the O&M costs included in **Appendix E**.

6.2.4 Summary of Proposed Optional Improvements

A summary of the optional components of the design schematic includes the following and are presented on **Figure 4**, along with the mandatory components:

- Closure of the drop-off site; and
- A backhauling program for accumulated metals and hazardous waste.

Based on the available airspace at the proposed new SWMF and estimated waste generation rate in the community, it is estimated that the mandatory design components will provide 20 years of solid waste disposal assuming little to no waste incineration occurs. The lifespan of the landfill will be reduced by approximately 1 year, if 1,100 m³ C&D materials from the drop-off site are relocated to the landfill cell. Conversely, the lifespan of the landfill will be prolonged if incineration of MSW at the PCSP facility is successfully implemented. Cost estimates are included in **Section 7**.

7.0

Class D Cost Estimate

A Class D Cost Estimate was prepared by Altus Group for the capital cost items for both the mandatory and optional components of the new SWMF, and for backhauling of specific waste types from the community (e.g., hazardous waste and scrap metal) for disposal or recycling in other parts of Canada. Dillon prepared a 20-year Class D cost estimate for O&M costs which is presented in **Appendix E**.

The cost estimates for both the mandatory and optional components are presented in **Table 4** and **Table 5**. A summary of both is presented in **Table 6**. The cost estimate includes the following contingencies and additional fee percentages, as specified by Altus:

- Design and pricing contingency of 10%;
- Escalation contingency of 12.3%; and
- Market Contingency of 40%.

Further information on each cost item is presented in a schedule of costs in **Appendix B**, and the Altus Group Nunavut Solid Waste Facility: Resolute Bay Class D Estimate report is included in **Appendix C**. Material quantities are based on the quantities provided by Dillon, which are based on anticipated waste generation rates from previous reports, as detailed in prior sections of this report. Post-contract construction contingency was excluded from the estimate.

Costs to close the current dump and burning are excluded from the cost estimates.

The cost estimate assumptions include:

- Project duration of 3 summers (mobilization is Summer 1, and construction work spanning Summer 2 and 3);
- Assumed average daily workforce of 10 persons;
- Local accommodations are not available (camp required);
- Tender date of Q2 2025;
- Materials to be barged to facility from major port;
- Excess excavation/cut material to be removed from facility;
- The contractor is nonlocal and will mobilize from Iqaluit or from a Canadian Province;
- Items such as totes, seacans, are assumed to be procured as part of the construction contract;
- Sorting existing waste materials and rubbish, by machine or by hand was assumed to be part of the contractor's scope; and
- For backhauling, costs for trucking and disposal of waste at a Quebec landfill are included as allowances only, and actual costs could vary from those in this estimate.

Table 4: Capital Cost Summary – Mandatory Components – New MSW Facility

Cost Item	Price
<i>Proposed New Municipal Solid Waste Facility – Mandatory Components</i>	
Access Road to Proposed SWMF Area	\$30,728
Storm Water Management	\$171,990
Attendants Building	\$229,944
Portable Washroom	\$67,046
Berming	\$146,960
Seacan Storage	\$100,000
Waste Cell	\$2,229,641
Leachate Pond including Pump	\$101,935
HHW Depot	\$36,066
Fencing	\$1,037,413
Signage	\$12,500
Uninsulated Vehicle Storage Building	\$330,823
Power to Site and Lighting	\$1,567,868
Other (Heavy Equipment Mobilization)*	\$735,000
Site Grading and Preparation	\$773,367
<i>Sub-Total</i>	<i>\$7,572,000</i>
<i>Other</i>	
Garbage Truck	\$288,750
Loader	\$535,500
Skid Steer with Forklift Attachment	\$110,250
<i>Sub-Total</i>	<i>\$934,500</i>
<i>Contingencies and Fees</i>	
General Requirements & Fees	\$2,893,000
Freight & Accommodations	\$2,297,000
Design and Pricing Contingency (10%)	\$851,000
Escalation Contingency (12.3%)	\$1,047,000
Market Contingency (40%)	\$3,403,000
<i>Sub-Total for Contingency</i>	<i>\$10,491,000</i>
Total for Mandatory Components	\$18,997,500

Notes:

*Mobilization of heavy equipment (\$735,000) is included under the assumption that there is no availability of local equipment for construction works.

Table 5: Capital Cost Summary – Optional Components

Cost Item	Price
<i>Proposed New Municipal Solid Waste Facility – Optional Components</i>	
Waste Incinerator	\$1,491,473
*Site Closure for the Drop-off Site	\$397,425
<i>Sub-Total for Optional Items</i>	<i>\$1,889,000</i>
<i>Backhauling All Stockpiled Scrap Metals, Bulky Waste and Hazardous Waste</i>	
Metals (est. 246 seacans)	\$3,960,210
Non-Hazardous/bulky waste (est. 68 seacans)	\$1,108,503
Hazardous Waste (est. 200 barrels)	\$183,333
<i>Sub-Total for Backhauling Legacy Waste</i>	<i>\$5,253,000</i>
<i>Contingencies and Fees</i>	
General Requirements & Fees	\$2,428,000
Freight & Accommodations	\$1,928,000
Design and Pricing Contingency (10%)	\$714,000
Escalation Contingency (12.3%)	\$878,000
Market Contingency (40%)	\$2,857,000
<i>Sub-Total for Contingency</i>	<i>\$5,948,000</i>
Total for All Optional Components	\$13,090,000

Notes:

* Costs associated with an environmental investigation and closure plan for the drop-off site are not included. Costs to backhaul metals and hazardous waste from the drop-off site are included in the Backhauling Stockpiled Waste cost section. This line item only includes adding fencing, a gate and signage to the drop-off site.

Table 6: Capital Cost Summary – Total (All Components – Mandatory and Optional)

Cost Item	Price
<i>Proposed New Municipal Solid Waste Facility – Mandatory Components</i>	
Access Road to Proposed SWMF Area	\$30,728
Storm Water Management	\$171,990
Attendants Building	\$229,944
Portable Washroom	\$67,046
Berming	\$146,960
Seacan Storage	\$100,000
Waste Cell	\$2,229,641
Leachate Pond including Pump	\$101,935
HHW Depot	\$36,066
Fencing	\$1,037,413
Signage	\$12,500
Uninsulated Vehicle Storage Building	\$330,823
Power to Site and Lighting	\$1,567,868
Other (Heavy Equipment Mobilization)*	\$735,000
Site Grading and Preparation	\$773,367
<i>Sub-Total</i>	<i>\$7,572,000</i>
<i>Other – Equipment</i>	
Garbage Truck	\$288,750
Loader	\$535,500
Skid Steer with Forklift Attachment	\$110,250
<i>Sub-Total</i>	<i>\$934,500</i>
<i>Proposed New Municipal Solid Waste Facility – Optional Components</i>	
Waste Incinerator	\$1,491,473
**Site Closure for the Drop-Off Site	\$397,425
<i>Sub-Total for Optional Items</i>	<i>\$1,889,000</i>
<i>Backhauling Metals, Bulky Waste and Hazardous Waste</i>	
Metals (est. 246 seacans)	\$3,960,210
Non-Hazardous/bulky waste (est. 68 seacans)	\$1,108,503
Hazardous Waste (est. 200 barrels)	\$183,333
<i>Sub-Total for Backhauling Legacy Waste</i>	<i>\$5,253,000</i>
<i>Contingencies and Fees</i>	
General Requirements & Fees	\$5,320,000
Freight & Accommodations	\$4,225,000
Design and Pricing Contingency (10%)	\$1,565,000
Escalation Contingency (12.3%)	\$1,925,000
Market Contingency (40%)	\$6,259,000
<i>Sub-Total for Contingency</i>	<i>\$19,294,000</i>
Total for All Mandatory and Optional Components	\$34,546,000

Notes:

*Mobilization of heavy equipment (\$735,000) is included under the assumption that there is no availability of local equipment for construction works.

** Costs associated with an environmental investigation and closure plan for the drop-off site are not included. Costs to backhaul metals and hazardous waste from the drop-off site are included in the Backhauling Stockpiled Waste cost section. This line item only includes adding fencing, a gate and signage to the drop-off site.

8.0

Recommendations

Given the significant constraints and concerns associated with the existing MSW dump and burning site in Resolute Bay, to bring waste management operations in Resolute Bay in line with best practices in waste management and create a safer facility for the community and for the environment, a new solid waste management facility is recommended. The mandatory facility upgrade components include the following:

- Building a new SWMF; and
- Purchasing dedicated equipment for its operation.

The recommendation for a new SWMF was based on compliance, environmental and health and safety concerns regarding current practices and conditions at the MSW dump and burning site (i.e., an undelineated, open burning site in close proximity to the marine environment and a historic site), operational concerns, potential impacts to the environment, and discussion with the local Municipality and the GN.

In addition, the following optional site upgrade components were considered:

- Closure of the drop-off site; and
- Backhauling stockpiled metals, end-of-life vehicles and hazardous waste.

It is suggested that discussions between the GN and PSCP occur to determine if a partnership could be created to pilot test incineration of municipal solid waste generated in the community using PSCP's incinerator. Problematic waste streams, such as organics and animal carcasses that attract wildlife, would be a priority for waste incineration.

With consideration of noted deficiencies, limitations and cost estimates, it is recommended that the following components presented on **Figure 4** be implemented:

- Construction of a new SWMF, including extending power to the new site;
- Purchasing dedicated equipment for its operation; and
- Closure of the drop-off site, including backhauling a portion of stockpiled bulky waste in the community to allow of drop-off site closure.

Implementation of these components will allow Resolute Bay to comply with the water license that authorizes waste disposal and provides a facility that meets modern waste handling standards.

Backhauling efforts are recommended, as required to close the drop-off site. Backhauling is not recommended for all scrap metals and hazardous waste stockpiles currently due to the need to prioritize the construction of a new SWMF. The scrap metals storage site has capacity for continued storage of metals, and it is fenced. The scrap metals storage site can meet material laydown needs of

the community. It is recommended that staff lock the gate to the scrap metals storage site, and limit its use to hamlet staff only, as needed. Costs associated with backhauling a portion of the scrap metals, end-of-life vehicles and hazardous waste to allow for the closure of the drop-off site is included in the recommended facility upgrades. Funds for future backhauling have been included in the O&M costs.

Closure of both the MSW dump and burning site and the drop-off site is recommended. As part of closure planning for both sites, it is recommended that an environmental investigation be undertaken to determine the extent of impacts of historical waste practices at the sites. The costs associated with an environmental investigation and closure plans for both sites are not included in this report.

A summary of recommended site improvements, and associated Class D cost estimates, are presented in **Table 7**. The recommendations are to be considered by the GN, in conjunction with the Business Case Reports being prepared in parallel for the waste sites in other communities, allowing for comparison of the priorities and associated costs so that the GN can provide the best allocations of funds as needed throughout the Territory.

Operations and maintenance, and lifecycle costs for a 20-year period for the recommended components, including the operation of the proposed new solid waste management facility, are presented in **Appendix E**. The costs include an allowance for a backhauling program on a 5-year frequency.

Table 7: Capital Cost Summary – Recommended Components

Cost Item	Price
Proposed New Municipal Solid Waste Facility – Mandatory Components	
Access Road to Proposed SWMF Area	\$30,728
Storm Water Management	\$171,990
Attendants Building	\$229,944
Portable Washroom	\$67,046
Berming	\$146,960
Seacan Storage	\$100,000
Waste Cell	\$2,229,641
Leachate Pond including Pump	\$101,935
HHW Depot	\$36,066
Fencing	\$1,037,413
Signage	\$12,500
Uninsulated Vehicle Storage Building	\$330,823
Power to Site and Lighting	\$1,567,868
Other (Heavy Equipment Mobilization)*	\$735,000
Site Grading and Preparation	\$773,367
Sub-Total	\$7,572,000
Other	
Garbage Truck	\$288,750
Loader	\$535,500
Skid Steer with Forklift Attachment	\$110,250
Sub-Total	\$934,500
Optional Recommended Items	
**Closure of the Drop-Off Site	\$397,425
Backhauling Metals for the Closure of the Dropoff Site (est. 47 seacans)	\$753,562
Backhauling ELVs or the Closure of the Dropoff Site (est. 12 seacans)	\$159,600
Backhauling Hazardous Waste for the Closure of the Dropoff Site (est. 5 seacans)	\$183,333
Sub-Total for Optional Items	\$1,494,000
Contingencies and Fees	
General Requirements & Fees	\$3,401,000
Freight & Accommodations	\$2,701,000
Design and Pricing Contingency (10%)	\$1,001,000
Escalation Contingency (12.3%)	\$1,231,000
Market Contingency (40%)	\$4,001,000
Sub-Total for Contingency and Fees	\$12,335,000
Total for Recommended Components	\$22,335,500

Notes:

*Mobilization of heavy equipment (\$735,000) is included under the assumption that there is no availability of local equipment for construction works.

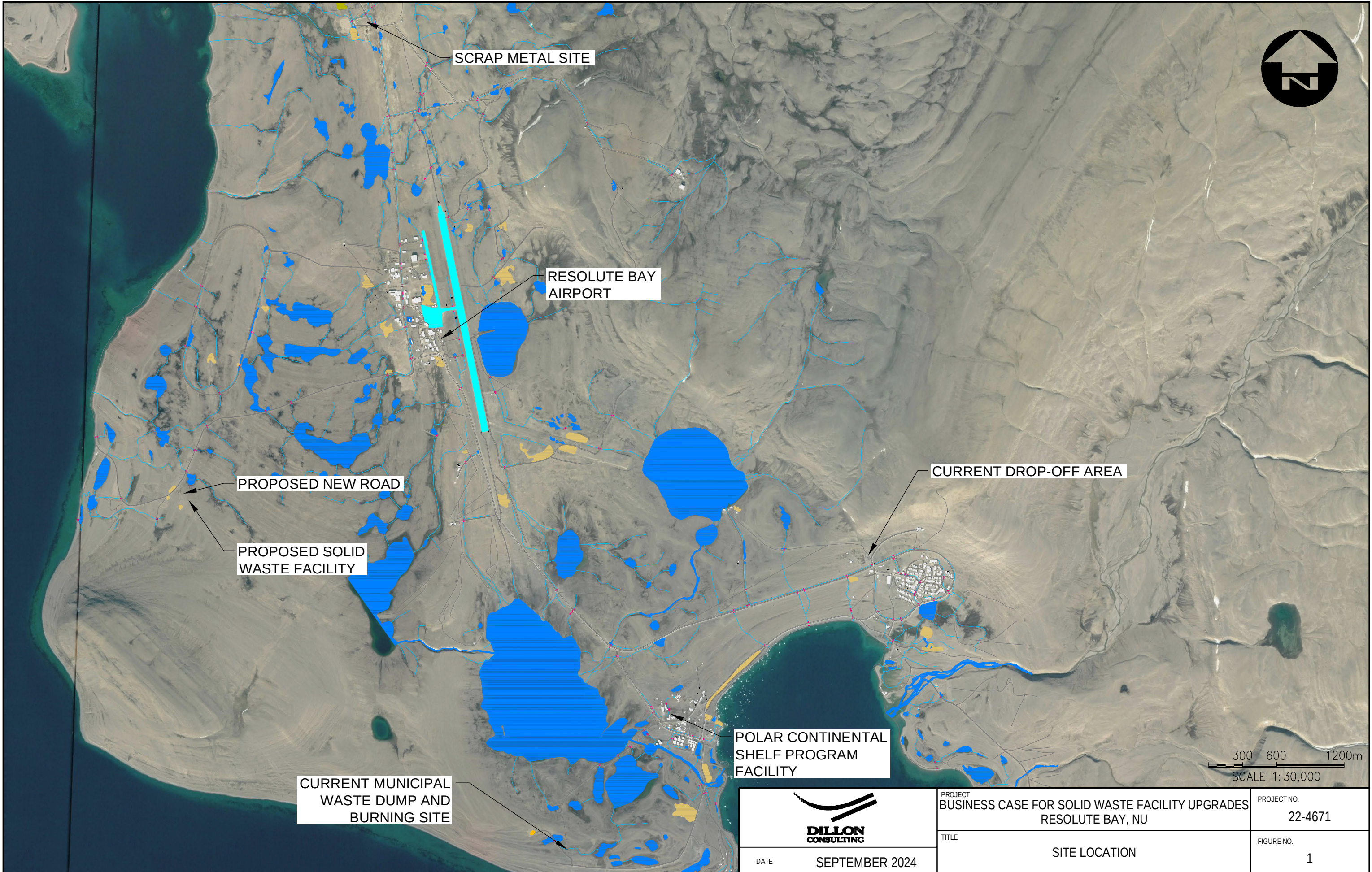
** Costs associated with an environmental investigation and closure plan for the drop-off site are not included. Costs to backhaul metals and hazardous waste from the drop-off site are included in the Backhauling Stockpiled Waste cost section. This line item only includes adding fencing, a gate and signage to the drop-off site.

The Business Case has been presented to Resolute Bay council and a motion for approval is included in **Appendix F**.

Figures



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CONSULTING

DATE SEPTEMBER 2024

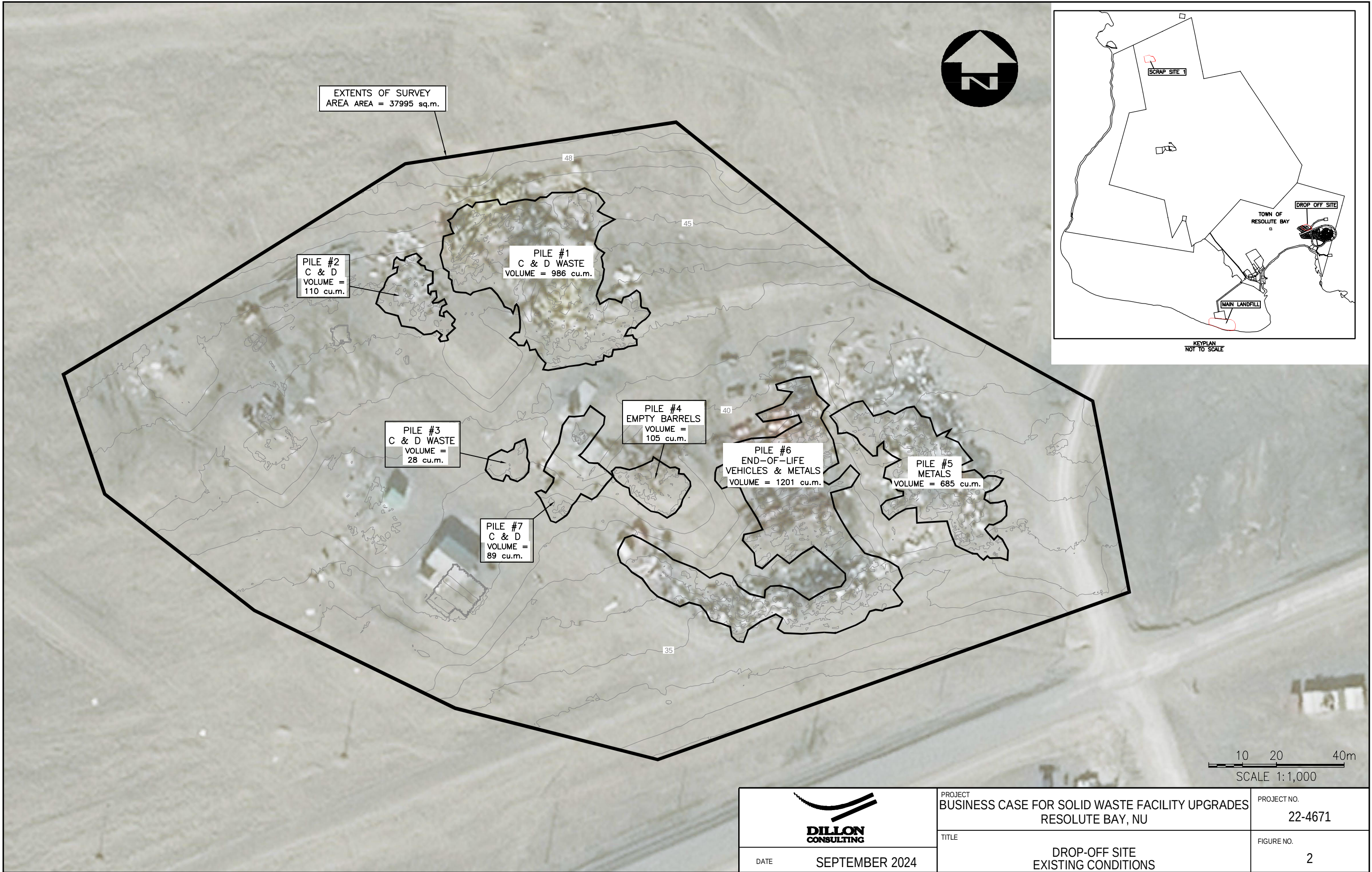
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BUSINESS CASE FOR SOLID WASTE FACILITY UPGRADES
RESOLUTE BAY, NU

TITLE
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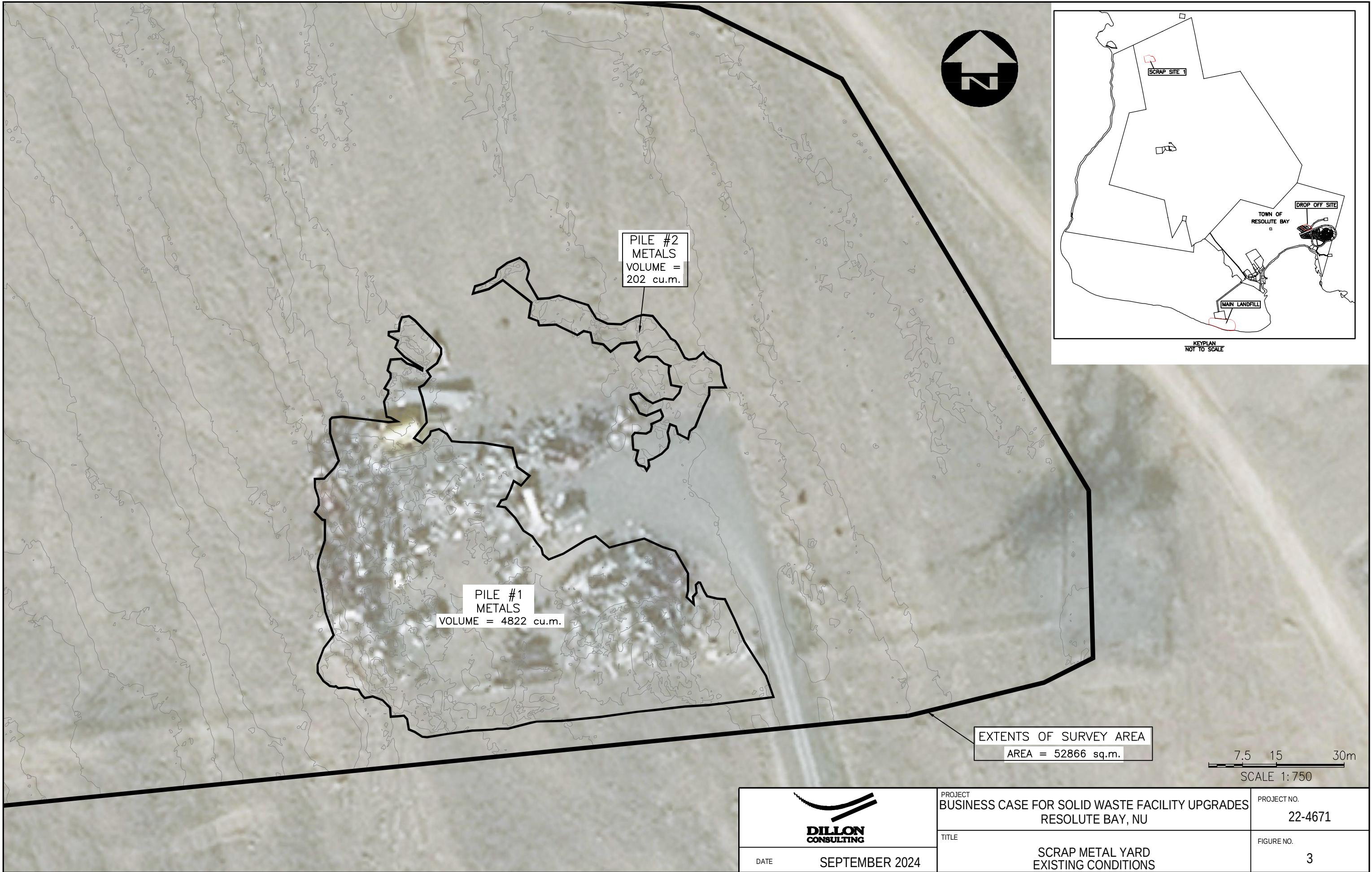
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22-4671

FIGURE NO.
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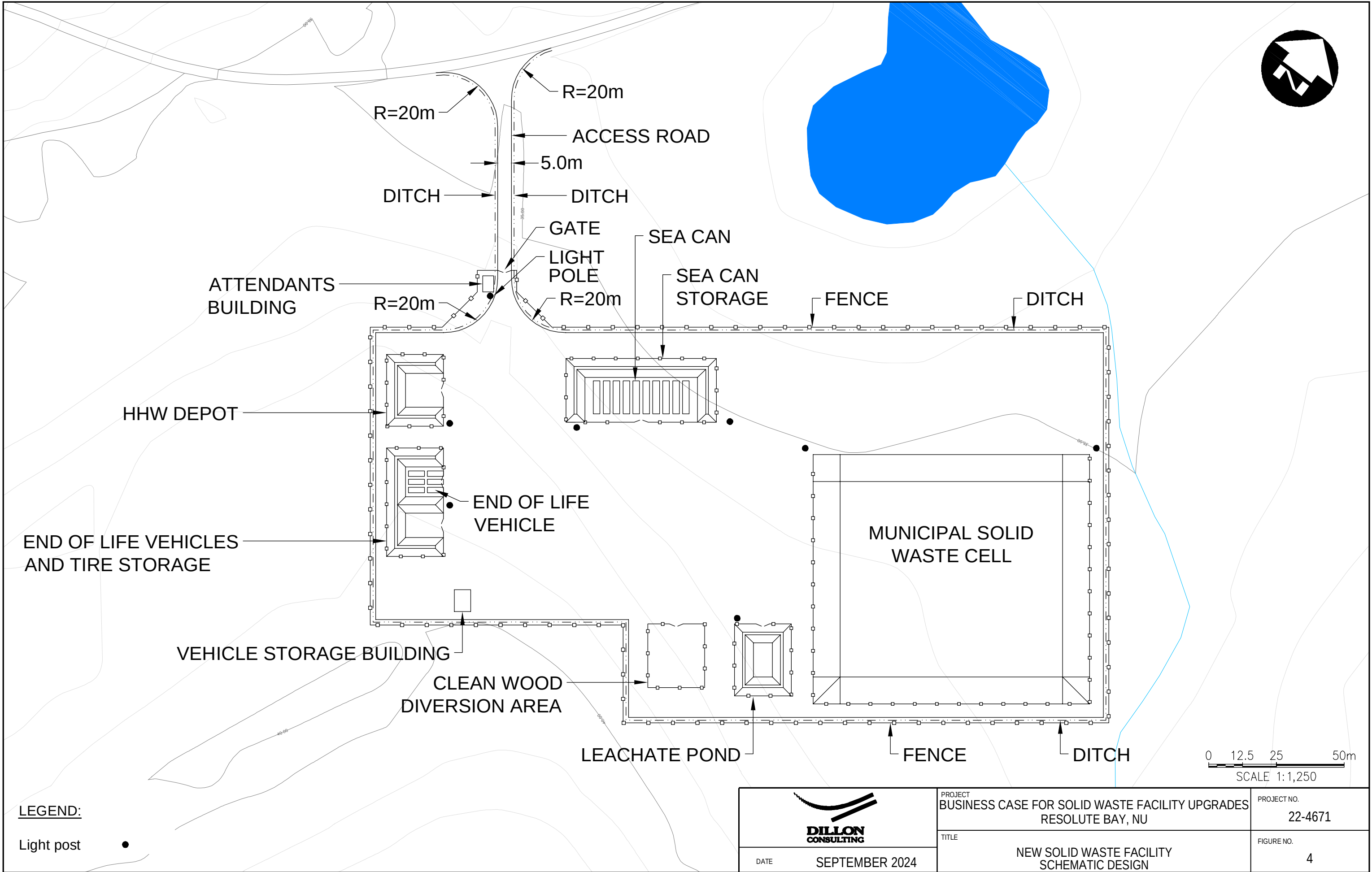
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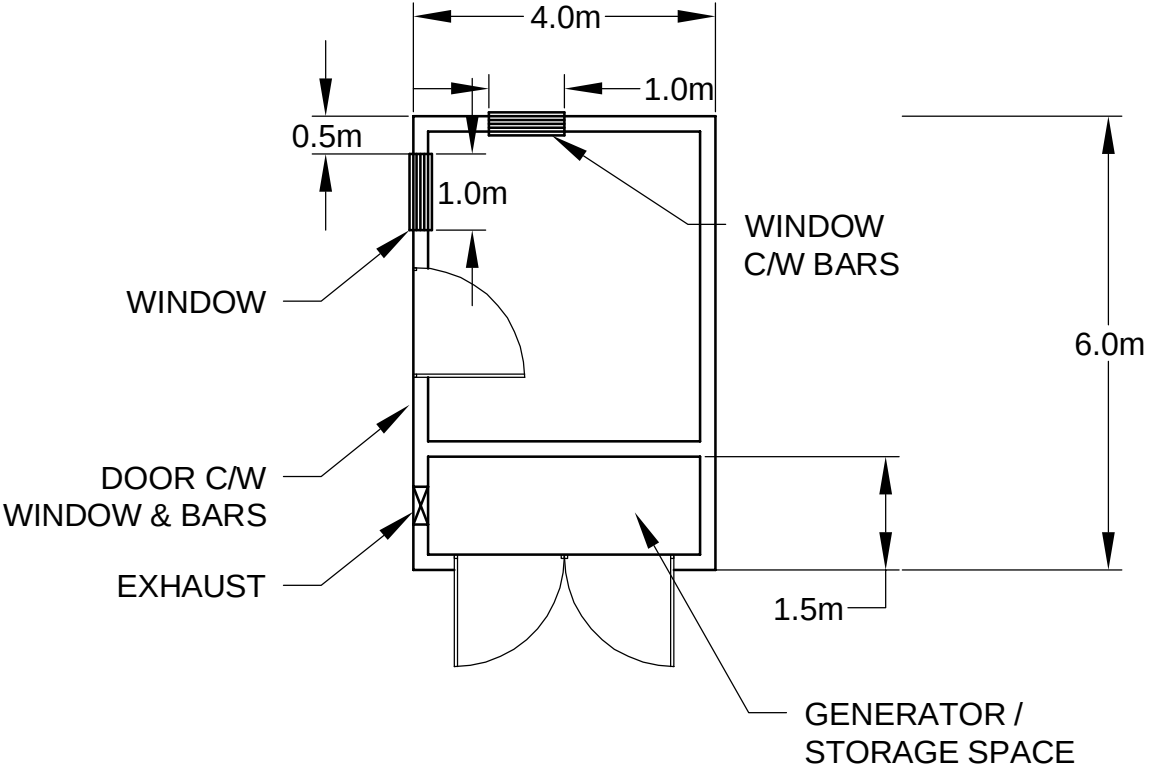


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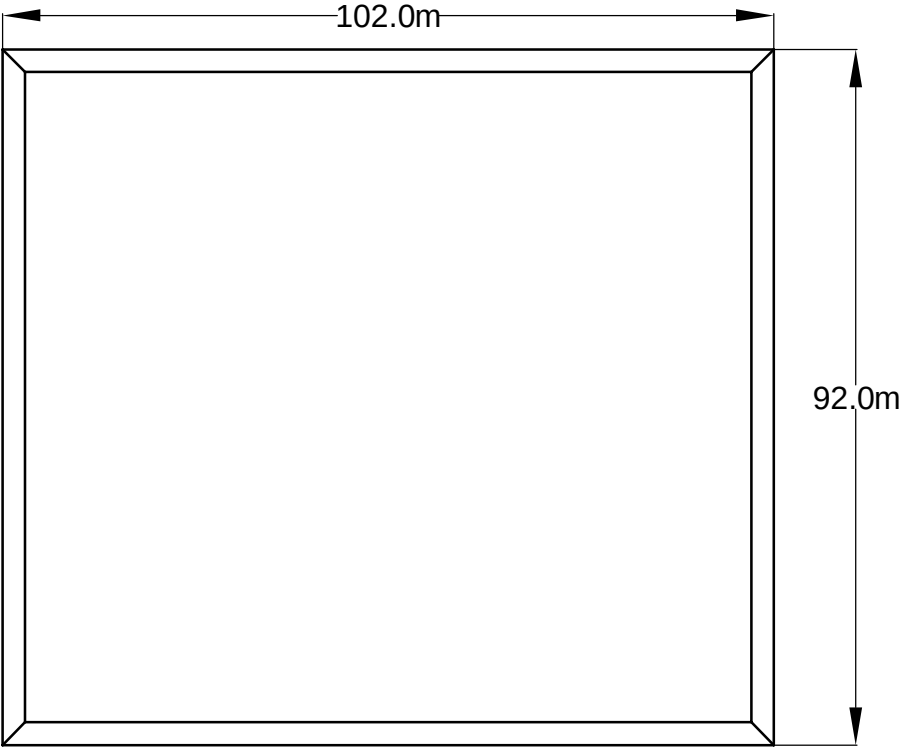
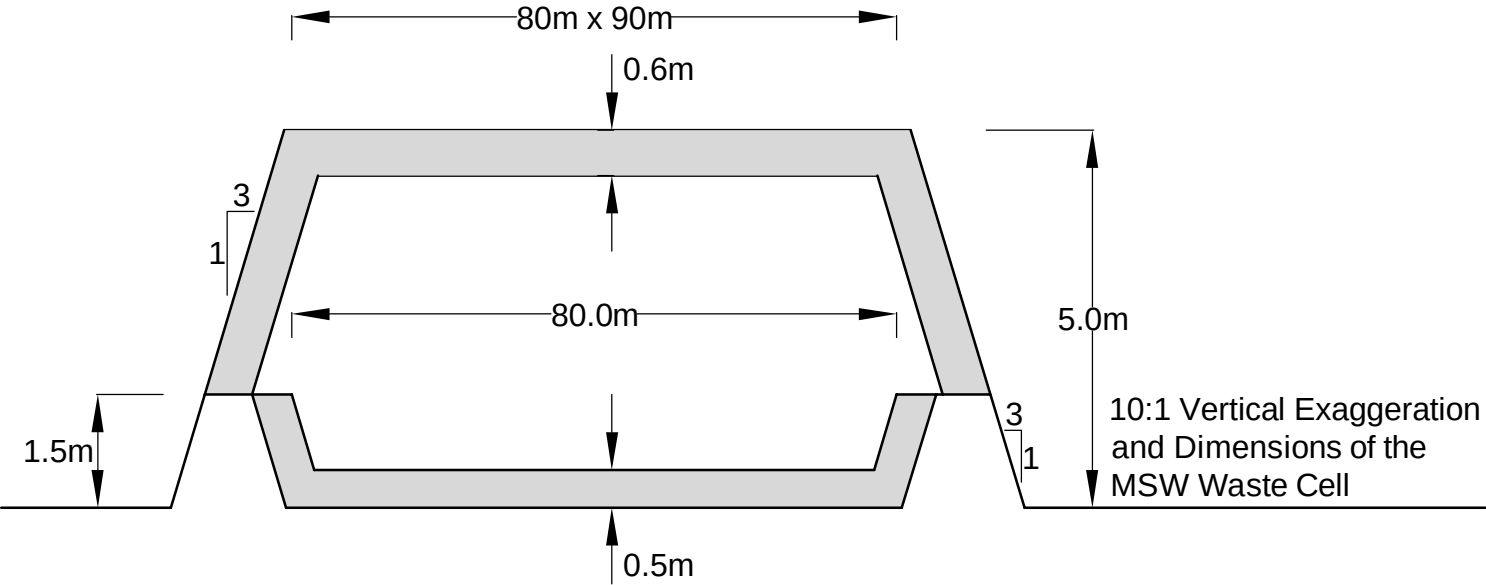
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	TITLE NEW SOLID WASTE FACILITY SCHEMATIC DESIGN	FIGURE NO. 4
DATE SEPTEMBER 2024		

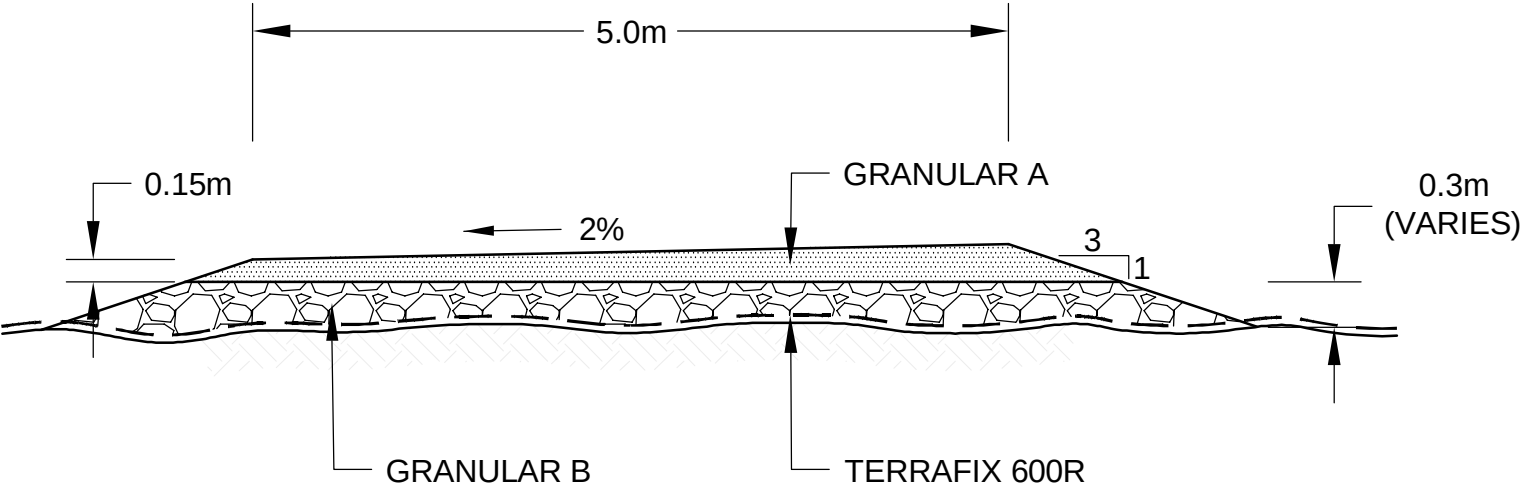
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ATTENDANTS BUILDING



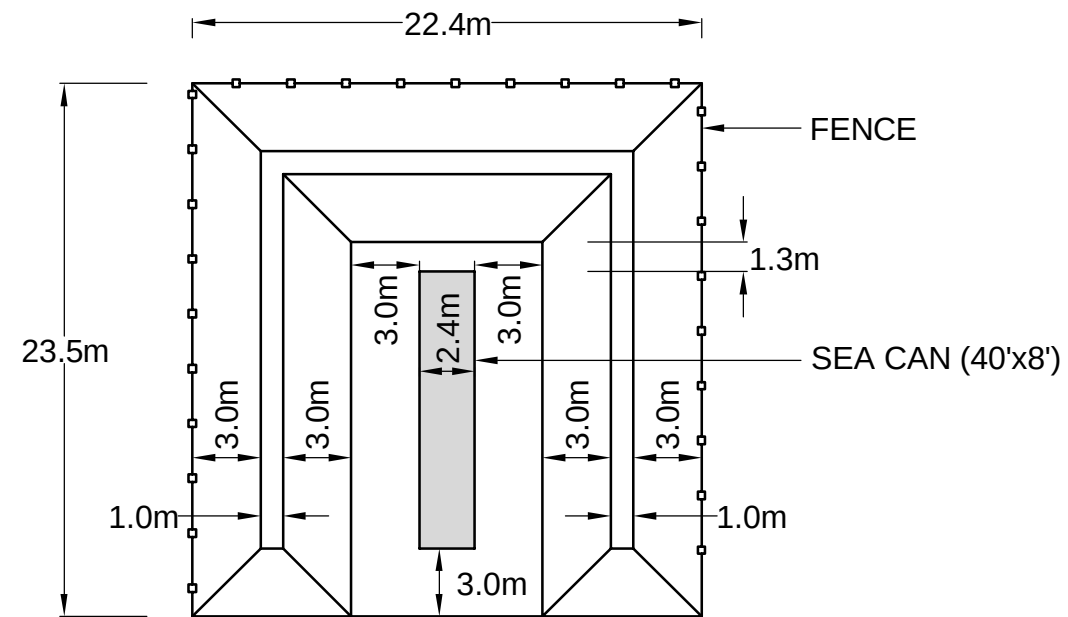
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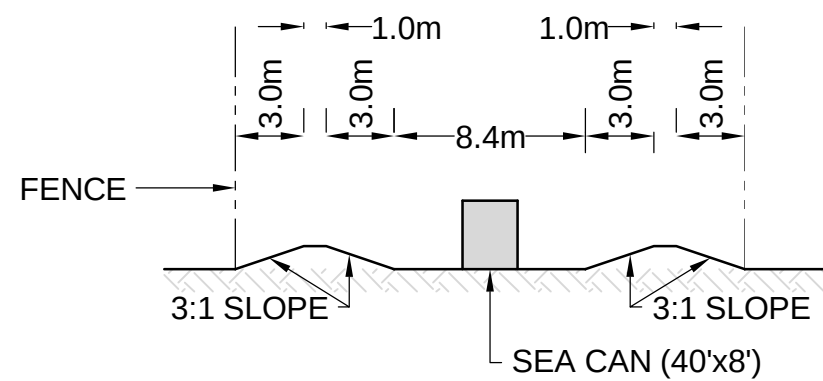
SITE ACCESS ROAD

NOT TO SCALE

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	TITLE DETAILS	FIGURE NO. 5
DATE SEPTEMBER 2024		

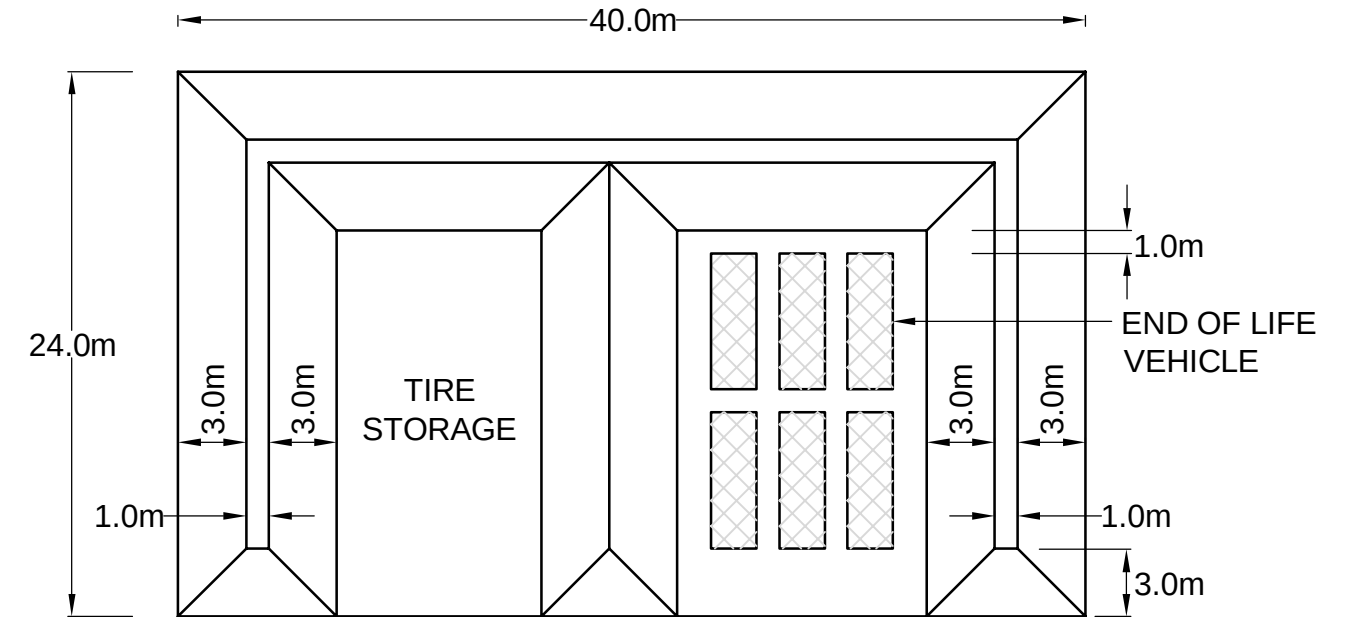


PLAN

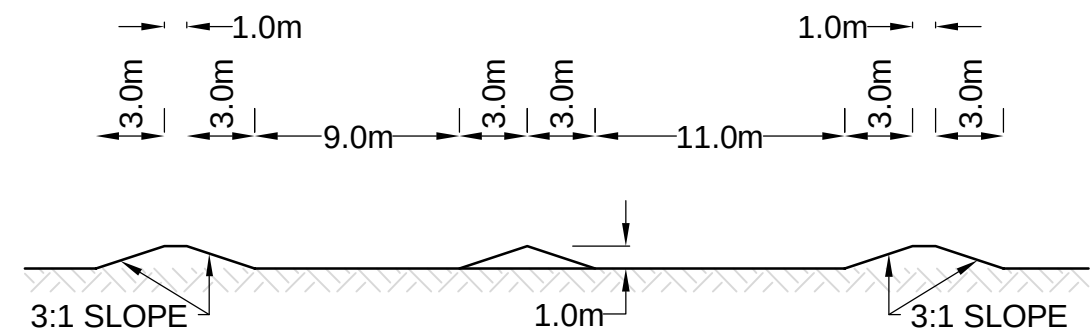


SECTION

HOUSEHOLD HAZARDOUS WASTE DEPOT



PLAN



SECTION

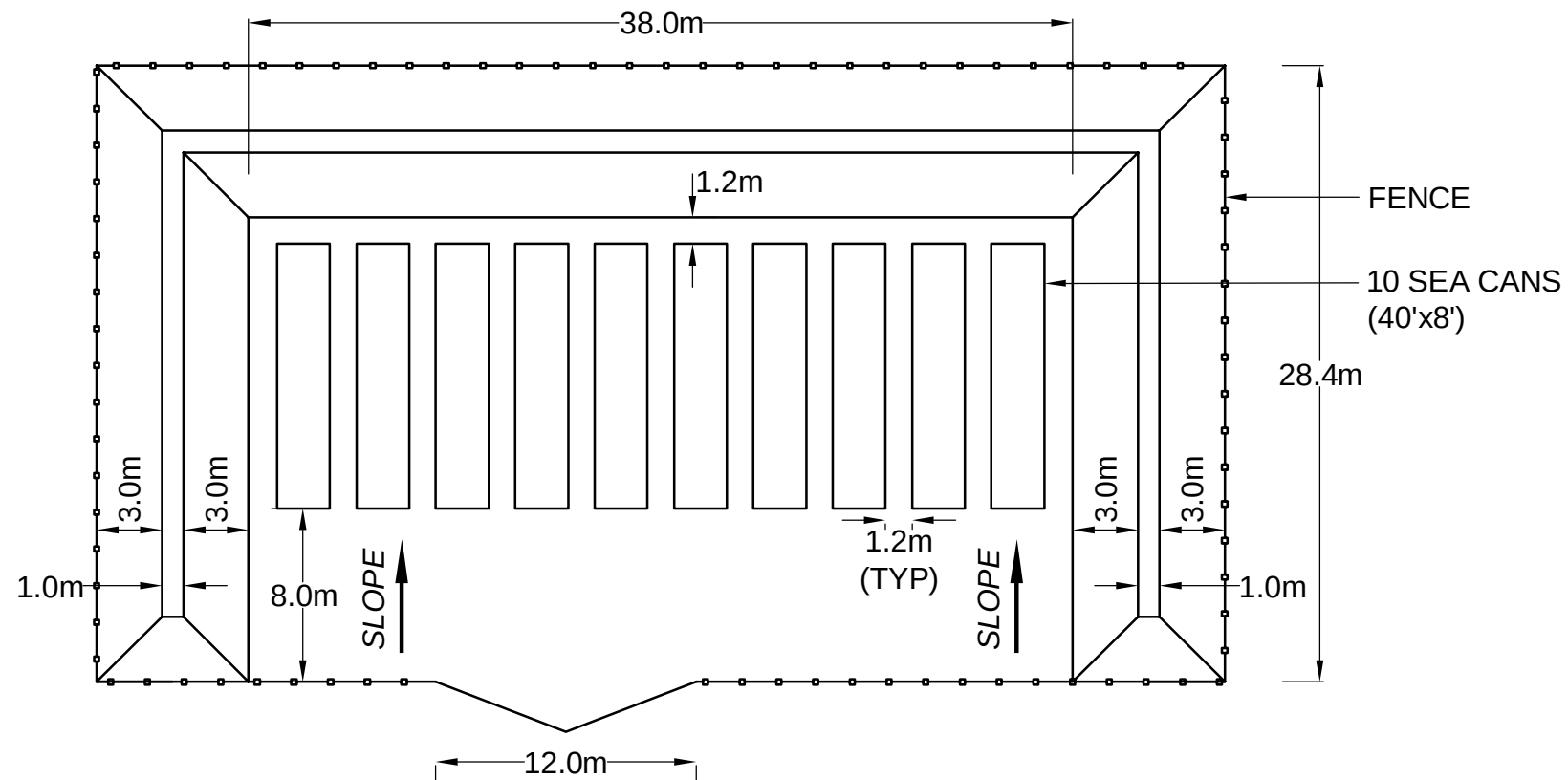
END OF LIFE VEHICLES AND TIRE STORAGE

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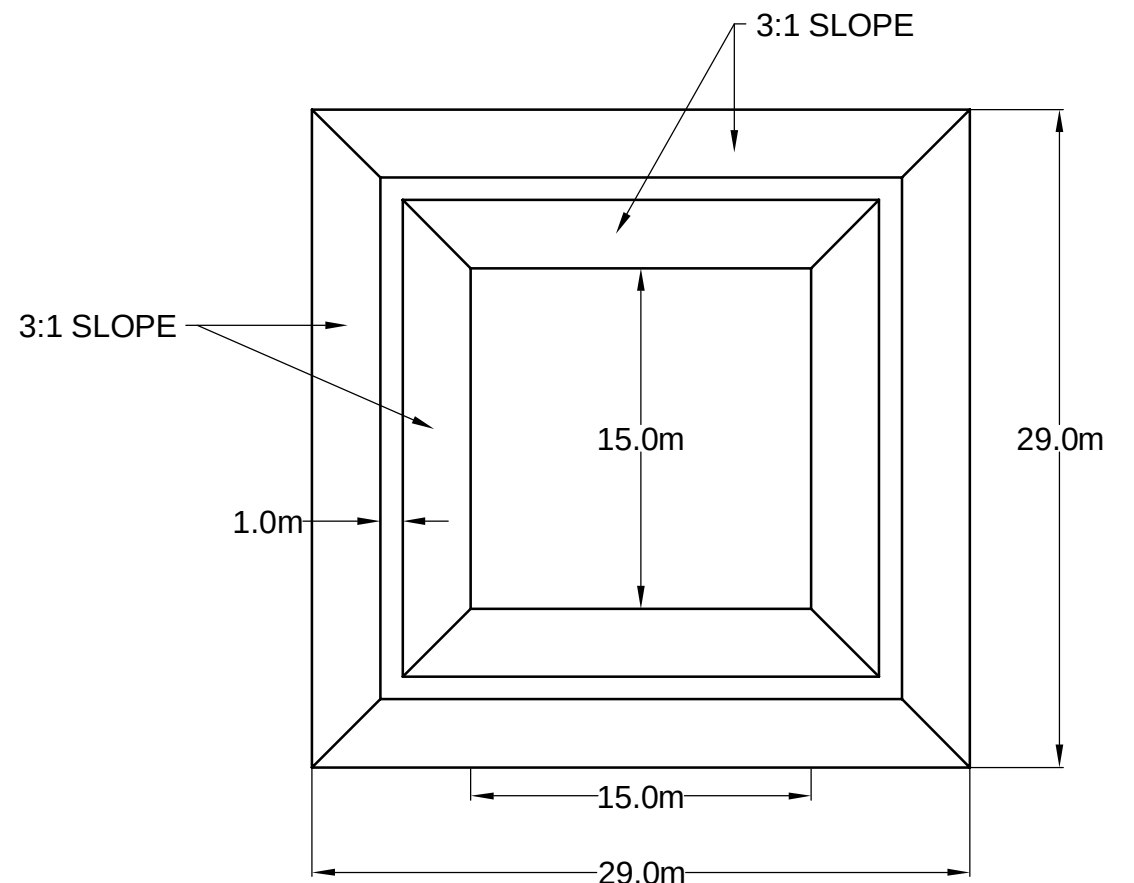
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	TITLE DETAILS	FIGURE NO. 6

DATE SEPTEMBER 2024

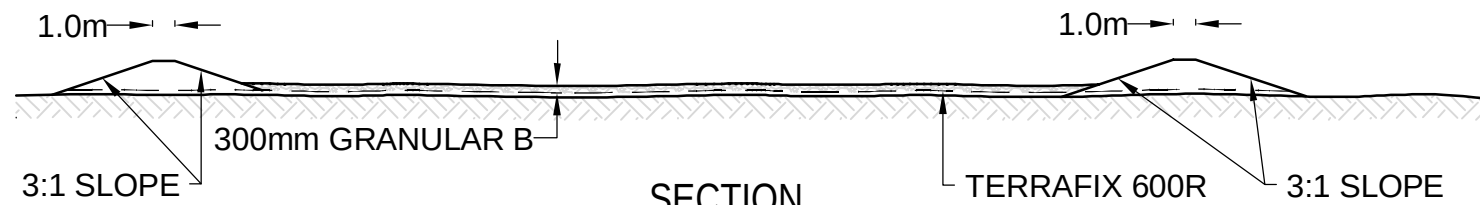
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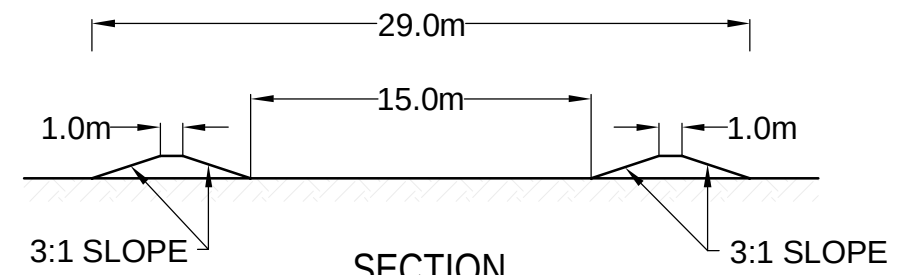
PLAN



PLAN



SECTION



SECTION

SEA CAN STORAGE PAD

SCRAP METAL PAD

NOT TO SCALE

 DILLON CONSULTING	PROJECT BUSINESS CASE FOR SOLID WASTE FACILITY UPGRADES RESOLUTE BAY, NU	PROJECT NO. 22-4671
	TITLE DETAILS	FIGURE NO. 7
DATE SEPTEMBER 2024		

Appendix A

Water License



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NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATIMAYINGI
OFFICE DES EAUX DU NUNAVUT

File No: 3BM-YRB2126

December 22, 2021

Darrin Nichol
Director
Nunavut Airport Operations, GN-EDT
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GN-CGS
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E-mail: broy@gov.nu.ca

RE: NWB Type “B” Water Licence No: 3BM-YRB2126

Dear Mr. Nichol and Mr. Roy:

Please find attached Licence No: **3BM-YRB2126** issued to the Government of Nunavut – Department of Economic Development and Transportation (GN-EDT or Licensee) by the Nunavut Water Board (NWB or Board), pursuant to its authority under Article 13 of the *Agreement between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in Right of Canada (Nunavut Agreement)* and the *Nunavut Waters and Nunavut Surface Rights Tribunal Act (NUNSRTA)*. The terms and conditions of the attached Licence related to the use of Water and the deposit of Waste are an integral part of this approval.

If the Licensee contemplates the renewal of this Licence, it is the responsibility of the Licensee to apply to the NWB for its renewal. The past performance of the Licensee, new documentation and information, and issues raised during a public hearing, if the NWB is required to hold one, will be used to determine the terms and conditions of the Licence renewal. Note that if the Licence expires before the NWB issues a new one, then Water use and Waste disposal must cease, or the Licensee may be in contravention of the *Nunavut Agreement* and the *Nunavut Waters and Nunavut Surface Rights Tribunal Act (Act)*. However, the expiry or cancellation of a licence does not relieve the holder from any obligations imposed by the licence. The NWB recommends that an application for the renewal of this Licence be filed at least **three (3) months** prior to the Licence expiry date. It should be noted that in accordance with Section 75(1)(a) of the *Nunavut Planning and Project Assessment Act (NuPPAA)*, the Board is not allowed to issue a permit or authorization for any project proposal that has not been submitted to the Nunavut Planning Commission (NPC) in accordance with Section 76 of *NuPPAA*.

If the Licensee contemplates or requires an amendment to this Licence, the NWB may decide, in the public's interest, to hold a public hearing. The Licensee should submit applications for amendment as soon as possible to give the NWB sufficient time to go through the amendment process. The process and timing may vary depending on the scope of the amendment; however, a minimum of **sixty (60) days** is required from time of acceptance by the NWB. It is the responsibility of the Licensee to ensure that all application materials have been received and are acknowledged by the Manager of Licensing.

The NWB strongly recommends that the Licensee consult the comments received from interested parties on issues identified. This information is attached for your consideration.¹

Sincerely,

Lootie Toomasie
Nunavut Water Board
Chair

LT/rqd/sk

Enclosure: Licence No: **3BM-YRB2126**

Comments: CIRNA, ECCC

Cc: Distribution List - Qikiqtani

¹ Crown-Indigenous Relations and Northern Affairs (CIRNA), November 4, 2021; and Environment and Climate Change Canada (ECCC), November 2, 2021.

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I. BACKGROUND

Application is by the Government of Nunavut – Community and Government Services (GN-CGS or the Applicant), on behalf of the Government of Nunavut – Department of Economic Development and Transportation (GN-EDT or Licensee), for the renewal, for a term of five (5) years, of Type “B” Water Licence No: 3BM-YRB1621 to allow for the continued operation of a Sewage Disposal Facility located within the municipal boundaries of the Hamlet of Resolute Bay in the Qikiqtani Region, Nunavut. The Licence under which the Sewage Disposal Facility operated is set to expire on December 15, 2021.

In the current Application, the Licensee notes that the scope of activities currently authorized under Water Licence No: 3BM-YRB1621 will remain unchanged.

II. FILE HISTORY

Historically, all or some aspects of the works, activities, and facilities associated with the undertaking have been licensed by the NWB and the Northwest Territories Water Board (NWTWB), as outlined in Table 1.

Table 1. Project Licensing History

Licence No.	Date Issued	Comments
N4L3-1561	May 1, 1996	Initial Licence issued by the NWTWB to the Government of the Northwest Territories – Arctic Airports Division to allow for the use of 50,000 cubic metres of Water annually and the deposit of Waste for a municipal undertaking
NWB3YRB0308/ 3BM-YRB0308	November 30, 2003	Renewal Licence issued by the NWB to the Government of Nunavut – Department of Community Government and Transportation to allow for the use of 600 cubic metres of Water annually and the deposit of Waste in support of a Municipal undertaking
3BM-YRB1621	December 16, 2016	Renewal-Amendment Licence issued to the GN-EDT: potable Water use and solid Waste deposit activities excluded from the scope of the Licence and moved to separate Licences issued to the Hamlet of Resolute Bay; 1 cubic metre of Water is allowed to be used per year for sampling purposes.

III. PROCEDURAL HISTORY

On August 30, 2021, the GN-CGS, on behalf of the GN-EDT, submitted to the NWB an Application, requesting to renew Water Licence No: 3BM-YRB1621. The following documents were included within the Application package:

- Cover Letter;
- Authorization Letter;
- Water Licence Renewal Application Form;
- Non-technical Summaries in English and Inuktitut; and
- Plan for Compliance of the Resolute Bay Airport Sewage Lagoon.

Following the Board's receipt of the Application, a preliminary review was conducted, in which additional information was requested from the Applicant on September 17, 2021. On September 26, 2021, the Applicant provided their responses to the NWB's questions, and on October 1, 2021 submitted an updated Spill Contingency Plan and a revised Water Licence Application Form. Following this, the NWB concluded that the Application met the requirements of section 48(1) of the *Nunavut Waters and Nunavut Surface Rights Tribunal Act (NWNSTRA or Act)* and forwarded Notice of the Application to interested parties. All parties were invited to make representations to the NWB by November 4, 2021.

On or before the deadline, the NWB received comments from Crown-Indigenous Relations and Northern Affairs (CIRNA)² and Environment and Climate Change Canada (ECCC)³. These comments were addressed by the Applicant on November 29, 2021 and were found satisfactory by CIRNA and ECCC on November 30, 2021 and December 1, 2021, respectively.

Complete details on Interveners' submissions received as well as the information provided for the Application are available from the NWB File Transfer Protocol (FTP) site using the following link:

<ftp://ftp.nwb-oen.ca/registry/3%20MUNICIPAL/3B/3BM%20-%20Municipality/3BM-YRB2126/2%20ADMIN/3%20SUBMISSIONS>

Based on the results of the detailed assessment of the Application, including consideration of any potential accidents, malfunctions, or impacts to Water that the overall Project might have in the area, the Board has approved the Application and has issued Water Licence No: 3BM-YRB2126.

IV. GENERAL CONSIDERATIONS

The Renewal Licence No: 3BM-YRB2126 will be effective on December 16, 2021 to allow the GN-EDT for the continuation of activities approved under the existing Licence No: 3BM-YRB1621. Since the Project activities have remained the same as with the existing or previous Licence, all terms and condition in the Renewal Licence will remain the same.

Term of the Licence

In accordance with Section 45 of the *Act*, the NWB may issue a licence for a term not exceeding

² CIRNA Letter, Re: Crown-Indigenous Relations and Northern Affairs Canada's Review of Water Licence 3BM-YRB1621 Renewal Application by the Government of Nunavut – Department of Economic Development and Transportation for the Airport Sewage Lagoon, Resolute Bay, dated November 4, 2021.

³ ECCC Letter, Re: Technical Review of Water Licence Renewal Application – Hamlet of Resolute Bay Airport Sewage Lagoon (3BM-YRB1621), dated November 2, 2021.

twenty-five (25) years. The Applicant requested a five (5) year licence, which the Board determined is consistent for the nature of the undertaking and has therefore granted.

Annual Reporting

As a requirement of section 14(1) of the *Nunavut Waters Regulations* (Regulations) and similar to the terms and conditions generally included in all licences issued by the NWB, the Board has included under [Part B, Item 1](#) of this Licence, requirement to submit Annual Reports for the purpose of ensuring that the NWB has an accurate annual update of the activities related to Water use and Waste disposal during each calendar year. This information is maintained on the Public Registry and is available to interested parties upon request. A “*Standardized Form for Annual Reporting*” is to be used by the Licensee and could be supplemented by additional monitoring documentation and Licensee’s annual reporting forms. The NWB Standardized Form is available from the NWB’s FTP site under the following Public Registry link at the NWB Website:

<ftp://ftp.nwb-oen.ca/other documents/Standardized Forms/>

Water Use

No Water use is requested under this renewal Licence. All potable Water is currently obtained and accounted for under Licence No: 3AM-RUT2035, issued to the Hamlet of Resolute Bay. The Board has, however, authorized under Part C, Item 1 of this Licence, the use of one (1) cubic metre of water per day for sampling and monitoring purposes involving Strip Lake.

Waste Management

All requirements pertaining to Waste management that were imposed by previous Water Licence have been carried forward into the newly issued Licence. The Applicant acknowledges that “Sewage effluent quality in the wetland is a concern. The truck sewage will be redirected into the new WWTP once it is built and commissioned in 2024/2025. Then this lagoon will be decommissioned”. The NWB encourages GN-EDT to pursue the plans of WWTP construction.

In their submission³, ECCC recommended to include both ‘no visible sheen’ and a Maximum Average Concentration (MAC) limit under the Effluent Quality Criteria (EQC) for oil and grease, as the Water Licence is associated with an airport. ECCC also noted that municipal oil and grease limits are typically 5 mg/L. The NWB considered this recommendation and included the MAC of 5mg/L for oil and grease under [Part D, Item 2](#) of the new Water Licence.

Management Plans/Manuals

The Licensee has submitted a plan entitled *Spill Contingency Plan, Resolute Bay Airport Existing Sewage Lagoon*; dated September 2021, which the Board reviewed and approved under [Part E, Item 3](#) of this Licence.

In their submission², CIRNA recommended to develop and submit a closure and reclamation plan for the existing Sewage Disposal Facility. The Applicant clarified that the design of the new

wastewater treatment plant (WWTP) will be done in 2022/2023 and the Abandonment & Restoration Plan for the Sewage Disposal Facility will be done at the same time.

In their submission³, ECCC recommended that the existing Operations and Maintenance Manual and the Quality Assurance/ Quality Control Plan be updated and submitted to the Board. With respect to the QA/QC Plan, ECCC recommended to include the following quality control sampling information:

1. In consultation with the analytical laboratory, describe how and when to collect duplicate samples, field blanks and travel blanks;
2. Incorporate at least one travel blank per sampling event; and
3. Ensure that the quality control samples represent at least 10% of the total samples collected.

The Applicant emphasized that COVID-19 situation and extremely tight schedule would make this very hard and proposed to include this as a condition in the renewed Licence to be completed within 4 (four) months from the date of issuance of the Licence.

The Board appreciates this clarification and included a requirement to submit the updated plans within the next Annual Report submission.

Monitoring

All Monitoring requirements imposed by previous Water Licence have been carried forward into newly issued Licence under [Part H](#).

As per ECCC's recommendation³, the Licensee is advised to measure and record the ambient conditions (including precipitation, wind speed and direction, air temperature, and pH and temperature of receiving water body) and any other notable conditions (such as algal growth) at the time of sampling, and use this information to support the interpretation of monitoring data.

DECISION

LICENCE NUMBER: 3BM-YRB2126

This is the decision of the Nunavut Water Board (NWB) with respect to an application dated August 30, 2021 for the renewal of Type “B” Water Licence made by the:

GOVERNMENT OF NUNAVUT – DEPARTMENT OF ECONOMIC DEVELOPMENT AND TRANSPORTATION

to allow for the continued deposit of Waste for a Municipal undertaking occurring within the municipal boundaries of the Hamlet of Resolute Bay, in the Qikiqtani Region of Nunavut, at the following general geographical coordinates:

Latitude: 74° 42’ 00” N Longitude: 94° 50’ 00” W

DECISION

After having been satisfied that the Application was in conformity with the North Baffin Regional Land Use Plan and exempt from the requirement for screening by the Nunavut Impact Review Board (NIRB) in accordance with Article 12, Section 12.4.4(a) of the *Agreement Between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in right of Canada (Nunavut Agreement)* and Section 92(1) of the *Nunavut Planning and Project Assessment Act*, as determined by the Nunavut Planning Commission (NPC)⁴, the NWB concluded that the Project could proceed through the NWB’s regulatory process. In accordance with s. 55.1 of the *Nunavut Waters and Nunavut Surface Rights Tribunal Act (Act)* and Article 13 of the *Nunavut Agreement*, public notice of the Application was given and interested persons were invited to make representations to the NWB.

After reviewing the submission of the Applicant and considering the representations made by interested persons, the NWB, having given due regard to the facts and circumstances, the merits of the submissions made to it and to the purpose, scope and intent of the *Nunavut Agreement* and of the *Act*, waived the requirement to hold a public hearing, and determined that:

Licence No: 3BM-YRB1621 be renewed as Licence No: 3BM-YRB2126, subject to the terms and conditions contained therein (Motion #: 2021-B1-020).

Signed this 22nd day of DECEMBER, 2021 at Gjoa Haven, NU.

Lootie Toomasie
Nunavut Water Board, Chair

LT/sk/se

⁴Nunavut Planning Commission (NPC) Conformity Determination, dated August 4, 2021.



NUNAVUT WATER BOARD RENEWAL WATER LICENCE

Licence No: 3BM-YRB2126

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 GOVERNMENT OF NUNAVUT – DEPARTMENT OF ECONOMIC
DEVELOPMENT AND TRANSPORTATION**

(Licensee)

P.O BOX 560, RANKIN INLET, NUNAVUT X0C 0G0

(Mailing Address)

hereinafter called the Licensee, the right to dispose of Waste for a period subject to restrictions and conditions contained within this Licence renewal:

Licence Number/Type: **3BM–YRB2126 / TYPE “B”**

Water Management Area: **BATHURST & CORNWALLIS ISLANDS
WATERSHED (55)**

Location: **HAMLET OF RESOLUTE BAY, QIKIQTANI REGION,
NUNAVUT**

Classification: **MUNICIPAL UNDERTAKING**

Purpose: **DEPOSIT OF WASTE**

Quantity of Water use not
to exceed: **ONE (1) CUBIC METRE OF WATER PER YEAR
(FOR SAMPLING PURPOSES ONLY)**

Effective Date: **DECEMBER 22, 2021**

Expiry of Licence: **DECEMBER 21, 2026**

This Licence renewal, issued and recorded at Gjoa Haven, Nunavut, includes and is subject to the annexed conditions.

**Lootie Toomasie,
Nunavut Water Board, Chair**

PART A: SCOPE, DEFINITIONS AND ENFORCEMENT

1. Scope

This Licence allows for the Deposit of Waste for a Municipal undertaking, by the Government of Nunavut – Department of Economic Development and Transportation, classified as per Schedule 1 of the *Regulations*, located in the Qikiqtani Region, Nunavut.

- a. This Licence is issued subject to the conditions contained herein with respect to 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 *Nunavut Waters and Nunavut Surface Rights Tribunal Act*, or other statutes imposing more stringent conditions relating to the quantity or type of Waste that may be so deposited or under which any such Waste may be so deposited, this Licence shall be deemed, upon promulgation of such Regulations, to be subject to such requirements; and
- b. Compliance with the terms and conditions of this Licence does not absolve the Licensee from responsibility for compliance with the requirements of all applicable Federal, Territorial and Municipal legislation.

2. Definitions

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

“**Addendum**” means the supplemental text that is added to a full plan or report usually included at the end of the document and is not intended to require a full resubmission of the revised report;

“**Amendment**” means a change to original terms and conditions of this Licence requiring correction, addition or deletion of specific terms and conditions of the Licence; modifications inconsistent with the terms of the set terms and conditions of the Licence;

“**Appurtenant Undertaking**” means an undertaking in relation to which a use of water or a deposit of waste is permitted by a licence issued by the Board;

“**Board**” means the Nunavut Water Board established under the *Nunavut Land Claims Agreement* and the *Nunavut Waters and Nunavut Surface Rights Tribunal Act*;

“**Effluent**” means treated or untreated liquid waste material that is discharged into the environment from a structure such as a sewage lagoon, settling pond, landfarm 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;

“Final Discharge Point” with respect to effluent means the stream from Finger Lake immediately prior to entry into Airport Lake;

“Freeboard” means the vertical distance between water line and crest on a dam or dyke’s upstream slope;

“Geotechnical 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.

“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 all liquid wastes from showers, baths, sinks, kitchens and domestic washing facilities, but does not include toilet wastes;

“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;

“Licensee” means the holder of this Licence;

“Modification” means an alteration to a physical work that introduces a new structure or eliminates an existing structure and does not alter the purpose or function of the work, but does not include an expansion;

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

“Nunavut Agreement” 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;

“Regulations” means the *Nunavut Waters Regulations* SOR/2013-69 18th April, 2013;

“Secondary Containment” means an impermeable structure, external to and separate from primary containment, which prevents unplanned spills of hazardous materials and provides a minimum capacity of 110% of the original vessel. Where multiple vessels are stored within the containment, it must provide a minimum capacity equal to the sum of

the largest vessel and 10% of the aggregate volume of all other vessels located in the containment. This structure shall also provide containment and control of hoses and nozzles;

“Sewage” means all toilet wastes and greywater;

“Sewage Disposal Facility” comprises the area and engineered lagoon and decant structures designed to contain sewage and commercial wastewater as described in the Application for Water Licence filed by the Applicant on August 30, 2021;

“Spill Contingency Plan” means a Plan developed to deal with unforeseen petroleum and hazardous materials events that may occur during the operations conducted under the Licence;

“Toilet Wastes” means all human excreta and associated products, but does not include greywater;

“Waste” means, as defined in s. 4 of the *Act*, any substance that, by itself or in combination with other substances found in water, would have the effect of altering the quality of any water to which the substance is added to an extent that is detrimental to its use by people or by any animal, fish or plant, or any water that would have that effect because of the quantity or concentration of the substances contained in it or because it has been treated or changed, by heat or other means;

“Water” or “Waters” means waters as defined in section 4 of the *Act*.

3. **Enforcement**

- a. Failure to comply with this Licence will 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*; and
- c. For the purpose of enforcing this Licence and with respect to the use of Water and deposit or discharge of Waste by the Licensee, Inspectors appointed under the *Act*, hold all powers, privileges and protections that are conferred upon them by the *Act* or by other applicable law.

PART B: GENERAL CONDITIONS

1. The Licensee shall file an Annual Report on the Appurtenant Undertaking with the Board no later than the 31st of March of the year following the calendar year being reported, containing the following information:
 - a. tabular summaries of all data generated under the “Monitoring Program” under Part H, and an indication of wastewater treatment levels upstream and downstream of the Wetland Area;
 - b. summary of modifications to the “Monitoring Program” in accordance with Part H, Item 10;
 - c. the annual quantity in cubic metres of any sludge removed from the Sewage Disposal Facility along with the treatment, storage, and disposal provided as required in Part H, Item 8;
 - d. a summary of modifications and/or major maintenance work carried out on the Sewage Disposal Facility, including all associated structures and facilities;
 - e. a list of unauthorized discharges and summary of follow-up action taken;
 - f. a summary of any abandonment and restoration work completed during the year and an outline of any work anticipated for the next year;
 - g. any updates or revisions for manuals and plans, including the Spill Contingency Plan, Quality Assurance/ Quality Control Plan and Operations and Maintenance Manual, as required by changes in operation and/or technology, may be subject to Board acceptance and/or approval;
 - h. detailed minutes of any public consultation and participation with local organizations and the residents of the community regarding licence amendments;
 - i. summary of any studies or reports requested by the Board that relate to Water use and Waste disposal or restoration, and a brief description of any future studies planned; and
 - j. any other details on Water use or Waste disposal requested by the Board by the 1st of November of the year being reported.
2. The Licensee shall comply with the Monitoring Program described in this Licence, and any amendments to the Monitoring Program as may be made from time to time, pursuant to the conditions of this Licence.
3. The Monitoring Program and compliance dates specified in the Licence maybe modified at the discretion of the Board in writing.
4. The Licensee shall install flow meters or other such devices, or implement suitable methods required for the measuring of Waste discharged as required under Part H, Monitoring Program.
5. The Licensee shall post the necessary signs to identify the stations of the “Monitoring Program”. All signage postings shall be in the Official Languages of Nunavut.
6. The Licensee shall ensure a copy of this Licence is maintained at the site of operations at all times. Any communication with respect to this Licence shall be made in writing to the attention of:

(a) Manager of Licensing:

Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU X0B 1J0
Telephone: (867) 360-6338
Fax: (867) 360-6369
Email: licensing@nwb-oen.ca

(b) Inspector Contact:

Manager of Field Operations, CIRNA
Nunavut District, Nunavut Region
P.O. Box 100
Iqaluit, NU X0A 0H0
Telephone: (867) 975-4284
Fax: (867) 979-6445

7. The Licensee shall submit an electronic copy of all reports, studies, and plans to the Board. Reports or studies submitted to the Board by the Licensee shall include a detailed executive summary in English and Inuktitut.
8. The Licensee shall ensure that all document(s) and correspondence submitted by the Licensee, to the NWB, are received and acknowledged by the Manager of Licensing.
9. The Licensee shall, for all Plans submitted under this Licence, include a proposed timetable for implementation. Plans submitted, cannot be undertaken without subsequent written Board approval and direction. The Board may alter or modify a Plan if necessary to achieve the legislative objectives and will notify the Licensee in writing of acceptance, rejection or alteration of the Plan.
10. The Licensee shall, for all Plans submitted under this Licence, implement the Plan as approved by the Board in writing.
11. The Licensee shall review the Plans referred to in this Licence, as required by changes in operation and/or technology, and modify the Plan accordingly. Revisions to the Plans shall be submitted in the form of an Addendum to be included with the Annual Report.
12. Every Plan to be carried out pursuant to the terms and conditions of this Licence shall become a part of this Licence, and any additional terms and conditions imposed upon approval of a Plan by the Board become part of this Licence. All terms and conditions of the Licence should be contemplated in the development of a Plan where appropriate.
13. The Board may alter or modify a Plan if necessary to achieve the legislative objectives and will notify the Licensee in writing of acceptance, rejection or alteration of the Plan.
14. The compliance dates specified in the Licence may be modified upon approval of the Board in writing.

15. This Licence is assignable as provided for in section 44 of the *Act*.
16. The expiry or cancellation of this Licence does not relieve the Licensee from any obligation imposed by the Licence, or any other regulatory requirement.
17. The Board has accepted the Plan for Compliance submitted as additional information with the Application.

PART C: CONDITIONS APPLYING TO WATER USE

1. The Licensee is authorized to use up to one (1) cubic metre of Water per year for sampling activities related to Strip Lake.
2. The Licensee shall not remove any material from below the ordinary High Water Mark of any Water body unless approved by the Board in writing.
3. The Licensee shall not cause erosion to the banks of any body of Water and shall provide necessary controls to prevent such erosion.
4. The Licensee shall implement sediment and erosion control measures prior to and maintained as required during Hamlet operations, to prevent entry of sediment into Water.

PART D: CONDITIONS APPLYING TO WASTE DISPOSAL

1. The Licensee shall direct all Sewage generated under the scope of this Licence to the Sewage Disposal Facility or as otherwise approved by the Board in writing.
2. All Effluent discharged from the Sewage Disposal Facility at Monitoring Program Station YRB-3 and YRB-4 shall not exceed the following Effluent quality limits:

Parameter	Maximum Concentration of any Grab Sample
BOD ₅	120 mg/L
Total Suspended Solids	180 mg/L
Faecal Coliforms	1 x 10 ⁶ CFU/100mL
Oil and grease	No visible sheen and 5 mg/L
pH	between 6 and 9

3. The Licensee shall ensure that a Freeboard limit of 1.0 metre, or as recommended by a qualified Geotechnical Engineer and approved by the Board, is maintained at all dykes and earth-fill structures associated with the Sewage Disposal Facility.
4. The Licensee shall advise an Inspector at least ten (10) days prior to initiating any decant of the Sewage Disposal Facility.

5. The Sewage Disposal Facility shall be maintained to the satisfaction of an Inspector, and operated in such a manner as to prevent erosion and structural failure.
6. If, during the term of this Licence, additional Final Discharge Points are identified, the Licensee shall submit the information pertaining to the new Final Discharge Point, within thirty (30) days after the discharge point is identified and at least sixty (60) days prior to the release of Effluent through the new Final Discharge Point and/or proposed changes are made to a Final Discharge Point.
7. The Licensee shall backhaul and dispose of all hazardous Wastes, Waste oil and non-combustible Waste generated through the course of the operation at a licensed Waste disposal site.
8. The Licensee shall maintain records of all Waste backhauled and records of confirmation of proper disposal of backhauled Waste. These records shall be made available to an Inspector upon request
9. The Licensee shall implement measures to monitor the impact of leachate from the Sewage Disposal Facility.
10. The Licensee shall measure, annually, the depth and quality of the sludge generated by the Sewage Disposal Facility as well as implement measures to ensure adequate management of the sludge generated.

PART E: CONDITIONS APPLYING TO MODIFICATIONS AND CONSTRUCTION

1. The Licensee shall submit to the Board for approval, for construction drawings stamped and signed by a qualified engineer, at least sixty (60) days prior to the construction of any dams, dykes or structures intended to contain, withhold, divert or retain Water or Wastes.
2. The Licensee may, without written approval from the Board, carry out modifications to the waste disposal facilities provided that such modifications are consistent with the conditions and scope 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. these modifications do not place the Licensee in contravention of the Licence or the Act;
 - c. 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
 - d. the Board has not rejected the proposed modifications.
3. Modifications for which all of the conditions referred to in Part E, Item 2(a) through (d), have not been met, may only be carried out upon written approval from the Board.

4. The Licensee shall provide as-built plans and drawings of the Modifications or construction referred to in this Part within ninety (90) days of completion of the Modification or construction. These plans and drawings shall be stamped and signed by an Engineer.
5. All activities shall be conducted in such a way as to minimize impacts on surface drainage and the Licensee shall immediately undertake any corrective measures in the event of any impacts on surface drainage.

PART F: CONDITIONS APPLYING TO OPERATIONS AND MAINTENANCE

1. The Licensee shall implement the plan entitled *Operation and Maintenance Manual for the Resolute Bay Airport Existing Sewage Lagoon*, dated April 2016, that was previously approved by the Board. The Licensee shall submit an updated version of this plan to the Board for review within the next Annual Report submission to include recommendations made during the review of Application.
2. An inspection of all engineered structures or facilities designed to contain, withhold, divert, or retain Water or Waste, shall be conducted by an Engineer, at least once annually, during the summer months (July/August) and/or during periods of flow. An Engineer's report shall be submitted to the Board within sixty (60) days of the date of inspection, including a cover letter from the Licensee outlining an implementation plan to address each of the Engineer's recommendations.
3. An inspection of all engineered facilities shall be conducted, during the summer period (July/August), by a Geotechnical Engineer in accordance with the Canadian Dam Safety Guidelines, at least one (1) year prior to expiry of the Licence or at five (5) year interval, whichever occurs first. The Geotechnical Engineer's report shall be submitted to the Board within sixty (60) days of the inspection, including a cover letter from the Licensee outlining an implementation plan to address each of the Engineer's recommendations.
4. The Board has approved the Plan entitled *Spill Contingency Plan, Resolute Bay Airport Existing Sewage Lagoon*; dated September 2021, which was submitted as additional information with the Application.
5. If during the term of this Licence, an unauthorized discharge of Waste occurs, or if such a discharge is foreseeable, the Licensee shall:
 - a. Employ the approved Spill Contingency Plan;
 - b. Report the spill immediately to the 24-Hour NWT/NU Spill Line at (867) 920-8130 and to the Inspector at (867) 975-4284; and
 - c. For each spill occurrence, submit to the Inspector, no later than thirty (30) days after initially reporting the event, a detailed report that will include the amount and type of spilled product, the GPS location of the spill, and the measures taken to contain and clean up the spill site.

6. The Licensee shall, in addition to Part F, Item 5, regardless of the quantity of releases of harmful substances, report to the 24-Hour NWT/NU Spill Line if the release is near or into a Water body.

PART G: CONDITIONS APPLYING TO CLOSURE AND RECLAMATION

1. The Licensee shall submit to the Board for approval in writing, at least six (6) months prior to abandoning any facilities and the construction of new facilities to replace existing ones, a Closure and Reclamation Plan that includes but is not limited, where applicable, to the following:
 - a. Water intake facilities;
 - b. the Water treatment and Waste disposal sites and facilities;
 - c. petroleum and chemical storage areas;
 - d. any site affected by Waste spills;
 - e. leachate prevention;
 - f. an implementation schedule;
 - g. maps delineating all disturbed areas, and site facilities;
 - h. consideration of altered drainage patterns;
 - i. type and source of cover materials;
 - j. future area uses;
 - k. hazardous Wastes; and
 - l. a proposal identifying measures by which restoration costs will be financed by the Licensee upon abandonment.
2. The Licensee shall implement the plan specified in Part G, Item 1 as and when approved by the Board in writing.
3. The Licensee shall conduct and submit together with the Plan required under Part G, Item 1, an Environmental Assessment of the area occupied by the Sewage Disposal Facility including Wetland Area.
4. The Licensee shall complete the restoration work within the time schedule specified in the Plan, or as subsequently revised and approved by the Board in writing.
5. The Licensee shall carry out progressive reclamation of any components of the project no longer required for the Licensee's operations.
6. All disturbed areas shall be stabilized and re-vegetated as required upon completion of work and restored as practically as possible to a pre-disturbed state.

PART H: CONDITIONS APPLYING TO THE MONITORING PROGRAM

1. The Licensee shall maintain Monitoring Program Stations and implement the program as described in the table below and the conditions under this Part.

Monitoring Program Station ID	Description	Frequency	Status
YRB-1a	Water Sampling Point at Strip Lake	Annually during Periods of Flow	Active (Water Quality)
YRB-1b	Effluent from the Sewage Disposal Facility	<u>Volume</u> Monthly and Annually during Periods of Flow	Active (Volume) (Water Quality)
YRB-2	Effluent within the Wetland Area	<u>Water Quality</u> Monthly during periods of flow	Active (Water Quality)
YRB-3	Effluent within the Wetland Area	<u>Water Quality</u> Annually during periods	Active (Water Quality)
YRB-4	Effluent at the Final Discharge Point / Downstream of the Wetland	<u>Water Quality</u> Annually during periods of flow	Active (Water Quality)

2. The Licensee shall confirm the locations and GPS coordinates for all monitoring stations referred to in Part H, Item 1 with an Inspector.
3. The Licensee shall sample Monitoring Stations YRB-1a, YRB-1b, YRB-2, YRB-3, and YRB-4 for the following parameters in accordance with the frequency outlined in Part H, Item 1:

Biochemical Oxygen Demand BOD ₅	Fecal Coliforms
Total Suspended Solids	pH
Conductivity	Nitrate-Nitrite
Oil and Grease (visual)	Total Phenols
Magnesium	Calcium
Sodium	Potassium
Chloride	Sulphate
Total Hardness	Total Alkalinity
Ammonia Nitrogen	Total Zinc
Total Cadmium	Total Iron
Total Cobalt	Total Manganese
Total Chromium	Total Nickel
Total Copper	Total Lead
Total Mercury Total	Organic Carbon (TOC)
Total Aluminum	Total Arsenic

Carbonaceous Biochemical Oxygen Demand (cBOD)

4. The Licensee shall record the ambient conditions (including precipitation, wind speed and direction, air temperature, and pH and temperature of receiving waterbody) and any other notable conditions (such as algal growth) at the time of sampling, and use this information to support the interpretation of monitoring data.
5. The Licensee shall revise and submit, within the next Annual Report submission, the Plan entitled *Hamlet of Resolute Bay Airport Sewage Lagoon Quality Assurance/Quality Control Plan*, dated April 2016, previously accepted by the Board. The revised Plan shall include a letter of approval from a certified or an accredited laboratory and recommendations made during the review of Application.
6. The Licensee shall conduct all sampling, sample preservation and analyses in accordance with methods prescribed in the current edition of *Standard Methods for the Examination of Water and Wastewater*, or by such other methods approved by a laboratory certified by the Canadian Association for Laboratory Accreditation (CALA) and as otherwise acceptable to the Board.
7. All analyses shall be performed in a laboratory accredited according to ISO/IEC Standard 17025. The accreditation shall be current and in good standing.
8. The Licensee shall measure and record in cubic metres the monthly and annual quantities of Effluent discharged at Monitoring Program Station Number YRB-4 into the receiving environment.
9. The Licensee shall measure and record in cubic metres, the annual quantities of Sewage solids removed from the Sewage Disposal Facility.
10. The Licensee shall include all of the data and information required by the Monitoring Program in the Licensee's Annual Report, as required under Part B, Item 1.
11. Modifications to the Monitoring Program may be made only upon written approval from the Board. Requests for changes to the Monitoring Program should be forwarded to the NWB in writing, and should include the justification and appropriate evidence to support the requested change.

Appendix B

Schedule of Costs

Cost Estimate - Proposed Site Upgrades for new SWMF (Mandatory and Optional Components)
Resolute Bay, NU

Cost Item	Description	Quantity	Units	Unit Rate (\$)	Price (\$)
1 Proposed Municipal Solid Waste Facility (Landfill)					\$ 7,572,000
Preparation					\$ 735,000
Allowance to mobilize heavy equipment only	Access Road, 5 m wide 450 mm granular, Terrafix Geotextile 420R see details on Figure 3.	1	sum	\$ 735,000	\$ 735,000
Access Road to Proposed Municipal Solid Waste (Landfill) Area					\$ 30,728
Access Road	Access Road, 5 m wide 450 mm granular, Terrafix Geotextile 420R see details on Figure 3.	85	lin.m	\$ 362	\$ 30,728
Storm Water Management					\$ 171,990
Ditching	Ditching(0.5m deep, 0.5 m w 3:1 slopes) on both sides of the road (118m x 2) and the perimeter of the site within the fence (856m)	1092	lin.m	\$ 158	\$ 171,990
Attendants Building					\$ 229,944
Building	Prefabricated 6.0m x 4.0m attendants building with storage space for generator, wall, floor ceiling finishes, timber foundation, insulation, furniture, lighting, as per Figure 3 detail	1	each	\$ 200,000	\$ 200,000
Heater	Space heater capable of heating 48 m2	1	each	\$ 3,238	\$ 3,238
Power connection	Power connection to Attendants Building	1	each	\$ 3,167	\$ 3,167
Utility Post Lighting	Outdoor Solar/ Generator light/ (10000LM), utility pole	1	each	\$ 23,539	\$ 23,539
Power to Site and Lighting					\$ 1,567,868
Electrical	Extending the electrical grid approximately 3 km to provide electricity to the site.	1	each	\$ 1,304,104	\$ 1,304,104
Site Lighting branch wiring		620	m	\$ 121	\$ 75,020
Utility Post Lighting	Solar Assisted LED Lights on a post.	8	each	\$ 23,593	\$ 188,744
Berming					\$ 146,960
HHW Depot (300 granular on floor)	berm is 1.0 m wide at top x 1 m high,, 3:1 side slopes; Dimentions of bermed area is 15 m long x 20.5 m wide (68.5lin.m quantity converted to m ³)	274	m3	\$ 110	\$ 30,140
End of Life Vehicles and Tire Storage (300 granular on floor)	berm is 1.0m wide at top x 1 m high, 3:1 slopes; Dimentions of the two bermed areas are 15 m long x 34 m wide (103 lin.m quantity converted to m ³)	412	m3	\$ 110	\$ 45,320
Seacan Storage (300 granular on floor)	berm is 1.0 wide at top m wide x 1 m high, 3:1 slopes ; Dimentions of bermed area 17m long x 49.5 m wide (102.5 lin.m quantity converted to m ³)	410	m3	\$ 110	\$ 45,100
Incinerator Area (300 granular on floor)	berm is 1.0 m wide at top,1 m high, 3:1 slopes; Dimentions of bermed area is Length 20m width 20m (60 lin.m quantity converted to m ³)	240	m3	\$ 110	\$ 26,400
Seacan Storage					\$ 100,000
Seacans	20 foot seacans	10	each	\$ 10,000	\$ 100,000
Waste Cell					\$ 2,229,641
Site grading		10,300	m ²	\$ 21	\$ 216,300
Granular leveling Pad	450 mm	10,300	m ²	\$ 52	\$ 535,394
Sand Bedding	200mm	10,300	m ²	\$ 24	\$ 248,745
Geotextile	Terrafix 420R	10,300	m ²	\$ 15	\$ 154,500
Geomembrane	1.5 mm HDPE	10,300	m ²	\$ 35	\$ 360,500
Geotextile	Propex Geotex 2801	10,300	m ²	\$ 15	\$ 154,500
Leachate Granular	450 mm granular	10,300	m ²	\$ 54	\$ 559,702

Cost Estimate - Proposed Site Upgrades for new SWMF (Mandatory and Optional Components)
Resolute Bay, NU

Cost Item	Description	Quantity	Units	Unit Rate (\$)	Price (\$)
Leachate Pond					
Site grading		650	m ²	\$ 21	\$ 13,650
Granular leveling Pad	450 mm	650	m ²	\$ 52	\$ 33,787
Sand Bedding	200mm	650	m ²	\$ 24	\$ 15,698
Geotextile	Terrafix 420R	650	m ²	\$ 15	\$ 9,750
Geomembrane	1.5 mm HDPE	650	m ²	\$ 35	\$ 22,750
Leachate Pond Discharge Pump	discharge pump - submerable, 5.0 l/s, 10 m TDH, fittings, 30m hose, float controls	1	each	\$ 6,300	\$ 6,300
HHW Depot					
Tote for used oil	1 m ³ chemical resistant totes to collect containers of used oil	2	each	2362.5	\$ 4,725
Seacan	20 foot seacan, with secondary containment floor	1	each	10000	\$ 10,000
Tote for used antifreeze	1 m ³ chemical resistant totes to collect containers of used antifreeze	2	each	2362.5	\$ 4,725
Tote for household chemicals	1 m ³ chemical resistant totes to collect containers of household chemicals	2	each	2362.5	\$ 4,725
Wire Mesh container/bin	Large Wire Mesh containers for receiving Paint Cans	2	each	840	\$ 1,680
Waste oil tank, double wall	Approx 1000 L, comply with waste oil storage regulations	1	each	8531	\$ 8,531
Leak Containment for wire mesh containers	Chemical resistant pans to be placed underneath the wire mesh containers	2	each	840	\$ 1,680
Fencing					
Site Perimeter Fencing	1.8m high fencing; chain link	856	lin.m	\$ 683	\$ 584,263
Individual Area Fencing	1.8m high fencing; chain link; 115 m fencing for EOL vehicles and HHW area; 255m Seacan and Incinerator building storage; 250m waste cell and leachate pond	620	lin.m	\$ 683	\$ 423,150
Main Gate	1.8m high fencing; chain link; 12 foot manual swing gates (two 6 foot panels)	1	each	\$ 7,500	\$ 7,500
Diversion Station Gates	1.8m high fencing; chain link; 12 foot manual swing gates (two 6 foot panels)	3	each	\$ 7,500	\$ 22,500
Signage					
Main Gate Sign	outdoor, printed sign 1.2mx 0.9m (3' x 4')	1	each	\$ 2,500	\$ 2,500
Disposal Area Signage	0.9m x 0.6m (2' x 3')	5	each	\$ 1,000	\$ 5,000
Danger Signs	Warning signs for chemical storage	5	each	\$ 1,000	\$ 5,000
Vehicle Storage Building					
Vehicle Storage Building	6.0m x 8.0m non-insulated metal, vehicle storage garage (concrete pad 150 mm 30 MPa, person door, OH door 4mx5m, windows c/w bars, interior lights, roof light panels,)	1	each	\$ 315,000	\$ 315,000
Incoming power	Incoming power to Vehicle Storage Building (interior lights, roof light panels)	1	each	\$ 15,823	\$ 15,823
Other					
Site Grading and preparation	Site development including , rough and fine grading (450 mm granular)	36,827	m ²	\$ 21	\$ 773,367
Portable Washroom	Portable washroom	1	each	\$ 67,046	\$ 67,046

Cost Estimate - Proposed Site Upgrades for new SWMF (Mandatory and Optional Components)
Resolute Bay, NU

Cost Item	Description	Quantity	Units	Unit Rate (\$)	Price (\$)
2 Other - Equipment					\$ 934,500
Garbage Truck	Small garbage truck (ie. Haul-All M-Class Refuse Unit 16 cubic yard or similar) with hydraulic oil heater	1	each	\$ 288,750	\$ 288,750
Loader	Medium sized loader - Cat 938	1	each	\$ 535,500	\$ 535,500
Skid Steer with Forklift Attachment	Skid Steer with forklift capabilities (Bobcat S66)	1	each	\$ 110,250	\$ 110,250
Additional Items					
3 Backhauling					
Backhauling (for closure of drop-off site)	Refer to cost breakdown in partial backhauling table for closure of the drop-off site only				\$ 1,096,495
Backhauling (all)	Backhauling all stockpiles of metals, white goods, tires, HW and ELVs				\$ 5,411,646
4 Closure of the Drop-off Site					\$ 397,425
Moving legacy waste to the new waste facility	Relocating C&D and non-hazardous waste to the landfill cell	1100	m ³	\$ 11	\$ 11,550
Perimeter Fence for Site Closure	Chain link perimeter fence around the drop-off site after site closure	550	lin.m	\$ 683	\$ 375,375
Gate for Site Closure	12 foot chain link gate (two 6 foot panels)	1	each	\$ 7,875	\$ 7,875
Sign for Site Closure	0.9m x 0.6m (2' x 3') freestanding outdoor printed sign	1	each	\$ 2,625	\$ 2,625
5 Incinerator (not recommended)					\$ 1,491,473
Incinerator	Incinerator with controlled monitoring equipment (temperature probes, differential pressure meters and auxiliary fuel flow). Capable of incinerating 15 m3 of uncompacted municipal solid waste per day.	1	each	\$ 883,750	\$ 883,750
Outdoor shelter	Shelter with no walls, a tin roof, to protect the incinerator from rain and snow, built with a hole for the flu stack. 6x6 meters.	1	each	\$ 105,000	\$ 105,000
Power connection	Cost to tie incinerator to generator distribution panel	150	m	\$ 121	\$ 18,150
Fuel Tank for Incinerator	75000L fuel tank, built in secondary containment, horizontal, on heavy duty skid base, with dispensing pump. Cost includes tank, piping, miscellaneous steel, fuel pump, level controls, heat trace, and an initial fuel fill (full-fill).	1	each	\$ 484,573	\$ 484,573

Notes and Assumptions:

For required earthworks materials -- assumed there is a quarry nearby
Assume 75% loaded by machine, 25% loaded by hand
Assumed weight per seacan maximum 11,000 lbs (5.5 tonnes)
Assume excavation not required during site grading

Appendix C

Resolute Bay Solid Waste Facility Class D Estimate



AltusGroup

NUNAVUT SOLID WASTE FACILITY: RESOLUTE BAY CLASS D ESTIMATE

0000000015

PREPARED FOR:

Dillon Consulting Limited

137 Chain Lake Drive Suite 100, Halifax, NS, B3S 1B3

PREPARED BY:

Altus Group - Development Advisory

2020 4th Street SW, Suite 310, Calgary, AB, T2S 1W3

Phone: (403) 508-7770

Issued Date: R1 - August 23, 2024

August 23, 2024

Project No.: 0000000015

Dillon Consulting Limited
137 Chain Lake Drive Suite 100
Halifax, NS
B3S 1B3

Attention: Rebecca Appleton

Re: Nunavut Solid Waste Facility: Resolute Bay, Class D Estimate R1

Dear Rebecca,

We submit for your review our Class D Estimate, at Q3 2024 in accordance with the terms of our engagement.

The estimate includes all direct and indirect construction costs and general conditions, as well as contractor's overheads and profit. The provisions for contingencies are based on the information provided and defined within the body of this report.

The estimate includes the following contingencies, which are defined within the body of this report.

- 10% for design and pricing contingency
- 0% post-contract contingency - EXCLUDED
- 12.3% for escalation contingency to assumed tender date of Q1 2024

It should be noted that this report is not intended for general circulation, publication or reproduction for any other person or purpose without express written permission to each specific instance.

Furthermore, this report was written for the exclusive use of Dillon Consulting Limited and is not to be relied upon by any other party. Altus Group Limited does not hold any reporting responsibility to any other party.

Should you have questions related to this report please do not hesitate to contact the undersigned.

Yours truly,

ALTUS GROUP LIMITED



David Jollimore, PQS
Associate



Ryan Makar, CET, PQS, MRICS
Director

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- 1.2 Area / Project Statistics

2 Project Details

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- 2.5 Taxes
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1 Introduction

1.1 Scope

This estimate is for upgrading the solid waste facilities located in Resolute Bay, Nunavut.

The Construction Estimate is intended to provide a realistic budget based on the information provided. The estimate reflects our opinion as to the fair market value for the construction of this proposed project and is not intended to predict the lowest bid.

The estimate includes all direct and indirect construction costs consistent with the information available. Certain exclusions and qualifications may apply; please refer to the detail within the estimate report.

1.2 Area / Project Statistics

Select quantities have been provided by the design team, where applicable. Remaining areas have been measured in accordance with the Canadian Institute of Quantity Surveyors (CIQS) Standard Method of Measurement. Detailed areas and project statistics are included in Appendix A.

2 Project Details

2.1 General Information

From the information provided, we have measured quantities where possible and applied unit rates considered competitive for a project of this nature, based on historical and current cost data for this type of project. Where design information was limited, we have had discussions with the relevant design disciplines and/or made assumptions based on our experience with projects of a similar type, size, and standard of quality.

2.2 Location

The location cost base for this estimate is Resolute Bay, Nunavut.

2.3 Measurement and Pricing

The estimate has been derived using generally accepted principles on method of measurement as per the Canadian Institute of Quantity Surveyors Elemental Cost Analysis and/or Method of Measurement of Construction Works.

The rates used and developed for this estimate where applicable include labour and material, equipment, and subcontractor's overheads and profit. Pricing is based on our experience with similar projects, or quotes provided by subcontractors as noted within the estimate.

The unit rates in this estimate are indicative of current market conditions and do not account for periods of extreme market volatility, or escalation during construction, unless noted otherwise in the estimate. These unit rates can be considered current and accurate for the current period.

This estimate is not intended to be a prediction of the lowest bid and assumes competitive bidding for all aspects of the work.

A Class D Estimate, has an accuracy range with an expected variance of -50% to +100%.

2.4 Environmental Sustainability

The estimate incorporates design elements consistent with Green Standards as identified within the design information. Although the design and pricing incorporates energy efficient and sustainable elements, actual certification with a regulatory body is not necessarily included. Premium costs could be applicable relating to additional site management required and submission of necessary documentation.

2.5 Taxes

The Goods and Services Tax (GST) has been excluded from this estimate.

2.6 General Requirements and Fees

The fee for the General Contractor is included. The general requirements are based on our assumptions of the anticipated construction approach and schedule.

The estimate includes premiums associated with bonding and insurance.

2 Project Details

2.7 Procurement Methodology

We have assumed that the project would be procured with a General Contractor approach under a CCDC standard form of contract.

We have assumed a minimum of three bids would be received for all trade categories to establish competitive bidding and tender results. The estimate is a determination of fair market pricing and not a prediction of lowest bid in any trade category. Please note that should the above minimum bidding conditions not occur on this project, construction bids received could vary significantly from the estimated costs included within this report.

2.8 Schedule / Phasing

The project has been priced to be completed as a single phase. The unit rates in our estimate are based on construction activities occurring during normal working hours and proceeding within a non-accelerated schedule.

3 Scope Assumptions & Exclusions

3.1 Inclusions and Assumptions

The estimate includes all direct and indirect construction costs indicated within the estimate and described below:

1. Tender date of Q2 2025
2. Assumed project start date of Q3, 2025
3. Assumed project duration of 29 months (13 on site and 16 off site)
4. On-site construction duration of 13 months with over 3 seasons September - October 2025, May - October 2026, and May - September 2027.
5. Mobilization in first season
6. De-mobilization in September 2027
7. On site construction start date of May, 2026
8. Assumes winter shut down between November - April
9. Setup and use of camp required
10. Materials such as textiles, liners, etc. are assumed to be barged to site from major port
11. Excess excavation/cut material to be removed from site
12. Contractor is assumed to be non local
13. Material quantities based on architect's/engineer's quantities, when provided
14. FF&E items like totes, seacans, are assumed to be procured as part of the construction contract
15. Sorting existing rubbish, by machine/hand, assumed to part of the contractors scope
16. Costs for trucking of waste to a Quebec landfill are included as allowances only as directed by design team, so actual costs could vary from those in this estimate
17. Escalation carried to July 2026

3 Scope Assumptions & Exclusions

3.2 Construction Budget Exclusions

The estimate excludes the following items:

1. Land and associated costs
2. Utility connection costs/charges
3. Soft costs and professional fees
4. Legal fees
5. Marketing/promotion
6. Realty taxes, levies
7. Operating expenses
8. Interest/finance charges
9. Requirement of extensive use for local workforce
10. Environmental site assessments
11. Exclusive use of local heavy earth moving equipment
12. Freight costs for gravel (assumed local source)
13. Disposal costs of scrap metal - costs to dispose of Metals at the nearest metals recycling facility form the Quebec Seaport
14. Disposal costs of waste oil barrels - cost to dispose of a waste oil barrel at the nearest waste disposal facility to the Quebec Seaport
15. Disposal costs of end of life vehicles - cost to dispose of a end-of-life vehicle at the nearest metals recycling facility
16. Working with any contaminated soil or hazardous materials, unless noted
17. Sole sourcing of materials, services, and equipment
18. Remedial work to existing buildings/structures/property unless noted
19. Owner supplied FF&E, unless noted
20. Construction contingency
21. GST

4 Contingencies

4.1 General

The effective use of contingencies in construction cost planning requires a clear understanding of estimating risks in both a project specific and general construction market sense. The appropriate level of contingency is dependent on the amount of information available, knowledge of the design teams' methods and philosophy, the timing of the estimate preparation relative to the project design and construction schedule, and the anticipated complexity of the construction work.

4.2 Design and Pricing

A design and pricing contingency of 10% has been included in the estimate.

This contingency covers the design and pricing evolution during the remaining design stages of the project. Please note this contingency is not intended to cover additional scope or additional functional program requirements.

4.3 Escalation

An escalation contingency of 12.3% has been included in the estimate. This contingency is intended to address anticipated changes in construction costs due to market fluctuations between the date of this report and the approximate mid point of Q3 2026.

4.4 Market Contingency

A market contingency has been included in the estimate at 40%. It is the intention of this contingency to cover the possibility of only receiving a single tender bid. Lack of bidders, single bid tenders, generally increases tender results by as much as 30%-50%. Should multiple bids be received at tender then the expected bids would be lower than we are carrying in our estimate.

4.5 Construction Contingency (Post-Contract)

A construction contingency has been excluded from the estimate. It is the intention of this contingency to cover post-contract change orders.

5 General Statement of Liability

5.1 Probable Costs and Ongoing Cost Control

Altus Group Limited does not guarantee that tenders or actual construction costs will not vary from this estimate. Acute market conditions, proprietary specifications, or competition/collaboration among contractors may cause tenders to vary from reasonable estimates based on normal and abnormal competitive conditions.

Altus Group Limited recommends the owner and/or design team review the cost estimate report including line item descriptions, unit prices, allowances, assumptions, exclusions, and contingencies to ensure the appropriate design intent has been accurately captured within the report.

It should be noted that the cost consultants are not qualified to confirm that construction work and design is in accordance with approved plans and specifications.

Details of our Client Data Policy can be found at www.altusgroup.com

6 Estimate Documentation

6.1 Documentation

Page Count	Description	Date
1	Business Case for Solid Waste Facility Upgrades, Resolute Bay, NU Figure 1 Site Location	April 2023
1	Business Case for Solid Waste Facility Upgrades, Resolute Bay, NU_Figure 2 Existing Conditions Drop Off Site	April 2023
1	Business Case for Solid Waste Facility Upgrades, Resolute Bay, NU Figure 3 Existing Conditions Scrap Metal Yard	April 2023
1	Business Case for Solid Waste Facility Upgrades, Resolute Bay, NU_Figure 4 Site Plan	April 2023
1	Business Case for Solid Waste Facility Upgrades, Resolute Bay, NU Figure 5 Details	April 2023
1	Business Case for Solid Waste Facility Upgrades, Resolute Bay, NU_Figure 6 Details	April 2023
1	Business Case for Solid Waste Facility Upgrades, Resolute Bay, NU Figure 7 Details	April 2023
n/a	Schedule of Costs - Resolute Bay.xlsx excel file	April 2023
n/a	Emailed comments	Aug 9, 2024

7 List of Appendices

7.1 Class D Estimate

A. Executive Summary

B. CIQS Elemental Summary & Details

Executive Summary

\$34,877,000
PROJECT TOTAL

\$855/m²
TOTAL /m²
\$79/sf
TOTAL /sf

40,800 m²
439,167 sf
PROJECT GCA

Building Component	Area (m ²)	Area (SF)	Total/SF	Total
Nunavut Solid Waste Facility Upgrades: Resolute Bay	40,800 m ²	439,167 sf	49 /sf	\$21,489,499
Pre-contingency Subtotal (GCA)	40,800 m ²	439,167 sf	\$49 /sf	\$21,489,499
Design and Pricing Contingency (10.0%)	40,800 m ²	439,167 sf	5 /sf	\$2,148,950
Design Contingency Subtotal (GCA)	40,800 m ²	439,167 sf	\$54 /sf	\$23,638,449
Escalation Contingency (12.3%)	40,800 m ²	439,167 sf	6 /sf	\$2,643,208
Market Contingency (40.0%)	40,800 m ²	439,167 sf	20 /sf	\$8,595,799
Construction Contingency				EXCLUDED
Total Construction Cost (GCA)	40,800 m ²	439,167 sf	\$79 /sf	\$34,877,456
GST				EXCLUDED
Total Construction Cost	40,800 m²	439,167 sf	\$79 /sf	\$34,877,000

CIQS Elemental Summary & Details

\$34,877,000

NUNAVUT SOLID WASTE FACILITY
UPGRADES: RESOLUTE BAY TOTAL

\$855/m²

TOTAL /m²

\$79/sf

TOTAL /sf

40,800 m²

439,167 sf

COMP. SCA

Element	SCA Ratio	Element Quantity	Element Unit Rate	Cost Total	\$ Total /m ² SCA	%
D SITE & ANCILLARY WORK				11,746,092	288 /m²	33.7%
D1 Site Work				11,746,092	288 /m ²	33.7%
D11 Site Development	1.00	40,800 m ²	213 /m ²	8,670,839	213 /m ²	24.9%
D12 Mechanical Site Services	1.00	40,800 m ²	35.47 /m ²	1,447,138	35 /m ²	4.1%
D13 Electrical Site Services	1.00	40,800 m ²	39.90 /m ²	1,628,115	40 /m ²	4.7%
NET COST				11,746,092	288 /m ²	33.7%
Net Construction Estimate				\$11,746,092	\$288 /m ²	33.7%
Z1 General Requirements & Fee				9,743,407	239 /m ²	27.9%
Z11 General Requirements & Fee		34.0 %		3,993,671	98 m ²	11.5%
Z12 Freight & Accommodations		27.0 %		5,749,736	141 m ²	16.5%
Total Construction Estimate (Excluding Contingencies)				\$21,489,499	\$527 /m ²	61.6%
Z2 Contingencies				13,387,958	328 /m ²	38.4%
Z21 Design and Pricing Contingency		10.0 %		2,148,950	53 m ²	6.2%
Z22 Escalation Contingency		12.3 %		2,643,208	65 m ²	7.6%
Z23 Market Contingency		40.0 %		8,595,799	211 m ²	24.6%
Z24 Construction Contingency				EXCLUDED		
TOTAL CONSTRUCTION COST				\$34,877,456	\$855 /m²	100%

		Quantity	Unit Rate (\$)	Total (\$)
D1 Site Work				
D11 Site Development				
	Preparation			
Site.D11.1	Allowance for heavy equipment loss of productivity, being on site a whole season and not being used	1 sum	735,000.00	735,000
	Access Road to Proposed Municipal Solid Waste (Landfill) Area			
Site.D11.2	Access road - 5 m wide 450 mm granular, terrafix geotextile 420R see details on figure 3. Quantity provided. Assumed no excavation or blasting required	85 m	361.50	30,728
	Storm Water Management			
Site.D11.3	Ditching - (0.5m deep, 0.5 m w 3:1 slopes) on both sides of the road (118m x 2) and the perimeter of the site within the fence (856m) Quantity provided	1,092 m	157.50	171,990
	Attendants Building			
Site.D11.4	Building - prefabricated 6.0m x 4.0m attendants building with storage space for generator, wall, floor ceiling finishes, timber foundation, insulation, furniture, lighting, as per Figure 3 detail Quantity provided	1 no.	200,000.00	200,000
Site.D11.5	Heater - space heater capable of heating 48 m2 Quantity provided	1 no.	0.00	Incl. in D12 Mechanical
Site.D11.6	Generator - diesel 20,000 W Genset capable of heating and powering the attendant trailer and a single pole mounted led utility light Quantity provided	1 no.	0.00	Incl. in D13 Electrical
Site.D11.7	Diesel Tank - diesel tank with build in double wall for biweekly diesel supply for the generator. Quantity provided	1 no.	0.00	Incl. in D12 Mechanical

		Quantity	Unit Rate (\$)	Total (\$)
D1 Site Work				
D11 Site Development				
Site.D11.8	Utility Post Lighting - outdoor solar/ generator light/ (10000LM), utility pole Quantity provided	1 no.	0.00	Incl. in D13 Electrical
Berming				
Site.D11.9	HHW Depot (300 granular on floor) - berm is 1.0 m wide at top x 1 m high,, 3:1 side slopes; Dimensions of bermed area is 15 m long x 20.5 m wide 68.50m Quantity provided, converted into m3	274 m3	110.00	30,140
Site.D11.10	End of Life Vehicles and Tire Storage (300 granular on floor) - berm is 1.0m wide at top x 1 m high, 3:1 slopes; Dimensions of the two bermed areas are 15 m long x 34 m wide 103m Quantity provided, converted into m3	412 m3	110.00	45,320
Site.D11.11	Seacan Storage (300 granular on floor) - berm is 1.0 wide at top m wide x 1 m high, 3:1 slopes ; Dimensions of bermed area 17m long x 49.5 m wide 102.5m Quantity provided, converted into m3	410 m3	11.00	4,510
Site.D11.12	Incinerator Area (300 granular on floor) - berm is 1.0 m wide at top,1 m high, 3:1 slopes; Dimensions of bermed area is Length 20m width 20m 60m Quantity provided, converted into m3	240 m3	110.00	26,400
Seacan Storage				
Site.D11.13	Seacans - 20 foot seacans Quantity provided	10 no.	10,000.00	100,000
Waste Cell				
Site.D11.14	Site grading Quantity provided. Assumed minor works only and no excavation/blasting required	10,300 m2	21.00	216,300

		Quantity	Unit Rate (\$)	Total (\$)
D1 Site Work				
D11 Site Development				
Site.D11.15	Granular leveling pad - 450mm Quantity provided	10,300 m2	51.98	535,343
Site.D11.16	Sand Bedding - 200mm Quantity provided	10,300 m2	24.15	248,745
Site.D11.17	Geotextile (nonwoven) - terrafix 420R Quantity provided	10,300 m2	15.00	154,500
Site.D11.18	Geomembrane - 1.5mm HDPE Quantity provided	10,300 m2	35.00	360,500
Site.D11.19	Geotextile (nonwoven) - Propex Geotex 2801 Quantity provided	10,300 m2	15.00	154,500
Site.D11.20	Leachate Granular - 450mm granular Quantity provided	10,300 m2	54.34	559,676
	Leachate Pond			
Site.D11.21	Site grading Quantity provided. Assumed minor works only and no excavation/blasting required	650 m2	21.00	13,650
Site.D11.22	Granular leveling pad - 450mm Quantity provided	650 m2	51.98	33,784
Site.D11.23	Sand Bedding - 200mm Quantity provided	650 m2	24.15	15,698
Site.D11.24	Geotextile - terrafix 420R Quantity provided	650 m2	15.00	9,750

		Quantity	Unit Rate (\$)	Total (\$)
D1 Site Work				
D11 Site Development				
Site.D11.25	Geomembrane - 1.5mm HDPE Quantity provided	650 m2	35.00	22,750
Site.D11.26	Leachate Pond Discharge Pump - discharge pump - submersible, 5.0 l/s, 10 m TDH, fittings, 30m hose, float controls Quantity provided	1 no.	6,300.00	6,300
HHW Depot				
Site.D11.27	Tote for used oil - 1m3 chemical resistant totes to collect containers of used oil Quantity provided	2 no.	2,362.50	4,725
Site.D11.28	Seacan - 20 foot seacan, with secondary containment floor Quantity provided	1 no.	10,000.00	10,000
Site.D11.29	Tote for used antifreeze - 1m3 chemical resistant totes to collect containers of used antifreeze Quantity provided	2 no.	2,362.50	4,725
Site.D11.30	Tote for household chemicals - 1 m3 chemical resistant totes to collect containers of household chemicals Quantity provided	2 no.	2,362.50	4,725
Site.D11.31	Wire Mesh container / bin - large wire mesh containers for receiving paint cans Quantity provided	2 no.	840.00	1,680
Site.D11.32	Waste oil tank, double wall - approx 1000 L, comply with wast oil storage regulations Quantity provided	1 no.	0.00	Incl. in D12 Mechanical

		Quantity	Unit Rate (\$)	Total (\$)
D1 Site Work				
D11 Site Development				
Site.D11.33	Leak Containment for wire mesh containers - chemical resistant pans to be placed underneath the wire mesh containers Quantity provided	2 no.	840.00	1,680
Fencing				
Site.D11.34	Site Perimeter Fencing - 1.8m high fencing; chain link Quantity provided	856 m	682.50	584,220
Site.D11.35	Individual Area Fencing - 1.8m high fencing; chain link; 115 m fencing for EOL vehicles and HHW area; 255m Seacan and Incinerator building storage; 250m waste cell and leachate pond Quantity provided	620 m	682.50	423,150
Site.D11.36	Main Gate - 1.8m high fencing; chain link; 12 foot manual swing gates (two 6 foot panels) Quantity provided	1 no.	7,500.00	7,500
Site.D11.37	Diversion Station Gates - 1.8m high fencing; chain link; 12 foot manual swing gates (two 6 foot panels) Quantity provided	3 no.	7,500.00	22,500
Signage				
Site.D11.38	Main Gate Sign - outdoor, printed sign 1.2m x 0.9m (3' x 4') Quantity provided	1 no.	2,500.00	2,500
Site.D11.39	Disposal Area Signage - 0.9m x 0.6m (2' x 3') Quantity provided	5 no.	1,000.00	5,000
Site.D11.40	Danger Signs - warning signs for chemical storage Quantity provided	5 no.	1,000.00	5,000

		Quantity	Unit Rate (\$)	Total (\$)
D1 Site Work				
D11 Site Development				
	Vehicle Storage Building			
Site.D11.41	Vehicle Storage Building - 6.0m x 8.0m non-insulated metal, vehicle storage garage (concrete pad 150 mm 30 MPa, person door, OH door 4mx5m, windows c/w bars, interior lights, 12000 w generator, roof light panels,) Quantity provided	1 no.	315,000.00	315,000
Site.D11.42	Electrical to above	1 no.	0.00	Incl. in D13 Electrical
	Other			
Site.D11.43	Site Grading and preparation - site development including , rough and fine grading (450 mm granular) Quantity provided	36,827 m2	21.00	773,367
Site.D11.44	Garbage Truck - small garbage truck (ie. Haul-All M-Class Refuse Unit 16 cubic yard or similar) with hydraulic oil heater Quantity provided	1 no.	288,750.00	288,750
Site.D11.45	Loader - medium sized loader - Cat 938 Quantity provided	1 no.	535,500.00	535,500
Site.D11.46	Skid Steer with Forklift Attachment - skid steer with forklift capabilities (Bobcat S66) Quantity provided	1 no.	110,250.00	110,250
Site.D11.47	Portable Washroom Quantity provided	1 no.	0.00	Incl. in D12 Mechanical

		Quantity	Unit Rate (\$)	Total (\$)
D1 Site Work				
D11 Site Development				
	Site Closure of the Drop-off Site			
Site.D11.48	Moving legacy waste to new waste facility - relocating the C&D and non-hazardous waste to the landfill cell (approx 9 km by road) Pile #1 and Pile #3 Quantity provided	1,100 m3	10.50	11,550
Site.D11.49	Seacan rental for backhauling - rental of seacan for transportation by sea for one year Quantity provided	47 no.	1,575.00	74,025
Site.D11.50	Loading scrap metal into seacans by machine - backhauling Pile #2, Pile #5 (1,300m3 75% loaded by machine) Quantity provided	975 m3	140.00	136,497
Site.D11.51	Loading scrap metal into seacans by hand - backhauling Pile #2, Pile #5 (1,300m3 25% loaded by machine) Quantity provided	325 m3	420.00	136,500
Site.D11.52	Wood Pallets - pallets for transportation of barrels Quantity provided	50 no.	210.00	10,500
Site.D11.53	Loading Waste Oil Barrels for Transportation - banding barrels into groups of 4 and banding to pallets Quantity provided	200 no.	262.50	52,500
Site.D11.54	Loading End-of-Life Vehicles onto transportation trays - loading and banding end-of-life vehicles to transportation trays Quantity provided	35 no.	105.00	3,675
Site.D11.55	Sea Transportation of one non-hazardous Seacan - sea transportation of metals from Resolute Bay to Quebec seaport Quantity provided	47 no.	8,400.00	394,800

		Quantity	Unit Rate (\$)	Total (\$)
D1 Site Work				
D11 Site Development				
Site.D11.56	Sea Transportation of end of life vehicles - cost to transport end-of-life vehicle to Quebec seaport Quantity provided	35 no.	2,100.00	73,500
Site.D11.57	Sea Transportation of a pallet of Barrels - sea transportation of a pallet of barrels from Resolute Bay to Quebec seaport Quantity provided	50 no.	672.00	33,600
Site.D11.58	Land Transportation of one non-hazardous Seacan (metals) - transportation from Quebec Seaport to disposal facility Quantity provided	45 no.	3,990.00	179,550
Site.D11.59	Land Transportation of one hazardous waste pallet - land transportation from Quebec Seaport to disposal facility for the pallets of banded barrels Quantity provided	50 no.	5,250.00	262,500
Site.D11.60	Land Transportation of one end of life vehicle - land transportation from Quebec Seaport to metals recycling facility Quantity provided	35 no.	997.50	34,913
Site.D11.61	Disposal costs of scrap metal - costs to dispose of Metals at the nearest metals recycling facility form the Quebec Seaport Quantity provided	1,300 m3	0.00	Excluded
Site.D11.62	Disposal costs of waste oil barrels - cost to dispose of a waste oil barrel at the nearest waste disposal facility to the Quebec Seaport Quantity provided	200 no.	0.00	Excluded
Site.D11.63	Disposal costs of end of life vehicles - cost to dispose of a end-of-life vehicle at the nearest metals recycling facility Quantity provided	35 no.	0.00	Excluded

		Quantity	Unit Rate (\$)	Total (\$)
D1 Site Work				
D11 Site Development				
Site.D11.64	Perimeter Fence for Site Closure - chain link perimeter fence around the drop-off site after site closure Quantity provided. Assumed 1.8m high	550 m	682.50	375,375
Site.D11.65	Gate for Site Closure - 12 foot chain link gate (two 6 foot panels) Quantity provided	1 no.	7,875.00	7,875
Site.D11.66	Sign for Site Closure - 0.9m x 0.6m (2' x 3') freestanding outdoor printed sign Quantity provided	1 no.	2,625.00	2,625
Site.D11.67	Phase 2 Environmental Site Assessment - Environmental Site Assessment to quantify extent of impacts to the site and determine costs to remediate Quantity provided	1 no.	0.00	Excluded
Site.D11.68	Incinerator Incinerator - incinerator with controlled monitoring equipment (temperature probes, differential pressure meters and auxiliary fuel flow). Capable of incinerating 15 m3 of uncompacted municipal solid waste per day Quantity provided	1 no.	0.00	Incl. in D12 Mechanical
Site.D11.69	Outdoor shelter - shelter with no walls, a tin roof, to protect the incinerator from rain and snow, built with a hole for the flu stack. 6x6 meters Quantity provided	1 no.	105,000.00	105,000
Site.D11.70	Fuel Tank for Incinerator - 75000L fuel tank, built in secondary containment, horizontal, on heavy duty skid base, with dispensing pump Quantity provided	1 no.	0.00	Incl. in D12 Mechanical

		Quantity	Unit Rate (\$)	Total (\$)
D1 Site Work				
D11 Site Development				
Site.D11.71	Power for incinerator - Genset for the required power for the incinerator Quantity provided	1 no.	0.00	Incl. in D13 Electrical
Additional Lighting				
Site.D11.72	Utility Post Lighting - solar assisted LED lights on a post Quantity provided	8 no.	0.00	Incl. in D13 Electrical
Site.D11.73	Generator - larger diesel Genset capable of heating and powering the attendant trailer and additional 8 outdoor LED utility posts Quantity provided	1 no.	0.00	Incl. in D13 Electrical
Site.D11.74	Diesel Tank - large diesel tank with build in double wall for biweekly diesel supply for the generator Quantity provided	1 no.	0.00	Incl. in D12 Mechanical
TOTAL FOR D11 SITE DEVELOPMENT		40,800 m2	\$213 /m2	\$8,670,839
D12 Mechanical Site Services				
Site.D12.1	Wall mounted electric heater for attendants building Wall mounted electric heater for the Mobile Office	1 sum 1 sum	3,237.50 3,237.50	3,238 3,238
Site.D12.2	Portable washrooms Portable washroom	1 sum 1 ea	67,046.00 67,046.00	67,046 67,046
Site.D12.3	Incinerator	1 sum	883,750.00	883,750
	Incinerator	1 sum	883,750.00	883,750
	Diesel fired			incl
	Fuel consumption 40 - 50 litres per hour			incl
	Electricity supply 110v or 230v			incl
	Auto ash removal			incl
	Remote monitoring capable			incl
	Dimensions in mm:6900 x 2900 x 6260			incl
	Operating footprint 58.41 m2			incl
	Loading method: Top Load			incl

		Quantity	Unit Rate (\$)	Total (\$)
D1 Site Work				
D12 Mechanical Site Services				
Site.D12.4	Fuel tank, piping and fuel for incinerator	1 sum	484,573.25	484,573
	75000L Fuel tank	1 ea	172,375.00	172,375
	Piping	45 m	341.25	15,356
	Misc steel	1 sum	7,875.00	7,875
	Fuel for incinerator 200L fill	1 sum	654.50	\$655
	Fuel pump	1 sum	11,375.00	11,375
	Levelometer controls	1 sum	21,875.00	21,875
	Heat trace for fuel line	1 sum	9,625.00	9,625
	Initial fuel fill for incinerator (full-fill) budget	1 sum	245,437.50	245,438
Site.D12.5	Waste oil tank - double wall	1 sum	8,531.25	8,531
	936L double walled waste oil tank	1 ea	5,906.25	5,906
	Misc steel	1 sum	2,625.00	2,625
TOTAL FOR D12 MECHANICAL SITE SERVICES		40,800 m2	\$35 /m2	\$1,447,138
D13 Electrical Site Services				
Site.D13.1	Incoming Power	1 sum	1,323,094.00	1,323,094
	1 Power, lighting/ branch Panel etc in Attendants Building - By others	1 nil	0.00	excluded
	1. Connection to attendants building	1 no	3,167.00	3,167
	1 Vehicle Storage Building .interior lights, roof light panels,	1 sum	15,823.00	15,823
	3km new overhead power distribution line, c/w connection to existing grid	1 sum	1,304,104.00	1,304,104
Site.D13.2	Site Lighting & Devices	1 sum	305,021.00	305,021
	1. Utility Post Light at attendant building - Solar assisted 10,000LM	1 no	23,539.00	23,539
	4 Cost to tie incinerator to Generator distribution panel	150 m	121.00	18,150
	4. Utility Post Light - Solar assisted (additional) assumed 10,000LM	8 no	23,539.00	188,312
	Site Lighting branch wiring	620 m	121.00	75,020
TOTAL FOR D13 ELECTRICAL SITE SERVICES		40,800 m2	\$40 /m2	\$1,628,115
NET COST		40,800 m2	\$288 /m2	\$11,746,092

	Quantity	Unit Rate (\$)	Total (\$)
NET COST			
Z1 General Requirements & Fee			
General Requirements & Fee	34.00 %		3,993,671
Freight & Accommodations	27.00 %		5,749,736
TOTAL CONSTRUCTION ESTIMATE (Excluding contingencies)	40,800 m2	\$527 /m2	\$21,489,499
Z2 Contingencies			
Design and Pricing Contingency	10.00 %		2,148,950
Escalation Contingency	12.30 %		2,643,208
Market Contingency	40.00 %		8,595,799
Construction Contingency			EXCLUDED
TOTAL CONSTRUCTION ESTIMATE (Including contingencies)	40,800 m2	\$855 /m2	\$34,877,456
TOTAL CONSTRUCTION ESTIMATE (Excluding Taxes)	40,800 m2	\$855 /m2	\$34,877,456

Appendix D

Backhauling Information

Backhauling Costs for Proposed Site Upgrades to Resolute Bay Solid Waste Site - **Backhauling All Materials**
Resolute Bay, NU

Item	Description	Quantity	Units	\$ per unit	Price (\$)
1 Backhauling Costs Non-Hazardous Waste		1213	m³		\$ 1,108,503
Seacan Rental	Cost of renting the seacan for one year, assuming sea lift schedule does not line up with the construction schedule	1	each	\$ 1,400	\$ 1,400
Loading	Cost to sort, crush, and load material into seacan (labour and equipment)	28	m3	\$ 133	\$ 3,733
Sea transportaion	Allowance for Sea transportaion of one non-hazardous seacan - transportation costs from Clyde River to Quebec	1	each	\$ 14,400	\$ 14,400
Land Transportaion	Allowance for land transportaion of one non-hazardous seacan from port in Quebec to nearest disposal facility (max 11000lbs)	1	each	\$ 5,000	\$ 5,000
Disposal costs	Allowance for the cost of disposal*	5.5	tonne	\$ 120	\$ 660
	Subtotal per seacan	1	each	\$ 25,193	\$ 25,193
	Subtotal for disposal costs of non-hazardous waste	44	each	\$ 25,193	\$ 1,108,503
2 Backhauling Costs - Metal for recycling (includes vehicles)		6910	m³		\$ 3,960,210
Seacan Rental	Cost of renting the seacan for one year, assuming sea lift schedule does not line up with the construction schedule	1	each	\$ 1,400	\$ 1,400
Scrap Metal Loading	Allowance for loading scrap metal into seacans. Crush and load (labour and equipment)	28	m3	\$ 133	\$ 3,733
Sea transportation	Allowance for Sea transportation of one non-hazardous seacan - transportation costs from Clyde River to Quebec	1	each	\$ 12,000	\$ 12,000
Land Transportation	Transportation to from port to a metal recycling facility	1	each	**	\$ -
Potential Refund	Approximate refund of scrap materials at \$200/tonne (\$0.10/lb)***	5.5	tonne	-\$ 200	-\$ 1,100
	Subtotal per seacan	1	each	\$ 16,033	\$ 16,033
	Subtotal for disposal costs of metal for recycling	247	each	\$ 16,033	\$ 3,960,210
3 Backhauling Costs - White Goods		0	m³		\$ -
Seacan Rental	Cost of renting the seacan for one year, assuming sea lift schedule does not line up with the construction schedule	1	each	\$ 1,400	\$ 1,400
Loading	Cost to sort, crush, and load material into seacan (labour and equipment) (including allowance for depolluting)	28	m3	\$ 150	\$ 4,200
Sea transportation	Allowance for Sea transportation of one non-hazardous seacan - transportation costs from Clyde River to Quebec	1	each	\$ 12,000	\$ 12,000
Land Transportation	Transportation to from port to a metal recycling facility	1	each	\$ 3,800	\$ 3,800
Disposal costs	Recycling fee	1	each	****	-
	Subtotal per seacan	1	each	\$ 21,400	\$ 21,400.00
	Subtotal for disposal costs of tires for recycling	0	each	\$ 21,400	\$ -
4 Backhauling Costs - Tires		0	m³		\$ -
Seacan Rental	Cost of renting the seacan for one year, assuming sea lift schedule does not line up with the construction schedule	1	each	\$ 1,400	\$ 1,400
Loading	Allowance for sorting and loading tires into a seacan	28	m3	\$ 133	\$ 3,733
Sea transportation	Allowance for Sea transportation of one non-hazardous seacan - transportation costs from Clyde River to Quebec	1	each	\$ 12,000	\$ 12,000
Land Transportation	Transportation to from port to a metal recycling facility	1	each	\$ 3,800	\$ 3,800
Disposal costs	Recycling fee	1	each	****	-
	Subtotal per seacan	1	each	\$ 20,933	\$ 20,933
	Subtotal for disposal costs of tires for recycling	0	each	\$ 20,933	\$ -

Item	Description	Quantity	Units	\$ per unit	Price (\$)
5	Backhauling Costs for Hazardous Waste - loose (ie. paint, cylinders or batteries, and crushed empty waste oil barrels)	0	m³		\$ -
Seacan Rental	Cost of renting the seacan for one year, assuming sea lift schedule does not line up with the construction schedule	1	each	\$ 1,400.00	\$ 1,400
Loading	Cost to sort, and load material into seacan (labour and equipment)	28	m3	\$ 133	\$ 3,733
Secondary Containment	Quatrex Secondary containment bags	12	each	\$ 200.00	\$ 2,400
Sea transportaion	Allowance for Sea transportaion of onehazardous seacan - transportation costs from Clyde River to Quebec	1	each	\$ 14,400.00	\$ 14,400
Land Transportation	Transportation to from port to a recycling/disposal facility	1	each	\$ 5,000.00	\$ 5,000
Disposal costs	Allowance for disposal costs of hazardous waste**	2.75	ton	\$ 120	\$ 330
	Subtotal per seacan	1	each	\$ 27,263	\$ 27,263
	Subtotal for disposal costs of hazardous waste - loose	0	each	\$ 27,263	\$ -
6	Backhauling Costs Hazardous Waste (fluid packaged in barrels****)	200	each		\$ 183,333
Seacan Rental	Cost of renting the seacan for one year, assuming sea lift schedule does not line up with the construction schedule	1	each	\$ 1,400	\$ 1,400
Loading	Allowance for sorting and banding barrels	14	m3	\$ 133	\$ 1,867
Sea transportation	Allowance for Sea transportation of one hazardous seacan - transportation costs from Clyde River to Quebec	1	each	\$ 14,400	\$ 14,400
Land Transportation	Transportation to from port to a recycling/disposal facility	1	each	\$ 5,000	\$ 5,000
Disposal costs	Allowance for disposal costs of one barrel of hazardous waste fluid barrel*	40	each	\$ 350	\$ 14,000
	Subtotal per seacan	1	each	\$ 36,667	\$ 36,667
	Subtotal for disposal costs of hazardous waste - barrels	5	each	\$ 36,667	\$ 183,333
7	Backhauling Costs End-of-Life Vehicles	35	each		\$ 159,600
Tray or Seacan rental	Cost of renting a tray (open seacan) or a seacan for one year (depending on vehicle size), assuming sea lift schedule does not line up with the construction schedule. Assume an average of 3 crushed vehicles per tray or seacan.	1	each	\$ 1,400	\$ 1,400
Loading	Allowance for crushing, loading, de-polluting, and banding to a tray for sea transportation	1	each	\$ 1,000	\$ 1,000
Sea transportation	Sea Transportation of a pallet of barrels from Arviat to Quebec Seaport	1	each	\$ 12,000	\$ 12,000
Land Transportation	Transportation to from port to a recycling facility	1	each	**	-
Potential Refund	Approximate refund of scrap materials at \$200/tonne (\$0.10/lb)***	5.5	tonne	-\$ 200	-\$ 1,100
	Subtotal per seacan	1	each	\$ 13,300	\$ 13,300
	Subtotal for disposal costs of end-of-life vehicles	12	each	\$ 13,300	\$ 159,600
Total Backhauling Costs					\$ 5,411,646

Notes

Volumes for backhauling are not exact due to the piles of waste not being segregated or in distinct piles. Volumes were estimated using a combination of visual inspection and pile volumes provided by a professional surveyor.

Assumed fillable volume per 20 foot seacan is 28 m³

Assume 75% loaded by machine, 25% loaded by hand

Assumed weight per seacan maximum 11,000 lbs (5.5 tonnes)

Potential for refund on scrap metal exists, sorted metals, vehicles, batteries, scrap electronics, can be a source of income depending on the market. Potential low estimates for unprepared scrap is estimated at \$0.10 per lb (\$200 per ton) and up in Quebec. Because acceptance of the load can not be guaranteed because of varying amounts of contamination or impurities in the load, this projection assumes payment for disposal of metals. It is recommended that metals be sorted and packaged with intention for refund.

Secondary containment bags provided by Quartex. Cost of Quatrex 27 bag is \$107.39 + PST + Shipping.

Assume the seacans will be stored within 1 km of the port and will be transported onto the sealift by the sealift company at no cost

Assume Hazardous waste seacans are half full

Refund for vehicles estimated at 200\$/tonne. Vehicle weight may vary and are estimated at one tonne each.

Metal density used for this study is based on the maximum shippable container weight of (1100 lbs per 28m³)

Costs for disposal of waste oil barrels was not provided by Altus. Costs of waste disposal vary depending with the material quantity, quality and change with the market demand. Value was estimated by Dillon.

*Cost of disposal is highly variable depending on the material and market. The cost for disposal is determined by the waste receiver at the time of acceptance and is estimated at this time using historical values for similar materials.

**Scrap metals recycling facility will provide free pickup from the port. Assuming all other loads will be shipped to other recycling and disposal facilities.

***Refund for the metal is provided as an allowance that is estimated based on recent market prices

****The recycling fee is assumed to be \$0. This may not be applicable depending on load acceptance and market prices. Potential refund may exist with certain metal recyclables.

*****Shipping of hazardous waste in barrels - barrels are banded in groups of 4 to a pallet, and shipped via seacan in a single layer, 10 pallets to a seacan. The potential for double stacking pallets may be possible depending on the condition of the barrels and the final height.

Hazardous waste excludes asbestos

Backhauling Costs for Proposed Site Upgrades to Resolute Bay Solid Waste Site - [Backhauling Partial Material, for Drop-off Site Closure Only](#)
Resolute Bay, NU

Item	Description	Quantity	Units	\$ per unit	Price (\$)
1 Backhauling Costs Non-Hazardous Waste		0	m³		\$ -
Seacan Rental	Cost of renting the seacan for one year, assuming sea lift schedule does not line up with the construction schedule	1	each	\$ 1,400	\$ 1,400
Loading	Cost to sort, crush, and load material into seacan (labour and equipment)	28	m3	\$ 133	\$ 3,733
Sea transportaion	Allowance for Sea transportaion of one non-hazardous seacan - transportation costs from Clyde River to Quebec	1	each	\$ 12,000	\$ 12,000
Land Transportaion	Allowance for land transportaion of one non-hazardous seacan from port in Quebec to nearest disposal facility (max 11000lbs)	1	each	\$ 5,000	\$ 5,000
Disposal costs	Allowance for the cost of disposal*	5.5	tonne	\$ 120	\$ 660
	Subtotal per seacan	1	each	\$ 22,793	\$ 22,793
	Subtotal for disposal costs of non-hazardous waste	0	each	\$ 22,793	\$ -
2 Backhauling Costs - Metal for recycling		1300	m³		\$ 753,562
Seacan Rental	Cost of renting the seacan for one year, assuming sea lift schedule does not line up with the construction schedule	1	each	\$ 1,400	\$ 1,400
Scrap Metal Loading	Allowance for loading scrap metal into seacans. Crush and load (labour and equipment)	28	m3	\$ 133	\$ 3,733
Sea transportation	Allowance for Sea transportation of one non-hazardous seacan - transportation costs from Clyde River to Quebec	1	each	\$ 12,000	\$ 12,000
Land Transportation	Transportation to from port to a metal recycling facility	1	each	**	\$ -
Potential Refund	Approximate refund of scrap materials at \$200/tonne (\$0.10/lb)***	5.5	tonne	-\$ 200	-\$ 1,100
	Subtotal per seacan	1	each	\$ 16,033	\$ 16,033
	Subtotal for disposal costs of metal for recycling	47	each	\$ 16,033	\$ 753,562
3 Backhauling Costs - White Goods		0	m³		\$ -
Seacan Rental	Cost of renting the seacan for one year, assuming sea lift schedule does not line up with the construction schedule	1	each	\$ 1,400	\$ 1,400
Loading	Cost to sort, crush, and load material into seacan (labour and equipment) (including allowance for depolluting)	28	m3	\$ 150	\$ 4,200
Sea transportation	Allowance for Sea transportation of one non-hazardous seacan - transportation costs from Clyde River to Quebec	1	each	\$ 12,000	\$ 12,000
Land Transportation	Transportation to from port to a metal recycling facility	1	each	\$ 3,800	\$ 3,800
Disposal costs	Recycling fee	1	each	****	-
	Subtotal per seacan	1	each	\$ 21,400	\$ 21,400.00
	Subtotal for disposal costs of tires for recycling	0	each	\$ 21,400	\$ -
4 Backhauling Costs - Tires		0	m³		\$ -
Seacan Rental	Cost of renting the seacan for one year, assuming sea lift schedule does not line up with the construction schedule	1	each	\$ 1,400	\$ 1,400
Loading	Allowance for sorting and loading tires into a seacan	28	m3	\$ 133	\$ 3,733
Sea transportation	Allowance for Sea transportation of one non-hazardous seacan - transportation costs from Clyde River to Quebec	1	each	\$ 12,000	\$ 12,000
Land Transportation	Transportation to from port to a metal recycling facility	1	each	\$ 3,800	\$ 3,800
Disposal costs	Recycling fee	1	each	****	-
	Subtotal per seacan	1	each	\$ 20,933	\$ 20,933
	Subtotal for disposal costs of tires for recycling	0	each	\$ 20,933	\$ -

Item	Description	Quantity	Units	\$ per unit	Price (\$)
5	Backhauling Costs for Hazardous Waste - loose (ie. paint, cylinders or batteries, and crushed empty waste oil barrels)	0	m³		\$ -
Seacan Rental	Cost of renting the seacan for one year, assuming sea lift schedule does not line up with the construction schedule	1	each	\$ 1,400.00	\$ 1,400
Loading	Cost to sort, and load material into seacan (labour and equipment)	28	m3	\$ 133	\$ 3,733
Secondary Containment	Quatrex Secondary containment bags	12	each	\$ 200.00	\$ 2,400
Sea transportaion	Allowance for Sea transportaion of onehazardous seacan - transportation costs from Clyde River to Quebec	1	each	\$ 14,400.00	\$ 14,400
Land Transportation	Transportation to from port to a recycling/disposal facility	1	each	\$ 5,000.00	\$ 5,000
Disposal costs	Allowance for disposal costs of hazardous waste**	2.75	ton	\$ 120	\$ 330
	Subtotal per seacan	1	each	\$ 27,263	\$ 27,263
	Subtotal for disposal costs of hazardous waste - loose	0	each	\$ 27,263	\$ -
3	Backhauling Costs Hazardous Waste (fluid packaged in barrels****)	200	each		\$ 183,333
Seacan Rental	Cost of renting the seacan for one year, assuming sea lift schedule does not line up with the construction schedule	1	each	\$ 1,400	\$ 1,400
Loading	Allowance for sorting and banding barrels	14	m3	\$ 133	\$ 1,867
Sea transportation	Allowance for Sea transportation of one hazardous seacan - transportation costs from Clyde River to Quebec	1	each	\$ 14,400	\$ 14,400
Land Transportation	Transportation to from port to a recycling/disposal facility	1	each	\$ 5,000	\$ 5,000
Disposal costs	Allowance for disposal costs of one barrel of hazardous waste fluid barrel*	40	each	\$ 350	\$ 14,000
	Subtotal per seacan	1	each	\$ 36,667	\$ 36,667
	Subtotal for disposal costs of hazardous waste - seacans	5	each	\$ 36,667	\$ 183,333
4	Backhauling Costs End-of-Life Vehicles	35	each		\$ 159,600
Tray or Seacan rental	Cost of renting a tray (open seacan) or a seacan for one year (depending on vehicle size), assuming sea lift schedule does not line up with the construction schedule. Assume an average of 3 crushed vehicles per tray or seacan.	1	each	\$ 1,400	\$ 1,400
Loading	Allowance for crushing, loading, de-polluting, and banding to a tray for sea transportation	1	each	\$ 1,000	\$ 1,000
Sea transportation	Sea Transportation of a pallet of barrels from Arviat to Quebec Seaport	1	each	\$ 12,000	\$ 12,000
Land Transportation	Transportation to from port to a recycling facility	1	each	**	-
Potential Refund	Approximate refund of scrap materials at \$200/tonne (\$0.10/lb)***	5.5	tonne	-\$ 200	-\$ 1,100
	Subtotal per seacan	1	each	\$ 13,300	\$ 13,300
	Subtotal for disposal costs of end-of-life vehicles	12	each	\$ 13,300	\$ 159,600
Total Backhauling Costs					\$ 1,096,495

Notes

Volumes for backhauling are not exact due to the piles of waste not being segregated or in distinct piles. Volumes were estimated using a combination of visual inspection and pile volumes provided by a professional surveyor.

Assumed fillable volume per 20 foot seacan is 28 m3

Assume 75% loaded by machine, 25% loaded by hand

Assumed weight per seacan maximum 11,000 lbs (5.5 tonnes)

Potential for refund on scrap metal exists, sorted metals, vehicles, batteries, scrap electronics, can be a source of income depending on the market. Potential low estimates for unprepared scrap is estimated at \$0.10 per lb

Secondary containment bags provided by Quartex. Cost of Quatrex 27 bag is \$107.39 + PST + Shipping.

Assume the seacans will be stored within 1 km of the port and will be transported onto the sealift by the sealift company at no cost

Assume Hazardous waste seacans are half full

Refund for vehicles estimated at 200\$/tonne. Vehicle weight may vary and are estimated at one tonne each.

Metal density used for this study is based on the maximum shippable container weight of (1100 lbs per 28m³)

Costs for disposal of waste oil barrels was not provided by Altus. Costs of waste disposal vary depending with the material quantity, quality and change with the market demand. Value was estimated by Dillon.

*Cost of disposal is highly variable depending on the material and market. The cost for disposal is determined by the waste receiver at the time of acceptance and is estimated at this time using historical values for similar

**Scrap metals recycling facility will provide free pickup from the port. Assuming all other loads will be shipped to other recycling and disposal facilities.

***Refund for the metal is provided as an allowance that is estimated based on recent market prices

****The recycling fee is asusmed to be \$0. This may not be applicable depending on load acceptance and market prices. Potential refund may exist with certain metal recyclables.

*****Shipping of hazardous waste in barrels - barrels are banded in groups of 4 to a pallet, and shipped via seacan in a single layer, 10 pallets to a seacan. The potential for double stacking pallets may be possible depending

Hazardous waste excludes asbestos

Appendix E

Operations and Maintenance

20-year Operations and Maintenance Cost Estimate for Resolute Bay Proposed New Solid Waste Management Facility

Table E-1 includes the Class D O&M cost estimates for the operation of the proposed new solid waste management facility after recommended improvements are implemented, for a 20-year period. The Annual O&M and 20-year lifecycle (OMLC) Estimate were provided by Altus and include the assumptions listed in the full report that follows in Appendix E. A summary of technical assumptions are as follows:

- Costs are based on 2023 estimates;
- Assumes 1 full-time and 1 part-time (50%) waste facility operator;
- No allowances included for training or mobilizing staff;
- Insurance costs are excluded;
- Assumes waste loader operates 4 hours per day, 2 days per week;
- Assumes garbage truck travels 20 km, 2 days per week;
- Estimate does not include removal of fluid waste from site;
- On-going backhauling will occur on a 5-year cycle within the lifecycle budget; and,
- General estimates have been provided for annual operating costs and can be refined as the design develops.

Table E-1: Operation and Maintenance Cost Summary - Estimated Annual Costs and Lifecycle Estimates

Cost Item	Annual Cost	20 yr. Forecast (Excludes CPI)
Site Maintenance		
Access Road Maintenance (maintenance of the road, re-gravelling, erosion (6 m wide))	\$3,200	\$64,000
Snow Clearing	\$76,000	\$1,520,000
Building Maintenance	\$7,700	\$154,000
Fence Maintenance	\$3,700	\$74,000
Ditch Maintenance	\$8,400	\$168,000
Housekeeping / Cleaning	\$9,500	\$190,000
Equipment Maintenance	\$5,000	\$100,000

Site Maintenance (General cleanup once a year)	\$4,500	\$90,000
Sub-Total Site Maintenance	\$118,000	\$2,360,000
Vehicle Maintenance		
Yearly Maintenance of medium sized loader (CAT 938), Garbage Vehicle M-Class (16 cubic yard), and Skidsteer	\$12,000	\$240,000
Sub-Total Vehicle Maintenance	\$12,000	\$240,000
Staffing Operating Costs		
Staffing Costs	\$214,000	\$4,280,000
Misc Costs (spares and materials, overtime, general overhead) at 10%	\$32,000	\$640,000
Sub-Total Staffing Operating Costs	\$246,000	\$4,920,000
Other Operating Costs		
Vehicle fuel cost (Garbage loader, loader, skidsteer)	\$33,000	\$660,000
Generator fuel (allowance for monthly tests and 6 x annual outage)	\$2,500	\$50,000
Utilities - power and lights	\$2,500	\$50,000
Sub-Total Other Operating Costs	\$38,000	\$760,000
Sub-Total Annual Operations and Maintenance Costs	\$414,000	\$8,280,000
Risk & Contingency allowance @ 10%	\$41,400	\$828,000
Total Annual Operations and Maintenance (O&M) Costs	\$455,400	\$9,108,000
Av annual lifecycle (includes \$61,000 allowance for backhauling per year (on a 5 year frequency))	\$200,000	\$4,000,000
Risk & Contingency allowance at 10%	\$20,000	\$400,000
Total Annual Lifecycle (LC) Costs	\$220,000	\$4,400,000
Total Annual OMCL	\$675,400	\$13,508,000

Appendix F

Council Motion

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