DILLON CONSULTING

CITY OF IQALUIT

Operations and Maintenance Manual (Revised – Version 4.0)

Landfill and Waste Transfer Station

October 2020 | 19-9543 – Version 4.0

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1.0 Introduction

1.1 Background

The City of Iqaluit (City) is in the process of implementing its Solid Waste Management Strategy to service their near and long-term (75 years) municipal solid waste disposal requirements. Founded on a previously completed conceptual design and facility siting exercise, key elements of the project include a solid waste transfer station (WTS) within the immediate urban area of the City, where residential and commercial waste will be hauled to, processed, and compacted in bales, or in the case of waste wood and cardboard, shredded for use as a fuel source for an on-site biomass boiler. Tires, metal, and some construction and demolition (C&D) wastes will also be shredded and/or baled for landfilling or transported south for recycling. The resulting solid waste bales and possibly a smaller amount of unbaled C&D waste will be trucked to an engineered balefill landfill site (Landfill) located approximately six kilometres from the WTS.

The overall site locations are presented in Figure 1-1, with the layouts for the WTS and the Landfill being provided on Figures 1-2 and 1-3, respectively.

Other planned features of the WTS include a public drop off area for household hazardous wastes (HHW) and a vehicle logger/compactor unit; in both instances allowing for the preparation of waste materials before shipping to approved management facilities in the south.

The access road that will be used to reach the new Landfill has been designed by EXP Services Inc., who will also be providing Construction Contract Administration services for the establishment of the road. It is anticipated that the construction of the road will be included in the new Landfill and WTS Contractor's scope of work.

To address their objectives, and following a competitive proposal process, the City engaged Dillon Consulting Limited (Dillon) to provide design and construction contract administration services to support the establishment of the WTS/baling facility and the engineered Landfill. The engineered Landfill will be designed for 75 years of operation but the construction/build portion of the project only the first stage of the Landfill (Stage 1 Operational Landfill) will be constructed (e.g., Cell 1 and ancillary components to meet requirements for an initial five years of operation).

Development of the proposed facilities is scheduled to commence in 2021, with facility commissioning occurring in 2023.

Commitment 17
New Technology/Lessons Learned
ECCC

Commitment 29
Fencing, Design Drawings (90%)
CIRNAC

Commitment 38
OMM
CIRNAC

Figure 1-2: Waste Transfer Station Layout Plan

Figure 1-3: Landfill Layout Plan

1.2 Content

The Operations and Maintenance Manual addresses the following topics:

- Days and hours of operation
- Security and access control
- Staff and equipment
- Waste quantities and types
- Waste control
- Daily bale/waste placement
- Adverse weather conditions
- Initial life construction
- Nuisance control protocols, including litter, dust, noise, odour, birds, vector, vermin and wildlife
- Complaint response protocol
- Traffic control
- Fire prevention and response
- Surface water management
- Leachate management
- Landfill gas (LFG) management
- Inspection and maintenance program
- Record keeping
- Reporting
- Operations monitoring program
- Sample site logs and forms

The development of the site will be consistent with applicable regulations and policies for environmental protection. The facility has been designed with a composite liner system, leachate management system, surface drainage control and an environmental monitoring network.

It is noted that equipment-specific manufacturer's documentation, providing details on operational and maintenance requirements, is to be referred to along with the attached Operations and Maintenance Manual.

2.0 Facility Operations

2.1 Access Control

2.1.1 Hours of Operation

The City of Iqaluit Landfill and WTS is open Monday through Saturday, excluding holidays. The site is open to receive waste from 8:00 am to 4:00 pm Monday through Friday, and 8:00 am to 12:00 pm Saturday. Only the WTS will be accessible by the general public.

The site will be closed on the following holidays:

- New Year's Day
- Good Friday
- Easter Monday
- Victoria Day
- Canada Day
- Nunavut Day
- Civic Day (first Monday in August)
- Labour Day
- Thanksgiving
- Remembrance Day
- Christmas Day
- Boxing Day

Site equipment may operate beyond posted hours. The additional time may be necessary for processing of materials at the WTS preparation of the working area receiving waste and for other work defined by management personnel.

The operating hours are prominently posted on the entrance signs for both the Landfill and WTS, which also identifies the site name and the site telephone number.

2.1.2 Site Security

Due to the nature of the work undertaken at the Landfill and WTS, site security and safety is an important feature of the overall operation. Lockable gates are situated at various locations throughout both properties. As detailed on the Engineering Drawings, permanent 2.4 m chain link fencing is provided around the perimeter of the WTS property. At the Landfill, similar fencing will be established around the leachate holding ponds as well as Cell 1. As additional cells are constructed in the future, the fencing will be extended to contain active and previously developed portions of the Landfill. No trespassing signage will be affixed to the fencing at regular intervals. Fencing of both the leachate ponds and the Landfill will serve as an access deterant to wildlife and the public.

Keys/electronic access cards will be provided to persons employed by the City and directly involved with the operation of the WTS and/or Landfill, at the discretion of the Director of Engineering and Public Works or Manager of Solid Waste (Manager). A record shall be kept at the Scale House relating to who

has keys, including contact name and phone number. A general visitor log (Appendix A) shall also be maintained at the Scale House.

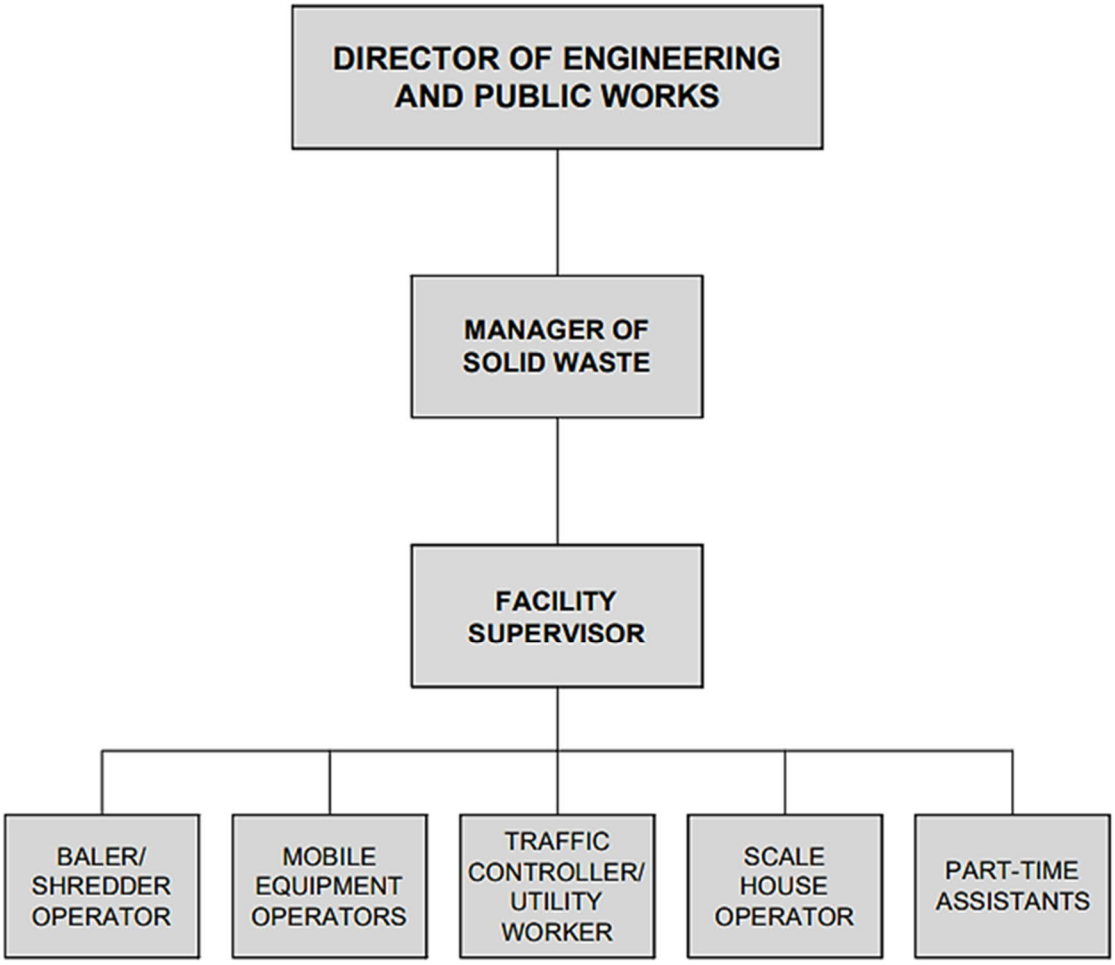
When either site is unattended, the gates will be closed and locked.

3.0 Personnel

3.1 Staffing

The Landfill and WTS will require full and part-time staff. In general, the facility requires a Manager, Facility Supervisor, Baler Operator, Mobile Equipment Operators, Scale House Operator, Traffic Controller/Utility Worker and Part-Time Assistants. An organization chart defining staffing and reporting responsibilities at the Landfill and WTS is presented in Figure 3-1. All employees will be properly trained in accordance with the tasks that they will be expected to complete.

Figure 3-1: Facility Organization Chart



A general outline of the minimum duties and responsibilities of each position follows. It is not intended to be comprehensive or to limit the employee's opportunity to expand their capabilities beyond this scope. It is also not intended to limit the employer's right to assign other duties. Further, it is anticipated

that the City of Iqaluit will refine/revise staff member roles and responsibilities consistent with existing employment agreements and identified operational needs.

Generally, consistent with their duties, facility staff will be situated at the WTS during the working day. The exception to this will be when baled or C&D wastes require delivery/placement at the Landfill or when scheduled maintenance or operational activities are necessary at the site.

3.1.1 Director of Engineering and Public Works

The Director of Engineering and Public Works assists the City's Chief Administrative Officer (CAO) and the Manager of Solid Waste in planning and coordinating operation at the Landfill and WTS, as they relate to:

- Developing operational budgets.
- Preparation of annual reports.
- Technical operation.
- Environmental monitoring.

3.1.2 Manager of Solid Waste

The Manager of Solid Waste is responsible to the Director of Engineering and Public Works for the operation of the facility. The Manager oversees and coordinates day-to-day operations at the site.

Reporting Relationships

Reports to: Director of Engineering and Public Works
Supervises: Landfill and WTS Personnel

Maintains Liaison with: CAO
Municipal Engineer
Citizen's Monitoring Committee (as applicable)
Purchasing Manager
Accounting Personnel
Payroll Clerk
Suppliers
Contractors

Duties and Responsibilities

The Manager shall:

1. Perform operations at the facility per the Operations and Maintenance Manual (latest approved version), applicable Engineering Drawings and the Water License issued by Nunavut Water Board (NWB), and in consultation with the CAO.

2. Ensure that only acceptable wastes, as indicated on the approved list for disposal, are permitted at the site, in consultation with the CAO and regulatory agencies.
3. Prepare regularly scheduled reports on progress and planning at the facility.
4. With the assistance of the CAO, prepare facility operating budgets and undertake staffing selections.
5. Communicate (as required) with NWB, including the forwarding of monitoring results.
6. Deal directly with the public, responding to disposal requests.
7. Coordinate site visits/tours.
8. Provide overall direction for daily site activities, including equipment and staff utilization.
9. Maintain the environmental monitoring program.
10. Coordinate the environmental sampling programs.
11. Ensure that site staff receives the required training.
12. Make recommendations to the CAO for major and minor repair work required for site equipment, as well as replacement of same.
13. Ensure that the site is maintained and operated cleanly and safely at all times, including regular collection of litter.
14. Ensure that solid waste bales and C&D debris materials are placed at the Landfill per the Operations and Maintenance Manual (latest approved version), and in consultation with the Municipal Engineer.
15. Coordinate the preparation of balefill areas for operation, including stockpiling cover material, and identifying the requirement for composite liner installation and the establishment of surface water control measures.
16. Ensure that there is no open burning of solid waste at the facility.
17. Perform other related duties, as may be assigned periodically by the CAO.

3.1.3 Facility Supervisor

Under the direction of the Manager, the Facility Supervisor is responsible for equipment and general site maintenance requirements at the facility.

Reporting Relationships

The Facility Supervisor reports directly to the Manager.

Duties and Responsibilities

The Facility Supervisor shall:

1. Perform operations at the facility per the Operations and Maintenance Manual (latest approved version), applicable Engineering Drawings and the Water License issued by NWB, and in consultation with the Manager.
2. Ensure that only acceptable wastes as indicated on the approved list for disposal are permitted at the site, in consultation with the Manager and regulatory agencies.
3. Be responsible for the maintenance of the facility machinery, including mobile equipment, the solid waste baler unit, material shredder, vehicle logger and related systems.

4. Make recommendations to the Manager for major and minor repair work required for facility equipment, as well as replacement of the same.
5. Ensure that the facility is maintained and operated in a clean and safe manner at all times, including regular collection of litter.
6. In coordination with the Manager, ensure that solid waste bales and C&D debris materials are placed at the Landfill, in accordance with the Operations and Maintenance Manual (latest approved version).
7. Be responsible for snow removal on the access roads within the site and other areas, as necessary.
8. Maintain the access roads to ensure there is reasonable access within the site and to the active Landfill at all times.
9. Be responsible for operating and maintaining the leachate handling equipment, and surface water control structures and facilities at the Landfill and WTS.
10. Undertake site security checks and report any problems to the Manager.
11. Inspect the public roads/areas surround the WTS, the Landfill access road, and the Landfill to recover any accumulation of garbage or other debris.
12. Recommend to the Manager the need for bird control, rodent, animal and odour control.
13. Ensure that there is no open burning of solid waste at the site.
14. Maintain records of site equipment usage and maintenance.
15. In coordination with the Manager, maintain the integrity of completed landfill cells and borrow areas.
16. Perform such other related duties, as may be assigned from time to time by the Manager.

3.1.4 Baler/Shredder Operator

Under the direction of the Facility Supervisor, the Baler/Shredder Operator is responsible for operating and maintaining the solid waste baler unit, material shredder, vehicle logger and related systems.

Reporting Relationships

The Baler/Shredder Operator reports directly to the Facility Supervisor.

Duties and Responsibilities

The Baler/Shredder Operator shall:

1. Perform operations at the facility in accordance with the Operations and Maintenance Manual (latest approved version), applicable Engineering Drawings and the Water License issued by NWB, and in consultation with the Facility Supervisor.
2. Ensure that only acceptable wastes as indicated on the approved list for disposal are permitted at the site, in consultation with the Facility Supervisor.
3. Make recommendations to the Facility Supervisor for major and minor repair work required for the solid waste baler, material shredder, vehicle logger, and related systems.
4. Maintain an operational record for the solid waste baler, material shredder, vehicle logger and related systems.

5. Ensure that the tipping floor and baling floor is maintained and operated in a clean and safe manner at all times.
6. Periodically operate mobile equipment associated with site operations.
7. Perform such other related duties, as may be assigned from time to time by the Facility Supervisor and/or the Manager.

3.1.5 Mobile Equipment Operators

Under the direction of the Facility Supervisor, the Mobile Equipment Operators are responsible for operating and maintaining mobile equipment utilized for waste handling and disposal operations. At least two Mobile Equipment Operators will be on-site every day the facility is open to the public.

Reporting Relationships

Mobile Equipment Operators report directly to the Facility Supervisor.

Duties and Responsibilities

The Mobile Equipment Operators shall:

1. Perform operations at the facility in accordance with the Operations and Maintenance Manual (latest approved version), applicable Engineering Drawings and the Water License issued by NWB, and in consultation with the Facility Supervisor.
2. Ensure that only acceptable wastes as indicated on the approved list for disposal are permitted at the site, in consultation with the Facility Supervisor.
3. Be responsible for the operation and routine maintenance of the site machinery.
4. Make recommendations to the Facility Supervisor for major and minor repair work required for site equipment.
5. Ensure that the site is maintained and operated in a clean and safe manner at all times.
6. Ensure that solid waste bales and C&D debris materials are placed at the Landfill, in accordance with the instructions of the Facility Supervisor.
7. Carry out activities for the maintenance and repair of access roads, snow removal, preparation of balefill areas, excavation and stockpiling of cover material, and the installation and/or repair of leachate collection and surface water control structures, as directed by the Facility Supervisor.
8. Advise the Facility Supervisor of the need for pest control.
9. Remove freon from refrigerators (and similar equipment) and specified liquids from vehicles, following applicable regulations.
10. Operate the HHW drop off facility.
11. Ensure that there is no open burning of solid waste at the site.
12. Perform such other related duties, as may be assigned from time to time by the Facility Supervisor and/or the Manager.

3.1.6 Traffic Controller/Utility Worker

Under the direction of the Facility Supervisor, the Traffic Controller/Utility Worker is responsible for directing the movement of vehicles delivering waste materials to the tipping floor within the WTS.

Reporting Relationships

The Traffic Controller/Utility Worker reports directly to the Facility Supervisor.

Duties and Responsibilities

The Traffic Controller/Utility Worker shall:

1. Direct incoming vehicles to the location on the tipping floor where solid waste is to be deposited.
2. Ensure that adequate signage and traffic control devices are in place in coordination with the Manager.
3. Direct the movements of waste delivery vehicles and their personnel within the transfer station compound to prevent conflicts with facility equipment operations.
4. Ensure that only acceptable wastes as indicated on the approved list for disposal are permitted at the site, in consultation with the Manager.
5. Segregate banned and salvageable materials noted on the tipping floor to designated storage areas.
6. Periodically operate mobile equipment associated with site operations.
7. Ensure that the area around the building and the tipping floor is operated in a clean and safe manner at all times, including regular collection of litter.
8. Perform such other related duties, as may be assigned from time to time by the Facility Supervisor and/or the Manager.

3.1.7 Scale House Operator

Under the direction of the Facility Supervisor, the Scale House Operator performs all duties related to the operation of the facility's scale component.

Reporting Relationships

The Scale House Operator reports directly to the Facility Supervisor or a designated member of staff.

Duties and Responsibilities

The Scale House Operator shall:

1. Identify and register vehicles within the computerized site database.
2. Manage the customer billing system.
3. Collect tipping fees from customers on-site.
4. Inspect incoming waste per the Operations and Maintenance Manual (latest approved version).
5. Answer incoming telephone calls and requests for information, directing such requests as required.
6. Monitor use of the public drop-off door at the WTS.
7. Clean and maintain the scale.
8. Perform such other related duties as may be assigned from time to time by the Facility Supervisor and/or the Manager.

3.1.8 Part-Time Assistants

Under the direction of the Facility Supervisor, the Part-Time Assistants are responsible for tasks assigned to them by a designated member of staff. These positions would typically serve to address periodic site maintenance requirements.

Reporting Relationships

The Part-Time Assistant reports directly to the Facility Supervisor or a designated member of staff.

Duties and Responsibilities

The Part-Time Assistant shall:

1. Perform duties as assigned by the Manager, Balefill Supervisor or a designated member of staff.

3.2 Training

Every Landfill and WTS employee will be trained to perform his or her job in a safe and environmentally responsible manner, following applicable regulations and City policy. Employees will be kept current with changes in regulations and technology through ongoing, comprehensive training courses, in such areas as regulations and the technical aspects of landfill operation. Specific training topics may include surface water control, leachate and LFG management, spill prevention, special wastes control, environmental monitoring and safety. A municipal employee's health and safety committee serves as a forum to identify potential concerns and define appropriate actions.

Continuing on-the-job training will be provided for all employees. The training will emphasize the safe and environmentally sound operation of the Landfill. A review of this Operations and Maintenance Manual will be a prerequisite for any employee before being declared eligible for work at the Landfill and WTS. All employees will be given safety training covering all equipment and systems, with which they will be expected to operate daily. The dangers associated with the use of protective equipment, methane (CH_4) gas and leachate handling, and the handling and precautions associated with special wastes, will also be included in the safety training. Documentation of the employee's participation in the safety and environmental training will be maintained in the employee's personnel file.

A training program for more specific tasks, such as those of the baler, shredder and mobile equipment operators, will be documented with written records of meetings and types of instruction. This instruction will include identification of special wastes and unacceptable wastes; emergency procedures in case of fire, spill or injury; confined space entry; respirator use and fit testing; and other issues that will periodically arise. All individuals must be trained in confined space entry and practice proper safety procedures, following applicable legislation and the requirements of the Nunavut Labour Standards Office. Documentation will also be kept on file at the Manager's office and reviewed annually for any necessary updates.

A general outline of some of the training that employees will require is found in Table 3-1. It is not intended to be a comprehensive list or to limit additional staff training, should legislation change, or limit the employer's or employee's right to require additional training.

Table 3-1: Staff Training Recommendations

Program	Manager of Solid Waste	Facility Supervisor	Equipment Operators	Control/Utility Worker	Scale House Operator	Part-Time Assistants

4.0 Site Structures

Primary structures associated with operations at the Landfill and WTS are illustrated in Figures 1-2 and 1-3. Infrastructure descriptions are subdivided as follows: 1) structures at/in proximity to the WTS are discussed in **Section 4.1**, and 2) structures associated with the Landfill are described in **Section 4.2**.

4.1 Waste Transfer Station

4.1.1 Facility Roads

The road network serving the WTS includes 1) Kakivak Court, acting as the main access route and connecting the site to Federal Road, 2) parking and maneuvering areas around the perimeter of the WTS, and 3) dedicated access to from the WTS compound to Qaqqamiut Road (as associated with the transport of baled waste to the Landfill). The perimeter of the WTS property is fenced with lockable access gates, situated at the Kakivak Court and Qaqqamiut Road entrances.

The facility roads/yard areas are private and their maintenance will be the responsibility of the City. Maintenance of the facility roads includes, but is not limited to, dust and mud tracking control, and snow removal/ice control.

4.1.2 Scale and Scale House

The Scale and Scale House are located southeast of the WTS Building. As described in **Section 8.2.1**, all vehicles entering the site are required to report to the Scale House. The Scale House, a premanufactured wood frame structure with electric heating, includes an elevated load inspection video camera and PC-based scale control/invoicing equipment. The Scale House entrance and exit ramps will have an asphalt surface.

4.1.3 WTS Building

The WTS Building is a pre-engineered, steel, slab on grade structure with a total floor area of approximately 2,400 m^2. With reference to Figure 4-1, the interior of the building is divided into five primary areas: 1) the **tipping floor** is used to allow haulage vehicles to discharge their loads within an enclosed area – it also includes a wall opening to allow for public drop off of refuse materials; 2) the baling/bale loading area is where the waste is compressed into wire-tied and plastic-wrapped bales and transferred to the flatbed transport truck; 3) select materials are processed and stored in the shredder area; 4) end of life vehicles are prepared for compaction at the **car and truck lift area**; and 5) a variety of control systems and equipment, including a biomass boiler, are located in the mechanical/electrical area.

Due to the nature of operations, the concrete walls extend upward from the slab in the tipping floor portion (southwest corner) of the building. The tipping floor's concrete walls are 2.4 m high, permitting storage of solid waste against the inside of the building and allowing for a smooth durable surface to work against. The concrete walls around the remainder of the interior perimeter are 1.2 m in height to provide impact protection to the building structure from mobile equipment.

Due to issues associated with clogging and an objective to minimize the number of slab penetrations, there are no floor drains within the interior of the WTS; interior slab slopes are typically towards exterior overhead doors. Liquid on the floor (primarily from incoming waste and hauling vehicles) is continuously monitored by facility staff, using the absorbent capacity of the waste, as required. Cleaning of the floor via sweepers and other means is conducted, as required.

A source of liquid generation at the WTS is the waste baler where liquids are squeezed out of the waste as the baler compacts the waste. The volume generated is variable and dependent on the moisture content of the waste and snow/ice that may be attached to the delivered waste Liquid from the baler would collect in the shallow trench around the baler and flow to a sump where it is pumped to a 4500 l tank for subsequent, testing if required, collection and transfer to the City's wastewater treatment plant (WWTP).

Mechanical and electrical features of the WTS building include the following:

- Interior heating requirements (using a hydronic system) are met using a biomass boiler that uses shredded as fuel. Back up requirements for select interior areas of the WTS will be provided by a No.2 fuel-fired hydronic heating unit. A 4,880 L double-wall aboveground tank situated outside the building provides fuel for the back-up unit.
- Exhaust fans serving the interior of the WTS to provide general ventilation and achieve interior air quality requirements.
- Select use of radiant heaters in defined locations to address equipment requirements and to prevent the freezing of waste.
- Provision of interior fire protection, using a sprinkler system with a dedicated on-site water tank inside a fire-protected room within the WTS.
- Water for interior building maintenance and equipment requirements addressed with an on-site storage tank. Staff washroom and shower facilities are located at the Site Office.

4.1.4 Site Office

A wood-framed, premanufactured building, situated adjacent to the Scale House, serves as the Site Office. The building incorporates staff facilities, including the Facility Supervisor's office, a lunchroom, a locker room and washroom/shower facilities. The building will be heated using an oil-fired, forced air furnace, and will be serviced with a water and wastewater tank.

4.1.5 Household Hazardous Wastes Depot and Storage

Steel intermodal ("seacan") containers, modified to address storage requirements for receiving HHW materials, as well as one pre-fabricated container specifically constructed as an HHW storage container with secondary containment (Loraday Model LEP/L73-4013 Storage Container or equivalent)are situated in the southwestern area of the WTS yard. One 12 m (40 ft) container serves as a public drop off location, where a trained staff member records incoming quantities and directs the materials to an appropriate initial storage location. As required, materials from the Drop Off Container are directed to one of the 12 m storage containers or the purpose-built HHW building with secondary containment (Loraday Model LEP/L73-4013 Storage Container or equivalent). Arrangements are made by the City for subsequent shipping to approved-management facilities in the south, as quantities warrant.

4.1.5.1 Household Hazardous Wastes Acceptable Materials

It is recommended that following wastes not be accepted for landfilling or recycling and instead be considered Household Hazardous Waste (HHW). Please note that this list is not exhaustive and is subject to change per City of Iqaluit and/or Government of Nunavut guidelines, :

- Alkaline batteries
- Button cell batteries
- Rechargeable batteries
- Lead-acid batteries
- Fluid paints, stains, varnishes, and oil paint products
- Empty paint, stain, varnish, and oil paint product cans
- Varnish remover
- Cleaning chemicals and disinfectants (i.e. toilet cleaner, oven cleaner, drain cleaner)
- Antifreeze/radiator fluids
- Bleach
- Brake fluid
- Pesticides/insecticides/rodenticides
- Herbicides/weed killer
- Chemical lawn fertilizers
- Insect repellants
- Gasoline
- Fuel oil
- Used oil products
- Solvents and thinners
- Pharmaceuticals and drugs (or return to pharmacy)
- Aerosols and empty aerosol cans
- BBQ propane tanks
- Camping fuel cylinders
- Oil tanks

- CFL and fluorescent light bulbs
- Fluorescent lighting ballasts manufactured before 1980
- Thermostats
- Household thermometers (mercury-containing)
- Residential fire extinguishers
- Any products labelled as corrosive, toxic, reactive, explosive, oxidizing, poisonous, infectious, or flammable
- Any product or container labelled as follows:

Reactive | Poisonous and **Infectious** | Oxidizing | Flammable and **Combustible** | Corrosive | Compressed Gas

4.1.5.2 Household Hazardous Waste Non-Acceptable Materials

The following materials are not accepted as HHW:

- Electronics
- Sharps and other household medical waste

4.1.6 Exterior Material Process and Storage Areas

The exterior yard area (gravel surface) includes equipment and locations for the processing and temporary segregated storage of select materials, including:

- Vehicle Baler/Logger unit (trailer-based).
- End of life vehicles awaiting decommissioning/crushing, crushed vehicles and salvageable metals.
- End of life vehicle and equipment tires.
- HHW intermodal containers.
- HHW 40'Lx12'D, 4-compartment, built in accordance to FM 6049 Standards (Loraday Model LEP/L73-4013 Storage Container or equivalent)
- Baled waste (to address short-term instances when direct transport to the Landfill is not possible).
- A dedicated area for the potential future installation/operation of an in-vessel organics composting unit (including a curing area allowance).
- A dedicated area for the potential future development of a greenhouse.
- Snow storage areas to support yard clearing efforts.

4.2 Landfill

4.2.1 Landfill Access Road

A two-lane, gravel-surfaced road connecting the existing Qaqqamiut Road to the Landfill site is being established by the City as a component of the Landfill and WTS project. The road will also provide access to the Northwest Aggregate Deposit, situated to the west of the landfill property.

With reference to Figure 1-3, two roads will extend off of the Northwest Aggregate Deposit road to access features of the Landfill;

- Main Landfill access and perimeter road.
- Leachate management system access road.

Lockable security gates are situated at the entrance of each access road, complete with identification signage. As new landfill cells are established, the perimeter road will be extended, as necessary. All site roads are two-lane and gravel-surfaced.

4.2.2 Landfill

A 22 ha area on property approximately 5.5 km north of the WTS has been designated to serve as the disposal location for the City's baled municipal solid waste (MSW), select processed materials (e.g., tires, bulky items) and non-divertible C&D waste materials for 75 years. A primary design feature of the Landfill is the use of a membrane liner system with a dedicated leachate collection layer within the defined landfill footprint. The liner is scheduled to be installed in 12 (number to be refined during the operational life of the facility) sequential sections or "cells" throughout the operational life of the site. As part of the initial construction effort for the Landfill (scheduled for the 2021, 2022 and 2023 construction seasons), the first landfill cell, with a total area of approximately 2.3 ha, is to be installed. Cell 1 has been designed to address the City's disposal requirements for approximately the first five years of operation.

Detailed discussion on the Landfill liner system is provided in **Section 7.0**. A description of waste placement procedures at the Landfill is presented within **Section 8.3**.

4.2.3 Cover Borrow Area

Cover material required to support Landfill operations, including bale/waste covering and final grading, is scheduled to be acquired from the Northwest Aggregate Deposit.

4.2.4 Attendant's Trailer

A premanufactured, wood frame trailer will serve as a shelter for site personnel while they are at the Landfill. The trailer will include a wood stove and a composting toilet. No equipment will be stored within the trailer due to the remoteness of the location, and the potential for theft and/or vandalism.

4.2.5 Leachate Management System

The Landfill's leachate management system includes a leachate collection layer/piping within the cell liner, a collection sump with extraction manhole, a portable pump complete with mechanical float control discharge hosing/discharge piping, two retention ponds (with the ability to convert into bioreactors). Acknowledging significant uncertainties regarding the quality and quantity of leachate that will be generated by the landfill (e.g., the unique situation of having plastic wrapped waste bales in an arctic setting), the initial leachate management system will consist of collection and storage infrastructure only. The landfill operator will install the pump and generator each day during the warm season, and the pump will operate on/off based on the float. At the end of the day the operator will remove and store the generator and pump.

The portable pump, located in the manhole, will be conrolled by portable floats in the manhole, which is in the cell sump. The allowable head would be equal to the depth of the sump of 1.0 m or approximately 300 mm over the floor of the cell.The leachate head in the landfill sumps will be measured by a staff gauge bolted (SS316 bolts) to the interior of the manhole. If required, the gauge can be removed at the end of the pumping season to prevent damage. Incase the staff gauge is missing a tapemeasue can be used to appeoximate the depthof leachate. Hoses would not be used for leachaete pumping, Flanged and bolted solid wall HDPE piping would be installed at the start of the season and removed and stored at the end of the pumping season.

The volume of the ponds has been established based (conservatively) with the objective of providing two years of leachate effluent and precipitation storage capacity. By assessing generation rates and effluent characteristics during the initial operational period of the landfill, it is believed that an economic treatment system appropriate to the unique conditions of the City of Iqaluit site can be designed and subsequently installed as part of a future initiative. As the ponds are lined with HDPE a HDPE staff gauge as presented in the design drawings would be welded to HDPE liner on the inside slope of the ponds.

Four sumps, located in Cell 1, Cell 4, Cell 7 and Cell 10, are proposed in the landfill. The Cell 1 sump would receive leachate from from Cells 1, 2 and 3. When Cell 4 is constructed the temporary berm between Cell 1 and Cell 4, as illustrated on Drawing LF-C15, would be removed and leachate in Cells 1 to 3 would flow toward the Cell 4 sump. The removal of the berm is necessary as the Cell 1 sump is located in the north of the cell and will be covered with waste as waste is placed in Cell 4. Cell 4 would receive flow from Cells 4, 5 , 6 and from Cells 1 , 2 nd 3. Cell 7 would accept flow from Cells 7, 8 and 9. And Cell 10 handles Cells 10, 11 and 12. For the sump in Cell 10 false grading is required to eliminate the low pount north of the sump so that leachate can be directed into the sump as illustrated on Drawing LF-C15.

Additional information on the leachate management system, including contingency measures, is presented in **Section 12**.

4.2.6 Monitoring Network

The development of the Landfill and WTS included the establishment of defined monitoring locations for surface water and active layer/groundwater. With regards to potential impacts of landfill infrastructure to permafrost, a thermistor array is situated in the base of the liner systems for both the landfill and the leachate treatment system ponds.

Details on the monitoring network and the overall monitoring program are presented in the latest version (under separate cover) of the Landfill and WTS Facility Monitoring Program (FMP).

5.0 Mobile Equipment

Mobile equipment selection has been based on the evaluation of the operational functions to be performed, including activities within the WTS, within the WTS yard and at the Landfill. Beyond waste handling related activities, other mobile equipment use requirements include access road maintenance, snow removal and dust control. Equipment used as part of site operations is owned by the City. The listing of recommended site equipment is as follows:

1. Wheel Loader
   - 150 - 160 HP, diesel.
   - Provided with quick-detach forks, grapple bucket, plow blade, general-purpose bucket and landfill package.
   - For waste handling in the WTS yard, bale/waste placement at the Landfill, snow removal and road/yard maintenance.
2. Compact Wheel Loader
   - 110 – 120 HP, diesel.
   - Provided with quick-detach forks, grapple bucket, waste handling bucket (complete with rubber leading edge), plow blade, solid tires, transfer station package.
   - Waste/bale handling within the WTS, snow removal and yard maintenance.
3. **Forklift**
   - Electric.
   - 2500 kg lifting capacity.
   - Bale handling within the WTS including loading of the Bale Truck.
4. Bale Truck
   - 350 HP, diesel.
   - Tandem straight truck, flatbed.
5. Vehicle Baler/Logger
   - 175-215 HP, diesel.
   - Trailer-based unit.
   - Provided with hydraulic landing gears, knuckle boom material handler, bale density 400 to 1300 kg/m^3.
   - Crushing and baling end-of-life vehicles, white goods and miscellaneous metals.
6. Portable Tire Shear
   - 25-35 HP, gasoline.
   - Trailer-based unit.
   - Minimum 3000 psi hydraulic rating.
7. Staff Truck
   - 4 x 4 Crew Cab, Super Heavy Duty.
   - Provided with snowplow attachment.

In addition, back up equipment will be available from local rentals and contractors, should anomalous situations dictate the need for additional equipment. Routine maintenance and cleaning will be performed (as necessary) to keep equipment in good operating order.

A maintenance program exists for all on-site equipment and is to be performed following the equipment manufacturer's guidelines. The City holds contracts with heavy equipment suppliers to provide all scheduled maintenance. Daily routine maintenance activities will be the responsibility of the mobile equipment operators. Routine activities will include (but not be limited to) the following:

Tires

- Check for debris embedded in the tire, repairing or replacing, as necessary.
- Check tire wear condition.

Air Filters

- Check for dust clogging and replace, as necessary.

Radiators

- Check for dust and debris clogging and clean, as required.
- Check for punctures and repair or replace, as necessary.

Undercarriage

- Check for damage and repair, as required.

Hydraulic Lines

- Check for wear points, cracks and fitting leaks, replacing, as necessary.

6.0 Stationary Equipment

The following list identifies stationary equipment associated with waste processing activities within the WTS:

1. Waste Baler
   - Two ram configuration.
   - Peak throughput = 20 tonnes/hour.
   - Dual hydraulic pumps, 600 VAC 60 Hz electric TEFC motors.
   - Dedicated above floor conveyor.
   - Automatic wire tier.
   - Complete with bale wrap system.
2. Waste Shredder
   - Stationary, low speed, high torque unit.
   - 30 HP electric drive motor, 460 VAC 60 Hz.
   - Suitable for MSW including wood pallets, furniture, select C&D materials and old corrugated cardboard (OCC).
   - Direction of processed material to either the Biomass Boiler (wood and OCC) or the Waste Baler for disposal at the Landfill.

Further information, including operational and maintenance requirements for the baler, shredder and other equipment/systems supporting WTS operation (e.g., biomass boiler/heating system, ventilation system, fire suppression system, electrical/control systems) is provided in manufacturer documents.

Manufacturer's information should be reviewed in detail by facility personnel before use, maintenance or repair.

7.0 Liner Development and Sequencing

7.1 Landfill Liner System

The four primary components of the landfill liner system, from the top down, consist of a leachate **collection layer**, a geomembrane liner, cushion layer and a base layer. These components are described below. Refer to Figure 7-1 for a typical schematic of the composite liner system.

Leachate Collection Layer

The leachate collection layer consists of a granular layer (38 mm clear stone) with a total thickness of 600 mm and perforated HDPE collection piping. The perforated collection piping is placed at the bottom of the collection layer to collect and direct leachate to the collection sump.

Geomembrane Liner

A flexible geomembrane liner (80 mil textured HDPE) is situated under the leachate collection layer, as the primary barrier to leachate migration. The top and bottom of the flexible membrane liner are protected with non-woven geotextile.

Cushion Layer

The cushion layer, 200 mm of designated fill material, provides the top working surface of the landfill cell and offers protection (e.g., vehicle/equipment movements, waste puncture hazards) to the underlying Leachate Collection Layer.

Base Layer

The entire liner system is constructed on an engineered base. The native material at the site will be graded, and a 200 mm thick granular grading pad will be placed over the native material. Additional compacted soils will be placed at the site, where required for grading. Where possible, a 1.5 m separation distance from the underside of the geomembrane and the seasonal high groundwater table.

To monitor potential impacts of the liner system to permafrost, a thermistor array is situated within the base layer.

Where required for soil separation, a geotextile will be placed below the base.

7.2 Liner Installation Sequence

The overall defined landfill footprint to accommodate 75 years of operation is approximately 22 ha in size. Within that footprint, a total of 12 disposal areas or cells (to be confirmed during site development) have been identified. The first designated cell in the overall sequence, Cells 1, is scheduled for installation during the 2021 and 2022 constructions seasons.

Timing the installation requirement for the next lined area in the sequence is critical. Installation can only be practically completed during the non-winter months and adequate time must be allotted for the development of design documents, tendering and delivery of construction materials. The calculation to determine this timing is linked to defined bale placement requirements. Specific aspects of bale placement are discussed in detail in **Section 8.3**.

Tracking of disposal area utilization is the responsibility of the Manager. The primary elements of the installation timing calculation are as follows:

1. Referring to the Engineering Drawings, determine the remaining space (volume) available for the placement of bales. This estimate must incorporate bale placement requirements including perimeter side slopes and the pre-defined lift installation sequence. For example:
   - Remaining Volume (Vr) = 6,240 m^3
2. Confirm the number of bales of waste per week currently requiring disposal. If significant changes to the current volume of incoming waste are anticipated (i.e., accepting material from a new service area), then this value should be adjusted accordingly. Based on an average bale volume of 1.5 m^3, calculate the weekly bale disposal volume requirement. For example:
   - Bale Volume Requirement (Vbr) = 120 m^3/week
3. Divide the estimate of remaining balefill volume (1) by the weekly bale disposal volume requirement (2) to determine the number of remaining weeks of disposal space. For example:
   - Vr/Vbr = 6,240 m^3/(120 m^3/week)
   - = 52 weeks

If it is determined that inadequate space is available to serve operations until late the following summer (i.e., August), then actions will need to be initiated towards the design and installation of the next lined disposal area in the sequence. For example, if the above sample calculation was completed in January 2024, the expectation would be that available balefilling space would be exhausted 52 weeks later in January 2025. Therefore, construction of the next disposal area would be necessary during the summer of 2024.

8.0 Waste Receiving, Placement and Sequencing

8.1 Types of Waste

8.1.1 Acceptable Wastes

Any waste disposal option has limitations with respect to the waste streams which may be handled in an environmentally safe manner. Limits must be placed on the types of waste accepted at a municipal disposal site, to protect the environment, the employees, the users and neighbours, as well as the equipment from damage, while simultaneously providing adequate levels of service.

The Manager shall allow only those materials to be accepted (for processing and/or disposal) at the Landfill and WTS, except for unique circumstances reviewed in consultation with NWB, for which the facility has been designed to accommodate, namely, MSW. Referencing the Environment and Climate Change Canada (ECCC) document Solid Waste Management for Northern and Remote Communities, Planning and Technical Guidance Document, MSW is defined to include "reusables, recyclables, compostables, and residual waste (i.e., garbage) from homes, businesses, schools, and other *institutions."* Concerning the IWMF, this definition includes end-of-life vehicles, large appliances, salvageable metals, furniture, passenger vehicle tires, and C&D materials

The following materials may be received at the site; although, none of the items listed is considered **suitable for routine baling/disposal**. As a result, the Manager will specify in each case an appropriate disposal method and location. The Manager reserves the right to limit the amount of these materials received at any one time, or to define the material as non-acceptable waste and to specify management requirements.

1. Contaminated soils meeting the acceptance requirements of NWB Analytical test results for all candidate materials will be evaluated by the City and NWB. No material will be accepted for disposal until this evaluation has been completed. Subsequent management requirements for accepted soils will be defined on a case-by-case basis, in consultation with NWB.
2. Non-hazardous incinerator ash, fly ash and wood ash when properly quenched and cooled. Large **quantities of ash may require special pre**-treatment before being accepted at the site and may require special disposal methods.
3. Electrical transformer casings on the condition that all oils have been removed consistent with applicable regulations and that the units have been rendered free of potentially hazardous materials. Salvageable casings will subsequently be held at the site's dedicated metals storage area.
4. Biomedical waste originating from human and animal health care facilities, providing it has been autoclaved or incinerated and is packaged according to the Government of Nunavut Environmental Guideline for Biomedical and Pharmaceutical Waste (dated March 2014 or as amended).
5. Carcasses of animals weighing less than 25 kg.

All wastes not specifically fitting into the above categories, and not specified as unacceptable, will be referred to the Manager and NWB for recommendations as to their acceptability and appropriate disposal methods.

8.1.2 Non-Acceptable Wastes

Wastes, which present a danger to the public, staff, infrastructure or the environment at the WTS or Landfill, which require special disposal techniques, and which may interfere with the level of service to the public or are in contravention with regulatory stipulations, are not acceptable for disposal. In some cases, wastes which are acceptable in small quantities may not be acceptable in large quantities from a single generator because they may cause the level of service to other users to deteriorate and cause handling problems at the site, and increased environmental liability. To some extent, the acceptability of large quantity wastes must be at the Manager's discretion, depending on the ability to accommodate disposal without deterioration in the level of service. In cases where unacceptable wastes are identified, site staff will attempt to identify allowable management alternatives to material haulers.

All wastes which pose potential safety or environmental problems cannot be listed in their entirety. The Manager and site personnel, in general, must be wary of accepting wastes which could cause future operational problems and must watch for the inclusion of unacceptable wastes in regular loads of refuse.

A list of materials which MAY NOT be accepted at the Landfill or the WTS are as follows:

1. Explosives or highly combustible materials of any nature.
2. Gas cylinders, unless the valve has been removed and the cylinder properly drained by a professional trained in handling gas cylinders.
3. Radioactive materials.
4. Chemicals and chemical wastes, including sludges from water and wastewater treatment plants and other generators.
5. Any hazardous materials, which may be classed as corrosive, reactive, toxic or flammable.
6. Carcasses of animals weighing more than 25 kg.
7. Liquid wastes, including herbicides, insecticides or other sprays, paints, oils, and solvents.
8. Septic tank waste and sewage treatment plant sludges, unless a facility is specifically designed for their disposal or they have been pre-treated following the requirements of the Nunavut Water Board and/or other relevant regulatory authority.
9. Fish/meat processing wastes.
10. Hot ashes.
11. Any liquids, or liquid waste, of a quantity greater than 5 L in any one load.
12. Dangerous goods as defined by the *Nunavut Consolidation of Transportation of Dangerous Goods* Act (e.g., poisonous substances, infectious substances, oxidizing substances).

13. Biomedical wastes that are not treated before disposal according to the Government of Nunavut Environmental Guideline for Biomedical and Pharmaceutical Waste (dated March 2014 or as amended).
14. Any other materials not listed as acceptable or conditionally acceptable with the approval of the Manager.

8.2 Waste Receiving and Processing

8.2.1 Waste Inspection and Control

All waste arriving at the WTS is subject to inspection for unacceptable materials (see **Section 8.1.2**). Inspections shall be conducted at the Scale House and on the tipping floor of the WTS. It is the responsibility of employees at the Landfill and WTS to be aware of acceptable wastes, and those that are unacceptable or hazardous to the staff and the general public.

The first opportunity for waste inspection and control at the WTS occurs at the Scale House, where the following procedures shall be employed:

- All incoming vehicles are required to report to the Scale House. Small, private residential haulers (i.e., cars or ½ ton pickup trucks) are directed to the small vehicle drop-off area located on the south wall of the tipping floor. Larger residential-source loads (i.e., ¾ ton pickup trucks, trailers) and all commercial waste haulers are weighed, charged based on the standard per tonne tip fee, and directed to the tipping floor for disposal.
- At the Scale House, all incoming loads are recorded using a computer-based tracking and billing system. Information collected includes waste type, origin and weight. Scale information is collected for materials destined for the WTS tipping floor, WTS material segregation areas and the Landfill.
- Incoming waste is subject to visual checking at the Scale House at the direction of the Facility Supervisor. A high-mounted video camera is provided at the Scale House for spot checks.
- The Scale House Operator shall advise the Facility Supervisor of any observed unacceptable waste.

The second opportunity for waste inspection control exists on the WTS tipping floor:

- Equipment operators and other staff will remain vigilant for unacceptable or potentially hazardous wastes during unloading, conveyor loading, and baling.
- All site operations personnel shall receive training to assist in recognizing unusual, unacceptable and hazardous wastes.
- When a staff member encounters suspect waste on the tipping floor, baling shall cease until the material is segregated and appropriate action (as identified in the **Section 8.2.2**) is taken. The procedures outlined in the facility's Emergency Response Plan (ERP) (see Appendix B) may apply if the waste is suspected to be hazardous.

In addition to these methods, thorough random checks may be performed on the tipping floor at the discretion of the Facility Supervisor:

- The Scale House Operator will inform the hauler that a random check is to be performed. If the hauler refuses, the vehicle will not be permitted entry to the site and will be selected for a check on its next visit. The Scale House Operator will record, as much information as possible, about haulers who refuse a random check.
- The selected hauler will be directed to an area on the tipping floor that is separate from all other incoming waste. Before dumping, the driver of the inspected vehicle will confirm the absence of unacceptable materials. An inspector (the Facility Supervisor or a designate) will examine the load for hazardous or unacceptable wastes.

8.2.2 Handling Unacceptable Waste

Unacceptable wastes may be classified as non-hazardous, potentially hazardous or unacceptable, and, depending on the time of discovery, may or may not be associated with a known hauler. The following outlines appropriate procedures for handling unacceptable waste:

- Non-hazardous, unacceptable waste delivered by a known hauler will be reloaded by the hauler, if necessary, and removed from the site.
- Non-hazardous, unacceptable waste delivered by an unknown hauler may be removed from the site, processed to render it acceptable, or accepted as a special circumstance at the discretion of the Manager.
- Suspected hazardous (and therefore unacceptable) waste delivered by a known hauler will be reloaded by the hauler, if necessary, and removed from the site. The responsible site staff will complete a Waste Inspection/Attempted Delivery of Hazardous Waste Form, included in Appendix A, and inform NWB of the attempted delivery.
- If reloading or further transporting of the suspected hazardous waste is considered unsafe, NWB will be contacted for direction. Costs associated with the attempted delivery will be borne by the hauler and they shall be notified that they will be financially responsible for removal of the waste.
- Suspected hazardous waste delivered by an unknown hauler (i.e., discovered at the site) will be transferred, as directed by the Manager to a portion of the tipping floor designed for storage of suspected hazardous waste. The waste will be tested by a qualified firm at the discretion of NWB and the final disposal options determined based on the results.

Depending on the nature and condition of the suspected waste, safe transfer to the holding area, may not be possible. NWB is to be contacted for direction. The costs will be borne by the City.

Further procedures for handling unacceptable and/or suspected hazardous wastes are provided in the ERP for the Landfill and WTS (see Appendix B).

Once a waste is suspected to be hazardous, the onus is on the hauler to demonstrate otherwise or remove the waste, at their expense. Repeat deliverers of unacceptable or hazardous wastes may be banned from the site at the discretion of, and for a period determined by the Manager and/or the City.

8.2.3 Waste Baling

Following the completion of inspection procedures, material on the tipping floor is pushed using a front end loader to the conveyor infeed. The rate of material transfer from the conveyor to the baler hopper is regulated by the Baler Operator. Similarly, the Baler Operator controls the hydraulic rams, wire tying device and bale wrapper associated with the baler.

Following ejection from the baler, the bales are transferred (utilizing a forklift) to a flatbed truck for transport to the bale*f*ill.

8.3 Waste Placement and Covering

8.3.1 Waste Placement

Utilizing the Landfill's access road, bales of municipal solid waste will be delivered by site personnel from the WTS to the active disposal area. With the possible exception of loads of unique or difficult wastes, waste delivery vehicles and/or the general public will not have access to the Landfill area.

The Landfill is constructed from a series of individual lifts. Bales are removed from the flatbed truck via a fork-equipped front end loader. A lift is constructed by stacking bales three to four high; the height limit being set by the reach limit of the front end loader. The total height of a four bale lift is approximately 3 m. During bale stacking, the bales are placed with their widest dimension perpendicular to the direction of balefilling. Processed (shredded) or modest-sized C&D materials can be placed in bale voids on perimeter side slopes with granular fill subsequently being placed to develop a base for the final landfill cap.

To address the potential requirement (due to the temporary unavailability of the WTS baler) to accept unbaled MSW at the Landfill, it is recommended that the material be placed in a constructed void space (e.g., not placing bales in a designated area to establish a shallow "disposal pit") within the active bale placement area. Aggregate cover can then be placed over the material to prevent the potential for blowing litter. A similar containment approach can be used for C&D debris that presents a blowing litter potential. As an alternative, should the baler be inoperable for an extended period, the site could be temporarily operated as a traditional landfill, with waste being placed over a larger horizontal area (e.g., 300 m^2 with individual lifts of 400 to 600 mm) and then compacted with a bulldozer or (if available) the North 40 landfill compactor. To address concerns of blowing litter, a thin (e.g., 75 mm) cover layer of aggregate would need to be placed over the final waste lift at the end of each day.

To allow for a minimum four (horizontal) to one (vertical) side slopes for the fill area, the bales must be staggered during placement, utilizing the arrangements shown in Figure 8-1. The required side slope is attained, while still providing efficient usage of the available disposal volume. The staggered arrangement should be maintained until the final design elevation is reached.

The horizontal top cover should be placed to provide between 2% and 4% grade. A minimum side slope of 1% should also be established on the horizontal surface towards the passive vertical faces to direct runoff away from the working face.

Elements relating to the progression of solid waste balefilling at the facility are illustrated on the Engineering Drawings. The Landfill area development follows a sequence of composite liner installation within a specified disposal area, the orderly placement (or stacking) of cells of baled solid waste within the disposal area, installation of composite liner in the next required disposal area, and the repeat of the process until final grades are reached and the area is capped.

Figure 8-1: Staggered Bale Placement

The staged, sequential development of the individual cells within the balefill area serves as the primary organizing factor in the facility's operation. The sequence established as part of the facility design is based on four main operational requirements:

1. To install the liner sequentially as defined cells.
2. To allow mobile site equipment access to all levels of the fill area.
3. To limit the height of vertical bale faces.
4. To achieve final design height (to allow for the installation of the landfill cap), as soon as possible.

Additional information relating to site development is included on the Engineering Drawings.

As the balefill reaches the final grades proposed on the Engineering Drawings, settlement can be expected. The completed areas should be inspected regularly, and any cracks in daily/intermediate cover or areas of ponding water should be regraded to maximize surface runoff. If necessary, additional cover material should be added to ensure positive surface drainage.

CH_4 gas is a by-product of solid waste anaerobic degradation. **Section 11.0** describes LFG vent installation and the Engineering Drawings present the proposed location of the vents.

8.3.2 Waste Covering

Acknowledging the baled and wrapped condition of the waste materials, the relatively limited amount of annual precipitation and a lack of available low permeability soil cover, the placement of locally-sourced aggregate cover over the waste bales is required only as a precursor to final capping. In select instances, at the discretion of the Manager, the placement of aggregate cover over a non-typical waste material (e.g., presenting a blowing litter, animal/vector attraction and/or litter generation risk) may be deemed appropriate.

8.3.3 Cover Borrow Areas

As noted in **Section 4.2.3**, cover material required to support the Landfill's operations, including bale/waste covering and final grading, is scheduled to be acquired from the Northwest Aggregate Deposit.

8.3.4 Inclement Weather

Wet weather operation may require the use of stockpiled crushed rock and (potentially) demolition rubble to maintain road access to the Landfill working face. This function should be undertaken to ensure reasonable access at all times, as required.

During the winter season, snow clearing of the Qaqqamiut Road, Northwest Aggregate Deposit access road and the two landfill components (Landfill and Leachate Management System) will be required. Similarly, ongoing snow removal the WTS access routes, as well as the general yard area, will be

necessary. It is acknowledged that extreme snowfall/blizzard events could result in temporary discontinuation of operations at the WTS and/or Landfill.

8.4 Surveying and Horizontal/Vertical Control

The landfill cell and footprint limits will be clearly defined in the field. To aid in the construction of the Landfill, permanent benchmarks have been established for horizontal and vertical control. The locations of these benchmarks are defined as a component of the Engineering Drawings.

As construction of the Landfill progresses, the Manager will utilize grades stakes to ensure that the construction is in accordance with the approved plans. The frequency of the staking is controlled by the size of the site and the volume of waste received. Due to settlement, stakes set on previously filled areas should not be used as temporary benchmarks for future staking. If the stakes are required for a long period, they will be checked and reset frequently.

During the application of the final cover, elevation control will be established daily. The required thickness of the final cover will be monitored using settlement plates placed at the top of the waste with painted gradations indicating the required layer thicknesses.

It is the Manager's responsibility to see that all necessary construction staking is accomplished and to apprise the equipment operators of their presence. The Manager will employ or engage the services of a qualified individual(s) to perform the day-to-day operational surveying needs of the site.

8.5 Landfill Cap

Upon achieving final design grades, future infiltration of precipitation into the waste mass (and thus the leachate collection system) will be mitigated through the installation of a landfill cap. The cap, as illustrated in Figure 8-2, consists of a surface drainage layer (450 mm of 75 mm clear stone) geomembrane barrier (60 mil textured LLDPE). Nonwoven geotextile is positioned above and below the geomembrane to provide protection during construction and closure activities.

As described in **Section 11**, vents will be installed at select locations in the final cap to allow for the release of LFG.

Figure 8-2: Landfill Cap Schematic

9.0 Nuisance Control

9.1 Litter Control

Litter can be a significant problem at municipal solid waste disposal sites. At the facility, three factors will serve to reduce the problem significantly:

1. All incoming waste (except for periodic bulky materials) will be handled within the WTS.
2. Waste arriving at the working face will be in high-density, wire-tied and plastic-wrapped bales, with deposition occurring in an orderly "stacking" manner.
3. Use specialized placement procedures and use of aggregate cover at the Landfill in instances where delivered waste presents a littering potential (see **Section 8.3.1**).

Acknowledging that a notable reduction in litter generation is expected at the City's site (over that associated with a standard landfill), a litter control program will still be maintained at this location. Litter control is best accomplished by a combination of proper disposal operations, litter retaining fences and a litter picking program. A clean, litter-free appearance will be maintained at the site at all times, not only for public relations but also for the efficient operation of the Landfill. Poor litter control would attract unwanted wildlife and contribute to surface drainage problems by blocking ditches and culverts.

In summary, litter control measures to be implemented at the Landfill and WTS include:

- Semi-permanent litter collection fencing shall be positioned around the active area to catch blowing litter (see Engineering Drawings).
- A vigorous litter collection and patrol program shall be directed by the Manager.
- Litter on fencing, on-site roadways, in ditches, in the WTS yard, and adjacent properties shall be monitored and collected on a minimum weekly basis.
- The arriving waste must be covered according to applicable City bylaws. Vehicles arriving uncovered shall be turned away.
- Use of specialized placement procedures at the Landfill for wastes that present a blowing litter potential.

With respect to the plastic bale wrap, it is recommended that its durability be monitored by facility staff on an ongoing basis to identify requirements for operational modificaitons, including applying additional layers of wrap and/or the selection of a different wrap product. This evaluation should be conducted in collaboration with the bale wrapping unit manufacturer.

9.2 Odour Control

Odours will be controlled at the facility by the implementation of the following daily measures:

- Timely removal of waste from the WTS tipping floor (e.g., baled and delivered to the Landfill).

- Short-term storage of waste bales at the designated location within the WTS yard only in exceptional circumstances (e.g., extreme weather events or landfill access issues).
- Gas venting and collection systems (if necessary) shall be established and maintained in good working order (see **Section 11.2**).
- Leachate springs at the Landfill shall be promptly repaired.
- Complaints regarding odour shall be recorded (see Appendix A) and acted upon. Complaints shall also be correlated to relevant weather information.

Odour control will also be achieved by routine site inspections to identify and eliminate localized surface water ponding and/or surface water drainage problems. Should odours become a problem, an on-site evaluation will be performed and appropriate remedial actions taken based on the results of the evaluation.

9.3 Dust Control

Due to transport and placement activities at the site, as well as the number of gravel surface roadways, dust control will be an important operational consideration. Dust control measures to be implemented at the Landfill and WTS include the following:

- The site shall be monitored daily during dry weather.
- Vehicle speeds shall be limited on-site to 10 kph within the WTS compound and at the Landfill, particularly during dry periods. Adequate signage shall be posted and limits enforced.
- On-site roads shall be maintained to minimize dust emissions.
- Asphalt surfaces (e.g., scale ramps) shall be routinely swept.
- Calcium chloride shall be applied to roads, as necessary. The rate of application shall be recorded, using the daily checklists (see Appendix A).

9.4 Vector and Bird Control

Solid waste disposal facilities can attract rodents and birds due to the availability of food and the potential for breeding habitats in the waste. Limiting the availability of food and void space, resulting from the compacted nature of the baled waste, will discourage their habitation.

9.4.1 Vector and Animal Control

Control measures include the following:

- Litter collection shall be conducted daily to mitigate the attraction of vectors and animals.
- If a baiting program is required for rodents, it shall comply with regulatory requirements regarding the use of pesticides.
- If burrowing animals utilize the leachate holding ponds as habitat, contact Nunavut Department of Natural Resources to determine the safest manner of removing the animals.

Acknowledging the potential risks, all staff assigned to duties at the Landfill shall be properly trained in bear safety.

9.4.2 Bird Control

Control measures include the following:

- Minimize potential roosting areas within the WTS (e.g., using netting and/or landing surface spikes).
- Litter collection shall be conducted daily.
- If the problem is persistent, a more intensive program shall be initiated, which may involve the use of noise-generating devices.

9.5 Noise Control

All equipment powered by internal combustion engines have mufflers installed and will be maintained following manufacturer's recommendations.

Regular hours of operation at the WTS shall be restricted to a posted schedule acknowledging the use of back up alarms/indicators on mobile equipment.

9.6 Open Burning

Open burning of any material will not be permitted at the Landfill or WTS.

9.7 Indiscriminate Dumping

Waste is to be disposed of at designated areas at the facility (i.e., WTS tipping floor, material storage areas or Landfill) only. When indiscriminately dumped materials are discovered, they are to be immediately relocated to the appropriate designated area.

10.0 Surface Water Management

10.1 General Description

Surface water at the Landfill is conveyed primarily via overland and sheet flow, ultimately concentrating into channel flow to the east of Sylvia Grinnell Territorial Park, at which point it flows southerly toward the Iqaluit Airport, ultimately discharging to the Koojesse Inlet at Frobisher Bay. Runoff from the WTS site follows the City's drainage network in a southerly direction and into Koojesse Inlet.

Surface water for the Landfill and WTS is classified into two categories:

Stormwater from Developed (Disturbed) Areas

- Includes any surface water from the WTS compound, active and non-active portions of the constructed Landfill, outside slopes of berms, access roads and capped areas. This water is collected in ditches and directed prescribed discharge points, as indicated on the Engineering Drawings.

Stormwater from Non-Developed (Undisturbed) Areas

- Surface water from undeveloped areas or right-of-way areas. This water is discharged directly off-site.

It is noted that precipitation coming in contact with waste materials (e.g., baled waste and C&D materials) will be captured within the Landfill's leachate collection system and will enter the site's surface water ditching.

10.2 Control Ditching

Surface water control is provided through permanent WTS compound/Landfill perimeter ditching, as well as interim/temporary ditching. All permanent ditching is designed to accommodate the peak 100 year return period stormwater flow condition. Permanent culverts are designed to accommodate peak 10 year return period stormwater flows. The interim ditching and culverts are capable of handling the peak five year return period stormwater flows generated on the site.

Noting the anticipated lack of fine grained, erodible soils at the Landfill or WTS, sedimentation control has not been identified as an issue of concern for the design of surface water management features. General operational procedures to limit the potential for negative impacts associated with erosion and sedimentation are incorporated in the Construction and Operations, Closure and Post-Closure Environmental Protection Plans for the Landfill and WTS project.

Primary operational requirements relating to the surface water control ditching include the following:

- Stable aggregate cover shall be maintained in the ditches and on other site surfaces.
- Positive flow shall be maintained away from all buildings.
- Ditches shall be maintained to prevent side slopes from sloughing.
- Ditches shall be kept free of debris, as required.
- Culvert headwalls shall be maintained.

11.0 Landfill Gas Management

11.1 General Description

CH_4 and carbon dioxide (CO_2) are the primary constituents of LFG and are produced by microorganisms within the balefill, under anaerobic conditions. Carbohydrates from paper, cardboard and similar materials are decomposed initially to sugars, mainly to acetic acid, and finally to CH_4 and CO_2. Other components of LFG include non-methane organic compounds (NMOC) and inorganic compounds. NMOC originate from the disposal of aerosols, paints, oils, solvents and similar products in the Landfill. Inorganic compounds, such as hydrogen sulphide, originate from the decomposition of reactive waste products.

LFG generation, including rate and composition, proceeds through four characteristic phases throughout the lifetime of a landfill. The first phase is aerobic (e.g., with oxygen available) and the primary gas produced is CO_2. The second phase is characterized by O_2 depletion, resulting in an anaerobic environment where large amounts of CO_2 and some hydrogen are produced. In the third anaerobic phase, CH_4 production begins, with an accompanying reduction in the amount of CO_2 produced. Nitrogen (N_2) content is initially high in the balefill gas in the aerobic first phase and declines sharply as the Landfill proceeds through the anaerobic second and third phases. In the fourth phase, gas production of CH_4, CO_2 and N_2 becomes fairly steady. LFG is typically described as comprised of 50% CH_4 and 50% CO_2; although, the percentage of each may vary considerably.

The phase duration and time of gas generation varies with site conditions (e.g., waste composition, cover materials, design, anaerobic state), and may also vary with climatic conditions such as precipitation rates and temperatures. Because CH_4 is combustible, it poses a greater risk to safety than CO_2. If vented in an uncontrolled manner, CH_4 can accumulate in enclosed spaces on, or close to, the disposal site. CH_4 gas is odourless, and because its density, is less dense than air. It rises until its movement is restricted by some impermeable medium. For example, in winter, the frozen surface of the ground may block the vertical escape of CH_4, forcing it to move laterally. Also, CH_4 is insoluble in water; therefore, it will not move below the groundwater table. This presents the risk of fire or explosion. Concentrations of CH_4 between 5 and 15% in air are explosive. With proper venting; however, CH_4 gas should not pose an unacceptable hazard. Research has shown that the rate of decomposition in landfills, as measured by CH_4 gas production, reaches a peak within the first two years and then slowly tapers off; although, continuing in many cases, for periods up to 25 years or more. Therefore, CH_4 venting must be accommodated during and after balefill completion.

It is expected that the low average annual temperature, relatively limited amount of annual precipitation and the baled and wrapped configuration of the waste will tend to reduce the intensity of LFG generation at the City's site. Further, migration of permafrost into the waste mass overtime at the Landfill may serve to deter waste degradation altogether. However, it is acknowledged that ongoing

effects associated with climate change (e.g., warmer and wetter weather in the north) could result in increased LFG generation rates in the future.

11.2 Landfill Gas Vents

LFG vents will be installed, as specified throughout the fill area, to allow for the controlled discharge of this gas. Suggested locations for these vents are shown on the Engineering Drawings. The vents should be extended in height as the site is developed. Recommended construction details for a typical gas vent are provided in Figure 11-1.

If explosive concentrations of CH_4 are detected during the monitoring program, the ventilation capability of the vent itself, as well as the overall spacing of vents, should be investigated. It may become necessary to consider a positive type ventilation system (such as gas extraction) if the problem is not easily remedied.

CO_2 gas is not considered to present a high risk to safety with regards to above ground operations. However, since it is heavier than air, CO_2 will collect in the bottom of manholes, poorly vented trenches, and other below-ground areas. Therefore, site personnel should take appropriate precautions, such as the use of a respirator or forced ventilation, before entering these areas.

Primary operational requirements relating to LFG control include the following:

- LFG vents shall be installed in the Landfill area, according to spacing identified on the Engineering Drawings.
- CH_4 gas detection levels shall be monitored at each vent semi-annually and recorded within a database.
- The area immediately surrounding vents shall be checked periodically for surface water ponding. Regrading shall be conducted, as necessary.
- The structural integrity of the exposed portion of vents shall be monitored periodically to ensure they are maintained.
- The gas vents shall be inspected to ensure that the vent caps are properly fitted and maintained.
- The height of the vents shall be checked to ensure that vents extend a minimum of 1200 mm above grade at all times.
- If measured gas concentrations are within the explosive range, venting capacity shall be evaluated for those vents with explosive readings; alternatively, additional passive vents should be installed.
- If the measured gas concentrations are within the explosive range and the condition is not remedied by modifying the passive vent system, the use of a positive venting system shall be evaluated.

Commitment 17
New Technology/Lessons Learned
ECCC

Commitment 29
Fencing, Design Drawings (90%)
CIRNAC

Commitment 38
OMM
CIRNAC

Figure 11-1: Typical Landfill Gas Vent

12.0 Leachate Management

As discussed in **Section 4.0**, leachate is created as a result of operations at the Landfill and WTS. Dedicated collection and storage systems serve each location. Management requirements for both locations are discussed in the following sections. Sampling and analysis requirements associated with leachate management are presented in **Section 13.**

12.1 Waste Transfer Station

Leachate within the WTS is generated during the waste baling process, as liquid is squeezed out of the waste mass. This liquid is collected via a shallow trench in the slab around the perimeter of the baling unit, with the effluent subsequently being pumped to the 4500L sewage holding tank. The sewage holding tank is XLPE polyethylene double wall construction. The secondary (outer) tank has 120% of the capacity of the inner tank and serves as containment in the event of a leak or spillage. The tank is equipped with an interstitial leak detector. As required, this liquid is collected and transported to the City's WWTP for treatment.

A record of details related to the transport of leachate to the WWTP (e.g., date, and quantity and/or quality) shall be maintained at the WTS. At the request of the WWTP operator, a characterization of the WTS leachate will be conducted to ensure compatability with the facility's treatment process and infrastructure.

12.2 Landfill

*The Landfill's leachate collection and management system, as described in **Section 4.2**, will initially incorporate several components, including the leachate collection layer/perforated pipe system within the disposal area liner system, collection sumps/manholes and retention and potential future bioreactor pond. For the first few years of landfill operations, leachate will be stored within the constructed pond system, allowing for the analysis of quality and quantity data towards defining a treatment system (potentially incorporating mechanical components) appropriate to the unique effluent characteristics of* the Iqaluit site.

WARNING!

LEACHATE IS POTENTIALLY HAZARDOUS.

Take appropriate safety precautions when handling or working near leachate or when entering confined spaces, such as the use of protective clothing, breathing apparatus and ventilation.

For the initial system, primary operational requirements relating to leachate management at the Landfill include the following:

- As leachate is generated and pumped to the new holding lagoons, Dillon recommends that weekly sampling be undertaken for the first three months, switching to monthly sampling afterwards.
    - If the quality varies significantly, more frequent sampling should be undertaken to properly identy the raw leachate quality.
    - The parameters that should be examined (at a minimum) are:
        - cBOD
        - BOD
        - COD
        - TSS
        - Particle size distribution
        - TKN
        - TP
        - pH (field)
        - Temperature (field)
        - Total chlorine
        - Total phenols
        - Unionized ammonia
        - Total ammonia
        - Oil & grease,
        - Total dissolved metals
        - Total metals
        - Total coliforms
        - Fecal coliforms
- A summary of the landfill leachate management system activities shall be included in each annual report. This summary shall include, at a minimum:
    - Landfill leachate generation rates;
    - Leachate characteristics;
    - Holding pond capacity; and
    - Any updates to the leachate management system and/or leachate management activities.
- During the summer months (e.g., mid-June to mid-September), the leachate collection manhole will serve as a location for the extraction of effluent using a portable pump and hosing. During the period of operation, facility staff will be required to monitor effluent depths in the manhole, operating the pump as necessary.
- The pump hosing will direct leachate to piping which will direct flows to the lined ponds. The two ponds have been designed to provide approximately two years of storage, eliminating the need for discharge during the facility's initial operational period based on anticipated rainfall amounts. The pump will be powered by a small portable generator. Staff will bring the portable pump, hosing and

generator to the site each morning and energize the system. Before leaving the site at the end of the day, the equipment will be disconnected and returned to the WTS for storage.

- The manhole pump system will be operated during the period of the year when leachate is being generated and flows into the manhole. Daily assessment of leachate generation status (e.g., observations within the manhole) shall commence in the late spring, confirming when active pumping efforts should be initiated.
- A complete inspection of the leachate collection system elements (manhole, pump, hosing, holding ponds) shall be conducted on an annual basis.
- Should it be determined that storage volumes within the ponds are nearing design capacity as measured by water levels in the ponds and corresponding capacity chart, the City, in consultation with the NWB, will access contingency actions including transporting quantities of leachate effluent via pumper truck from the site to either the West 40 landfill (e.g., controlled discharge through the existing waste mass) or the City's WWTP. As a secondary contingency (to be implemented only with the approval of NWB), a valved discharge manhole at the second storage pond will allow for the controlled release of effluent to a gravel bed diffuser. It is acknowledged that it is anticipated that implementation of the secondary contingency measure will necessitate additional environmental effects (e.g., surface water) monitoring requirements at the Landfill site.

13.0 Site Monitoring

As described in **Section 4.2.6**, environmental effects monitoring requirements at the Landfill and WTS are defined in the latest version (under separate cover) of the Landfill and WTS Facility Monitoring Program (FMP).

14.0 Facility Records

Maintaining facility records is important for operational decisions related to both daily activities and long-term facility management. Copies of all records shall be kept at the WTS Office and up-to-date for inspection subsequent reporting purposes. The following records should be maintained as a minimum. It is noted that the daily and weekly checklists discussed in this section (and presented in Appendix A) provide an efficient and concise means to maintain an operational record:

1. **Incoming Material Quantities** – All materials entering the WTS are weighed before subsequent handling. A computerized database serves to consolidate all collected information by source and material type allowing for subsequent reporting. Weigh scale information can be used for determining waste compaction values, soil to waste ratios, trends in waste generation and general quantification of the waste stream.
2. Site Visitor Log – All visitors accessing the Landfill or WTS are to be registered in the site visitor log (see Appendix A). The logbook will be held at the Scale House.
3. Correspondence – A filing system shall be maintained to keep any correspondence associated with site operation.
4. Financial – Complete records of budget forecasts and actual expenditures must be maintained for the operation. This information is to be summarized in an annual report, as well as forecasts for the upcoming year.
5. **Site Operations Log** – The site log will consist of the daily and weekly checklists (see Appendix A), as well as periodic print-offs (i.e., monthly) of Scale House records. Other operations forms, including weather logs, waste inspection forms, complaint forms, can also be incorporated into the site log. It is recommended that the log itself take the form of a binder, allowing for the easy addition of documentation. The landfilling log will be held and maintained by the Manager.
6. Weather – Records relating to temperature, wind conditions and precipitation shall be recorded daily, using a standardized form (see Appendix A).
7. Liner – When landfill cell liner installation is required, a topographic survey of the base area shall be performed before liner construction. The area to receive the liner shall be graded according to the dimensions and elevations shown on the Engineering Drawings. Installation of the liner system shall be undertaken by personnel/firms experienced in the application of the specified materials. Installed sections of liner shall be tested for quality control, as indicated in the specification. Record engineering drawings of the area shall be prepared each time the liner is installed. Inspection records documenting quality control during liner installation shall be maintained by the City. A section of liner capable of accommodating one year of landfilling shall be installed at a minimum. The determination of timing requirements associated with the installation of the liner system is discussed in **Section 7.2**. A sketch of the location of landfilling, with respect to the liner, shall be developed on an annual basis.
8. **Compaction Control** – To monitor site operations on a yearly basis, overall compaction of the balefill shall be examined. A topographic survey of the active soil borrow area and the active Landfill area shall be conducted annually to determine the volume occupied. Survey drawings generated, as part

of this undertaking, shall provide an annual record of site development. Using the weigh scale records, as well as the overall degree of compaction of the balefill, shall be determined.

9. Landfill Cap – When an area reaches final design elevation, a topographic survey shall be conducted to establish final grade. Similar to the disposal area liner, the landfill cap installation shall be undertaken by experienced, qualified personnel with quality control testing being completed, as noted in the specification. All landfill cap installations shall include the completion of record engineering drawings. Other features that shall be noted on the record drawings including leachate collection system elements and surface water runoff ditches. The requirement to install or cap an area shall be forecasted at least 12 months in advance of design and construction for the cap.
10. Leachate Control – Documentation shall include leachate quality test results, sketches showing the progress of installation of the Landfill leachate collection network, leachate pumping and volumes. A record of dates, volumes and any testing data for baler leachate transported from the WTS to the City's WWTF (or other approved facility) shall also be maintained.
11. LFG Control – Documentation associated with the development of the gas vents (if deemed necessary) within the Landfill area, including locations of the gas vents/gas recovery infrastructure and data on periodic gas sampling, shall be maintained.
12. **Surface and Active Layer Water Monitoring** – A database of all surface and active layer (groundwater) monitoring results, including water quality and monitoring point integrity information, shall be maintained.
13. Bird/Pest Control – If control measures are undertaken, all activities are to be recorded on the daily and weekly checklists.
14. Reports – As directed by the Director of Engineering and Public Works, written facility reports shall be prepared by the Manager. Annual material disposal/diversion reports, based on site weigh scale records and in accordance with the requirements of NWB, shall also be prepared.

15.0 Summary Schedule of Facility Activities

Section 15 summarizes facility operational (Table 15-1), maintenance (Table 15-2), monitoring (Table 15-3) and reporting (Table 15-4) activities in point form. This section offers a summary of the requirements on a daily, weekly, monthly, quarterly, annual and "as needed" basis for the WTS and Landfill. It is intended for use as a quick reference only and does not encompass detailed information. Supporting sections of this Operations Manual as well as manufacturer's manuals for specific pieces of mobile and stationary equipment should be referred to for further details.

Table 15-1: Schedule of Operations

As Necessary	Annually	Quarterly	Monthly	Weekly	Daily
(LF/WTS) Provide initial ERP training to new facility employees.	(LF/WTS) Manager of Solid Waste to conduct a review of the ERP, identifying revisions as necessary.	(WTS) Conduct a building control systems function assessment.	(WTS) Conduct an assessment of the building fire suppression system and facility portable fire extinguishers.	(WTS) Inspect stationary waste processing equipment, including shredder, baler and conveyors, conducting repairs/ maintenance as required.	(WTS) Maintain traffic access to and around the building compound at all times.
(LF/WTS) Train all site staff in safety precautions for handling and identifying hazardous materials.	(LF/WTS) Review status of staff training requirements, including OH&S, defining subsequent action as necessary.	(LF) Prepare a three-month landfill development work plan noting deviations from the previous quarter's predicted requirements.	(LF/WTS) Assess status of first aid kits situated within buildings and mobile equipment, replenishing as necessary.	(WTS) Inspect HHW storage unit containment sumps. Empty and clean as required.	(WTS) Ensure all incoming waste loads are properly covered and secured.
(LF/WTS) Assess requirement for litter collection.	(LF/WTS) Conduct an ERP simulation exercise.			(LF/WTS) Inspect sediment control features. Repair or replace as required.	(LF/WTS) Ensure acceptability of incoming waste per O&M Manual definitions.
(LF/WTS) Undertake pest and wildlife control measures as required.	(LF/WTS) Assess status of portable fire extinguishers situated within buildings and mobile equipment, recharging as necessary.			(LF/WTS) Inspect drainage features and structures. Conduct repairs/maintenance as required.	(WTS) Divert salvageable/ recyclable materials away from tipping floor to designated storage areas when possible.
(WTS) Based on daily noted volume, co-ordinate pumping of leachate holding tanks (baler area) as required.	(LF) Assess requirement for leachate management system modifications.				(LF) Maintain road access to the landfill working face at all times.
(LF) Install temporary stormwater ditching, culverts and access roads.	(WTS) Assess requirements to ship salvaged/segregated materials by sealift to identified management locations.				(LF/WTS) Ensure the site buildings and gates are locked when unattended.
(LF) Maintain a stockpile of 100 m^3 of granular material for wet weather operation.	(LF) Assess requirement to develop the next cell in the landfill sequence, acknowledging time required for design, tendering and construction.		.		(LF) Follow the sequential cell development plan as depicted in the design drawings.
(LF/WTS) Apply dust suppressants on access roads and yard areas.	(LF/WTS) Review Facility Operations and Maintenance Manual, updating as				(WTS) Access size of snow storage piles within WTS yard, allowing adequate

As Necessary	Annually	Quarterly	Monthly	Weekly	Daily
	necessary.				space for additional snowfall events.
(LF) Install liner system following disposal area development plan.					(LF) Minimize areal extent of disturbance within undeveloped portions of the landfill footprint.
(LF) Remove inter-liner stormwater control piping barriers as required.					
(LF) Install final landfill cap as required.					

Table 15-2: Schedule of Maintenance

As Necessary	Annually	Quarterly	Monthly	Weekly	Daily
(LF/WTS) Maintain all stationary and mobile equipment following manufacturer's requirements.	(LF) Commission the leachate lift station in the summer to allow for pumping of effluent to the holding ponds.	(WTS) Inspect Site Office water and wastewater system, repairing as necessary.	(LF/WTS) Take inventory of first aid kits for completeness. Replenish as needed	(LF/WTS) Confirm quantity of bale wire and wrap in storage, replenishing as necessary.	(LF/WTS) Inspect site mobile equipment, assessing the need for maintenance or repair.
(LF/WTS) Maintain snow removal, placement of gravel, pothole repair, culvert cleaning, litter control and ditch upgrade of entrance and internal roads.	(LF) Decommission the leachate lift station in the fall before the onset of winter conditions.	(LF/WTS) Check for surface water ponding around buildings, regrading as necessary.	(LF/WTS) Take inventory of safety equipment and PPE. Replenish as needed.	(WTS) Inspect WTS compound ditching assessing need for maintenance or repair.	(WTS) Monitor weather forecasts for significant rain or snowfall events, making appropriate preparations, including fuel for the backup heating and emergency generator and adequate snow storage capacity.
(WTS) Have Site Office wastewater tank pumped with effluent being transported to an approved management location.	(LF) Check for surface water ponding around monitoring wells, regrading as required.		(WTS) Take inventory of operational supplies including lubricants, filters and other consumables, replenishing as necessary.	(LF) Inspect leachate holding ponds, repairing as necessary.	(LF) Ensure positive surface water drainage (no ponding) within the active landfill area.
(WTS) Have the baler leachate collection tank pumped with the effluent being transported to an	(LF/WTS) Engage qualified persons to inspect building structures and equipment.		(LF) Inspect Attendant's Trailer, repairing as necessary.		(WTS) Clean (sweep/water wash) interior and exterior areas within the WTS compound.

As Necessary	Annually	Quarterly	Monthly	Weekly	Daily
approved management location.					
	(LF/WTS) Ensure site building roof structures are weather tight.		(LF) Inspect areas that have achieved final grade for settlement, repairing as necessary.		(WTS) Record fuel level in heating system storage tanks, replenishing as required.
	(LF/WTS) Lubricate and inspect doors of buildings ensuring that they are weather tight.				(LF/WTS) Check for litter within/adjacent to the WTS compound and the Landfill access road and clean up as required.
	(LF) Examine all monitoring wells for structural integrity.				(LF/WTS) Evaluate the requirement for the establishment or removal of sediment control procedures/ structures.
	(LF) Inspect leachate management system, repairing as necessary.				(WTS) Record volume of water and wastewater in Site Office holding tanks, taking follow up action as required.

Table 15-3: Schedule of Monitoring

As Necessary	Annually	Quarterly	Monthly	Weekly	Daily
(LF) Visual monitoring as specified in the Facility Monitoring Program.	(LF) Record static water level depth of all monitoring wells.		(LF) Take samples and analyze at groundwater stations as specified in the Facility Monitoring Program.		(LF) Record liquid levels in leachate holding ponds, confirming ability to accommodate forecasted rainfall events.
(LF/WTS) Wildlife monitoring as specified in the Facility Monitoring Program.	(LF) Undertake a topographic survey of the landfill area, assessing fill compaction		(LF) Take samples and analyze at surface water stations as specified in the Facility Monitoring Program.		
	(LF) Compare actual to final design grades.				

Commitment 17
New Technology/Lessons Learned
ECCC

Commitment 29
Fencing, Design Drawings (90%)
CIRNAC

Commitment 38
OMM
CIRNAC

Commitment 17	Commitment 29	Commitment 38
New Technology/Lessons Learned	Fencing, Design Drawings (90%)	OMM
ECCC	CIRNAC	CIRNAC

Currently working on scheduling a discussion with all involved parties.

Table 15-4: Schedule of Reporting

As Necessary	Annually	Quarterly	Monthly	Weekly	Daily
(LF/WTS) Complaint forms.	(LF/WTS) Facility Operating Report.		(LF/WTS) Summary of Daily Reports.	(LF/WTS) Facility weekly operations checklist.	(LF/WTS) Facility daily operations checklist.
(LF/WTS) Emergency Response Report.	(LF/WTS) Facility Monitoring Plan Report.		(LF/WTS) Summary of Waste Quantities.		(LF/WTS) Record of waste quantities.
(LF/WTS) Form for attempted delivery of hazardous waste.	(LF/WTS) Contingency Plan for Emergency Response.		(LF/WTS) Summary of Hazardous Waste.		
(LF/WTS) Damage waiver for immobilized vehicles.	(LF/WTS) NWB Waste Diversion Report.				
	(LF/WTS) Wildlife Monitoring Reports.				

Commitment 18 - Reclamation of the West 40 Landfill
Resolved

Commitment 19 - OMM - CIRNAC
Updated drawings will be provided October 9

Commitment 20 - OMM - CIRNAC
Updated drawings will be provided October 9

Response to item 21:

The practice of baling and wrapping MSW in northern climates is, to our knowledge, relatively novel (Yellowknife balefills, but does not wrap). Dillon prepared a risk assessment and options report for the City, which identified several options previously mentioned. The current planned approach as selected by the City/Colliers in November 2019 is to collect and monitor leachate quality in two new lined holding ponds for a period up to two years, or sooner if the leachate quality can be consistently characterized.

During these two years, if effluent at the outlet of the second pond (sampled via the new manhole) meets NWB surface water discharge requirements, it will be released to the level spreader downstream of the lagoons. If the quality does not meet land discharge limits (as defined in Table 1, Non-Point Source Discharge, Environmental Guideline for Industrial Waste Discharges into Municipal Solid Waste and Sewage Treatment Facilities, Government of Nunavut 2011), but is lower than the allowable influent strength at the City's municipal WWTP (as defined in the Iqaluit WWTP Upgrade Redesign Development Report, Stantec, 2017), it may be hauled there instead. Hauling to the City's municipal WWTP or existing West 40 treatment system will also be an emergency backup in the event the ponds begin to fill faster than anticipated due to increased rainfall. This will be monitored through a staff gauge indicating depth and associated volume in each pond. It is important that throughout the life of the landfill, leachate is monitored each year to identify if the quality and quantity is changing.

If the leachate quality is not suitable for disposal on land or at the municipal WWTP, two options are available: potential reuse of the West 40 leachate treatment system, which is largely portable and could be relocated; or, construct a new treatment system at the landfill based on the sampled leachate parameters. It is estimated that it would take three months to design a system, and one construction season to build (after the lagoons are constructed).

The proposed leachate sampling program should consist of weekly sampling of the raw leachate, the outlet of pond 1 and the outlet of pond 2. If the quality appears to stablize after one treatment season, the monitoring may be reviewed and reduced.

Commitment 22 - Landfill leachate collection, Design Drawings (90%) - CIRNAC
Updated drawings will be provided October 9

Commitment 23 - Landfill leachate collection, Design Drawings (90%) - CIRNAC
Updated drawings will be provided October 9

Part 1 General

1.1 Description

.1 These specifications describe the manufacture, supply and installation of high density polyethylene (HDPE) geomembrane. All procedures, operations and methods shall be in strict accordance with specifications, plans and engineering drawings.

1.2 Related Requirements

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 61 00 - Common Product Requirements.

.3 Section 01 74 00 – Cleaning.

.4 Section 01 74 19 - Construction Waste Management and Disposal.

.5 Section 31 32 19 - Geotextiles.

.6 Section 31 37 00 - Rip-Rap.

1.3 Measurement and Payment

.1 Furnish and install 2.0mm (80mil) textured HDPE liner:

.1 Geomembranes will be measured in square metres of surface covered by material. No allowance will be made for seams and overlaps.

.2 Quality Control all liner and extrusion materials supplied to the job site.

.3 Quality Control all aspects of liner installation required in this Section.

.4 Furnish all drawings and reports required in this Section.

1.4 Reference Standards

.1 ASTM International:

.1 ASTM D638-14, Standard Test Method for Tensile Properties of Plastics.

.2 ASTM D746-14, Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.

.3 ASTM D751-19, Standard Test Methods for Coated Fabrics

.4 ASTM D792-13, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

.5 ASTM D1004-13, Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.

.6 ASTM D1204-14, Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature.

.7 ASTM D1238-13, Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.

.8 ASTM D1505-18, Standard Test Method for Density of Plastics by the Density-Gradient Technique.

.9 ASTM D1603-14, Standard Test Method for Carbon Black in Olefin Plastics.

.10 ASTM D1693-15, Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.

.11 ASTM D4218-15, Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.

.12 ASTM D4833/D4833M - 07(2013)e1, Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.

.13 ASTM D5199 - 12(2019), Standard Test Method for Measuring the Nominal Thickness of Geosynthetics.

.14 ASTM D5397 - 19a, Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test.

.15 ASTM D5596 - 03(2016), Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.

.16 ASTM D5820 - 95(2018), Standard Practice for Pressurized Air Channel Evaluation of Dual-Seamed Geomembranes.

.17 ASTM D5885/D5885M-17, Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry.

.18 ASTM D5994/D5994-10(2015)e1, Standard Test Method for Measuring Core Thickness of Textured Geomembranes.

.19 ASTM D6392-12(2018), Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.

.20 ASTM D6693/D6693M-04(2015)e1, Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.

.21 ASTM D7238-06(2017), Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus.

.2 Federal Testing Method Standard:

.1 Puncture Test Federal Test Method Standard (FTMS) 101C - Method 2065.

.3 National Sanitation Foundation:

.1 NSF International Standard 54-1993, Flexible Membrane Liners.

1.5 Action and Informational Submittals

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Manufacturer:

.1 The manufacturer of the geomembrane shall be approved by the Engineer and have satisfactory experience in extruding polyethylene materials and a reputation for producing a high quality product.

.2 The manufacturer shall submit product data as follows:

.1 Manufacturer's instructions, printed product literature and data sheets for geomembrane(s) and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Installer

.1 The Installer shall have at least five (5) years continuous experience in the installation of HDPE geomembrane and/or experience totalling 500,000 m^2 of installed HDPE geomembrane for at least 10 completed projects.

.2 Installation shall be performed under the direction of a single installation supervisor who shall remain on-site and be responsible throughout the liner installation for subgrade acceptance, liner layout, seaming, testing and repairs, and all other activities contracted by the Installer. The installation supervisor shall have supervised the installation of at least 200 000 m^2 of polyethylene geomembrane. No installation will be allowed to proceed without this person present on the site

.3 Actual seaming shall be performed under direction of a master seamer. The master seamer should be present during all seaming operations and shall have a minimum of 100,000 m^2 of polyethylene liner seaming experience using the same type of seaming apparatus specified in this project. The installation supervisor and master seamer shall be on-site whenever seaming is being performed.

.4 The Installer shall be approved by the Manufacturer.

.5 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Nunavut, Canada.

.2 Submit shop drawings and indicate installation layout, dimensions and details, including fabricated and field seams, pipe boots, anchor trenches and protrusion details.

.6 Samples:

.1 Submit four weeks minimum before beginning Work samples as follows:

.1 Minimum 2 m length of standard width membrane.

.2 Minimum of 1 m seam with at least 300 mm of membrane on both sides of seam.

.7 Certificates:

.1 Submit certificates, including test results at least two weeks before delivery of materials to job site.

.2 Prior to inspection and delivery of the geomembrane to the job site, the Contractor shall submit the following to the Engineer for approval. Work shall not commence until the Engineer has all of the following in their possession:

.3 Resin Manufacturer’s Certificates:

.1 Written certification that the product delivered was extruded from the specified resin including the following information:

.1 The origin of the resin: Resin Supplier's name, resin production plant, brand name, number and production date of the resin.

.2 A copy of the quality control certificate issued by the Resin Supplier.

.3 A statement that no reclaimed polymer is added to the resin.

.4 Geomembrane Manufacturer's Certificates:

.1 Submit four copies of manufacturer's mill test data four weeks minimum before beginning Work.

.2 Geomembrane manufacturer's certificates for each shift's production of geomembrane. Quality control certificates shall be signed by responsible parties employed by the Manufacturer. No geomembrane will be permitted to be delivered until the Engineer has in their possession the following information:

.1 Roll numbers and identification.

.2 Sampling procedures and results of quality control tests.

.3 Extrusion rod shall be certified by the Manufacturer that it is made of the same resin as the parent geomembrane supplied.

.3 Manufacturer’s Standard Warranty.

.8 Installation and erection data and schedule.

.9 Installer’s Quality Control plan.

.10 Installer’s guarantee.

.11 Maintenance and repair requirements.

.12 Resumes and certifications of all technical personnel who will perform work on the geomembrane liner installation.

.13 Certificate that the HDPE membrane and its installation complies with the requirements and standards specified herein.

.14 Shop Drawings showing the following:

.1 Proposed Panel Layout:

.1 Drawings showing proposed placement of panels and seams prior to installation, and their proposed numbered sequence, as well as areas for adding material for proposed thermal compensation.

.2 Drawings and detailed descriptions of all methods of welding and patching the membrane, anchoring details, sealing at all penetrations and structures shown on the approved plans.

.2 Record Shop Drawings:

.1 The Installer shall provide final "as recorded" layout drawings to scale to reflect any changes from the proposed panel layout and details.

.2 As-built drawings shall include the numbered identification and location of all seams, panels, patches and areas of added material for proposed thermal compensation.

.3 Included shall be drawings and descriptions of all methods of welding the membrane, anchoring details, sealing at all penetrations and structures.

.15 Construction Waste Management Plan:

.1 Provide project Waste Management Plan highlighting recycling and salvage requirements.

1.6 Quality Control

.1 For the purpose of this specification, quality control is defined as a planned system of inspections and activities carried out by an independent third party company that provides assurance that the geomembrane liner was manufactured and installed as specified and directly monitors and controls the quality of the work.

.2 The quality control program carried out by the Contractor shall meet the requirements of Section 3.9 - Quality Control of this specification.

.3 The Contractor shall assist and cooperate with the Engineer in the execution of the quality assurance program.

1.7 Quality Assurance

.1 Test quality of resin and membrane to ensure consistency of raw material and geomembrane quality in accordance with manufacturer's recommendations.

.2 Test seams in strength and peel at beginning of each seaming period and at least once every four hours if welding operation is interrupted, for each seaming apparatus and seamer used that day.

.1 Also test at least two samples from each panel, with samples taken from extra material, such that panel is not damaged and blanket geometry is not altered.

.3 If seam test specimen fails in seam, repeat on new specimen.

.1 If new specimen fails in seam, material will not be used for seaming until deficiencies are corrected and two consecutive successful test seams are achieved.

.4 Test seams by non-destructive methods over their full length, using vacuum test unit or air pressure test as detailed in Section 3.9 - Quality Control of this specification.

.5 Provide test results to the Engineer, for each shift's production, including documentation of non-destructive testing and repairs at end of each shift.

1.8 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 During delivery and storage, protect geo-membranes from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris, deformation, vandalism and animals.

.4 Storage and Handling Requirements:

.1 Store materials in accordance with manufacturer's recommendations.

.2 Replace defective or damaged materials with new.

1.9 Schedule of Work

.1 Submit schedule of expected work for approval by the Engineer including means and methods of installation.

.1 Installer shall submit the expected schedule of work to the Contractor. The schedule shall include:

.1 Amount of seaming equipment, extrusion and fusion, to be mobilized and maintained on the job site.

.2 Type and certification of tensiometer to be maintained on the site.

.3 Resumés of personnel on the job site.

.4 Requirements for additional labourers.

.5 Sample forms proposed to be used on the site for equipment start-up, seam vacuum test, seam air pressure test, seam destructive test.

.2 Adhere to approved schedule. Deviate only after approval from the Engineer.

1.10 Approved Manufacturers

.1 Flexible membrane liner to be supplied by approved manufacturers. Pre-approved flexible membrane liner manufacturers are as follows:

.1 Manufacturer/Supplier
Layfield Group of Companies
117 Basaltic Road, Unit 2
Vaughan, Ontario
L4K 1G4
Phone: (587) 400-8690
Toll-Free: (855) 203-0079
Email: containment@layfieldgroup.com

.2 Manufacturer/Supplier
Solmax
2801 Marie-Victorin Blvd.
Varennes, Quebec
J3X 0J4
Phone: (450) 929-1234
Toll Free: 1-800-571-3904

.3 Manufacturer/Supplier
Titan Environmental Containment
777 Quest Blvd
Ile des Chenes, Manitoba
R0A 0T1
Phone: (204) 478-3955
Toll-Free: (204) 878-3980

Part 2 Products

2.1 HDPE Geomembrane Properties

.1 The geomembrane shall be manufactured from new first quality polyethylene resin of the type specified in this document. Polyethylene geomembrane shall meet all requirements for the specified end use.

.2 Reclaimed polymer shall not be added to the resin except the polymer recycled during the manufacturing process. Recycled polymer shall not exceed 2% by weight.

.3 Manufacturer to provide certificate stating name of resin supplier, complete with product description and stated properties and to certify resin product has not been produced from a blend of resins.

.4 Geomembrane: extruded synthetic sheet:

.1 Supplied in panels of size as indicated.

.2 Composed of high density polyethylene resin with inhibitors added to base plastic to resist deterioration by ultra-violet and heat exposure.

.5 The sheet geomembrane shall demonstrate the typical physical properties from the following table:

	Minimum Average Roll Values (metric)		
Description:	**2.00 mm (80mil) Textured HDPE**		
Material Property	**Standard**	**Units**	**Value**
Thickness (nominal)	ASTM D5199 ASTM D5994	mm	2.00
Thickness (min. avg.)	ASTM D5994	mm	1.90
Indent lowest individual reading	ASTM D5994	mm	1.70
Asperity Height	ASTM D7466	Mm	0.4
Density	ASTM D792 ASTM D1505	g/cm^3	≥0.940
Carbon Black Content	ASTM D4218	%	2.0 – 3.0
Carbon Black Dispersion	ASTM D5596	Category	Cat. 1/Cat. 2
Minimum Tensile Properties	ASTM D6693	-	-
Stress/Strength at Yield		N/cm	29
Strain/Elongation at Yield		%	12
Stress/Strength at Break		N/cm	21
Strain/Elongation at Break		%	100
Tear Resistance	ASTM D1004	N	249
Puncture Resistance	ASTM D4833	N	534
Stress Crack Resistance (SCR)	ASTM D5397	hours	500
UV Resistance (retained after 1600 hours)	ASTM D7238 ASTM D5885	%	50
Low temperature brittleness	ASTM D746	°C	-77
Field Seam Properties	ASTM D6392	N/cm	
Shear Strength			21.0
Peel Strength (fusion)			FTB†/ 17.5
Peel Strength (extrusion)			15.4
†Film Tear Bond (FTB) is defined as failure of one of the sheets by tearing, instead of separating from the welded seam-the test specimen shall not fail by more than 10% into the seam. For double hot wedge fusion welded seam, both inside and outside tracks shall be tested.			

.6 Seams: welded in accordance with manufacturer's recommendations.

.1 Physical properties for resin used for welding are same as those for resin used in manufacture of membrane.

2.2 Manufactured Geomembrane

.1 Material specifications to meet or exceed those listed in Section 2.1.

.2 Geomembrane to have a maximum permeability of 1×10^{-11} cm/sec.

.3 HDPE geomembrane to consist of sheets containing no plasticizers, chemical additives, fillers or extenders, excluding the carbon black content as specified in Section 2.1.

.4 Geomembrane to be free of pinholes, blisters, undispersed raw materials, striations, roughness or any sign of contamination by foreign matter.

.5 Rolls to be minimum 8.0 metres in width consisting of a continuous width seamless panel. Minimum length to be Manufacturer's standard length for the specified thickness and such that seaming requirements are minimized.

.6 Each roll to be clearly marked in two separate locations on the roll with the following information:

.1 Manufacturer
.2 Product Type
.3 Thickness
.4 Resin Lot Number
.5 Roll Number
.6 Length and Width

.7 Failure to label each roll as specified in Section 2.2.5 shall be cause for rejection.

.8 Material Warranty:

.1 The HDPE membrane manufacturer shall provide a written warranty for the membrane against manufacturing defects for a period of twenty (20) years from the date of installation.

2.3 Extrudate Rod and/or Bead

.1 Extrudate rod and/or bead to be produced from the same resin used in the manufacture of the geomembrane rolls. Contractor to provide documentation supporting this requirement.

2.4 Documentation

.1 Prior to delivery of the geomembrane to the job site, the Installer shall be required to provide the Engineer with a written certification that the product delivered was extruded from a resin which meets or exceeds the properties listed in Section 2.1. The manufacturer of the geomembrane shall provide quality control certificates for each batch of resin and each shift's production of geomembrane, and shall follow the quality control testing program as described in Section 1.6. Failure to meet specifications shall be cause for rejection.

.2 Prior to delivery of the geomembrane on site the Installer shall provide the Engineer with their Thermal Compensation Plan. The plan shall address, but not be limited to, stiffness and placement, flexing, seaming/welding, solar heat, moisture, frozen backfill, drop height, portable heat

.3 These quality control certificates shall be signed by responsible parties employed by the Manufacturer, and shall be supplied to the Engineer or his Representative. No geomembrane will be permitted to be delivered until the Engineer has in his possession such certification.

.4 Testing of lining materials prior to delivery.

.1 Lining materials proposed to be used on the project shall be set aside by the manufacturer, complete with certificates. Each roll of geomembrane and extrusion rod shall be marked as specified in Section 2.2 and 2.3 and the following information shall accompany the roll certificates:

.1 Thickness: ASTM D5199/ASTM D5994.
.2 Density: ASTM D1505/ASTMD792.
.3 Melt Flow Index - 190/2.16(max): ASTM D1238.
.4 Tensile Properties: ASTM D6693.
.5 Tear Resistance: ASTM D1004.
.6 Puncture Resistance: ASTM D4833.

.5 Transportation shall be the responsibility of the Installer. Any damaged or unacceptable material shall be replaced by the Installer.

.6 Once on site, storage of the geomembrane shall be the responsibility of the Contractor. The geomembrane shall be stored to avoid deformation of rolled goods from one place to another.

Part 3 Installation

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for geomembranes installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of the Engineer.

.2 Inform the Engineer of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Engineer.

.2 Prior to installation, Contractor to survey subgrade and certify it has been graded and compacted to conform to earthworks requirements.

.3 Prior to installation, Contractor to inspect the subgrade and provide written certification to the Engineer stating the prepared surface is suitable for membrane installation.

.4 Contractor to maintain geomembrane subgrade surface to suitable conditions throughout installation period.

.5 Placement of geomembrane shall be done in accordance with sequence on approved shop drawings and may be revised on-site with the approval of the Engineer to suit field conditions.

.6 On slopes steeper than 10%, all seams shall be oriented down slope and not across the slope. No horizontal seams shall occur less than 1.5 m (and preferably 3 metres) from the crest or toe of such slopes.

.7 Panels shall be installed so overlaps are primarily downstream and downwind. Install panels to eliminate the alignment of butt seams of successively joined panels; butt seams should be offset a minimum of 500 mm after production welding, as directed by the Engineer. Install panels so that seams in collection areas or depressions are minimized and preferably eliminated.

.8 Equipment used to handle and weld the geomembrane shall not cause any damage to the geomembrane or on the subgrade due to handling, trafficking, leakage of hydrocarbons or any other means. All damage of soils to be corrected to the Engineer’s satisfaction prior to geomembrane deployment.

.9 Personnel shall not engage in activities or wear footwear which could damage the geomembrane.

.10 **Apart from approved welding equipment, no mechanical equipment shall be allowed on the geomembrane (including rubber tire ATV's).**

.11 Panels shall be placed in such a way as to minimize scratches, crimps and other damage to material. Minimize wrinkles and "fishmouths" along seams.

.12 Do not deploy geomembrane panels if moisture prevents proper placement or seaming.

.13 Do not allow geomembrane to "bridge over" voids or low areas in the subgrade. Repair subgrade if required and place geomembrane such that it rests on the subgrade surface.

.14 At the end of each day or installation segment all unseamed edges shall be anchored by rope, sand bags, or other approved device. Sand bags securing the geomembrane on the side slopes should be connected by rope fastened at the top of the slope section by a temporary anchor. Staples, U-shaped rods or other penetrating anchors shall not be used to secure the geomembrane. Any damage to the liner due to inclement weather shall be the sole responsibility of the Contractor.

.15 Any panel or part thereof which becomes seriously damaged shall be replaced at the Contractor's expense. Such damaged panels shall be removed from the site immediately. Minor damage such as crimps, wrinkles, etc., shall be repaired as described in this section.

.16 Contractor to provide site protection to prevent bird and/or animal attack on the geomembrane.

3.2 Seaming Methods – Equipment

.1 Approved methods for seaming are double wedge fusion welding for general seaming and extrusion welding for patching. Proposed alternatives must be submitted for approval to the Engineer or his Representative. Details of the specific apparatus to be used for seaming, including seaming using approved methods, shall be submitted for approval by the Engineer or his Representative prior to commencement of any seaming.

.2 Double Wedge Fusion Welding. The seam shall be produced by self-propelled wedge welding apparatus. The apparatus shall be equipped with gauges to monitor weld temperature. Weld temperature and machine speed shall be varied according to ambient conditions in order to maintain and demonstrate a consistent acceptable weld. All welding surfaces shall be kept clean and dry.

.3 Extrusion Welding. The seam shall be produced by extruding molten resin at the edge of two overlapped sheets of geomembrane to effect a homogeneous bond. The extrusion apparatus shall be equipped with gauges to monitor extrudate temperature. Temperature and flow rate shall be varied according to ambient conditions to maintain and demonstrate a consistent acceptable weld. The extruder shall be purged of all heat degraded or cooled extrudate prior to the commencement of each seaming sequence.

.4 The Installer shall maintain at least one spare operable seaming unit of each type on-site at all times.

3.3 Seaming Procedures

.1 Where conditions warrant, the Installer shall be allowed to use a temporary support surface between the geomembrane and the subgrade to achieve proper support during the seaming operation. The Engineer or his Representative shall decide whether the support material may be left in place or must be removed on completion of seaming.

.2 Seaming shall be a continuous process with a minimum of interruptions along any given seam.

.3 Prior to seaming, the geomembrane shall be overlapped a minimum of 75 mm for extrusion welding and 100 to 150 mm for fusion welding. Sufficient overlap must be provided on both sides of the double fusion weld to allow for destructive testing in accordance with the specified ASTM procedures.

.4 Seams shall be aligned so as to create a smooth and wrinkle free surface in the overlap area.

.5 Seam area to be free of dirt, dust, moisture, debris or any other foreign matter.

.6 Extrusion Welding.

.1 The weld area shall be prepared by sanding or grinding to a depth of less than 0.02 mm in the sheet surface to be in contact with the extrudate.

.2 Grinding required along a seam shall be done concurrent with or within ten minutes of the seaming operation and shall not damage the geomembrane.

.3 Membrane shall be overlapped a minimum of 75 mm prior to seaming. The weld area shall be kept clean and dry during this process.

.4 Installer shall determine when preheating of the area to be seamed is required.

.5 Artificially induced cooling of extrusion welds, by water or any other means, shall not be allowed.

.6 Care shall be taken during vacuum testing that extrusion welds being vacuum tested are at ambient temperatures.

.7 Cross-seams.

.1 The top and bottom excess overlap shall be removed and the top and bottom edge of the cross-seam shall be ground to a smooth transition prior to seaming.

.2 If the cross seam is welded by means of fusion apparatus, the cross seams shall still be cut back to the edge of the fusion weld and have a bead of extrusion applied 100 mm in all directions from the confluence of the two seams to form a "T".

.8 Seams shall run parallel to the slope.

.9 Any membrane area showing injury due to excessive scuffing, puncture, or distress from any cause shall, at the discretion of the Engineer, be replaced or repaired with an additional piece of HDPE membrane at the Contractors expense.

.10 All geomembrane seams to be welded.

.11 Methods used to temporarily bond adjacent rolls shall not result in any damage to geomembrane. Solvents and/or adhesives shall not be used without written approval of the Engineer.

.12 If hot air leisters are used to provide temporary bonding, no damage to geomembrane will be permitted. If, upon visual inspection or destructive testing techniques damage is noted, it will be repaired to the satisfaction of the Engineer.

.13 If grinding is required along seam, do so according to Manufacturer's recommendations

3.4 Panel Development – Thermal Compensation

.1 Compensation for thermal contraction of the Thermal Compensation geomembrane shall be provided as necessary during the liner installation.

3.5 Climatic Conditions

.1 The following procedure shall be followed when the ambient temperature falls to or below 2°C as measured 600 mm above the surface of the liner by the Engineer.

.1 The temperature shall be measured and logged every hour during cold weather seaming conditions by the Engineer.

.2 Test Seams:

.1 Test seams shall be run as soon as the temperature falls to 2°C and every four hours thereafter, or if the temperature falls an additional 5°C from the time of the last test seam, or if the seaming equipment has not been used for a 2 hour period in the case of fusion welding, one hour in the case of extrusion welding.

.2 Test seams shall be made in the same area and under the same conditions and procedures as the liner about to be installed with experience, including production of each test seam on the subgrade over which the liner will be placed. Test seams shall be sized according to the specifications.

.3 Six samples shall be taken from each test seam, spaced equally along the length of the seam. Four samples shall be tested in peel and two in shear on the Installer's tensionmeter. Seams shall pass all criteria for film tear bond (FTB) and seam strength as listed in that section.

.3 Sampling Frequency of Seams Produced Under Cold Weather Conditions:

.1 End of Seams:

.1 One 125 mm wide sample shall be taken out of the beginning and end of each seam produced:

.1 One 25 mm sample each from each sample shall be tested in peel and shear, and shall meet the requirements for FTB and seam strength as listed in Section 2.1.

.2 The remainder of each sample shall be labelled and saved.

.2 Destructive tests shall be taken at the same frequency as described in Section 3.9.1.4 and tested according to the specifications.

.3 Do not perform seaming when ambient temperatures are greater than 40°C.

.4 Do not place geomembrane under conditions of rain or snow or in the presence of excessive fog or dew.

.5 Keep seam areas clean, dry and sheltered from wind if required, during seaming operation.

3.6 Preparation

.1 Temporary Erosion and Sedimentation Control:

.1 Provide temporary erosion and sedimentation control measures to prevent erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties to sediment and erosion control plan, specific to site, that complies with requirements of authorities having jurisdiction.

.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent containment structure has been established.

.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.7 Construction Sequence

.1 Coordinate the installation to ensure smooth transfer of responsibilities between earthworks and geosynthetics contracts and operations.

.2 Be responsible for the condition of the prepared sub-grade and surface of the recompacted clay liner once these surfaces have been accepted.

.3 Be responsible for the condition of the geosynthetic materials geotextile, HDPE liner until these installations have been accepted.

3.8 Installation

.1 Geomembrane to be delivered to site with each roll clearly identified on two (2) separate locations on the roll as specified for verification prior to installations. Extensively damaged rolls shall be rejected and replaced at the Installer's expense.

.2 Maintain area of installation free of water, ice, and snow accumulations.

.3 Prepare excessively soft supporting material as directed by the Engineer.

.4 Do not proceed with panel placement and seaming when ambient temperatures are below minus 5 °C or above 40 °C, during precipitation, in presence of excessive moisture (i.e. fog, dew), nor in presence of high winds.

.5 Place and seam panels in accordance with manufacturer's recommendations on graded surface in orientation and locations indicated.

.6 Minimize wrinkles, avoid scratches and crimps to geomembranes and avoid damage to supporting material.

.7 Protect installed membrane from displacement, damage or deterioration before, during and after placement of material layers.

.8 Replace damaged, torn or permanently twisted panels to approval of the Engineer and remove rejected damaged panels from site.

.9 Keep field seaming to a minimum. Locate field seams up and down slopes, with no horizontal field seam less than 1.5 m beyond toe of slope.

.10 Keep seam area clean and free of moisture, dust, dirt, debris and foreign material.

.11 Make field seam samples in accordance with requirements described in PART 2 on fragment pieces of geo-membrane and test to verify that seaming conditions are adequate.

.12 Test field seams as seaming work progresses by non-destructive methods over their full length. Repair seams which do not pass non-destructive test. Reconstruct seam between failed location and any passed test location, until non-destructive testing is successful.

.13 Repair minor tears and pinholes by patching until non-destructive testing is successful. Patches to be round or oval in shape, made of same geomembrane material, and extend minimum of 75 mm beyond edge of defect.

3.9 Quality Control During Installation

.1 Site Test Equipment:

.1 The Installer shall maintain on-site, in good working order, the following items:

.1 Field Tensiometer

.1 The tensiometer shall be a load certified motor driven unit and have jaws capable of travelling at a measured rate of 50 mm/min.

.2 The tensiometer shall be equipped with a gauge which measures units of force exerted between the jaws.

.3 Certification of the unit shall have been performed within six months of the installation date.

.2 Vacuum Box:

.1 The vacuum box shall consist of a rigid housing with a transparent viewing window on top and a soft, closed-cell neoprene gasket attached to the bottom of the housing.

.2 The housing shall be equipped with a bleed valve and a vacuum gauge capable of reading in tenths of a bar.

.3 A separate vacuum source shall be connected to the vacuum box such that a negative pressure can be created and maintained inside the box.

.4 A sudsy solution consisting of soap and water shall be dispensed on the seam immediately ahead of the vacuum box.

.3 Air Pressure Test Equipment

.1 This method shall apply only when the split hot wedge seaming method is used.

.2 Equipment shall consist of an air pump capable of generating and maintaining a positive pressure of between 1.5 to 2.0 bars.

.3 A manometer capable of reading up to 2.0 bar attached to a needle or nipple shall be used to pressurize the air channel in the seam.

.2 Geomembrane Testing

.1 Contractor to perform a minimum of one complete set of quality control tests on geomembrane rolls from each different resin lot to verify that all other specified parameters are in compliance with the material specifications.

.2 Test samples which fail to meet strength and environmental specifications shall result in rejection of applicable rolls. Conduct further testing on geomembrane manufactured from same resin batch to determine acceptability.

.3 Contractor to provide written certification to the Engineer, for review and acceptance, confirming required quality control has been done and certifying quality of the geomembrane, prior to delivering to job site.

.4 Quality control certificate required for each batch of resin and each production shift. Certificate to include:

.1 Product Identification.

.2 Roll Numbers.

.3 Sampling Procedures.

.4 Test Methods.

.5 Test Results (including Environmental Stress Cracking or single-point Notched and Constant Tensile Load Time to Failure test data).

.6 Signature of Responsible Party.

.7 The Engineer may also request that all production line records be submitted for review.

.5 The Engineer shall have authority to visit the manufacturing facility at any time to witness production and quality control testing, examine production records and to independent samples. The Contractor and/or manufacturer shall extend full cooperation in this regard.

.3 Non-Destructive Testing:

.1 Test Seams (Start-up):

.1 Test seams shall be made to verify that adequate conditions exist for field seaming to proceed.

.2 Each seaming apparatus shall produce a test seam at the beginning of each shift.

.3 In addition, if a seaming operation has been suspended for more than four hours, or after every five hours or if a breakdown of the seaming equipment occurs, a test seam shall be produced prior to resumption of seaming operations.

.4 Test seams shall be made in the field on pieces of the approved geomembrane.

.1 Each test seam shall be at least 1.5 m long by 300 mm wide for extrusion and 3 m long by 300 mm wide for fusion, with sufficient overlap for peel testing in the field tensiometer.

.5 Two samples 25 mm wide shall be taken from each end of the test seam using an approved template.

.1 The samples shall be tested in the field tensiometer, one from each end in peel and shear respectively.

.2 Samples tested in peel shall not fail in the seam.

.3 All test samples shall exhibit film tear bond and strength as defined under seam properties, section 2.1.5.

.6 If the seam fails to pass, the seaming apparatus shall not be used for field seaming until any deficiencies have been corrected. This shall be verified by the production and successful testing of two consecutive test seams.

.2 Vacuum Testing:

.1 All extrusion welded seams and "T" seams shall be evaluated using vacuum box testing.

.2 A sudsy soap solution shall be applied to the test section and the vacuum box placed over the section. The bleed valve is then closed and the vacuum valve opened.

.3 The vacuum box shall maintain at least 20 kPa (0.2 bar) vacuum during the test.

.4 Once a tight seal has been established, the test section shall be visually examined for a period of not less than 10 seconds to determine whether bubbling of the soapy solution at the seam is occurring.

.5 The vacuum box is then moved and the process is repeated on the next adjacent section. A minimum of 100 mm overlap shall be provided between all test sections.

.6 All locations where bubbling of the sudsy solution is observed shall be clearly marked for repairs with a high visibility marker and recorded by number on field test reports.

.1 Any failed portion of seam shall be repaired and retested.

.3 Air Pressure Testing:

.1 Double wedge welded seams shall be sealed off at both ends.

.2 If the end of a seam will be an integral part of the geomembrane, the sealing shall be done in such a way that it does not harm the function of the geomembrane.

.3 The pressure feed device shall be inserted into the air channel at one end of the seam and pressurized to 1.5-2.0 bars. The feed valve shall be closed and the pressure sustained for a period of not less than three minutes.

.1 The pressure shall then be released by slitting the air channel at the opposite end of the seam.

.2 The Engineer shall observe the drop in pressure on the manometer to verify the continuity of the air channel.

.4 If a pressure loss of greater than 0.2 bar is observed or if the required pressure cannot be reached, then the seam shall be rejected, and shall be either reconstructed in its entirety or the leak located and patched. The entire seam shall then be retested according to the procedure outlined above.

.4 All seams shall be non-destructively tested by the Installer over their full length to verify the integrity of the seam.

.1 Non-destructive testing shall be performed concurrently with field seaming.

.2 All non-destructive testing shall be observed and documented by the Engineer.

.5 Repair and test again any seam failing a test.

.6 Cap seams are to be tested by the vacuum box method as described in Section 3.9.1.3.2.

.1 Where cap seams cannot be tested by the vacuum box method, the Engineer may approve a different non-destructive test method.

.2 If no non-destructive test method can be used, the method of remediation of the seam shall be directed by the Engineer, and may include removal and replacement of the seam and adjacent geomembrane panel.

.7 At least one spare operable testing unit shall remain on-site at all times.

.8 Approved non-destructive testing procedure is as above. Alternate procedures shall be submitted for approval to the Owner or the Owner's Representative prior to the commencement of non-destructive testing.

.4 Destructive Testing

.1 Destructive testing of field seams shall be performed at selected locations in order to verify seaming properties.

.2 All sampling and testing shall be done concurrently with field seaming so that verification of field seam properties is made as the work progresses and corrective action implemented, if necessary.

.3 Test samples shall be taken at an average frequency of one test location per 150 meters of seam.

.4 Sample locations shall be determined by the Engineer taking into consideration the difficulty of subsequent repair and testing.

.1 The Installer shall not be informed in advance of the locations where the seam samples will be taken.

.5 Samples shall be cut by the Installer under the direction of the Engineer.

.1 Each sample shall be indelibly numbered and identified.

.2 Each sample shall be identified with the sample number, seam number, panel number, date, name of welding technician, and welding equipment number.

.6 The Engineer may increase the amount of destructive testing based on the results of previous testing.

.1 Additional samples may also be required when the Engineer has reason to suspect the presence of excess crystallinity, contamination, faulty seaming equipment or any other reason affecting seam quality.

.7 The test sample shall measure approximately 300 mm wide by 1.0 metre long with seam centered lengthwise along the sample.

.8 The Owner, at their option, may send the remaining sample to a lab of their choosing for further destructive testing and approval.

.9 In any event, the samples shall not be considered to pass the test until the Engineer is satisfied that they meet the seam pass/fail criteria of film tear bond and minimum seam properties.

.10 2.5 cm wide sample strips shall be cut from the sample using an approved die, and tested in the Installers tensiometer in the presence of the Engineer according to the following procedure:

.1 Two 25 mm wide samples shall be taken from each end for shear and peel testing by the Installer.

.2 Seam shall not fail either test as specified in Section 2.1.

.11 The Owner shall test the remaining sample in an independent tensiometer to qualify seam strength properties and FTB according to the procedures outlined in 4.1.4.

.12 The Engineer shall cut ten (10) 25 mm wide replicate specimens from their sample and shall test five specimens for seam shear strength and 5 for peel strength:

.1 To be acceptable, five out of the five replicate specimens must pass for each mode of testing.

.2 All specimens must fail in Film Tear Bond (FTB).

.3 Any specimen that fails through the weld, or by adhesion at the weld-sheet interface, is a non-film Tear Bond break and shall be considered a failure.

.13 The test method and procedures to be used by the Engineer shall employ a grip separation rate of 50 mm/min for peel and shear.

.14 The area from which the destructive test sample was taken shall be repaired without delay and shall be non-destructively tested by vacuum box as described in Section 3.9.1.3.2.

.5 Inspection and Acceptance:

.1 As the work progresses, the Engineer shall document all locations requiring repair work and shall verify and document that all repairs have been successfully made by the Installer.

.2 No work on the liner shall be allowed if the Engineer is not present.

.1 This is to include start-up tests, general seaming and patching, and any work at penetrations or structures.

.3 Seams are only considered to be accepted after they have passed the specified non-destructive and destructive tests, and the equipment used to produce the seams have passed the required start-up tests.

.1 If a seam fails the above criteria, the Installer must reconstruct the seam.

.4 A double hot wedge fusion seam shall be considered acceptable only when both outside and inside track welds are destructively tested and meet the specification criteria.

.5 If a seam fails the destructive test, the Installer may reconstruct the seam between the point of failure and any previously accepted test.

.1 In lieu of .5 above, Installer may trace the extent of unacceptable seam.

.1 Take 25 mm samples at minimum 3 metre distance on each side of failed section and test in both shear and peel.

.2 If one or both tests fail, continue along seam at minimum 3 metre increments.

.3 Continue until tests indicate pass results. Then take large samples for field laboratory tensiometer testing. If field laboratory tests pass, make repairs - if fail, continue.

.6 Reconstruction or repair of failed seam lengths shall be either by capping of the failed seam (extrusion or fusion weld) or, in the case of a double fusion weld, by extrusion fillet welding the overlap to the bottom sheet:

.1 Cutting off the overlap and topping the failed fusion weld with extrudate will not be permitted.

.7 If the overlap of the outside (i.e. visible) weld is less than 30 mm extrusion welding of the overlap to the bottom sheet in the failed section will not be permitted.

.8 Continuity of all reconstructed seams to be subject to non-destructive testing:

.1 If reconstructed length exceeds 50 metres, sample shall be taken for laboratory destructive testing.

.9 The cost of all failed laboratory destructive tests shall be deducted from monies owning to the Contractor:

.1 Actual cost to be based upon testing company invoices.

.10 The entire geomembrane surface shall be examined by the Engineer to confirm that it is free of any defects, holes, blisters, undispersed raw materials, or contamination by foreign matter:

.1 The geomembrane surface shall be cleaned by the Installer, if required, so that it is free of dust, mud, debris or any other material which may inhibit a thorough examination of the surface.

.2 Any suspect areas shall be clearly marked by the Engineer and non-destructively tested according to the appropriate specified testing procedure.

.11 Overburden shall not be applied to any portion of the liner system until that portion system is inspected by the Contractor and the Engineer and all documents affecting that portion have been approved in writing by the Engineer.

.12 Gouges or scratches associated with grinding or from other sources whose depth is in excess of 10% of the geomembrane thickness shall be classified as defects and will require appropriate repairs in accordance with these specifications.

.13 Small tears, wrinkles or pinholes to be repaired by seaming or patching to the satisfaction of the Engineer.

.14 Patches shall be round or oval, of the same material and thickness as the base geomembrane, and shall extend a minimum of 150 mm beyond the damaged or faulty area in all directions.

.15 Geomembrane surfaces to be patched shall be abraded in accordance with Manufacturer's requirements and these specifications.

.16 Use approved extrusion welding equipment only.

.17 All repairs shall be non-destructively tested.

.18 Cut and repair any large wrinkles or "fishmouths" identified by the Engineer to the satisfaction of the Engineer.

3.10 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: separate waste materials for 01 74 19 - Construction Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.11 Disposal of Scrap Material

.1 On a daily basis remove scrap material and trash from the site and dispose in a location approved by the Owner:

.1 No scrap material shall be left on the geomembrane surface.

.2 Subsequent installation of other geosynthetics, geotextiles, overburden, or soil over the geomembrane shall not proceed until the geomembrane is accepted by the Engineer.

3.12 Protection

.1 Do not permit vehicular traffic directly on membrane.

3.13 Guarantee

.1 The Contractor shall guarantee the HDPE membrane against defects in installation and workmanship for the period of five (5) years commencing with the date of final acceptance. The guarantee shall include the services of qualified service technicians and all materials required for the repairs. The installer shall further provide a written guarantee that all products have been installed in accordance with the specifications.

Part 4 Completion of Work

4.1 Geomembrane Acceptance

.1 The installation of the geomembrane shall be considered complete when all required deployment, seaming, repairs, testing and site clean-up, including sand bags have been completed by the Installer; the Installer has submitted all the required certifications to the Engineer; and the Engineer is satisfied that the geomembrane has been installed in accordance with the above Specifications.

.2 The geomembrane liner will be accepted by the Engineer when:

.1 The geomembrane is clean.

.2 The entire installation, or an agreed section of the installation, is finished.

.3 All documentation pertaining to the installation has been submitted to the Engineer.

.4 Verification of the adequacy of all field seams, repairs, and associated testing is complete.

.5 As-recorded drawing of the field panels and seams including defects and test locations is submitted.

END OF SECTION

Part 1 General

1.1 Related Requirements

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 61 00 - Common Product Requirements.

.3 Section 01 74 00 - Cleaning.

.4 Section 01 74 19 - Waste Management and Disposal.

.5 Section 31 37 00 - Rip-rap.

.6 Section 33 47 14 - Geomembranes.

1.2 Reference Standards

.1 American Society for Testing and Materials International (ASTM):

.1 ASTM D4533/D4533M-15, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.

.2 ASTM D4632/D4632M-15a, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

.3 ASTM D4759-11(2018), Standard Practice for Determining the Specification Conformance of Geosynthetics.

.4 ASTM D5261-10(2018), Standard Test Method for Measuring Mass per Unit Area of Geotextiles.

.5 ASTM D6241-14, Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.

1.3 Work Included

.1 Materials and installation of polymeric geotextiles used in revetments, breakwaters, retaining wall structures, filtration, drainage structures, and roadbeds, the purpose of which is to:

.1 Separate and prevent mixing of granular materials of different grading.

.2 Act as hydraulic filters permitting passage of water while retaining soil strength of granular structure.

1.4 Action and Informational Submittals

.1 Provide in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit to the Engineer following sample at least four (4) weeks prior to beginning Work:

.1 Provide manufacturer's instructions, printed product literature and data sheets for geotextiles and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Samples:

.1 Minimum length of two (2) m of roll width of geotextile.

.2 Methods of joining.

.3 Test and Evaluation Reports:

.1 Submit two (2) copies of mill test data and certificate at.

.4 Construction Waste Management:

.1 Provide project Construction Waste Management Plan highlighting recycling and salvage requirements in accordance with Section 01 74 19 - Construction Waste Management

1.5 Delivery, Storage and Handling

.1 Deliver, store and handling, protect geotextiles from direct sunlight and ultraviolet rays, excessive heat, mud, dirt, dust, debris, vandalism, and animals.

.2 Replace defective or damaged materials with new.

Part 2 Products

2.1 Materials

.1 Geotextile: non-woven synthetic fibre fabric, supplied in rolls.

.1 Width: 3.8 m minimum.

.2 Length: 110 m minimum.

.3 Composed of: minimum 85% by mass of polypropylene with inhibitors added to base plastic to resist deterioration by ultra-violet and heat exposure for sixty (60) days.

.2 Minimum physical requirements for the geotextiles shall be as follows:

Property	Test Method	Qualifier	Type "A"	Type "B"	Type "C"	Unit
Mass/unit area	ASTM D5261	MARV	-	-	949	g/m^2
Grab tensile strength	ASTM D4632	MARV	712	1330	2447	N
Tear strength	ASTM D4533	MARV	267	510	1112	N
Puncture resistance	ASTM D6241	MARV	1820	3780	8914	N

.1 Type "A" to be Terrafix 360R or approved equal.

.2 Type "B" to be Terrafix 800R or approved equal.

.3 Type "C" to be Geotex 2801 or approved equal.

.4 Approved geotextile manufacturers are:

.1 Texel.

.2 Synthetic Industries.

.3 Nicolon/Mirafi.

.3 Acceptance of geotextile materials shall be based on ASTM D4759.

Part 3 Execution

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for geotextile material installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of the Engineer.

.2 Inform the Engineer of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Engineer.

3.2 Installation

.1 Place geotextile material by unrolling onto graded surface in orientation, manner and locations indicated and retain in position with sand bags.

.2 Place geotextile material smooth and free of tension stress, folds, wrinkles and creases.

.3 Place geotextile material on sloping surfaces in one continuous length from a minimum of three (3) metres on the flat from the toe of slope to upper extent of geotextile.

.4 Overlap each successive strip of geotextile 600 mm over previously laid strip.

.5 Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of material layers.

.6 After installation, cover with overlying layer within four (4) hours of placement.

.7 Replace damaged or deteriorated geotextile to approval of the Engineer

3.3 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: separate waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

.4 Remove construction debris from Project site and dispose of debris in an environmentally responsible and legal manner.

3.4 Protection

.1 Vehicular traffic not permitted directly on geotextile.

.2 Do not overload soil or aggregate covering on geotextile.

END OF SECTION

Commitment 25 - Landfill leachate collection, Design Drawings (90%) - CIRNAC
Updated drawings will be provided October 9

Commitment 26 - Landfill leachate collection, Design Drawings (90%) - CIRNAC
Updated drawings will be provided October 9

Commitment 27 - Resolved

Commitment 28 - Landfill leachate collection, Design Drawings (90%) - CIRNAC
Updated drawings will be provided October 9

2.0 Facility Operations

2.1 Access Control

2.1.1 *Hours of Operation*

The City of Iqaluit Land*fi*ll and WTS is open Monday through Saturday, excluding holidays. The site is open to receive waste from 8:00 am to 4:00 pm Monday through Friday, and 8:00 am to 12:00 pm Saturday. Only the WTS will be accessible by the general public.

The site will be closed on the following holidays:

- New Year's Day
- Good Friday
- Easter Monday
- Victoria Day
- Canada Day
- Nunavut Day
- Civic Day (*fi*rst Monday in August)
- Labour Day
- Thanksgiving
- Remembrance Day
- Christmas Day
- Boxing Day

Site equipment may operate beyond posted hours. The additional time may be necessary for processing of materials at the WTS preparation of the working area receiving waste and for other work defined by management personnel.

The operating hours are prominently posted on the entrance signs for both the Landfill and WTS, which also identifies the site name and the site telephone number.

2.1.2 Site Security

Due to the nature of the work undertaken at the Landfill and WTS, site security and safety is an important feature of the overall operation. Lockable gates are situated at various locations throughout both properties. As detailed on the Engineering Drawings, permanent 2.4 m chain link fencing is provided around the perimeter of the WTS property. At the Landfill, similar fencing will be established around the leachate holding ponds as well as Cell 1. As additional cells are constructed in the future, the fencing will be extended to contain active and previously developed portions of the Landfill. No trespassing signage will be affixed to the fencing at regular intervals. Fencing of both the leachate ponds and the Landfill will serve as an access deterant to wildlife and the public.

Keys/electronic access cards will be provided to persons employed by the City and directly involved with the operation of the WTS and/or Landfill, at the discretion of the Director of Engineering and Public Works or Manager of Solid Waste (Manager). A record shall be kept at the Scale House relating to who

has keys, including contact name and phone number. A general visitor log (Appendix A) shall also be maintained at the Scale House.

When either site is unattended, the gates will be closed and locked.

Commitment 30
Commitment 35
Permafrost, MSC, FMP, OMM
CIRNAC

During construction generally accepted best practices will be followed in accordane with CSA PLUS 4011:19 Technical Guide: Infrastructure in permafrost: A guideline for climate change adapatation. Cuts will be minimized and insulation utilized where possible to prevent heat transfer to permafrost. Future design may be adjusted based on knowledge gained during temperature monitoring from thermistors placed within the active cell.

Commitment 31
Permafrost, MSC, FMP, OMM
CIRNAC

The construction of leachate ponds have been designed to avoid cuts into the active layer and placed over a thick gravel pad on a bedrock base, minimizing potential for impact to permafrost.

Commitment 32
Permafrost, MSC, FMP, OMM
CIRNAC

The original thermistor locations were designed to provide a baseline assessment of the site without drilling conduit holes in locations where bales and drainage paths may be influenced. Once the final alignment of cells is located, thermistors will be placed to best assess the permafrost conditions, that could include vertical and horizontal thermistors. Thermistor installation will be included in the phased cell construction contract, and for the lagoons and WTS. Temperatures below the access road will not be monitored.

Updated drawings will be provided by October 9.

Commitment 33
Permafrost, MSC, FMP, OMM
CIRNAC

Heat generation from decomposing municipal bale waste (high density) in a northern climate has not been well documented. In addition, heat generation is typically delayed, if it occurs at all, until bale placement and thermal-chemical conditions within the bales satisfy conditions to allow for waste decomposition. Such thermal-chemical conditions for heat generation require the presence of oxygen, which will be limited due to the wrapping of the waste bales with LLDPE.

Commitment 34
Permafrost, MSC, FMP, OMM
CIRNAC
Waste Transfer Station geotechnical report - to be provided by City of Iqaluit

8.2.3 Waste Baling

Following the completion of inspection procedures, material on the tipping floor is pushed using a front end loader to the conveyor infeed. The rate of material transfer from the conveyor to the baler hopper is regulated by the Baler Operator. Similarly, the Baler Operator controls the hydraulic rams, wire tying device and bale wrapper associated with the baler.

Following ejection from the baler, the bales are transferred (utilizing a forklift) to a flatbed truck for transport to the bale*f*ill.

8.3 Waste Placement and Covering

8.3.1 Waste Placement

Utilizing the Landfill's access road, bales of municipal solid waste will be delivered by site personnel from the WTS to the active disposal area. With the possible exception of loads of unique or difficult wastes, waste delivery vehicles and/or the general public will not have access to the Landfill area.

The Landfill is constructed from a series of individual lifts. Bales are removed from the flatbed truck via a fork-equipped front end loader. A lift is constructed by stacking bales three to four high; the height limit being set by the reach limit of the front end loader. The total height of a four bale lift is approximately 3 m. During bale stacking, the bales are placed with their widest dimension perpendicular to the direction of balefilling. Processed (shredded) or modest-sized C&D materials can be placed in bale voids on perimeter side slopes with granular fill subsequently being placed to develop a base for the final landfill cap.

To address the potential requirement (due to the temporary unavailability of the WTS baler) to accept unbaled MSW at the Landfill, it is recommended that the material be placed in a constructed void space (e.g., not placing bales in a designated area to establish a shallow "disposal pit") within the active bale placement area. Aggregate cover can then be placed over the material to prevent the potential for blowing litter. A similar containment approach can be used for C&D debris that presents a blowing litter potential. As an alternative, should the baler be inoperable for an extended period, the site could be temporarily operated as a traditional landfill, with waste being placed over a larger horizontal area (e.g., 300 m^2 with individual lifts of 400 to 600 mm) and then compacted with a bulldozer or (if available) the North 40 landfill compactor. To address concerns of blowing litter, a thin (e.g., 75 mm) cover layer of aggregate would need to be placed over the final waste lift at the end of each day.

To allow for a minimum four (horizontal) to one (vertical) side slopes for the fill area, the bales must be staggered during placement, utilizing the arrangements shown in Figure 8-1. The required side slope is attained, while still providing efficient usage of the available disposal volume. The staggered arrangement should be maintained until the final design elevation is reached.

The horizontal top cover should be placed to provide between 2% and 4% grade. A minimum side slope of 1% should also be established on the horizontal surface towards the passive vertical faces to direct runoff away from the working face.

Elements relating to the progression of solid waste balefilling at the facility are illustrated on the Engineering Drawings. The Landfill area development follows a sequence of composite liner installation within a specified disposal area, the orderly placement (or stacking) of cells of baled solid waste within the disposal area, installation of composite liner in the next required disposal area, and the repeat of the process until final grades are reached and the area is capped.

4.1.5 Household Hazardous Wastes Depot and Storage

Steel intermodal ("seacan") containers, modified to address storage requirements for receiving HHW materials, as well as one pre-fabricated container specifically constructed as an HHW storage container with secondary containment (Loraday Model LEP/L73-4013 Storage Container or equivalent)are situated in the southwestern area of the WTS yard. One 12 m (40 ft) container serves as a public drop off location, where a trained staff member records incoming quantities and directs the materials to an appropriate initial storage location. As required, materials from the Drop Off Container are directed to one of the 12 m storage containers or the purpose-built HHW building with secondary containment (Loraday Model LEP/L73-4013 Storage Container or equivalent). Arrangements are made by the City for subsequent shipping to approved-management facilities in the south, as quantities warrant.

4.1.5.1 Household Hazardous Wastes Acceptable Materials

It is recommended that following wastes not be accepted for landfilling or recycling and instead be considered Household Hazardous Waste (HHW). Please note that this list is not exhaustive and is subject to change per City of Iqaluit and/or Government of Nunavut guidelines, :

- Alkaline batteries
- Button cell batteries
- Rechargeable batteries
- Lead-acid batteries
- Fluid paints, stains, varnishes, and oil paint products
- Empty paint, stain, varnish, and oil paint product cans
- Varnish remover
- Cleaning chemicals and disinfectants (i.e. toilet cleaner, oven cleaner, drain cleaner)
- Antifreeze/radiator fluids
- Bleach
- Brake fluid
- Pesticides/insecticides/rodenticides
- Herbicides/weed killer
- Chemical lawn fertilizers
- Insect repellants
- Gasoline
- Fuel oil
- Used oil products
- Solvents and thinners
- Pharmaceuticals and drugs (or return to pharmacy)
- Aerosols and empty aerosol cans
- BBQ propane tanks
- Camping fuel cylinders
- Oil tanks

- CFL and fluorescent light bulbs
- Fluorescent lighting ballasts manufactured before 1980
- Thermostats
- Household thermometers (mercury-containing)
- Residential fire extinguishers
- Any products labelled as corrosive, toxic, reactive, explosive, oxidizing, poisonous, infectious, or flammable
- Any product or container labelled as follows:

Reactive | Poisonous and Infectious | Oxidizing | Flammable and Combustible | Corrosive | Compressed Gas

4.1.5.2 Household Hazardous Waste Non-Acceptable Materials

The following materials are not accepted as HHW:

- Electronics
- Sharps and other household medical waste

4.1.6 Exterior Material Process and Storage Areas

The exterior yard area (gravel surface) includes equipment and locations for the processing and temporary segregated storage of select materials, including:

- Vehicle Baler/Logger unit (trailer-based).
- End of life vehicles awaiting decommissioning/crushing, crushed vehicles and salvageable metals.
- End of life vehicle and equipment tires.
- HHW intermodal containers.
- HHW 40'Lx12'D, 4-compartment, built in accordance to FM 6049 Standards (Loraday Model LEP/L73-4013 Storage Container or equivalent)
- Baled waste (to address short-term instances when direct transport to the Landfill is not possible).
- A dedicated area for the potential future installation/operation of an in-vessel organics composting unit (including a curing area allowance).
- A dedicated area for the potential future development of a greenhouse.
- Snow storage areas to support yard clearing efforts.

Commitment 39
OMM
CIRNAC

Resolved

Commitment 40
Regulatory Advice
NWB
See Commitment 12 (Page 178-179)

Commitment 41
Operational Costs
NWB

Request extension to October 23 to respond to this commitment.