HATCH

Labrador Straits Waste Disposal Inc.

Southern Labrador Waste Disposal Facility

Project Registration

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HATCH						**Client**

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1. Name of the Undertaking

Southern Labrador Waste Disposal Facility.

2. Proponent

PROPONENT:

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3. The Undertaking

Labrador Straits Waste Disposal Incorporated (LSWDI) is considering a site for a Waste Disposal Facility between Port Hope Simpson and Mary's Harbour.

The Project is identified as the Southern Labrador Waste Disposal Facility (hereafter referred to as the "Undertaking" or "Project") and is to be located in south eastern Labrador, just off of the Trans Labrador Highway 510 (see Figure 1 and Figure 2) for Regional Context and Project Location).

This facility is designed as a non-containment landfill in Labrador for residual general and unsorted Construction and Demolition (C&D) wastes after separation of organic, recyclable, and hazardous wastes from the waste stream. Section 4.6.2 provides a summary of the separation approach proposed for this facility. Commissioning of this facility is intended to allow the closure of existing municipal dumps in the Southern Labrador area. The facility is designed to service the following communities in Southern Labrador:

- Capstan Island
- Cartwright

- Charlottetown
- Forteau
- Lanse-au-Clair
- Lanse-au-Loup
- Lodge Bay
- Mary's Harbour
- Paradise River
- Pinsent's Arm
- Pinware
- Port Hope Simpson
- Red Bay
- St. Lewis
- West St. Modeste

The facility will be designed and operated in accordance with the Provincial Waste Management Strategy, the Environmental Standards for Labrador Landfills and the initiatives of the Multi Materials Stewardship Board (MMSB) as summarized in Sections 4.6 and 4.7.

4. Description of the Undertaking

This section provides a description of the Project (or undertaking) including its geographical location, physical features and existing biophysical and socio-economic environment (or setting), alternatives considered, conceptual design, and construction.

4.1 Geographical Location

The proposed location is a six hectare property with a 300 m long by 15 m wide Right-of-Way (ROW) to accommodate an access road off the Trans Labrador Highway (HMM, 2014; AMEC, 2004).

The proposed Project Site is located approximately 2.5 km south of the St. Lewis Inlet on the west side of Route 510 (AMEC, 2004) (refer to Figure 3 for the Project Study Area). The approximate coordinates for the site are 52°,22',52" N and 56°,07',01"W with a proposed road extending 300 m east to intersect Route 510 (HMM, 2014).

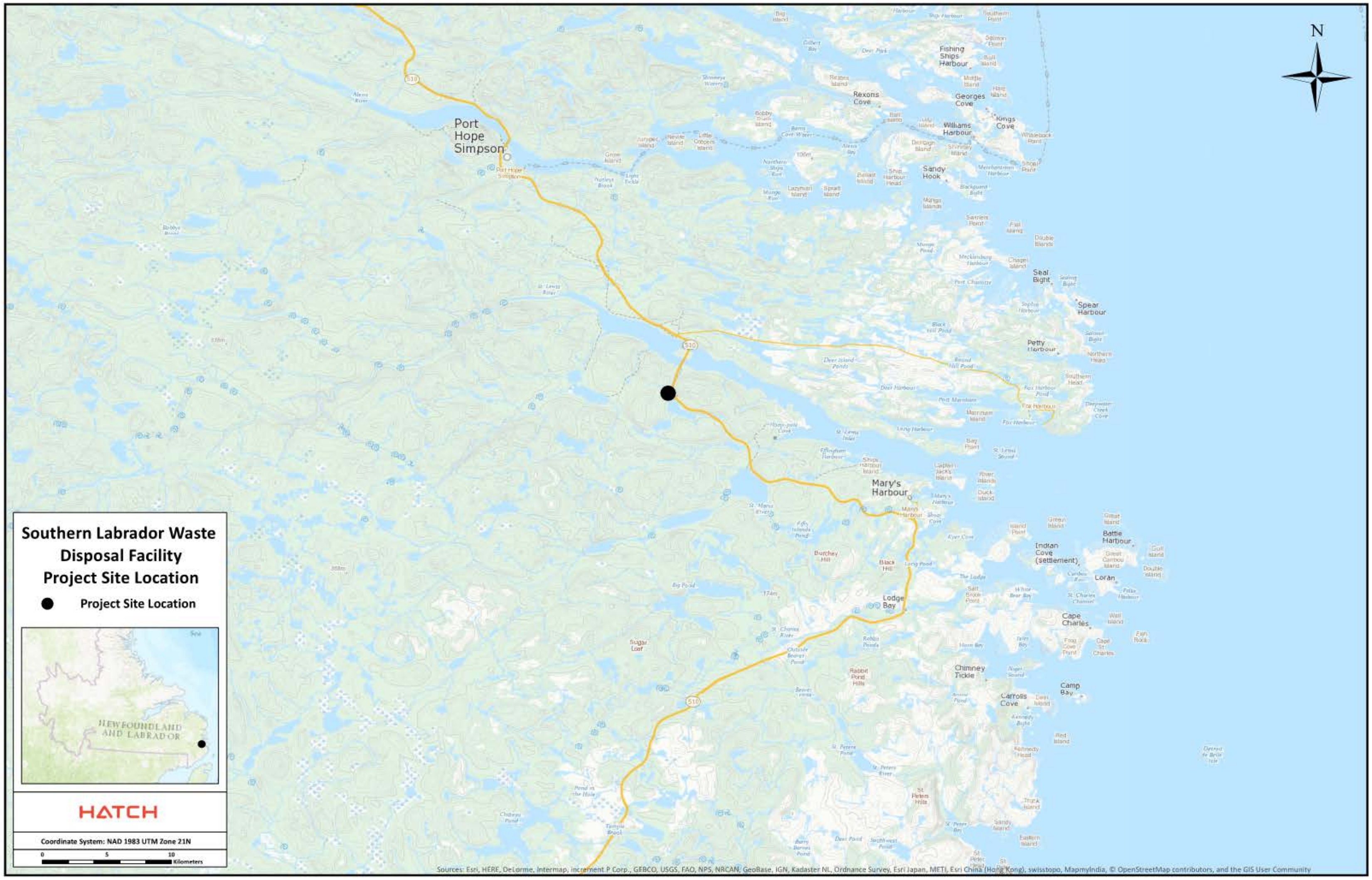

Figure 1: Project Site Location

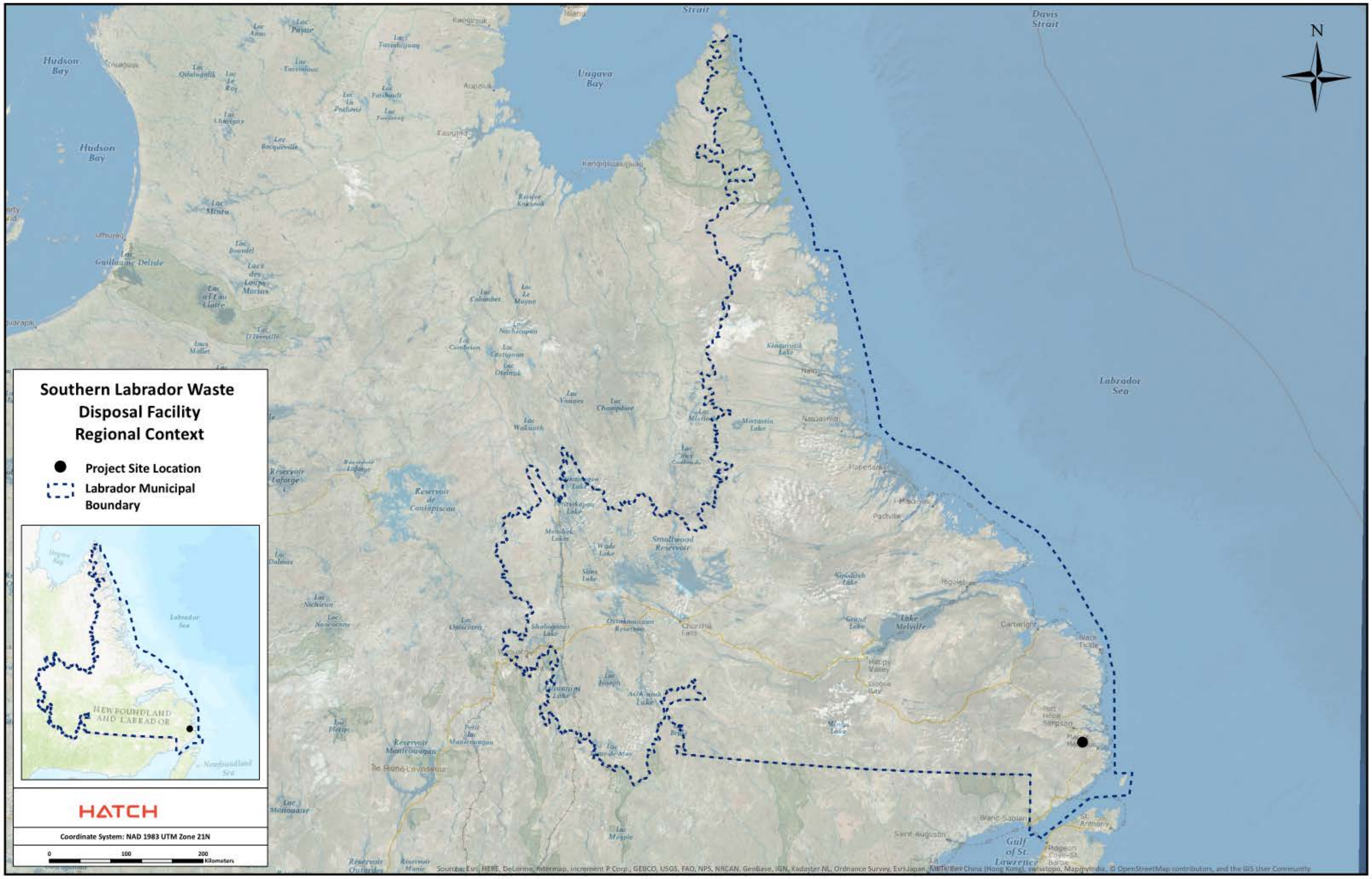

Figure 2: Project Site and Regional Context

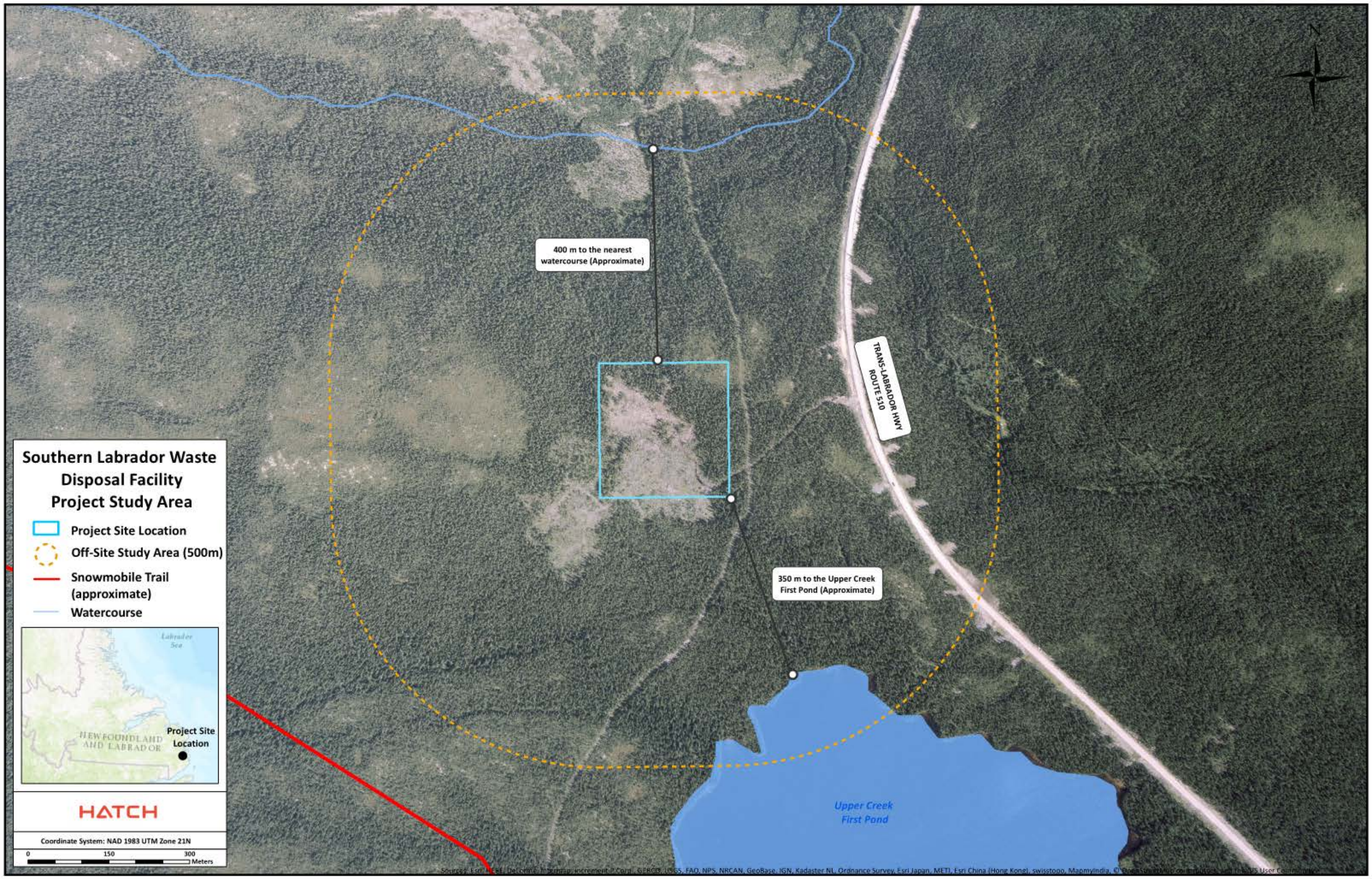

Figure 3: Project Study Area

4.2 Description of the Existing Physical, Biological and Socio-Economic Environments

In preparing the baseline description of the Project study area, available background information was assembled and reviewed. To this end, a number of secondary sources of information (e.g., maps, reports) were obtained and used to characterize the Project study area and record significant physical, biological, social and/or economic features that could be affected by Project construction and/or operations.

Based on the above activities, a description of the Project study area is provided below. For the purposes of this document, the Project study area is defined to include the Project Site (area within the property boundary), plus the lands within a 500 m radius of the site boundary. Collectively, these areas represent the geographic range over which the potential effects of the Project could occur. This description serves as the baseline for identifying and assessing potential environmental effects associated with the proposed Project.

4.2.1 Description of the Physical Environment

4.2.1.1 Topography

The Project site and off-Site study area is located in a physiographic region assigned to southeastern Labrador by Sandford and Grant called the Mecatina Plateau (HMM, 2015; Doran et al., 2013). The southern coast of Labrador is rugged with varying topography including undulating hills, barren land areas, and hills with peaks up to 300 m above sea level (masl), which steeply descend to valleys at sea level. As the road network traverses through the interior of this region towards the community of Cartwright, elevations increase on the order of 600 to 900 masl (HMM, 2015; Doran et al., 2013).

The Project site and off-Site study area is located on the edge of these undulating hills, which is south of St. Lewis Inlet. The site appears to slope moderately at an approximately 5% grade to the south/southeast (HMM, 2015).

4.2.1.2 Geology and Soils

Due to the isolated nature of the Project Site, no formal soil surveys have been conducted, as such they are considered unclassified (US, 2015). Soils found within the ecoregion where the Project Site is located are mostly acidic (Protected Areas Association (PAA) of Newfoundland and Labrador, 2008; FAA, 2015). Those soils found along upper slopes are shallow and well drained, and those that are in low lands are also shallow, but they are identified as poorly drained (PAA, 2008). As part of a hydrologic investigation completed in 2015 by Hatch Mott MacDonald (HMM), soil and rock coring's were completed as part of the monitoring well program. Soils within all the completed boreholes were well-graded sand with silt and gravel, consistent with basal till as known within the vicinity of the Project study based on surficial geology mapping (HMM, 2015).

This ecoregion is said to be underlain by rocks which belong to the Grenville Province, which represents the most recent period of mountain building in Labrador (PAA, 2008). Bedrock was encountered within 0.3-1 m from the ground surface and was classified as medium-grained, slightly foliated, un-weathered quartz dolite which is consistent with the geological map of the Project study area that classified it as PMdr (refer to Figure 4 for bedrock geology map of the Project study area) (HMM, 2015).

Section 4.3 provides a summary of the hydrogeological investigation for this facility.

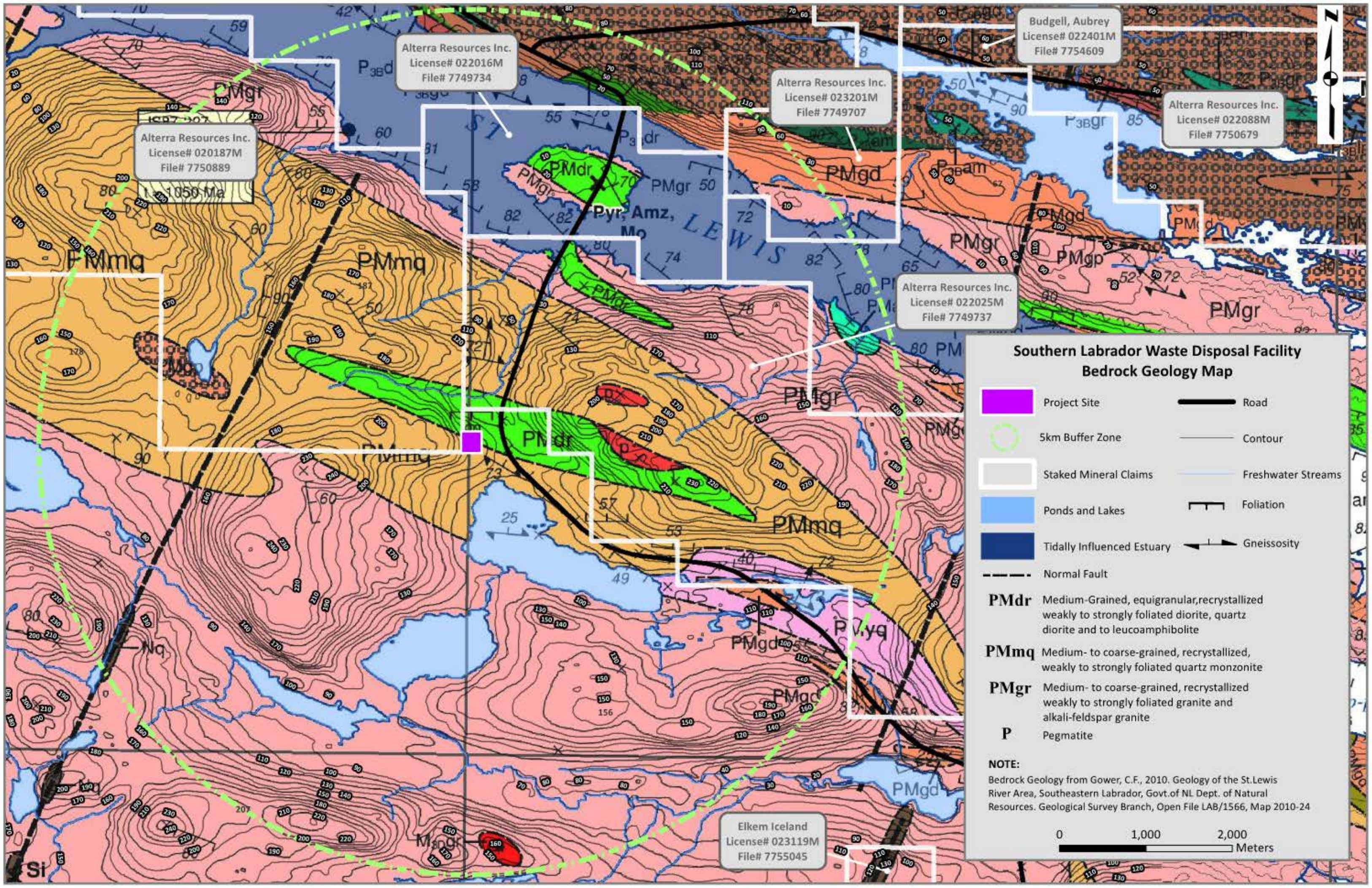

Figure 4: Bedrock Geology Map

4.2.1.3 Watercourse and Waterbody

Both a watercourse and waterbody (pond) are located within the off-Site study area. A watercourse is located approximately 400 m north of the Project site that flows towards the St. Lewis Inlet, and a waterbody identified as the Upper Creek First Pond is located approximately 400 m south (refer to Figure 3).

4.2.1.4 Climate

The Project Site and surrounding 500 m off-Site study area are situated within the Mid Boreal Forest Ecoregion (PAA, 2008).

Table 1 provides a summary of climate data obtained from 1981 to 2010 as recorded at Environment Canada's Cartwright Station which is approximately 160 km north west of the Project Site. As noted therein, the average daily temperature documented during the 20-year timeframe was recorded as 0°C and the average annual rainfall was measured as 616.8 mm, while the average annual snowfall was measured at 462 cm (Environment Canada, 2015). Table 1 indicates that the month of August is the warmest, with a daily average temperature of 12.7°C, while January is the coldest, with a daily average of -14.3°C (Environment Canada, 2015a).

Table 1: 1981 to 2010 Canadian Climate Normals Station Data: Cartwright

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature (°C)													
Daily Average	-14.3	-13.5	-8.7	-1.8	3.3	8.6	12.3	12.7	9	3.7	-2	-8.8	0
Daily Maximum	-9.5	-8.5	-3.6	2.4	7.7	13.8	17.8	18	13.3	6.8	1	-5	4.5
Daily Minimum	-18.9	-18.5	-13.8	-6.1	-1.1	3.4	6.8	7.4	4.6	0.5	-4.9	-12.6	-4.4
Precipitation													
Rainfall (mm)	5.3	9.8	10.5	21.1	47.9	95	100.8	94.1	88.8	88.6	37.6	17.6	616.8
Snowfall (cm)	83.7	82.2	80.7	54.4	20.5	3	0	0	0.8	12.7	48	76	462
Wind													
Speed (km/h)	22.5	22.2	22	19.8	17.4	17.1	14.9	14.5	18.3	20.8	23.7	24.3	19.8
Most Frequent Direction	SW	SW	NW	N	N	N	SW	SW	SW	SW	SW	SW	SW

(Source: Environment Canada, 2015a).

4.2.1.5 Air Quality

In Newfoundland and Labrador, air quality criteria are legislated under the Air Pollution Control Regulations, 2004 (39/04) made under the Environmental Protection Act (2002) and Environment Canada's Air Quality Health Index (AQHI). The AQHI is calculated based on the relative risks of a combination of common air pollutants known to be harmful to human health. These pollutants are Ozone (O_3), Particulate Matter (PM2.5/PM10) and Nitrogen Dioxide (NO_2).

There are a total of seven air monitoring stations (National Air Pollution Surveillance (NAPS) network monitoring sites) located in Newfoundland and Labrador.

The closest station that measures the air quality parameters in the previous paragraph is Grand Falls-Windsor, which is approximately 385 km south. The Grand Falls-Windsor station monitors the ambient levels of Sulphur Dioxide (SO_2), oxides of Nitrogen (NOx), NO_2, Carbon Monoxide (CO), O_3 and PM2.5 on a continuous basis (DEC, 2015).

Based on a review of the AQHI index on November 15, 2015, the area for Grand Falls-Windsor was considered low risk (Government of Canada, 2015a). The closest monitoring station located in Port au Choix in Newfoundland, is approximately 200 km south west of the Project Site. This monitoring station monitors the ambient levels of O_3 (DEC, 2015).

In summary, the air quality at both of these stations is generally considered to be good (DEC, 2015). It is expected that the air quality where the proposed site is located would also have good air quality, as there are no cities or industries located in close proximity.

The Ambient Air Quality Standards based on the Air Pollution Control Regulations (2004) (39/04) for those most harmful to human health are provided in Table 2. For a full list please refer to Schedule A in Newfoundland and Labrador Regulation 39/04. This table serves as a guidance framework for which facilities will need to comply with in relation to the air quality standards for specific contaminants (Department of Environment and Conservation (DEC, 2012)). The maximum permissible ground level concentrations are standards that the Minister has deemed to be acceptable for the protection of the environment, which includes humans, wildlife and vegetation (DEC, 2012).

Table 2: Ambient Air Quality Standards at Reference Conditions

Contaminant	Averaging Period	Maximum Permissible Ground Level Concentrations $\mu g/m^3$
Carbon Monoxide (CO)	1 hour	35000
	8 hour	15000
Hydrogen Sulphide (H_2S)	1 hour	15
	24 hours	5
Nitrogen Dioxide (NO_2) (1)	1 hour	400
	24 hours	200
	annual	100 (1)
Ozone (O_3)	1 hour	160
	8 hour	87
Sulphur Dioxide (SO_2)	1 hour	900
	24 hours	300
	annual	60
Particulate Matter (less than 2.5 microns)	24 hours	25
	annual	8.8
Particulate Matter (less than 10 microns)	24 hours	50
Total Particulate Matter	24 hours	120
	annual	60 (2)

Source: Air Pollution Control Regulations (2004) (39/04)
(1) Arithmetic mean
(2) Geometric mean
$\mu g/m^3$ - Micrograms per cubic metre of air

4.2.1.6 Noise

Within the vicinity of the Project Site, there are no known noise receptors. The existing tree stand likely acts as a barrier and serves to naturally attenuate noise (i.e., provide a noise buffer).

4.2.2 Description of the Biological Environment

The Project Site is located in the Mid Boreal Forest Ecoregion 7 (Paradise River) (PAA, 2008; DEC, 2007). The Mid Boreal Forest ecoregion is located in south eastern Labrador, is mostly forested, and covers approximately 18,600 km^2. The landscape is characterized as undulating with numerous rock outcrops. The rolling uplands are associated with shallow tills, while the lowlands are associated with deeper tills (PAA, 2008).

4.2.2.1 Vegetation Community Profile and Stand Characteristics

The Mid Boreal Forest Ecoregion is characterized by part of the boreal forest that stretches across northern Canada. Additional ecoregions such as tundra and peatland are also present. The forest community is not considered productive as plant growth within the ecoregion is slim (PAA, 2008). Hardwoods are found here, which are mainly non-existent in many subarctic forest communities. Hardwood species consisted of White Birch (Betula papyrifera) and Trembling Aspen (Populus tremuloides) (PAA, 2008). Upper slopes are dominated by Black Spruce (Picea mariana) forests, Balsam Fir (Abies balsamea) and hardwood associates (PAA, 2008). Ground cover within the upper slopes and lowland areas range from feathermoss (Ptilium spp.) in dryer areas, to herbaceous plants within fresh to moist communities (PAA, 2008). Both recent and past forest fire activity has shaped the communities (PAA, 2008). Additional communities found within this ecoregion include domed bogs and kalmia heaths (PAA, 2008). The domed bogs (dominated by sphagnum and heath moss) are found in valleys and are considered the principle peatland of the region that can range from four to nine meters deep (PAA, 2008). Additional herbaceous plants found within this wetland community consist of Pitcher Plants (Nepenthes spp.), Round-leaved Sundew (Drosera rotundifolia), Bog Rosemary (Andromeda polifolia), Bog Laurel (Kalmia polifolia) and Labrador Tea (Ledum spp.). Kalmia heaths (those areas dominated by small shrubs) are typically found in exposed highland areas that also support similar shrubs found in the bog community such as Labrador Tea, Sheep Laurel (Kalmia angustifolia) and Lowland Blueberry (Vaccinium spp.) (PAA, 2008).

The natural features associated with the Project Site and off-Site Study Area is provided in Figure 5. Overall, treed communities are evident on-Site, and it was noted during the hydrogeology field program in October 2015 that a portion of the Project Site had been cut relatively recently. No wetlands are mapped for the Project Site or off-Site Study Area, but there may be low lying areas that contain water during certain time periods of the year.

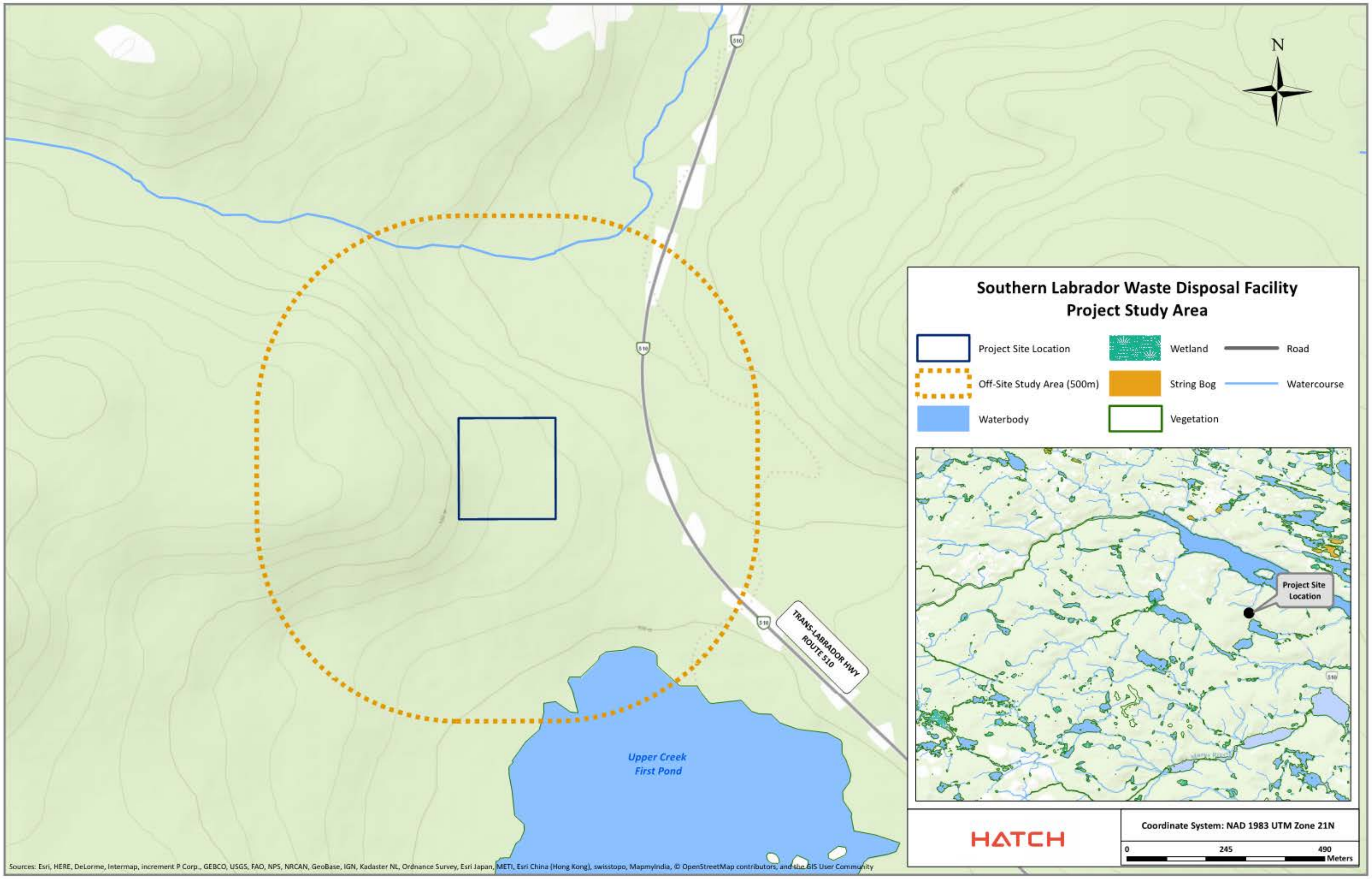

Figure 5: Natural & Life Science Features

A number of terrestrial mammals and furbearers are associated with the Mid Boreal Forest Ecoregion. Generally, species such as Moose (Alces alces), Porcupine (Erethizon dorsatus), Lynx (Lynx canadensis), Little Brown Bat (Myotis lucifungus), Flying Squirrel (Glaucomys sabrinus), and Meadow Jumping Mouse (Zapus hudsonius), Snowshoe (Arctic) Hare (Lepus americanus) (PAA, 2008).

Caribou (Rangifer tarandus caribou) and Northern Bog Lemming (Synaptomys borealis) are both characteristic of the barrens. Black Bear (Ursus americanus), Red Fox (Vulpes vulpes), Short-tailed Weasel (Mustela spp.) and Wolf (Canis lupus) are examples of mammals common in all habitats (PAA, 2008).

Beaver (Castor canadensis caecator) and Muskrats (Ondatra zibethicus obscurus), Water Shrew (Sorex palustris) and River Otters (Lontra canadensis) occur in ponds, lakes and near rivers (PAA, 2008).

Given the proximity of the Site to many natural features (i.e. woodlands, lakes and watercourses etc.), there is a high likelihood of encountering a number of mammal species within the Project Site and off-Site Study Area. Considering the expanse of woodlands outside of the Project Site and the 500 m Study Area, habitat loss is expected to be minimal through the creation of the facility due to its footprint relative to the surrounding area.

4.2.2.2 Amphibians and Reptiles

According to the Canadian Herpetological Society (2012), Newfoundland has fewer native species of amphibians than any other province in Canada, and no known reptiles. Newfoundland and Labrador is only home to eight species of amphibians, two of which are non-native, and six of which are only native to Labrador. Within the Mid Boreal Forest Ecoegion, the American Toad (Anaxyrus americanus) and Northern Leopard Frog (Lithobates pipiens) are found (PAA, 2008).

Based upon the information known at this time, it is uncertain whether populations of amphibians exist within the Project Site or off-Site Study Area. If there are low lying areas that are inundated with water during the spring season, following spring freshet, there is a probability that amphibian populations may exist. Smaller wetland communities not currently mapped may be present adjacent to waterbodies, which may also serve as habitat for these species.

4.2.2.3 Avifauna

A large number of birds (400+) have been recorded within the province of Newfoundland and Labrador, including 94 migratory birds according to the Breeding Bird Survey completed by Environment Canada in 2014 (DEC, 2014; Environment Canada, 2014).

Birds associated within the Mid Boreal Forest Ecoregion are those associated with forested habitat such as the Blackpoll Warbler (Setophaga striata), Hermit Thrush (Catharus guttatus), Northern Flicker (Colaptes auratus), Yellow-bellied Flycatcher (Empidonax flaviventris), Boreal Chickadee (Poecile hudsonicus), Fox Sparrow (Passerella iliaca) and White Throated Sparrow (Zonotrichia albicollis). Northern Hawk Owl (Surnia ulula) (PAA, 2008).

Birds associated with marine environments include Greater Yellowlegs (Tringa melanoleuca), Common Snipe (Gallinago gallinago), Belted Kingfisher (Megaceryle alcyon), Canada Goose (Branta canadensis), Red Breasted Merganser (Mergus serrator), Red-necked Phalarope (Phalaropus lobatus) (PAA, 2008).

It is likely that the Facility site it may serve as habitat to the forested avian species as identified above. If and when clearing occurs it should be respective of annual breeding periods, and follow requirements made under the Migratory Birds Convention Act, 1994.

According to Environment Canada, there are no Migratory Bird Sanctuaries (MBS) situated within the Project Site, or within the 500 m off-Site Study Area. The closest MBS is identified as the Shepard Island MBS which is approximately 180 km to the south east of the Project Site (Environment Canada, 2015b).

Similarly, according to Nature Canada and Bird Studies Canada, there is no Important Bird Areas (IBA) located on the Project Site or within the 500 m off-Site Study Area (Bird Studies Canada and Nature Canada (BSCNC), 2015). The closest IBA is approximately 28 km east of the Project Site and identified as the St. Peter Bay, Mary's Harbour IBA. Harlequin Ducks (Histrionicus histrionicus) (designated as nationally endangered) have been observed in relatively large numbers around the inlets and islands of St. Peter Bay; it is also a major moulting area for Common Eiders (Somateria mollissima) (BSCNC, 2015). It is considered continentally significant under the IBA criteria, and its congregation status is considered nationally significant (BSCNC, 2015).

4.2.2.4 Freshwater Fish

The vast system of rivers lakes and ponds supply habitat to a large number of fish species, with the most common identified as Arctic Char (Salvelinus alpinus), Atlantic Salmon (Salmo Linnaeus), Three-spine and nine spine sticklebacks (Gasterosteus Linnaeus; Pungitius Coste), Brook Trout (Salvelinus fontinalis), Rainbow Smelt (Osmerus mordax), Longnose Sucker (Catostomus catostomus), White Sucker (Catostomus commersonii) and Northern Pike (Esox Lucius) (PAA, 2008).

Given the Site proximity to watercourses, depending on design and discharge requirements, there may be associated impacts to waterbodies that contain freshwater populations. Requirements for self-assessment under the Fisheries Act are included in Section 6 based on consultation with Fisheries and Oceans Canada and Department of Fisheries and Aquaculture (DFA).

4.2.2.5 Species at Risk

There are a total of 40 species-at-risk (SARs) listed in the province of Newfoundland and Labrador and a total of 29 species that are listed as per Schedule 1 federal Species at Risk Act (SARA) (Government of Canada, 2015b). Based on a review of their habitat ranges according to documents provided by the Department of Environment and Conservation Wildlife Division and COSEWIC a total of 15 species have ranges within the Project Study Area including the Project Site.

It is noted that SARA establishes Schedule 1 as the official list of wildlife SARs, which are identified as extirpated, endangered, threatened or of special concern. Those listed as threatened or endangered are provided protection on a species and habitat level. As such, for the purposes of this Project, only those species identified as Schedule 1 within Newfoundland and Labrador have been included in Appendix A.

Based on the Project Site characteristics, the likelihood of provincially or federally listed SARs inhabiting the Project Site is moderate-high given the relative lack of disturbance in the area. Additional reconnaissance of the Project Site shall be conducted prior to clearing in order to document site conditions and habitat suitability.

Additionally, based upon a review, there does not appear to be any migratory routes for Woodland Caribou (a threatened species under the Species-at-Risk Act (DEC, 2010a).

4.2.3 Description of the Social and Economic Environment

4.2.3.1 Regional Context

The Project Site and off-Site Study Area are within Southern Labrador. The communities that are associated with this region stretch along the coast line from Quebec North Shore and the Mealy Mountains of Central Labrador. Southern Labrador is home to nineteen small fishing communities that are split between two sub-regions: The Labrador Straits and Southeastern Labrador. The Project Site and off-Site Study area is located within Southeastern Labrador which extends from Lodge Bay to Cartwright (SMI, 2010).

Given the Project Site location, there are no regional official plans for the area to document development and land use. Land use information was requested and provided by Mr. Peter Hearns, from the Land Management Division of the Department of Municipal & Intergovernmental Affairs. This information is illustrated on Figure 6, and details the location of known land claims. It is important to note that no specific land claims or land use has been documented for the Project site. A snowmobile trail is located east of the Project site within the off-Site study area as discussed in Section 4.2.3.4.

The closest community is located approximately 19 km east and is identified as Mary's Harbour. This community was not considered a permanent settlement until 1930. Several services provided within this community include (SMI, 2010):

- Mary's Harbour Community Clinic Health Services.
- Banking Services.
- Post Office.
- Harbourview Manor (Assisted Living for Seniors serving Southeastern sub-region).
- St. Mary's All Grade School.
- Shopping.
- Government Services:

- Department of Fisheries and Aquaculture.
- Human Resources and Employment.
- Royal Canadian Mounted Police (RCMP) Detachment.
- Southern Start Employment Services.

4.2.3.2 *Census Information*

According to Statistics Canada, the Project Site and off-Site Study area are located with Division No. 10 Subd. B, (unorganized) (refer to Figure 7 for the census boundary outline), within the Province of Newfoundland and Labrador. Key data points collected are summarized in Table 3. Since the 2001 Census, the population within this sub-region has declined, which is consistent with Labrador as a whole. The remoteness of this sub-region is likely a contributing factor to unemployment. The dominant industry within Southeastern Labrador is fishing which also represents the dominant source of income and/or revenue (SMI, 2010).

Table 3: Key Census Details Related to the Project Site and Study Area

	2006
Population	475
2001 to 2006 population change (%)	-3.7
Population density per sq kilometre	0
Median age of the population	34.6
Median income in 2005 - all census families ($)	34,304
Employment Rate (%)	22.1
Unemployment Rate (%)	63
Dominant industry employment	Agriculture and other resource-based industries and other services

Source: Statistics Canada, 2007
Data from 2006 Census unless noted

4.2.3.3 *Parks and Protected Areas*

There are no parks, ecological reserves or protected areas within the Project Site and off-Site Study Area.

According to the Wilderness and Ecological Reserve Map of Newfoundland and Labrador (DEC, 2009), and Parks and Protected Areas Map (DEC, 2010b), a Marine Protected Area identified as Gilbert Bay is located approximately 25 km north east of the Project Site. This protected area is managed by Fisheries and Oceans Canada. A Provincial Park identified as Pinware is located 90 km south of the Project Site and Gannett Islands Ecological Reserve is located 169 km north (DEC, no date).

Figure 6: Land Use Map

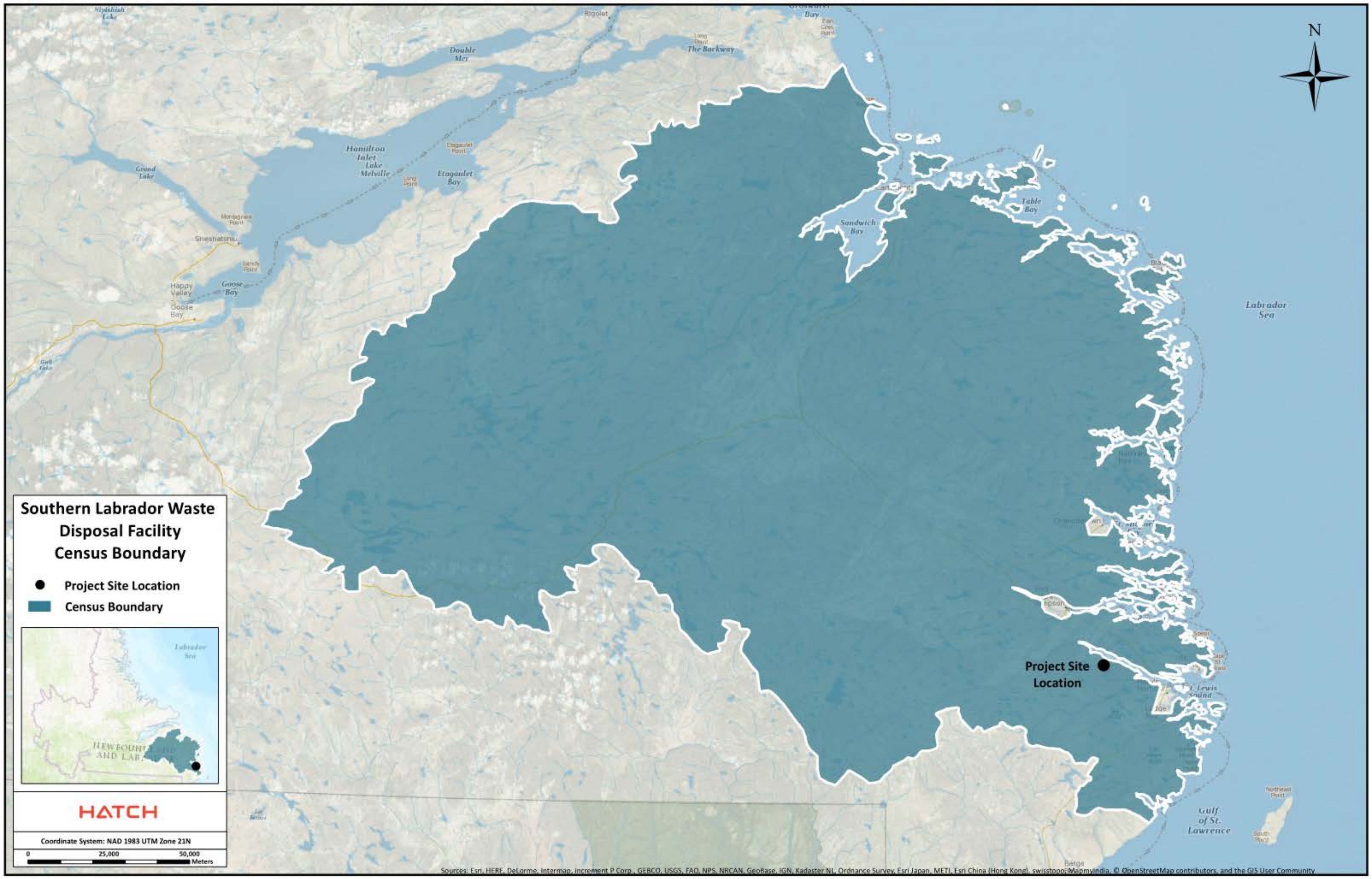

Figure 7: Census Boundary

Similarly according to the Canadian National Parks Map, no National Parks are located within the Project Site or Study Area. The closest National Park is identified as Gros Morne which is 290 km south of the Project Sit (Parks Canada, 1997).

4.2.3.4 *Existing Transportation Infrastructure*

Roads and Highways

Adjacent to the site is the Trans Labrador Highway Route 510. This is the primary road within Labrador and has a length of 1,185 km (CLEDB, 2012). The road is comprised of asphalt and gravel that is usually re-graded on an annual basis. This Highway is managed by the Department of Transportation and Works.

Trails and Walkways

According to the Labrador Coast Drive Regional Map (2005), a snowmobile trail runs just east of the Project site and is within the 500 m off-Site study area of the Project Site (refer to Figure 3). The trail will cross the access road to the facility, signage must be provided to notify trail users to stop prior to crossing the access road and signage must be provided on the access road notifying drivers of the snowmobile crossing. Notification to trail users must be provided prior to construction.

Airports

The closest airstrip to the Project Site is located in Mary's Harbour 19 km to the east. The closest airport is identified as the St. Anthony Airport approximately 110 km south east on the island of Newfoundland (DTW, 2015).

4.2.3.5 *Emergency Services*

Police

The RCMP is responsible for policing in the Southern Labrador region. It provides 24-hour service, with daily office hours within each detachment (SMI, 2010). There are three RCMP detachments within the region located in Cartwright, Mary's Harbour and Forteau (SMI, 2010). Mary's Harbour is the closest detachment to the Project Site and Study Area.

Medical

The Labrador-Grenfell Health Board is responsible for providing health and community services throughout the southeastern region (SMI, 2010). The Labrador South Health Centre (one of four in the Province) is the regional centre that is located in Forteau approximately 116 km south west (SMI, 2010).

In proximity to the Site is the Mary's Harbour Community Clinic (SMI, 2010). This clinic houses both a physician and dentist that visit the clinic every six weeks (SMI, 2010). On a regular basis however, the clinic is staffed by three regional nurse practitioners, one community health nurse, one social worker, one personal care attendant and one maintenance repairman (SMI, 2010).

Ambulance Services

Ambulance services in proximity to the Project Site are located within the communities of L'Anse au Clair to Charlottetown and accessible through the local Clinic (SMI, 2010).

Fire Protection

There are no specific fire halls within the communities. Larger towns are equipped with fire trucks and equipment which are serviced by trained volunteers to respond to fire emergencies within the communities of Southeastern Labrador (SMI, 2010). The stormwater management ponds on site, as noted in Section 4.6.15, will be wet ponds to provide water for firefighting.

4.2.3.6 Heritage Sites, Archaeological Sites and Other Cultural Resources

The Provincial Archaeology Office (PAO), of the Culture and Heritage Division, Department of Business, Tourism, Culture and Rural Development (DBTCRD) is the regulatory agency for all archaeological activities carried out within the province (DBTCRD, 2015a). The PAO aids the Minister in protecting, preserving, developing, studying, interpreting, and promoting an appreciation of the historic resources of the Province of Newfoundland and Labrador (DBTCRD, 2015a). It is noted that historic resources are protected under the Historic Resources Act.

Based on a preliminary review of archaeology sites in Newfoundland and Labrador, some are situated along the shorelines of the St. Lewis Inlet (DBTCRD, 2015b). Paleo Eskimo occupation CA. 3500-2000 BP (before present) is mapped for the Project site and off-site study area. Additional potential archaeological remains might be associated with Inuit, Maritime Archaic Indian, Recent Indian, and European settlement sites (DBTCRD, 2015b). A review of the Inuit land claims agreement map indicated that no land claims are mapped within the Project site and off-site study area (DBTCRD, 2015b).

In order to complete construction that will involve excavation discussions with the PAO should be completed (DBTCRD, 2015c). A Historic Resources Impact Assessment (HRIA) may be required, which is an evaluation of the effect of the proposed operation or activity on historic resources (DBTCRD, 2015d). These assessments must be carried out by a professional archaeologist and may involve three separate stages: historic resource overview assessment; detailed impact assessment; and, an impact management mitigation document (DBTCRD, 2015d).

As part of preparation of this Project Registration the PAO was contacted and they have advised that the Study Area has no archaeological concerns. The PAO notes however that a 100 metre buffer from construction disturbance must be maintained around Upper Creek First Pond.

There is one National Historic Site within Labrador identified as Red Bay, a 16th Century Basque Whaling Industry Complex (Parks Canada, 2015). It is located approximately 75 km south of the Project Site. The nearest Provincial Historic Site is the Point Amour Lighthouse located along L'Anse Amour Road off Highway 510, which is approximately 114 km south of the Project Site (Newfoundland and Labrador Tourism, 2015).

4.2.4 Biophysical and Socio-economic Summary

Due to the isolated area of the Project Site and off-Site Study Area, the creation of the facility may have negative impacts on the bio-physical features of the area, but the Project would be considered to have positive impacts on socio-economic aspects. Although there may be negative impacts to the bio-physical environment and habitats of associated species, mitigation measures can be incorporated with the Project to help off-set impacts during the planning and design phases of the facility. This, along with the notion that the woodlands are expansive in this area providing similar habitat leads to the conclusion that overall impact is considered to be low. Creation of the Waste Disposal Facility will enable local communities to permanently close their existing municipal dumps, and replace them with a facility designed to segregate and manage hazardous wastes, collect recyclable and compostable materials, and minimize the volume of waste landfilled (as detailed in Section 4.6.2). The creation of the facility will also promote growth and industry within Southeastern Labrador, through the creation of jobs, not only for the construction of the facility but for the long-term facility maintenance and management within the future.

4.3 Hydrogeological Assessment

A hydrogeological investigation of the site was completed by HMM in 2015 (HMM357238-001), a copy is included in Appendix B. A set of three boreholes were advanced and completed as monitoring wells to assess the characteristic of the soil, confirm bedrock depth below ground level, measure groundwater levels, assess surficial soil hydraulic conductivity, and analyze groundwater chemical characteristics.

The soils encountered in all the completed borings were well-graded sands with silts and gravel, consistent with the description of basal till as described in the surficial geologic mapping of the area in the vicinity of the site. Bedrock was encountered within 0.3 to 0.9 m (1 to 3 feet) of the ground surface in all borings. The bedrock was medium-grained, slightly foliated, unweathered quartz diorite, consistent with the mapped geologic unit PMdr.

The hydrogeologic investigation determined that the water table is within the upper 0.3 to 0.6 m (1-2 feet) of the ground surface, and that the depth to bedrock ranges from 0.3 to 0.9 m (1-3 feet) in the areas where the monitoring wells were installed. Calculations of hydraulic conductivity from the development of these monitoring wells range from 2×10^{-2} to 5×10^{-4} cm/s, which aligns with information on similar wells completed in fractured granite and gneiss throughout Labrador, which are generally low-yield wells.

Groundwater flow at this site is expected to mimic the surface topography, which in turn is expected to generally reflect the underlying bedrock surface, due to the absence of substantially thick glacial deposits. Groundwater flow direction was determined by interpretation of the measured water levels at MW-1, MW-2, and MW-3, in this context. The direction of groundwater flow was determined to be generally to the southeast.

The water quality parameters are within expected ranges, aside from the elevated iron results. Resampling is recommended at a later date or after full purging of the wells has been completed to ensure that samples represent undisturbed groundwater from the formation, and to confirm the elevated iron results, which are uncharacteristic for the region.

This site was considered for a natural attenuation landfill under the ENVC Environmental Standards for Labrador Landfills (Feb 2014). The standards require that natural attenuation landfills shall be sited in areas of low to medium hydraulic conductivity (1 x 10^{-6} cm/s or less) and shall be at least 1.5 m above the seasonal high groundwater table. Areas where there is a reasonable soil depth and no useful groundwater resources are preferred locations. The standard does however allow for variances if the required hydraulic conductivity cannot be achieved under natural conditions. Due to the shallow depth of the groundwater, high hydraulic conductivity, and shallow soil depth, the site is not suitable for a natural attenuation landfill, unless variances are allowed by the ENVC.

Consultation with the ENVC Water Resources Management Division was conducted to review the site conditions and develop the following variances to the ENVC Environmental Standards for Labrador Landfills (Feb 2014). The variances required for this site include importing locally-sourced fill material to raise the level of the landfill cells by between 1.2 and 1.3 m to attain the vertical separation above the groundwater table. Local fill material is expected to have hydraulic conductivity values typical of surficial deposits in Labrador, such as fine to coarse sand is typically in the range of 10^{1} to 10^{-4} cm/s (Doran et al. 2013). As a result, local fill material with hydraulic conductivity equal to or below the specified maximum value (1 x 10^{-6} cm/s) is not expected to be available. The maximum hydraulic conductivity observed at the site was 2 x 10^{-2} cm/s, although this reflects the bedrock or a combination of bedrock and surficial materials. A variance allowing the imported fill material to have hydraulic conductivity up to this value is recommended.

4.4 Alternatives

The following Table 4 is a summary of the review of potential sites considered in the Regional Solid Waste Management Study Southeastern Labrador. Phase 2 Site Assessment. Final Report, completed in 2004 by AMEC.

The sites considered were near the waste centroid calculated for the southern Labrador area, centred near Port Hope Simpson. At the end of the evaluation Site 9 was selected as the preferred location, due to the separation from the Trans Labrador Highway and proximity to the waste centroid for the southern Labrador area.

Table 4: Summary of Potential Waste Disposal Sites

Site Area	Coordinates	Location	Land Type	Grade	Constraints/Notes
Area 1	N52° 26’ 37” W56° 10” 6”	Southwestern side of Trans Labrador Highway, 6 km northwest of	Heavily Forested	6% moderately toward St. Lewis Inlet	- Located close to St. Lewis Inlet Visible from St. Lewis Inlet.

Site Area	Coordinates	Location	Land Type	Grade	Constraints/Notes
		intersection with St. Lewis Access Road.			- Potential Cabin Development near end of St. Lewis Inlet.
Area 2	N52° 27' 14" W56° 10' 49"	Southwestern side of Trans Labrador Highway, 7.5 km northwest of intersection with the St. Lewis Access Road.	Heavily Forested	May be more gently sloping than Area 1	- Located close to St. Lewis Inlet Visible from St. Lewis Inlet. - Potential Cabin Development near end of St. Lewis Inlet.
Area 3	N52° 27' 35" W56° 11' 34"	Southwestern side of Trans Labrador Highway, 8.5 km northwest of intersection with the St. Lewis Access Road.	Less Forested than Area 1	More gently sloping than Area 1	- Located close to St. Lewis Inlet Visible from St. Lewis Inlet. - Potential Cabin Development near end of St. Lewis Inlet *to a lesser extent than Area 1.
Area 4	N52° 28' 45" W56° 11' 23"	Eastern side (1 km from highway) of Trans Labrador Highway, 8.5 km northwest of intersection with the St. Lewis Access Road.	Moderately Forested	+/- 9% down toward southeast	- Area is visible from the Trans Labrador Highway Proximity to small pond and Notleys Brook.
Area 5	N52° 29' 36" W56° 11' 24"	Eastern side (500 m from highway) of Trans Labrador Highway, 10 km northwest of intersection with the St. Lewis Access Road.	Moderately Forested	+/- 5% down toward east	- Potential for visibility from highway. - Highway access is problematic due to steep grade of highway in this area.
Area 6	N52° 27' 35" W56° 11' 34"	Northeastern side (1 km east from highway) of Trans Labrador Highway, 6.5 km northwest of intersection with the St. Lewis Access Road.	Open high country, sparsely forested	Generally flat with natural undulations	- Potential for visibility from highway, even from some distance away.
Area 7	N52° 28', 17.7" W56° 11' 23"	Southwestern side (500 m west from highway) of Trans Labrador Highway, 6.5 km northwest of	Moderately forested	+/- 6% up toward north	- Potential visibility from snowmobile trail (area is adjacent to and north of snowmobile trail between Port Hope Simpson and

Site Area	Coordinates	Location	Land Type	Grade	Constraints/Notes
		intersection with the St. Lewis Access Road.			St. Lewis).
Area 8	N520 29', 4.4" W56° 11' 25"	Southwestern side (500 m west from highway) of Trans Labrador Highway, 6.5 km northwest of intersection with the St. Lewis Access Road.	Moderately forested	+/- 3% down grade to south	- Potential small body of water south of site.
Area 9	N52° 22' 49" W56° 06' 52"	2.5 km south of St. Lewis Inlet.	Heavily treed	5% toward south	- Test pit surveys revealed thin layer of organics underlain by about 1.2 m of silty sand material containing small cobbles and boulders. - Potential for acquiring some cover material on site, and borrow pits developed in nearby area.

4.5 Waste Generation Estimate

The updated waste generation estimate for the Labrador Straits area is provided in Appendix C. For the purposes of sizing the SLWDF, the population will be assumed to remain steady at 3648. Any decreases in population could allow the facility to remain in operation longer than the planned 50 year lifespan if waste generation rates remain unchanged per person.

For this waste generation update, waste data from Central Newfoundland Waste Management (CNWM) was obtained for sub-catchment areas of similar population and community type. The sub-catchment areas of Indian Bay and Fogo Island have populations of approximately 4,800 and 2,400 respectively, which are comprised of smaller communities along their respective coastlines. The total waste generation rates from these sub-catchment areas ranged between 1.6 and 1.8 kg per person per day. CNMW collects data on the waste streams entering their facility. This data was used to develop the waste estimates for the SLWDF summarized in Appendix C.

Table 5: SLWDF Projected Annual and Operational Lifespan Waste Generation Rates

Waste Stream	Per Capita Rate (kg/day)	Annual Mass (tonnes)	Initial 10 Years of Operations (tonnes)	Operational Lifespan (tonnes)
To Landfill				
C & D Unsorted	0.51	183	1,830	9,151
Clear Bag	0.14	681	6,812	34,058
Diverted from Landfill				
C & D Sorted	0.48	645	6,452	32,259
Cardboard	0.05	72	723	3,613
E-Waste	0.01	11	108	540
HHW	0.00	2	15	77
Metals	0.12	163	1,632	8,160
Tires	0.01	13	135	673
Wood	0.02	31	310	1,548
Organics	0.25	225	2,248	11,239
Blue Bag	0.09	115	1,146	5,731
Total Waste	1.69	2,141	21,410	107,049
Total Waste to Landfill	0.65	864	8,642	43,209
Total Waste Diverted from Landfill	1.04	1,277	12,768	63,839

4.6 Conceptual Design

Labrador Landfills for a facility designed for a community of between 1000 and 5000 people. Design elements include:

- Household Hazardous Waste Segregation (Section 4.6.2 and 4.6.9).
- Composting (Section 4.6.4 and 4.6.8).
- Recycling for metals, plastics, and paper (Section 4.6.5, 4.6.6, 4.6.11, 4.6.12).
- Reuse of construction and demolition debris where possible as landfill cover and through composting (Section 4.6.7 and 4.6.11).
- Site signage.
- Bi-weekly covering of waste during summer .
- Site specific environmental monitoring (see Section 4.7.6 through 4.7.8).

The following section summarizes the conceptual design of the facility based upon these standards and the waste generation estimate in Section 4.5.

The general features of the proposed landfill facility will include the following:

- A cleared area approximately 240 m by 240 m.
- A right of way approximately 15 m wide by 300 m long extending from the site to the Trans Labrador Highway. The access road will be an all season gravel road with a granular maintenance grade topping and security gate to limit access to the site.
- A maintenance/utility building to house a small office, washroom, and space for equipment storage and maintenance.
- A landfill area approximately 3 hectares in size and broken up into a number of individual cells constructed with a 3 m high by 25 m wide perimeter berm.
- Material Drop off area for public to deliver waste for landfilling, recyclable materials, construction and demolition wastes, Household Hazardous Waste (HHW), organics for composting, used electronics, appliances and vehicles.
- An area allocated for stockpiling/storage of landfill cover materials (soil).
- Composting area to manage organics.
- Construction and Demolition debris area to segregate and stockpile this material either for reuse onsite or to accumulate for offsite recycling.

The conceptual layout for the facility is included in Appendix D.

4.6.1 Variance from Landfill Standards

As noted in Section 4.3, the site has shallow soil conditions overlying bedrock with the depth to the groundwater table ranging between 0.2 and 0.3 m below existing ground level. Under the Environmental Standards for Labrador Landfills siting requirements the landfill variances are considered based upon justification. The following variances are proposed for this facility and are incorporated into the conceptual design:

- Placement of 1.2 to 1.3 m of fill across the site to raise the level of the landfill cell to 1.5 m above the groundwater table. This material must be sourced from off-Site pits along the Trans Labrador Highway. This material should have a minimum hydraulic conductivity of 1×10^{-4} cm/s. Total fill quantity is in the order of 36,000 to 39,000 m^3 for the entire landfill area, with between 11,500 and 12,500 m^3 for the initial 10 year landfill cell.
- Considering the shallow soil depth, the landfill cell must be constructed above ground. To achieve this, a perimeter berm will be constructed above the fill noted previously. This berm is proposed to be 3 m high and will be constructed of material similar to the material used for the landfill cell fill. The perimeter berm will require on the order of 23,000 m^3 of fill for the entire landfill, and approximately 11,500 m^3 of fill for the perimeter of the initial 10-year landfill cell.

4.6.2 Community Waste Drop-off

The community waste drop-offs are an essential component of the Facility. These transfer facilities provide the opportunity to source separate waste types prior to transportation to the Facility. This source separation is critical to the success of the non-containment landfill approach proposed for the Facility. The community waste drop-off must be arranged to maximize the public's ability to separate their waste streams and must be supported by an education program that informs and supports public's efforts.

Priority will be given to promote local composting efforts in communities for either individuals or community gardens through distribution of composting bins and an education program.

Each community waste drop-off will consist of a series of disposal bins. The bins could either consist of covered roll-off bins or in-ground waste bins, such as the Molok™ system. The bins would be provided for the following waste streams:

- Organics (food and yard waste) if not managed through local composting activities.
- General Waste (non-recyclable and non-organic waste).
- Blue Bin Recyclables (Plastics, glass, paper and cardboard).
- Construction and Demolition wastes (wood, concrete, metals and unsorted wastes).

Drop-off of appliances, tires, electronic wastes and HHW would be arranged periodically during the year to have drop off supervised by the LSWDI driver.

Each drop-off would provide signage providing instructions on acceptable wastes for each bin, collection schedule, and contact information for inquiries.

To assist with implementation of the new waste collection approach an ongoing education program must be established to inform residents of the changes in waste management. This program should include:

- Review waste streams, as well as transfer facility and waste disposal facility operations with each community at Public Meetings.
- Distribute Information on acceptable waste streams prior to implementation in the form of posters, refrigerator magnets, newsletters, and website.
- Distribute blue bins and green (organics) bins to each household prior to implementation.
- Review supply and sale of acceptable clear, blue and organics bags with local retailers.
- Conduct tours and question and answer sessions at transfer facilities during construction.
- Conduct youth outreach programs at schools prior to implementation and during operations.

- Provide positive reinforcement on diversion performance through the actions of the communities through ongoing newsletters and website updates.

4.6.3 Landfill Cells

The SLWDF landfill will be developed in a series of five 10 year lifespan cells to be developed sequentially to accommodate a total of 43,209 tonnes of solid waste over a 50-year operational lifespan. The conceptual sizing of the facility accounts for the placed density of the waste, berms between the landfill cells, the use of cover materials during operations and settlement.

Density of waste is a key consideration for the calculating the landfill cell airspace. Landfill airspace is the volume of landfill available between the top of the base and the invert of the cover material. Heavy compaction equipment is typically used for larger landfill sites to maximize the density of the waste at placement to increase the mass of waste landfilled within a given airspace. This type of equipment has limited use for other operational activities, such as grading, snow clearing, compost windrow turning and materials movement necessary at the SLWDF, thus it is difficult to justify its cost, therefore one will not be used at the SLWDF. The inplace density used to calculate the airspace volume will 5.2 kN/m^3 or 530 kg/m^3, based upon a study on compactive effort and moisture addition by Hanson et al.

Cover material typically accounts for up to 20% of the landfill airspace volume due to the need for daily and intermediate cover. Since this facility will not accept organic materials for the landfill and in accordance with the Environmental Standards for Labrador Landfills requirement of biweekly cover for summer months only, it is assumed that the cover requirement can be reduced to 10% of the volume of waste placed.

Table 6: Landfill Sizing

Landfill Sizing	Value	Unit	Value	Unit	Notes
Total Waste Mass			43,209	Tonnes	
Placed Density	5.2	kN/m^3	0.530	$Tonnes/m^3$	
Total Waste Volume			81,488	m^3	
Cover Material	10%	waste volume	8,149	m^3	Assume only biweekly cover in summer months
Total Landfill Airspace			89,637	m^3	
Maximum waste height	6	m			Initial Assumption to develop overall landfill footprint
Basic Landfill Footprint			14,939	m^2	Used to develop overall landfill dimensions
Internal Landfill Length			160	m	South to North, from internal toes of perimeter berms
Internal Landfill Width			93	m	East to West, from internal toes of perimeter berms
External Landfill Length			210	m	Including 25 m perimeter

					berm
External Landfill Width			143	m	Including 25 m perimeter berm
Landfill Airspace within Perimeter Berm			52,145	m^3	
Volume Lost for Internal Berms Between Landfill Cells			12,285	m^3	Assuming 3 m high berm with 3H:1V slopes with 1 m berm top, 4 internal berms to create five 10-year cells
Volume Required above Perimeter Berm			49,776	m^3	
Height Above Perimeter Berm			5.1	m	Assuming 5H:1V slopes along perimeter of waste
Total Height of Waste			8.1	m	Height of waste within perimeter berm plus height above perimeter berm
Initial Landfill Cell					
Volume of Waste			17,927	m^3	Assuming 1/5th of total landfill volume
Internal Cell Length			93	m	East to West, from internal toes of perimeter berms
Internal Cell Width			17.1	m	North to South, from internal toes of perimeter berms
External Cell Length			143	m	Including 25 m wide, 3 m high perimeter berm
External Cell Width			67.1	m	Including 25 m wide, 3 m high perimeter berm
Volume within Perimeter Berm			8,230	m^3	
Volume Required above Berm			9,698	m^3	
Average Height of Waste Above Berm			4	m	Assuming 5H:1V slopes along perimeter of waste

To fit within the overall limits of the site, the landfill footprint will be 210 m long and as a result 143 m wide, both dimensions from the outside toes of the perimeter berm. The inside base length and width of the landfill footprint are 160 m by 93 m, respectively.

The landfill will be developed in stages, with the initial landfill cell constructed at the south end of the landfill footprint. This initial cell will be have outside dimensions of 143 m long by 67.1 m wide. The internal footprint of the initial landfill cell will be 93 m long by 17.1 m wide, as measured between the internal toes of the perimeter berm slopes.

As noted in Section 4.6.1, the landfill must be built above ground to account for the shallow soil conditions on site. A layer of fill material 1.2 to 1.3 meters thick must be placed and compacted over the area of each landfill cell prior to construction of the perimeter berm. The initial landfill cell will be surrounded by a 3 m high berm, with an outside slope of 5:1, a 1 m wide crest and an inside slope of 3:1, which results in an overall width of 25 m. The initial landfill cell will be located at the south end of the overall landfill footprint. Future landfill cells will be consist of constructing 3 sided berms onto the north side of the previous landfill cells. The conceptual layout of the landfill is shown in Appendix D.

4.6.4 Composting Facility

The composting facility will be sized to accommodate the organic materials, untreated wood, and potentially cardboard wastes, which in total is less than 500 tonnes per year. The ENVC Environmental Standards for MSW Composting Facilities (2010) are applicable to facilities processing greater than 1,000 tonnes per year, thus it is not applicable to the SLWDF compost facility. A 30 m by 60 m area has been allocated for composting and stockpiling of finished compost. The area is uncovered; however a light structure could be installed to divert precipitation from the active composting area if runoff from the windrow becomes an issue.

This facility will be operated with a group of three three-sided bins, with successive bins for fresh organic matter, partially composted and finishing. The Facility's front end loader will be used to turn the organics in each bin periodically to mix the composting material. A wood chipper will be necessary to chip untreated wood and wood debris, such as tree trunks and branches, and shrubs prior to adding this material to the bins. The chipper would be brought onto the site when sufficient woody material has been accumulated.

The compost produced will remain onsite to be utilized for the final cover on the landfill cell as topsoil to vegetate the final cover.

4.6.5 Material Recycling

The Facility will provide drop-off areas for materials for recycling, including:

- Blue Box Materials (bottles, cans, plastics, paper and cardboard).
- Wood Waste.
- Yard Waste.
- Household Hazardous Waste.
- Electronic Wastes.
- Metals.
- Vehicles.

The following sections describes the facilities for receiving and stockpiling these materials in the 100 m by 25 m Public Materials Drop-off Area.

4.6.6 Blue Box Materials

A group of four to five covered 20 yard roll-on/roll-off bins will be provided for placement of blue box recycling materials. The covers are intended to protect the materials from precipitation and vectors. When full the bins will be taken offsite for recycling. A contract for removal and recycling of blue box material with a receiving facility will be established prior to commencement of operations.

4.6.7 Wood Waste

Wood waste, including plywood, particle and chip board, dimensional lumber and treated wood will be accepted at the Facility. Treated wood will require segregation from untreated wood waste. Untreated wood waste will only be accepted if fasteners, such as nails, screws, staples and bolts are removed to allow for chipping prior to composting. Two 20 yard roll-on/roll off bins will be set aside for this material to be placed, one for treated and the other for untreated wood. When the untreated bin is full it will be dumped at the compost area for chipping prior to being added to the compost bins. When the treated wood waste bin is full it will be emptied in the landfill cell.

4.6.8 Yard Waste

Yard Waste, including trees, shrubs, brush, sod and plant materials will be accepted in the Public Materials Drop-off Area. An signed area will be set aside for this material to be placed. When sufficient material has been stockpiled a chipper will be brought to site for chipping prior to adding it to the compost bins.

4.6.9 Household Hazardous Waste

Household Hazardous Waste (HHW) will be collected at the Facility to divert it away from the landfill. In accordance with the definitions of HHW provided by the Multi Materials Stewardship Board (MMSB), HHW includes the following material groups:

- Toxic/Poison: Toxic/poisonous materials include solvents, batteries, antifreeze, medications, pesticides, fertilizers, non-oil based paint wood stains and preservatives, radiator coolants, compact fluorescent light bulbs, and any confirmed or suspected carcinogens.
- Corrosive: Corrosive materials include bleach and household cleaners, rust removers, wax strippers, laundry stain removers, oven and drain cleaners, and automotive lead-acid batteries.
- Flammable: Includes fuel oil, gasoline, motor oil, kerosene, camping fuel, paint thinners, methyl hydrate, lighter fluids, contact cement, oil based paints, insect repellent, furniture cleaners, paint brush cleaners, and gasoline/oil mixtures.
- Reactive/Explosive (pressurized container): Includes gas cylinders that carry propane or butane, and aerosol cans containing unused product.

The HHW depot at the SLWDF will consist of a group of shipping containers to hold the four groups of HHW material separately. The facility operator will confirm that the materials are in suitable sealed containers and will direct the public to the correct storage unit. A contract for removal and recycling of HHW with a licensed hauler and receiving facility will be established prior to commencement of operations.

4.6.10 Electronic Wastes

Electronic waste will be stored in a shipping container to protect them from the elements. Acceptable products are based upon the Electronic Products Recycling Association (EPRA) list, and include:

- Desktop computers (and their components).
- Portable personal computers, laptop, notebook, netbook, tablets.
- Desktop printers, fax machines and scanners.
- MP3 Players, including headphones.
- Headsets with base station.
- Multimedia photo viewers.
- Portable multi-media projectors.
- Portable Stereos.
- Portable video surveillance systems.
- Business card scanners.
- Vehicle audio and video systems.
- Audio systems, amplifier, disc player, speakers, sub woofers, remote control.
- Video systems, DVD players, VCRs.
- Power cords, connecting cables.
- AM/FM radio or clock radio.
- Non-cellular telephones, corded and cordless, and answering machines.
- Televisions: CRT, LCD, Plasma, rear projection.

When the shipping container is full it will be shipped to an EPRA approved recycling facility and then returned empty to the Facility. A contract for removal and recycling of electronic waste with a receiving facility will be established prior to commencement of operations.

4.6.11 Metals

Metals, including light vehicle wrecks, washers, dryers, refrigerators, hot water tanks, and oil tanks which have been split and purged will be accepted at the facility.

A 20 cubic yard roll-on/roll-off disposal bin will be located in the Public Materials Drop-off Area to place these materials (with the exception of vehicle wrecks). A contract for removal and recycling of metals with a receiving facility will be established prior to commencement of operations.

4.6.12 Tires

Passenger vehicle and light and medium truck tires will be accepted at the Facility. All tires must be whole (not fragments), free of mud and debris, and have been removed from their rims prior to delivery to the site. Old rims can be left as waste metal. All-Terrain Vehicle (ATV) and Off the Road (OTR) vehicle ATV, and other industrial tires will be accepted for a fee as these are not recyclable, thus they must be landfilled.

A 20 cubic yard roll-on/roll-off disposal bin will be located in the Public Materials Drop-off Area for acceptable used tires for recycling. A contract for removal and recycling of tires with a receiving facility will be established prior to commencement of operations.

4.6.13 Construction and Demolition Waste

A 50 m by 30 m area has been allocated to receive and stockpile construction and demolition waste. The overall approach with this waste is diversion from the landfill by either reusing the material as part of the Facility's operation, composting, or recycling. Concrete waste can be used for either cover material or to maintain the Facility's roads. A crusher unit will be necessary to process the concrete, this unit would be brought to site when sufficient concrete wastes are stockpiled. Untreated wood wastes can be chipped for composting. Metals will be stockpiled for recycling. Roofing materials will be stockpiled for recycling. Preference should be given for sources separated C&D waste as mixed C&D waste will be landfilled. Source separation shall be encouraged through charging a tipping fee for mixed C&D waste, while accepting source separated C&D waste for either a reduced tipping fee or for free.

4.6.14 Soil Stockpile

As noted in Section 4.6.3, the cover for waste for this size of facility is, at a minimum, of bi-weekly during summer months. Based upon soil volumes given in Table 6 for the Facility's operational lifespan, a minimum of 165 m^3 of soil is necessary annually for use as cover. Soil will also be necessary for the final landfill cover that will be progressively constructed as the landfill is filled to capacity. The final cover is expected to require on the order of 20,000 m^3 of soil over the Facility's 50-year operational lifespan.

This soil is expected to originate off-site and it is expected that it can be augmented by C&D waste, such as concrete and granular material. Local quarries along the TLH may be a source of cover material and are shown on Figure 6.

An area of 50 m by 30 m has been allocated within the Facility for soil stockpiling. This allows for segregation of soils that arrive on site for inspection and if necessary testing prior to acceptance.

4.6.15 Drainage

The site generally slopes from the southwest to the northeast. Surface water runoff for land to the southwest of the Facility will be diverted around the site via the perimeter ditch located within the site perimeter. The perimeter ditches will discharge to the second of two stormwater management ponds. The public drop-off area, compost, soil stockpile and construction and demolition waste areas will be graded to drain away from perimeter ditches towards the internal ditch network. Surface water drainage from within the Facility will be directed via internal ditches to the first stormwater management pond. This pond will have a connection to the second pond that can be closed if during surface water monitoring there are issues with the quality of the runoff from the Facility. The stormwater management ponds will be constructed and operated as wet ponds to provide water for firefighting on-Site. The drainage system shall be designed to manage the one in 100-year storm event in accordance with the General Environmental Standards - Municipal Solid Waste Management Facilities/Systems.

4.6.16 Support Facilities

Support facilities consist of the off-site and on-site road access, access control, support buildings, water supply and wastewater disposal.

Site assess will be via Highway 510. This access road is planned to be an 8 m wide gravel road and will be constructed in accordance with the Resource Road Construction Environmental Guidelines and Design Criteria. The access at Highway 510 must be designed in accordance with the Department of Transportation and Works design criteria for commercial development access.

The perimeter ditch is intended to limit access to the site to only the access road. Access to the Facility is via the main gate at the access road. The Facility sign at the gate will include hours of operations, contact numbers, acceptable materials and instructions regarding site access.

The support building must provide office space for the Facility operator, washroom, and storage/maintenance space for the site equipment. A 130 m^2 prefabricated building is planned to provide ease of construction and maintenance.

Drinking water supply is planned to be supplied through bottled water. Washroom facilities are planned to the use a chemical toilet.

4.7 Construction

4.7.1 Sequence of Construction

Construction of the Facility is expect to begin in the early fall 2016 with the Facility beginning operations in summer 2017. The following is a summary of the construction staging for the Facility:

- Mobilize the contractor's site office and facilities.
- Install construction signage on the TLH in accordance with DTW standards.
- Conduct tree cutting and grubbing operations. Establish a wood chipping and stockpiling area on the site to process wood wastes for site restoration.
- Install the erosion and sediment control measures around the perimeter of the site.
- Construct the access road to the site.
- Excavate the perimeter ditches and stormwater management ponds. Cover the exposed slopes with chipped wood material and seed for revegetation.
- Establish local pits for fill material and begin importing fill material to regrade site. Compaction and grading of the site to occur in coordination with the import of fill.
- Construct perimeter berms for initial land cell, place woodchips and seed on outer facing slopes to establish vegetative cover.
- Establish internal drainage ditch network draining to the first stormwater management pond.
- Construct internal road network.
- Install permanent monitoring well system around perimeter of the site.
- Prepare compost, soil stockpile, construction and demolition, and public drop off area granular pads.
- Deliver and install prefabricated site building.
- Install access gate.
- Deliver and place public drop-off bins and storage containers.
- Install site signage.
- Commission site facilities, conduct final inspections and handover to LSWDI.
- Remove construction erosion and sediment control measures and demobilize contractor equipment.

4.7.2 *Mitigation Measures during Construction*

During construction the following environmental impacts are expected to occur if mitigation measures are not implemented:

- Erosion and sediment release.
- Dust.
- Construction debris on local roads.
- Risk of fuel, lubricant and hydraulic fluid release.
- Airborne emissions from construction equipment.
- Noise pollution from construction activities.

The following mitigation measures will be taken during construction to reduce environmental impact concerns will include:

- Prior to vegetation clearing a reconnaissance of the Project Site shall be conducted to document site conditions and habitat suitability for Species at Risk.
- Silt laden runoff from construction areas will not be permitted to discharge directly into any body of water or watercourse. All runoff will be controlled by means of silt fence construction, natural vegetation buffers, stone rip rap, settling ponds and drainage channels as required.
- Efforts will be made to minimize dust generation during the construction phase of the project. Excessive dust from construction activities will be controlled by frequent water or wood chip applications. Any application of calcium chloride will only be allowed in strict accordance with applicable guidelines from the Department of Transportation and Works.
- Trucks leaving the site will pass over a mud mat to remove soil from the wheels prior to entry on to the Trans Labrador Highway. The mud mat will require removal of accumulated soil on a regular basis.
- Solid waste disposal practices will be in compliance with the Environmental Protection Act and associated guidelines. Any construction debris generated during construction will not be permitted to be disposed of onsite but will have to be stored in proper containers and later disposed of when the Facility begins operations.
- All machinery will be inspected for leakage of lubricants and/or fuel and must be in good working order. Any accidental spills or leaks will be promptly contained, cleaned up and reported to the 24-hour environmental emergencies report system at 1-800-563-2444.
- All on site fuel handling and storage will be in compliance with The Storage and Handling of Gasoline and Associated Products Regulations. Refueling of construction equipment will not be permitted within 30 m distance to any water body.

- Equipment exhaust systems will be maintained to provide emissions meeting the manufacturer standards for the equipment.
- Exhaust systems will be maintained to ensure noise levels are within the design specifications of the machinery.

4.7.3 *Operations and Maintenance*

The Southern Labrador Waste Disposal Facility is expected to begin operation in May 2017 and is being designed for an operational minimum time span of 50-years. Operations and maintenance, monitoring, vector control, and decommissioning are summarized in the following sections.

4.7.4 *Site Access and Load Inspection*

All vehicles delivering waste to the site will be screened by trained site workers to ensure acceptable waste materials is being off loaded and to direct the vehicles to the correct location to place the waste. The public will be directed to the drop-off area. Larger loads of general waste that is acceptable for landfilling will be directed to the landfill cell for placement under the supervision of a site worker.

Site access will be controlled through the site access gate, which will be locked when site workers are not on-Site.

4.7.5 *Landfill Cell Filling*

The Facility will start operations with the initial landfill cell sized for a 10-year operational lifespan. The following is the overall filling approach:

- General waste filling will commence at the low point of the landfill cell at the southeast corner and will proceed west and north to create a layer of waste.
- Cover material will be added bi-weekly during the summer months to control vectors and potential odours.
- The waste will be progressively added in lifts to reach the final height of waste on the south side of the landfill cell.
- The final cover will be progressively installed over the waste to divert precipitation from the landfill to reduce the generation of leachate from the landfill cells over time.

As the initial landfill cell fills and approaches its waste volume limit the second landfill cell will be constructed to the north by extending the west and east perimeter berms and creating the second inter cell berm on the north side. Prior to berm construction a layer of fill between 1.2 and 1.3 m deep must be placed and compacted to raise the base level of the landfill cell 1.5 m above the seasonal high ground water level.

Waste filling in the second and future landfill cells must progress along the south side of each cell and then to the north to progressively fill the cell to the maximum height to allow the final capping to be placed on the previous cell.

4.7.6 *Environmental Management Plan*

The potential sources of pollutants to the environment during operations will consist of those associated with daily transportation, dumping and storage of waste. Strict monitoring and mitigation practices during operation will control these activities and minimize risks associated with the following:

- Silt and sediment.
- Dust.
- Construction debris.
- Risk of fuel, lubricant and hydraulic fluid release.
- Airborne emissions from operations equipment.
- Noise pollution from daily operation activities.
- Scattered debris.
- Ground and surface water impacts.

The Facility operations will be conducted in such a manner as to protect public health and safety, minimize fire hazard potential, does not create a nuisance or eye sore to adjacent properties, and will not contaminate ground or surface waters off site. The mitigation measures previously outlined for construction equipment use and silt/sediment control will be adopted during operations of the Facility. In addition the following measures will be undertaken during normal operations of the site in order to minimize potential environmental impacts:

- All vehicles delivering waste to the site will be monitored for acceptable waste material and to ensure all dumping is at approved designated areas on-Site.
- Public access to the site will be controlled by site employees and secure fencing/gate.
- Any identified hazardous waste received at the site will be properly segregated and stored until removed from the site by a licensed contractor to an approved facility.
- An active animal, rodent and vector control program will be put in place.
- Loose debris and litter will be addressed with an appropriate program in place to include regular litter collection, covering of all loads, debris control fencing and other measures as required.
- A fire safety program will be developed in consultation with local fire departments, Fire and Emergency Services - Newfoundland and the Forestry and Agri-Foods Agency.

4.7.7 *Groundwater Monitoring Program*

The operational groundwater monitoring program will be conducted in accordance with the Environmental Standards for Municipal Solid Waste Landfill Sites (GD-PD-049.1) - Appendix C Environmental Baseline and Monitoring Typical Surface and Groundwater Monitoring Program.

A series of four wells will be installed around the perimeter of the landfill positioned to account for the groundwater flow direction to the south east. One well will be positioned at the up-gradient (northwest corner) of the Site. The three other wells will be positioned at the southern side, southeastern corner and east side of the initial landfill cell. As the landfill site develops with additional landfill cells, this monitoring network is expected to increase with additional wells located along the east side of the landfill. The wells will be drilled to monitoring groundwater from the interface zone between the surface soils and the underlying bed rock.

This monitoring program will consist of:

- Annual samples collected and analyzed for the parameters listed Environmental Standards Appendix C Table 1 Column 1.
- Quarterly samples and analyzed for the parameters listed Environmental Standards Appendix C Table 1 Column 2.
- Groundwater level measurements taken in conjunction with annual and quarterly groundwater sampling.

An annual report will be prepared and submitted to the ENVC summarizing the results of the monitoring program.

4.7.8 *Surface Water Monitoring Program*

The operational surface water monitoring program will be conducted in accordance with the Environmental Standards for Municipal Solid Waste Landfill Sites (GD-PD-049.1) - Appendix C Environmental Baseline and Monitoring Typical Surface and Groundwater Monitoring Program. The program will include:

- Visual inspection for leachate seeps from the landfill cell.
- Surface water monitoring from an up stream control point on the west side of the facility, discharge from the first and second stormwater management ponds.
- The sample will be collected quarterly and analyzed for the parameters in the Environmental Standards Appendix C Table 1 Column 3.
- Samples will also be taken semi-annually and analyzed for the parameters in the Environmental Standards Appendix C Table 1 Column 4.
- Annual monitoring the biological features and benthic community of the waterbody located downstream of the Facility to review changes.

An annual report will be prepared and submitted to the ENVC summarizing the results of the monitoring program.

4.7.9 *Vector Control*

Vectors at the Facility are expected to include birds, rodents, bears and insects. The primary control approaches are as follows:

- Provision of cover for organic wastes in the public drop off area through the use of latched covers on disposal bins.
- Use of processed wood and woody yard waste chips to cover the compost bins in the compost area.
- Installation of decoy hunting birds, such as owls or hawks on perches, near the landfill working area, the compost area and the public drop-off for nuisance birds.
- Installation of decoy wasp traps near recycling bins if wasps become an issue.
- Noise devices to scaring birds and bears as a last resort, as these measures generally become ineffective over time.

4.7.10 *Decommissioning Plan*

Decommissioning of the facility is expected to occur at the end of the final year of the operational lifespan.

The Facility is considered a Class B site under the Guidelines for Closure of Non-Containment Municipal Solid Waste Landfill Sites for the following reasons:

- Primary source of waste is residential.
- Attention to site maintenance will be moderate during the operating lifespan.

The classification of the site must be reviewed as part of the development of the closure/decommissioning plan to confirm that Class B remains the correct classification.

Advanced notice of impending closure to the Regional Government Services Centre (GSC) is the first part of the process. The process for Site Closure includes the following:

- Submit application for Closure.
- Submit landfill closure/decommissioning plan for approved by the Waste Management Strategy Technical Committee.
- Prepare and submit summary report to GSC when site closure/decommissioning completed.
- Conduct a final joint inspection with the GSC to confirm compliance with the approved closure/decommissioning plan.

Activities required as part of the closure/decommissioning:

- Site cleanup and preparation - This includes removal of all buildings and infrastructure no longer required on the site, removal of recyclable materials and HHW.
- Site grading and waste compaction - It is expected that the landfill cells will be progressively covered with their final cover as the cells are filled to their maximum height with soil collected from offsite and topped with compost material prepared onsite. During closure site grading for the waste collection and stockpiling areas will be completed to provide positive drainage from these areas and to prevent the pooling of water. Compost prepared onsite will also be used to assist with revegetating the waste collection and stockpiling areas.
- Final cover - The final cover will consist of a 60 cm thick cover soil layer with 15 cm of compost to provide erosion protection and to support growth of the vegetative cover.
- Perimeter ditching - The perimeter ditching installed during construction will continue to be used to divert upgradient drainage away from the disposal area.
- Location record - the Facility's limits will be geo referenced and included in the closure/decommissioning reporting.
- Access Control - the perimeter ditch and access road gate shall be maintained to continue to provide access control to the facility after closure.
- Signage of closure - Advance notification of the impending closure will be posted on the site notice board at the access gate. Post-closure signage will include prohibitions on illegal dumping at the facility with contact information directing the public to the new regional waste management facility.
- A contingency plan to cover illegal dumping and fire safety, which should include regular site inspections during the post closure period to confirm that drainage remains effective, the perimeter fencing is in good condition, final covers do not require maintenance, and no dumping has occurred.

4.8 Occupation

The Labrador Straits Waste Disposal Inc. offers an equal employment opportunity, free of gender and age specific qualifications. It is anticipated that during the construction phase of the project the workforce will consist of the following summarized in Table 7.

Table 7: Construction Work Force

National Occupations Classification Group	Anticipated Number of Positions	Description
0711	1	Construction Manager
2154	2	Surveyors
7217	4	Contractors & Supervisors - Heavy Construction
7219	4	Contractors & Supervisors
7411	4	Truck Drivers

National Occupations Classification Group	Anticipated Number of Positions	Description
7412	2	Heavy Equipment Operators
7611	2	Construction Trades Helpers & Labourers
2264	1	Health & Safety Inspectors

During operations of the facility the anticipated workforce will consist of the following summarized in Table 8.

Table 8: Operations Workforce

National Occupations Classification Group	Anticipated Number of Positions	Description
1211	1 - (Part Time)	General office and Administration Support
7421	1	Site Attendant & Operator
7411	2 - (Half Time)	Truck Drivers

5. Project Related Documents

To date, there are several project related documents that have been generated for the proponent. These documents are listed:

- H.T. Kendell & Associates, 2002. Solid Waste Management Plan for the Straits Region.
- AMEC Earth & Environmental Limited, 2003. Draft Report - Regional Solid Waste Management Study for the Southeastern Region of Labrador. Phase I Preliminary Review.
- AMEC Earth & Environmental Limited, 2004. Final Report - Regional Solid Waste Management Study for Southeastern Labrador. Phase 2.
- Hatch Mott MacDonald Limited, 2010. Draft Report - Southern Labrador Waste Management Study.
- Hatch Mott MacDonald Limited, 2015 HMM357238-001. Southern Labrador Waste Disposal Facility - Hydrogeology Report.

6. Approval of the Undertaking

Prior to construction and operations of the facility a number of permits, approvals and authorizations may be necessary for the undertaking, which include the following in Table 9.

Table 9: Summary of Approvals

Permit, Authorization & Approval	Governing Body	Trigger/Notes
Federal		
Approval under the Fisheries Act	Fisheries and Oceans Canada	*The Fisheries Act (Nov 25, 2013) requires that projects avoid causing serious harm to fish unless authorized by the Minister of Fisheries and Oceans. This applies to work being conducted in or near waterbodies that support fish that are part of or that support a commercial, recreational or Aboriginal fishery. People proposing to conduct work in or near water are now required to self-assess using the DFO "Projects Near Water" website, located at http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html , and determine if their project requires a review by the Department of Fisheries and Oceans.*
Provincial		
Release from the Environmental Assessment (EA) Process	Government of Newfoundland & Labrador Department of Environment and Conservation, Environmental Assessment Division	*Required by anyone who plans a project that could have a significant impact on the natural, social or economic environment to present the project for examination. Must go through EA process, and be released by minister before any permits, approvals, or authorizations are issued.*
Application for Permit for Constructing a Non-Domestic Well	Government of Newfoundland & Labrador Department of Environment and Conservation, Water Resources Division	*For proper protection of our groundwater resources, it is important that all drilled water well construction, hook up, maintenance and abandonment be done in accordance with the Well Drilling Regulations under The Water Resources Act SNL 2002 CW 4.01.*
Permit for Access off any Highway	Government of Newfoundland & Labrador Department of Transportation & Works	*The construction of an access to a highway that is classified as a Protected Road requires the prior approval of the Department of Transportation and Works and/or the Government Service Centre.*
Authorization to Handle or Transport Dangerous Goods	Government of Newfoundland & Labrador Department of Transportation & Works	
Quarry Permit	Government of Newfoundland & Labrador Department of Natural Resources - Mineral Lands Division	*Required to conduct quarrying activity in the province of Newfoundland.*

Permit, Authorization & Approval	Governing Body	Trigger/Notes
Permit to Destroy Problem Animals	Government of Newfoundland & Labrador - Forestry and Agrifoods Agency, Wildlife Division	*A permit is required to destroy moose, black bears or other wildlife which may be interfering with farm crops, operations, dwellings or the like when other mitigations fail or may not be effective. Suitable particulars of the situation must be provided for a permit to be issued.*
Permit to Burn	Government of Newfoundland & Labrador - Forestry and Agrifoods Agency, Wildlife Division	*Each year a specified period for the Forest Fire Season is declared by the minister. If conditions warrant, the season can be extended beyond the specified periods. During the Forest Fire Season a permit to burn must be obtained to ignite a fire on forest land or within 300 m of forest land during the Forest Fire Season.*
Commercial Cutting Permit	Government of Newfoundland & Labrador - Forestry and Agrifoods Agency, Forestry Division	*A permit issued under the Forestry Regulations to cut and remove from Crown or public land, timber for sale or barter.*
Operating Permit	Government of Newfoundland & Labrador - Forestry and Agrifoods Agency, Forestry Division	*A permit issued in accordance with the Forest Fire Regulations giving permission to carry out a logging or industrial operation during the Forest Fire Season on Crown or private land at a specified site.*
Certificate for Approval for Storage and Handling of Gasoline and Associated Products as per Fire Protection Act and GAP Regulations	Government of Newfoundland & Labrador Department of Service NL, Operations Division	*Registration is required for all underground and above ground storage facilities for the storage and handling of gasoline and associated products.*
Certificate of Approval Used Oil Control Regulations	Government of Newfoundland & Labrador Department of Environment and Conservation, Petroleum Storage Division	*Certificate of approval required for installation of used oil storage facility.*
Building Accessibility Design Registration	Government of Newfoundland & Labrador Department of Service NL, Operations Division	*A Building Accessibility Design Registration is issued for a building or part thereof that is either being constructed, reconstructed or renovated where the work is required to conform to the Buildings Accessibility Act and Regulations.*
Electrical permit	Government of Newfoundland & Labrador Department	*To ensure public safety, approval must be issued before the installation or repair of any electrical equipment commences, including:*

Permit, Authorization & Approval	Governing Body	Trigger/Notes
	of Service NL, Operations Division	*-Wiring installations in residential, public and industrial / commercial sites and or buildings.* *-Installations for the private generation of electricity.* *-The installation of apparatus such as generators, transformers, switchboards and large storage batteries.*
Permit in Accordance with Urban and Rural Planning Act for access onto a Protected Road.	Government of Newfoundland & Labrador Department of Service NL, Operations Division	*A development permit is required to build on and develop land, whether Crown or privately owned, within the building control lines of a Protected Road (defined as road designated under Section 61 of the Urban and Rural Planning Act for the purpose of controlling development) or within the boundaries of a Protected Area.*
Permit for Flammable and Combustible Liquid Storage and Dispensing and for Bulk Storage.	Government of Newfoundland & Labrador Department of Service NL, Engineering Services	*All new facilities a permit is also required for flammable and combustible liquid storage and dispensing (above or below ground) and for bulk storage (above ground only) under the Fire Prevention Act.*
Environmental Approval for Waste Management System	Government of Newfoundland & Labrador Department of Service NL, Environmental Protection	*All waste management systems, both private and municipal, must receive prior environmental approval from the Government Service Centre. This includes the construction or enlargement of waste disposal facilities (i.e. landfill sites, incinerator sites), approval to become special waste haulers in this Province (i.e. sewage hauler, salvage metal haulers, etc.) and for waste management facilities associated with farms.*
License of Occupation to Occupy Crown Land	Government of Newfoundland & Labrador Department of Municipal Affairs	*Commercial titles are available where no land use conflicts exist, and within municipal and planning area boundaries provided the Municipal Council gives written approval.*
Municipal		
Approval for Waste Disposal	Town/Community Council	

7. Schedule

After completion of the environmental assessment process, this facility must progress through final design, design approval, tender call/award of contract and mobilization. Based on this, it is projected that the earliest start date for the construction project would be the fall of 2016 with anticipated construction completion by spring 2017.

Project Release by Minister: June 2016.
Detailed Design: July 2016.
Permitting and Approval: September 2016.
Tender: October 2016.
Construction Completion: June 2017.

8. Funding

Funding for the project is expected to be through various government sources, including the Department of Municipal Affairs. The capital cost for construction of the site and facility is estimated to be $3,000,000, not including HST, with the following major cost items:

- Contractor Mobilization/Demobilization $367,000
- Environmental Controls $17,000
- Site clearing and grubbing $67,000
- Landfill Cell Construction (Fill and Berm) $1,300,000
- Access Roads and Waste Receiving Areas $197,000
- Site Building, Waste Storage, and Signage $214,000
- Engineering (8% of Capital) $174,000
- Construction Administration (5% of Capital) $109,000
- Contingency (25% of Capital) $542,000

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Appendix A

List of Potential Species at Risk Known to the Project Site and Study Area

Table A-1: List of Potential Species-at-Risk known to the Project Site and Study Area

Species Type	Scientific Name	Common Name	Status NL	COSEWIC Status	SARA Status[1]	Potential for Habitat within Proposed Project Site	Potential within 500 m Study Area
Mammal	*Martes americana atrata*	American Marten	THR	Threatened	Threatened	Yes	No
	Myotis lucifugus	Little Brown Myotis		Endangered	Endangered	Yes	Yes
	Myotis septentrionalis	Northern Myotis		Endangered	Endangered	Yes	Yes
	Ursus maritimus	Polar Bear	VUL	Special Concern	Special Concern	Potential unlikely due to Sites proximity from the shore	Potential unlikely due to proximity from the shore
	Rangifer tarandus caribou	Woodland Caribou	THR	Threatened	Threatened	No	No
Bird	*Bucephala islandica*	Barrow's Goldeneye	VUL	Special Concern	Special Concern	No	Yes
	Numenius borealis	Eskimo Curlew	END	Endangered	Endangered	No	No
	Histrionicus histionicus	Harlequin Duck	VUL	Special Concern	Special Concern	No	Yes
	Pagophila eburnea	Ivory Gull	END	Endangered	Endangered	No	No
	Catharus minimus minimus	Newfoundland Gray-cheeked Thrush	THR	N/A	N/A	Yes	Yes
	Calidris canutus rufa	Red Knot	END	Endangered	Endangered	No	Yes
	Euphagus carolinus	Rusty Blackbird	VUL	Special Concern	Special Concern	Yes	Yes
	Asio flammeus	Short-eared Owl	VUL	Special Concern	Special Concern	No	No
Fish	*Anguilla rostrata*	American Eel	VUL	Threatened	No status	No	No

Source: Government of Canada, Species-at-Risk Public Registry, 2015; Department of Environment and Conservation, 2014

Note: NL (Newfoundland and Labrador); COSEWIC (Committee on the Status of Endangered Wildlife in Canada); SARA (Species-at-Risk Act Canada); N/A (No date/not listed)

[1] This table only references Schedule 1 species within Newfoundland and Labrador that have habitat ranges within the Project Site and off-Site Study Area

Appendix B

Hydrogeology Report

Labrador Straits Waste Disposal Inc
Southern Labrador Waste Disposal Facility

Hydrogeology Report

Issue and Revision Record					
Rev	**Date**	**Originator** (Print) (Signature)	**Checker** (Print) (Signature)	**Approver** (Print) (Signature)	**Description**
A	2015-11-23	J. Freeman	D. Nusser	M. Armstrong	Draft
B	2016-02-08	J. Freeman	D. Nusser	M. Armstrong	Final Draft
	Signatures:				

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APPENDICES:

Appendix A - Boring Logs / Well Construction Records, Core and Site Photos.
Appendix B - Hydraulic Conductivity Estimate from Drawdown Recovery.
Appendix C - Groundwater Quality Analytical Results Package.

1. Introduction

1.1 Site Location

The site of the proposed Southern Labrador Waste Disposal Facility is on the western side of the Trans-Labrador Highway, approximately 2 km to the south of St. Lewis Inlet. The site is set back approximately 300 m from the road, and is accessible by foot via what appears to be a logging path, oriented roughly perpendicular to the highway. A snowmobile trail also crosses the Trans-Labrador Highway in the vicinity and continues to the southwest. The site is approximately halfway between the communities of Port Hope Simpson and Mary's Harbour, located in the Southern Labrador/The Labrador Straits Region. A site investigation completed by Nova Consultants Inc. and AMEC Earth and Environmental LTD in 2004 identified this location as the option that best meets the various requirements identified for a potential waste disposal site in the Labrador Straits region (NCI, 2004). Test pits that were completed at the site identified and described soils to depths of 1.2 m, although it was not mentioned whether this was the full extent of the cover material over bedrock.

The Labrador Straits region is situated across the Strait of Belle Isle from the island of Newfoundland and is approximately 10,000 km2 in size. Southern Labrador includes the coastal communities extending from L'Anse au Clair in the south to Cartwright in the east. Port Hope Simpson, founded in 1934 as a logging camp, is the largest community in southeastern Labrador. Mary's Harbour is a snow crab fishing village where most employment is in the fishery sector. The coastal Labrador highway, or Trans-Labrador Highway, is fairly new gravel road connecting these communities and others along the rivers draining into the Labrador Sea and Strait of Belle Isle (Doran et al., 2013).

1.2 Purpose and Scope

The purpose of this report is to fulfill the requirements for a hydrogeologic assessment as indicated in Part 1.0 of Appendix C – Environmental Baseline and Monitoring, of the Typical Surface and Groundwater Monitoring Program, part of the General Environmental Standards - Municipal Solid Waste Management Facilities/Systems, Government of Newfoundland and Labrador, Department of Environment and Conservation, July 2010, as well as to investigate the initial baseline groundwater chemistry as per Part 4.0, with the results evaluated in the context of the appropriate standards as described in Part 5.0. Appendix C, Parts 2.0 and 3.0 are beyond the scope of this assessment.

2. Relevant Existing Conditions

2.1 Topography

The site is located in a physiographic region assigned to southeastern Labrador by Sandford and Grant called the Mecatina Plateau. This region is characterized by undulating topography that rises from sea level at the south and eastern coasts of Labrador towards the central portion of the plateau. Eskers and river terraces are common fluvioglacial features of the Plateau. The southern coast of Labrador is rugged with varying topography including undulating hills, barren land areas, and hills with peaks up to 300 metres above sea level (masl), which steeply descend to valleys at sea level. As the road network traverses through the interior towards Cartwright, elevations increase into the Mecatina Plateau to elevations on the order of 600 to 900 masl (Doran et al., 2013).

The site is located on the edge of these undulating hills, which lies to the south of St. Lewis Inlet where the Trans-Labrador Highway crosses Wood Island, and rises to an elevation of approximately 200 masl. The site appears to slope moderately at an approximately 5% grade to the south/southeast.

2.2 Climate and Hydrology

Climate monitoring in Labrador is conducted through a network of climate stations monitored by Environment Canada, the Newfoundland and Labrador Department of Environment and Conservation (NLDEC), and private companies. Of the 22 active climate stations in Labrador, the nearest to the site is the Cartwright climate station. Climate normal data for Cartwright indicates the area typically receives 1073.5 mm of annual precipitation, of which 616.8 mm occurs as rain and 462 cm (occurs as snow. The mean annual temperature in the area is 0 °C, with mean daily extremes ranging from -14.3 °C in January to +12.7 °C in August (Environment Canada).

Table 1: Annual Data for Cartwright

Parameter	Value
Daily Average Temperature (°C)	-0.0
Precipitation (mm)	1073.5
Rainfall (mm)	616.8
Snowfall (cm)	462

The overall pattern of surface drainage in Labrador, including long, ribbon lakes and irregularly configured rivers, reflects pre-glacial drainage patterns among the many folds and fractures within underlying bedrock. Wetlands are found throughout Labrador, because widespread low relief and poorly integrated drainage patterns impede drainage, while cool temperatures inhibit the decomposition of organic matter. Wetlands in Labrador commonly form in local depressions on bedrock surfaces or on till plains. It is likely that development in most areas of Labrador will encounter at least small areas of poorly drained, organic soils (Doran et al., 2013).

The St. Lewis Inlet is the largest body of water in the vicinity of the site, located less than 2 km to the north. Several small lakes characteristic of the region are located generally to the south of the site within approximately 1-3 km. St. Lewis Inlet extends approximately 23 km to the southeast, and empties into the Labrador Sea where the community of St. Mary's Harbour is located. A topographic high north of the St. Lewis Inlet divides surface drainage that is collected by St. Lewis Inlet from surface drainage that is collected by the Alexis River to the north, along which Port Hope Simpson is located. The large rivers and inlets in the coastal region of southern Labrador, including the St. Lewis Inlet and Alexis River, are tidally influenced by the Labrador Sea/Atlantic Ocean.

2.3 Land Cover, Land Use and Zoning

The site and surrounding area are forested land, and are part of the taiga ecosystem. The taiga generally lies to the south of the tundra and is typified by very low winter temperatures, a longer growing season than the tundra, and more precipitation in the form of rain and snow. This biome is dominated by coniferous trees, especially balsam fir and black spruce, and large expanses of wetlands, especially bogs and fens. Fisheries, logging and tourism are the main industries of southern and southeastern Labrador (Doran et al., 2013). In the area of St. Lewis Inlet, within a 5 km radius of the site, Alterra Resources, Inc. holds several licenses for mineral resources. One of these (license # 020187M, file # 7750889), on land to the west of Route 510 and south of St. Lewis Inlet, is immediately adjacent to the project site. The extents of these licenses are shown on Figure 1.

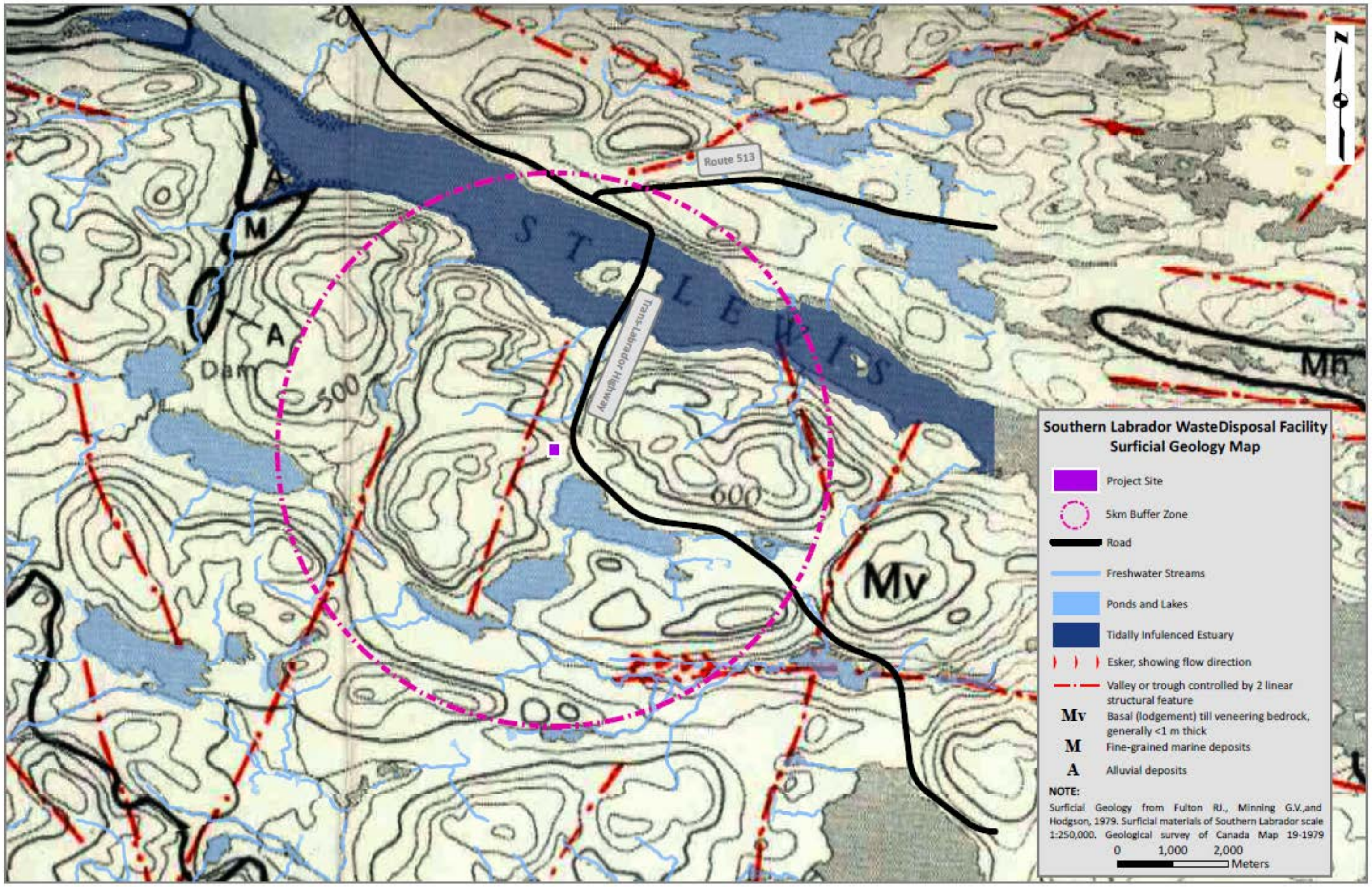

Figure 1: Site Surficial Geology Map

Although evidence of prior logging activity may be found throughout the site, the majority of the site remains heavily treed. Some areas have been largely cleared of coniferous trees, but large stumps, downed trees/logs, and heavy brush remain. Due to the topography, existing vegetation, and poorly developed access path, the site is currently not accessible by a regular vehicle. Therefore, the hydrogeologic investigation was completed using a track-mounted Geoprobe 8040DT drill rig, which is able to traverse the uneven ground conditions and relatively steep topography, once significant trees, stumps, and dense vegetation have been removed.

3. Regional Geologic and Hydrogeologic Conditions

3.1 Bedrock Geology

Labrador belongs to the Canadian Shield physiographic region of Canada, which consists of a core of massive, Precambrian age crystalline rocks. The Grenville Province forms much of southern Labrador. This province is a linear Proterozoic age remnant mountain belt that extends along the east coast of North America, west of the better known and much younger Appalachian Mountains. High-grade gneissic rocks comprise most of the Grenville Province in Labrador, although some metasedimentary rocks, metavolcanic rocks, and granite-type plutons also occur (Doran et al., 2013).

The 2010 geologic map of the St. Lewis River Area indicates that the site is located near the contact of the geologic units PMdr and PMmq. These are recrystallized igneous rocks of unknown age, although associated with the late Paleoproterozoic and early Mesoproterozoic time (1800 to 1350 million years ago). PMdr is a medium-grained, equigranular, recrystallized, weakly- to strongly-foliated diorite, ranging to quartz diorite or leucoamphibolite. PMmq is a medium- to coarse-grained, recrystallized, weakly- to strongly-foliated quartz monzonite (Gower, 2010). The diorite contains the mafic minerals of biotite and hornblende, with trace accessory sulfide, and this rock is intruded by pegmatite (Gower, 2012). Both of these rocks are characteristic of the Grenville Province. The other prevalent geologic unit in the vicinity is PMgr, which is a medium- to coarse-grained, recrystallized, weakly- , to strongly-foliated granite and alkali feldspar granite. The bedrock geology within 5 km of the site is shown on Figure 1.

3.2 Surficial Geology

The late Wisconsinan Glaciation, which occurred 25,000 - 10,000 years before present, combined with the pre-existing bedrock topography and lithologies, resulted in the existing surficial geologic deposits of Labrador. The most common surficial material in Labrador (64%) is till, which is sediment deposited directly by glacial ice. Basal till, derived from various types of intrusive bedrock, and deposited beneath moving ice, is most widespread type of till in Labrador. This surficial deposit forms a blanket over bedrock, of depths from about 1 m to locally more than 10 m. As a result, it is predominantly non-stratified, poorly sorted, silty to sandy diamicton. Till in the Goose Bay area, has been documented to have sandy matrices with less than 10% silt and clay; and matrix-supported clasts are predominantly pebbles and cobbles, although boulders are occasionally encountered (Doran et al., 2013).

The 1979 surficial geologic map for Southern Labrador indicates that the site is located in a large area characterized as Mv, basal (lodgement) till veneering rock. This surficial geologic unit is indicated to be till that is generally <1 m thick, though it may be thicker on lower parts of slopes and distal / down-ice sides of hills. The geomorphology of areas classified as Mv tends to reflect the underlying rock. The map shows several features classified as “valley or trough controlled by a linear structural feature” in the vicinity of the site. There are also eskers to the north and south of St. Lewis Inlet, which are indicated to have flow directions to the east and southeast (Fulton, Minning, and Hodgson, 1979). The surficial geology within 5 km of the site is shown on Figure 2.

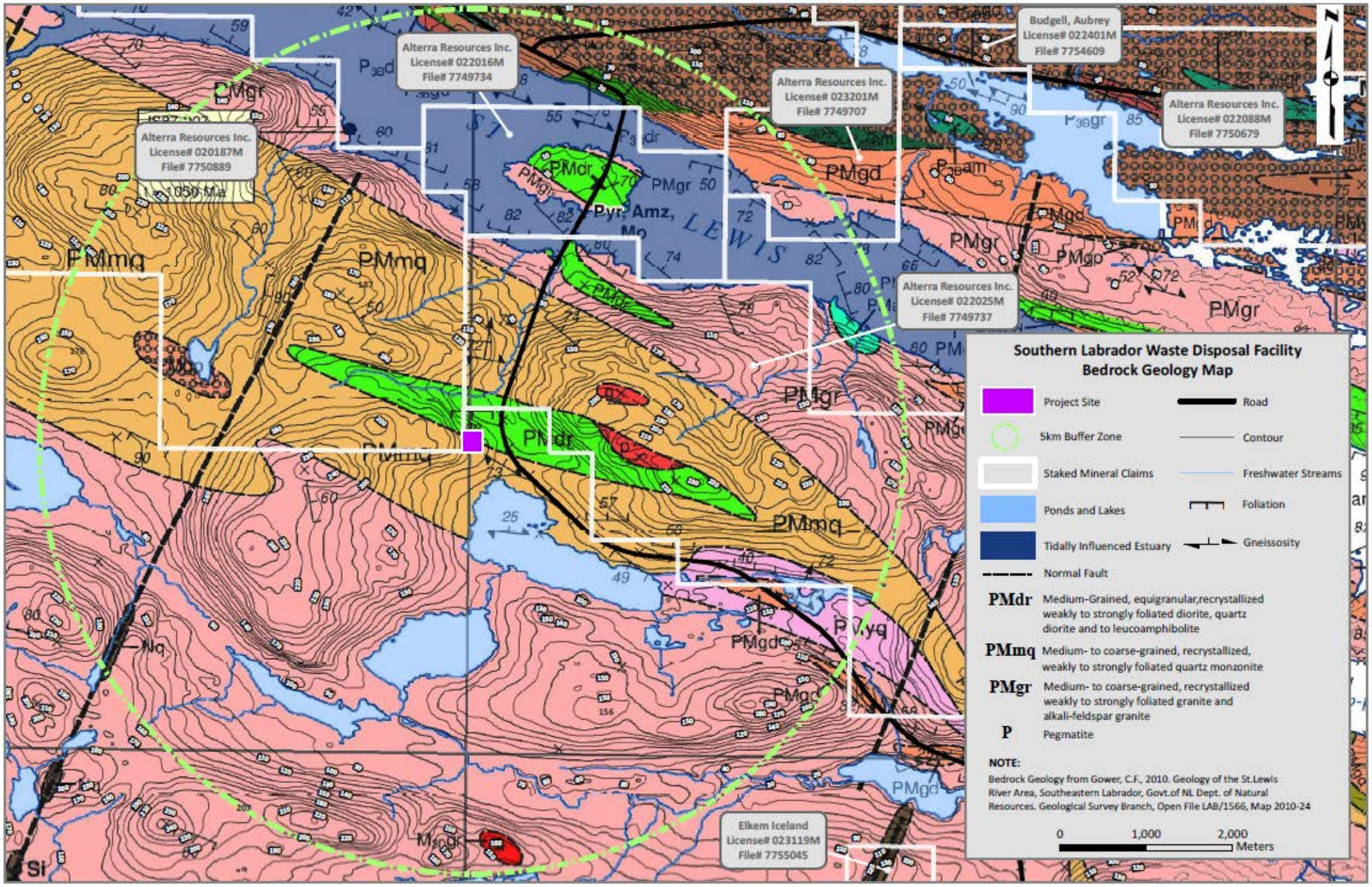

Figure 2: Site Bedrock Geology Map

3.3 Regional Hydrogeology

There is an overall lack of information regarding groundwater quantity and groundwater quality in Labrador, as stated in the report on the Hydrogeology of Labrador, prepared by AECOM Canada Ltd for the Government of Newfoundland and Labrador Department of Environment and Conservation - Water Resources Management Division in 2013.

The primary source of groundwater information in Labrador Water is from water wells installed by residents and municipal governments in the spatially limited population centers, which consist of several interior towns and villages, and certain coastal areas. Therefore, most of Labrador has been left unexplored in terms of groundwater potential beyond these developed areas. To illustrate this, a total of 18,000 records are contained in the provincial well log database, but of these, only 352 are sited in Labrador (Doran et al., 2013).

Given this lack of information, the 2013 report on the Hydrogeology of Labrador grouped lithologies together based on lithological interpretations, and defined hydrostratigraphic units by inferring groundwater development potential from areas where drilled well information was available for interpretation, to areas where only mapped lithologic information is available.

Surficial hydrostratigraphic units were established by grouping lithostratigraphic units and their inferred groundwater potential from available drilled well information. Given the diverse range of settings in which till can be deposited by glacial activity, the sedimentology and hydrogeological properties of till strongly depend on its origin. Areas classified as the "Exposed Bedrock and Drift-Poor Areas" hydrostratigraphic unit were interpreted to have very low yield, with no estimates of the typical hydraulic conductivity range available. Areas classified as "Till and Ribbed (Rogen) Moraine Deposits" were interpreted to have low to moderate yield. Typical hydraulic conductivity ranges for this unit were projected to be 103 to 10-2 m/d for fine to coarse sand, with these estimates being drawn from general hydrogeologic literature (Doran et al., 2013).

Groundwater production in metamorphic and igneous rocks, such as those found in the vicinity of the site, and throughout the Canadian Shield, is generally low. In these rock types, secondary porosity resulting from folding, faulting and weathering dominates over primary porosity present when the rock was formed, which is not present in crystalline rocks. The size, orientation and connectivity of fractures or cavities vary with lithology, stress history, and the degree of weathering. Hydraulic conductivity may vary drastically in rocks with fractures and joint systems, and will depend on the openness, connectivity and lateral extent of these flow pathways. Fracture and joint systems tend to become tighter with depth, so as the depth of well increases, the availability of water tends to decrease (Doran et al., 2013).

Of the 232 bedrock well logs available for Labrador, a majority are completed in granite (168 wells), with an additional 22 wells completed in gneiss. The lithologies reported to be in the provincial well log database appear to be general interpretations, with other identified (though less common) types including sandstone, shale, quartzite, ironstone, and limestone.

The designation of “granite” or “gneiss” in this database likely includes other similar rock types which were not differentiated. Weakly-foliated quartz diorite, which is the lithology at the site of this investigation, and which is similar in composition, appearance, and other physical properties to granite and gneiss, is an example of a type of rock that is probably included in this general designation in the provincial well log database.

The Hydrogeology of Labrador report indicates that most of the wells completed in “granite” were drilled in communities located in southern Labrador near the Straight of Belle Isle, including communities extending from English Point in the south along the coast to Charlottetown in the east. The communities of Cartwright, Rigolet, Makkovik, Posteville and Hopedale also have wells completed in granite. The towns with wells completed in “gneiss” include William’s Harbour, West St. Modeste and Charlottetown. The well logs indicate these wells were drilled for use as domestic wells, municipal water supply wells and public supply. For wells indicated to be in granite, overburden thickness or depth to bedrock ranges from zero (i.e. no overburden cover) to 45 m, with a geomean of 2.9 m. For wells indicated to be in gneiss, overburden thickness ranged from zero to 12 m, with a mean thickness of 4 m (Doran et al., 2013).

Information about static water levels, or the depth to the water table, is not provided in the Hydrogeology of Labrador report. Various links to the Drilled Well Database on NLDEC Water Resources Management Division were not functional at the time of this report. The division was contacted and this database was requested in order to gain additional context for this assessment.

Pumping test information is generally lacking for wells in Labrador (only a total of 66 wells), and the information provided is limited to pumping test rates and durations (Doran et al., 2013) summarized in Table 2. Of these, records for 40 short duration pumping tests completed in wells completed in granite and gneiss are included. The results of these tests indicate variable, but generally low yields. The water bearing potential for other wells completed in granite or gneiss bedrock in other areas of Labrador, including the Strait of Belle Isle region of southeastern Labrador, western Labrador and coastal northeastern Labrador, is inferred to be comparable to these testing results. To get a rough estimate of the hydraulic conductivity (K) associated with these pumping test results, the Empirical Equation was used, using the mean pumping rate as the flow rate and the mean total depth as inputs (Driscoll, 1986). The resulting estimated K is 0.75 m/d, or 0.001 cm/s, for wells completed in granite and gneiss bedrock. The equation is included in Appendix B.

Table 2: Pumping Tests in Wells Completed in Granite and Gneiss

Statistical Parameter	Total Depth (m)	Air Lift Yield (Liters per minute)	Pumping Test Rates (Liters per minute)
Minimum	13.4	0	0.6
Maximum	177	300	315
Mean	62.4	21.5	28.7
Geomean	-	7.2	8.6
Median	57.9	9	6.5
Standard Deviation	30.7	43.5	60.6
No. of Wells	186	171	40

4. Soil and Geologic Conditions of the Site

4.1 Soil Boring and Rock Coring Observations

As part of the hydrogeologic investigation, soil and rock corings were completed prior to the construction of monitoring wells. Three boring locations were chosen based on accessibility and were located as far as possible from each other, within the boundaries of the site, in order to gain as thorough of a characterization as possible. Final monitoring well locations are shown in Figure 3. It should be noted that the imagery included in Figure 3 and Figure 4 reflect site conditions 9 years prior to this investigation, and does not show existing vegetation. Direct push sampling using a 2" split-spoon was used to retrieve soil samples until refusal. Rock coring was completed by advancing a HW 5.66" diameter casing to bedrock, and drilling to depth using HQ/HWL 3.790" diameter rods. For the completion of B-1A / MW-1 and B-3/MW-3, water for rock coring was obtained from a small surface water stream to the south of the site which was accessible via the snowmobile path. Water for coring at B-2A / MW-2 was obtained from a ponded water located within 4.5 m (15 feet) of the drilling location. Both water sources had minimal flow, and it was undetermined at the time of drilling whether they represented accumulated snow-melt runoff or were perennial surface water drainage features. In general, it was observed that surface drainage patterns on the site appear to have been disrupted by previous logging activities and in some cases logging debris appears to be retaining water/hindering drainage. Approximately 40 litres of water per foot of coring completed was used for each borehole.

The soils encountered in all the completed borings were well-graded sands with silts and gravel, consistent with the description of basal till as described in the surficial geologic mapping of the area in the vicinity of the site. Bedrock was encountered within 0.3 to 0.9 m (1 to 3 feet) of the ground surface in all borings. The bedrock was medium-grained, slightly foliated, unweathered quartz diorite, consistent with the mapped geologic unit PMdr. Although quartz diorite was the dominant lithology, large intervals or veins of pegmatite were also encountered. Rock cores retrieved from coring tended to have very close to moderate discontinuities in the form of open joints, most of which were either fresh or had minor weathering in the form of iron-oxide discoloration. Soil boring and rock coring logs are included in Appendix A.

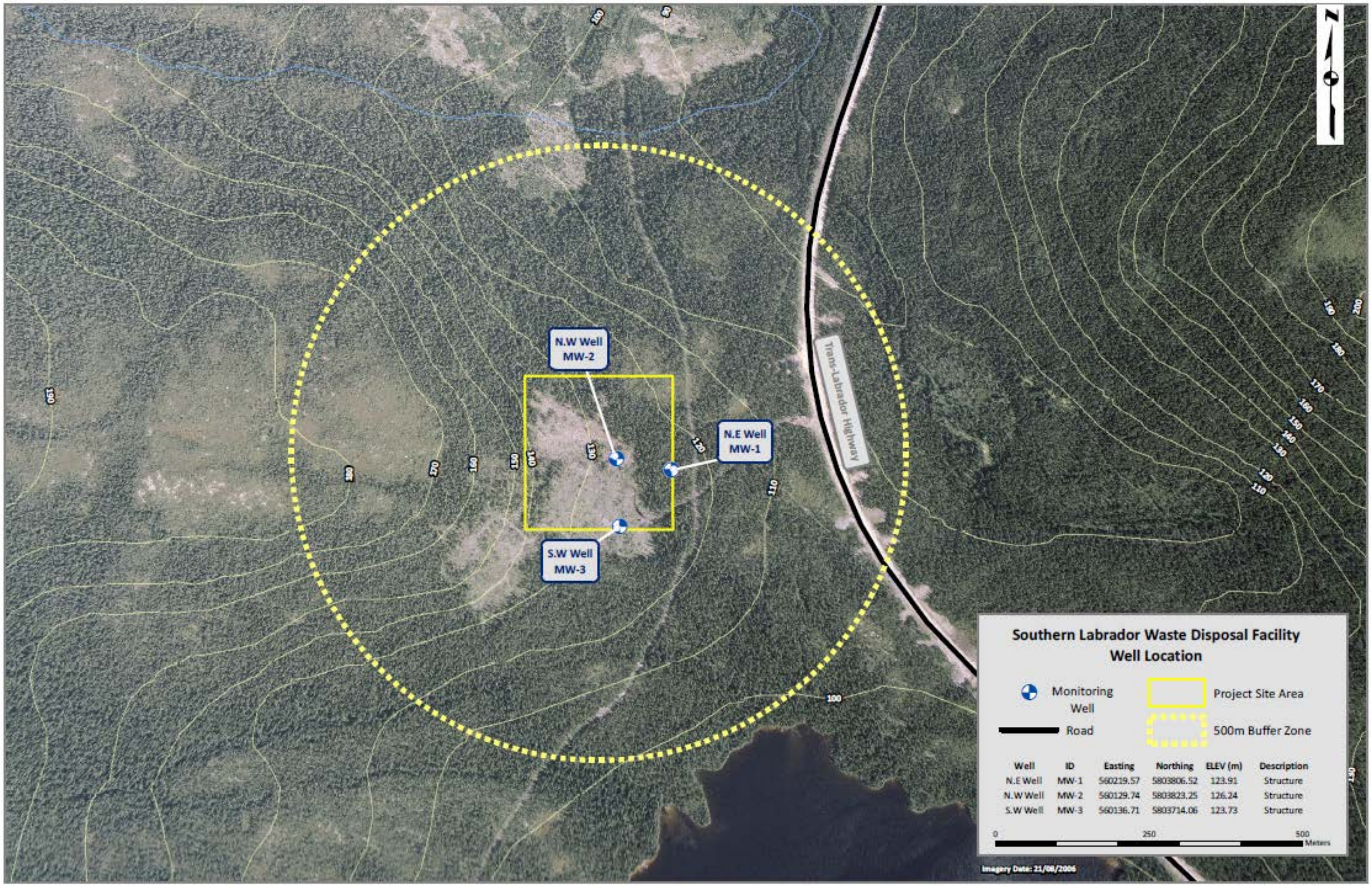

Figure 3: Well Location

5. Hydrogeologic Conditions of the Site

5.1 Monitoring Well Installations

Three monitoring wells were constructed for this hydrogeologic assessment, at locations selected with the aim of best gaining as complete of an initial characterization of the groundwater hydrogeology as possible. These wells are considered preliminary, for the purpose of characterizing the existing groundwater conditions. The wells established during this assessment may or may not be integrated into a formal monitoring well network, if a waste disposal facility is established at the site. MW-1 was constructed near the center of the proposed eastern boundary of the site, to a depth of 1.2 m below ground surface. MW-2 was constructed in the central portion of the site as far to the northwest as was accessible due to existing forest vegetation and rising topography to the northwest, to a depth of 3.66 m below ground surface. MW-3 was constructed near the proposed southern boundary of the site, as far to the west as accessible due to forest vegetation and rising topography to the west, to a depth of 1.5 m below ground surface. All well installations were completed with standard 2-inch, Schedule 40 PVC, 10-slot screens, size 0 filter sand, bentonite seal above the screens, and steel or PVC outer casings. Groundwater was encountered at depths ranging from 0.2 to 0.34 m below the ground surface in all wells. Since soil saturation was not observed during direct push soil sampling, further drilling into bedrock was completed. Due to the introduction of water during the bedrock coring process, the depth to the water table was not measured until after well completion. Coring also confirmed that bedrock had been encountered, rather than just large boulders or cobbles, which are prevalent in glacial till. Coring to 3.66 m depth in MW-2 was completed to ensure that the water encountered was not a perched water table. Boring logs, including well construction details, core photos, and general site photos are included in Appendix A.

5.2 Well Development and Recovery Observations

Well development was completed by manually surging standard 1/2" inner diameter polyethylene tubing, with a Waterra check valve at the end to prevent return flow. Note that this methodology limits the rate at which water may be removed from the well. All three of the monitoring wells were developed until insufficient water remained in them to continue to extract via the Waterra tubing. Well recovery was then recorded using a stopwatch and water level meter.

The well development method used was intended for developing wells established in overburden materials; this method does not introduce external water into the subsurface. Since bedrock was encountered within 0.3 to 0.9 m of the surface, monitoring wells were established in bedrock using coring, and therefore, drilling water was introduced into each well. Manual development by Waterra tubing may not have removed all drilling water from the formation.

Complete recovery was not observed in any of the wells, with residual displacements of a few mm in each case. This is interpreted to be a result of the wells continuing to equilibrate from the time of installation shortly beforehand, due to the volume of water was introduced through coring that disturbed the static water level in the formation. Hydraulic conductivity (K) estimates from well recovery were calculated using Theis's Recovery Method (Kruseman and de Ridder, 1990)

Table 3: Hydraulic Conductivity Estimates from Well Recovery Observations

Location	K (m/day)	K (cm/s)
MW-1	17.68	0.02046
MW-2	0.77	0.00089
MW-3	0.48	0.00055

These values are in the range expected for wells installed in fractured granite and gneiss bedrock in Labrador, which is 0.75 m/d or 0.0009 cm/s, which were discussed in Section 3.2. It could be expected that the K value found by testing shallow wells such as these would be somewhat higher, since fractures in rock tend to be more open toward the surface and less open at greater depths.

The higher value for MW-1 may be indicative that a single large fracture is supplying water to this particular well, and once it was dewatered the lesser contributing fractures could not sustain the water inflow. By contrast, the results of MW-2 and MW-3 seem to indicate that these wells are intersecting well-connected fracture network that provides significant water inflow more consistently.

5.3 Groundwater Flow Patterns

Groundwater flow at this site is expected to mimic the surface topography, which in turn is expected to generally reflect the underlying bedrock surface, due to the absence of substantially thick glacial deposits. Groundwater flow direction was determined by interpretation of the measured water levels at MW-1, MW-2, and MW-3, in this context. The direction of groundwater flow was determined to be generally to the southeast. Potentiometric contours and the overall interpreted flow direction are shown on Figure 4.

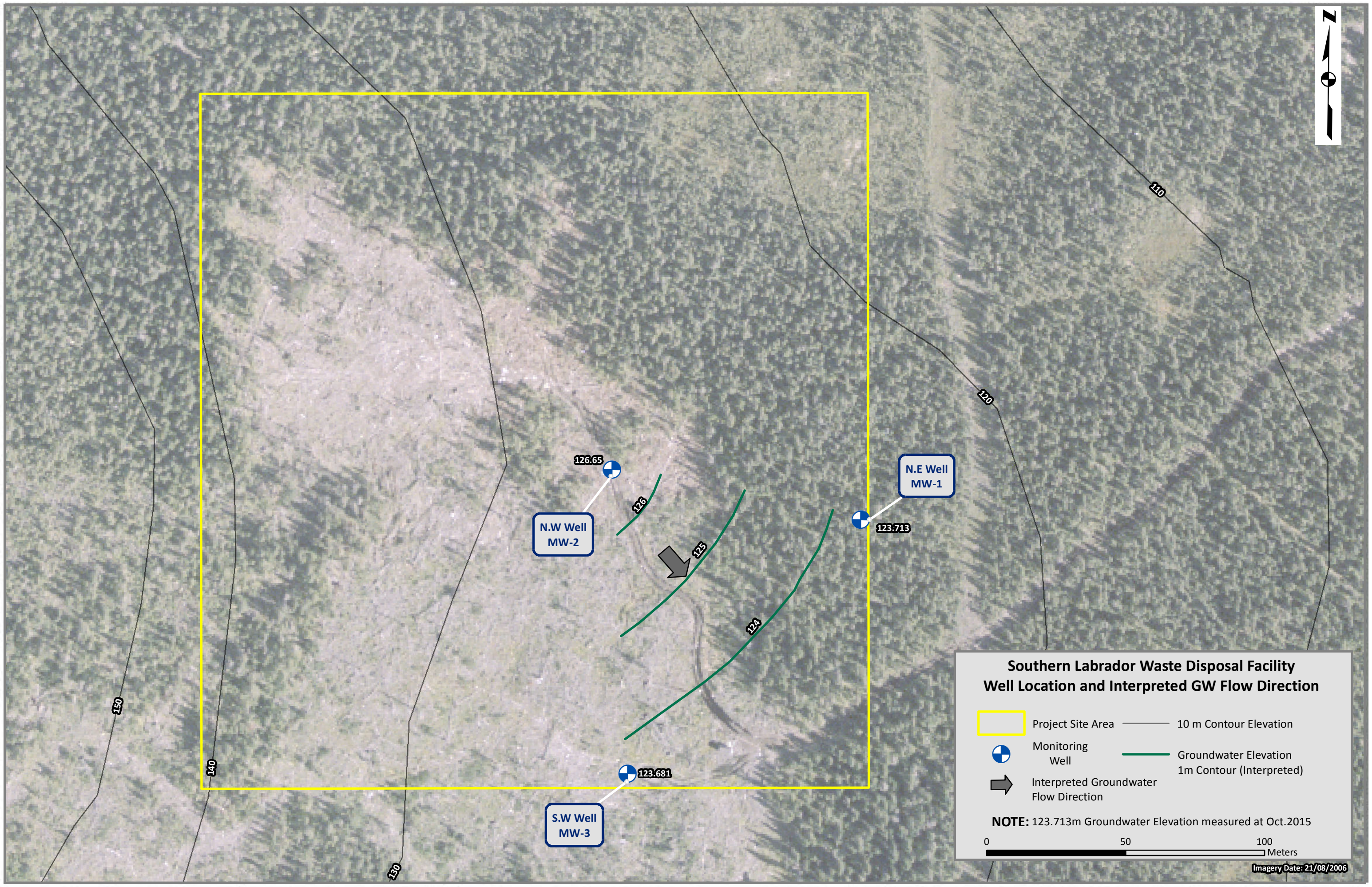

Figure 4: Zoomed Well Location

6. Groundwater Quality

6.1 Initial Sample Collection

Water samples were collected following the initial development of the newly established monitoring wells. Samples were collected into 3.78 L (1-gallon) jugs by surging the dedicated Waterra tubing at each well. Samples were then decanted later in the day into bottleware for the analyses required by Landfill Column 1 of Appendix C of the Environmental Standards for Municipal Solid Waste Landfill Sites (NS Dep. Of Environment, 1997).

6.2 Initial Characterization of Groundwater Quality

The water samples collected following the initial well development were analyzed by AGAT Laboratories in Dartmouth, Nova Scotia for the parameters required by the Environmental Standards for Municipal Solid Waste Landfill Sites. An additional analysis was also performed for glycols, since ethylene glycol is a common ingredient in windshield washer fluid, which was added to the drilling fluid to prevent freezing of rig components overnight. A “field blank,” consisting of the spring water originally contained in the 1-gallon jugs which were used to collect the samples, was also analyzed for all the parameters, in order to detect any possible interference from the sampling containers. Analytical results are included in Appendix C of this report.

Chemical oxygen demand (COD) results are significantly elevated in all the wells, ranging from 32 mg/L to 448 mg/L. Values for dissolved organic carbon (DOC) were also elevated in all wells, ranging from 33.5 mg/L to 126 mg/L. Biological oxygen demand (BOD) results was elevated in MW-1 at 213 mg/L, but was low or undetected in the other wells. These results, in conjunction with relatively high levels of Total Kjeldahl Nitrogen (an organic form of nitrogen) ranging from 0.6 mg/L to 3.2 mg/L, seem to indicate that the sampled water is influenced by organic processes. This may be indicative of either shallow groundwater in close hydraulic connection with the ground surface and the organic processes taking place in poorly drained soils, or that the samples themselves are the water that was introduced during the drilling process. However, glycol analysis was completed as a possible indicator of the presence of the drilling fluid, and no detection of glycols were recorded in any of the samples. There are no standards for COD, DOC, and BOD in the CEQG-WQG for the Protection of Agriculture or the WQG for the Protection of Aquatic Life.

Total suspended solids (TSS) were elevated in MW-2, with a result of 947 mg/L, and also had concentrations of 102 mg/L and 29 mg/L, in MW-1 and MW-3, respectively. There is no standard listed for TSS in the GCDWQ. Total dissolved solids (TDS) results were also notable, ranging from 94 to 120 mg/L, but are well below the GCDWQ Aesthetic Objective of 500 mg/L.

Iron was detected at very elevated concentrations ranging from 4.82 mg/L at MW-1 to 11.8 mg/L at MW-2. The standard for iron in the Canadian Environmental Quality Guidelines - Water Quality Guidelines (CEQG-WQG) for the Protection of Aquatic Life is 0.3 mg/L, the same as the GCDWQ aesthetic objective for drinking water. The CEQG-WQG for the Protection of Agriculture is somewhat higher, at 5 mg/L, but this standard was exceeded at both MW-2 and MW-3.

Detections at low or trace concentrations of ammonia, chloride, phosphorus, and several metals including calcium, chromium, magnesium, manganese, potassium, and sodium, were also recorded, in most cases at all three of the wells. There were no detections of benzene, 1,4-Dichlorobenzene, methylene chloride, toluene, or vinyl chloride.

It is recommended that the monitoring wells be resampled to confirm that water introduced for coring did not affect the results and to reassess the iron concentrations. Once this is complete, it is recommended that additional groundwater samples be collected and analyzed for the parameters required by the Environmental Standards for Municipal Solid Waste Landfill Sites.

6.3 Interpretation of Groundwater Quality Results

Groundwater quality data in Labrador are limited to sample results from only six communities with public groundwater supplies and two additional communities. The nearby communities of Port Hope Simpson and Mary's Harbour use surface water rather than groundwater as their water supply source. In general, the chemical composition of groundwater reflects the geochemistry of the host bedrock (Doran et al. 2013). Of these communities, the nearest is the Charlottetown community in the South Eastern region of Labrador, located approximately 43 km to the north of the site. These average parameter values are included in Table 4 below. It should be recognized that this distance is great enough that the water quality may not be comparable to the water quality documented at the site; however, this represents the nearest available information at the time of this investigation.

Table 4: Average Groundwater Quality Parameters - Charlottetown, Labrador (8 samples)

Hardness (mg/L)	pH	Alkalinity (mg/L)	TDS (mg/L)	Conductivity (uS/cm)	Turbidity (NTU)	Na (mg/L)	Ca (mg/L)	Cl (mg/L)	Fe (mg/L)
129.2	8	109.7	-	414	3	97	-	4	0.5

The average iron concentrations at Charlottetown also exceed the GCDWQ aesthetic objective for drinking water and the CEQG-WQG for the Protection of Aquatic Life of 0.3 mg/L. However, the iron concentrations detected during this initial site groundwater characterization, are significantly higher than Charlottetown. The values are also more elevated than the highest average iron concentration documented in the Hydrogeology of Labrador report, for any part of Labrador, which is 5.1 mg/L at the Happy Valley-Goose Bay well field (see Table 14 of Doran et al. 2013). Additional sampling might be advisable to confirm if these elevated iron results are representative of the site groundwater quality.

Surface water chemistry in Labrador also reflects the composition of soils and bedrock. Higher pH, hardness, alkalinity and major ion concentrations are observed in surface waters in areas where underlying geology is composed of carbonate-rich sedimentary bedrock, whereas in areas where underlying geology consists primarily of gneiss and granite bedrock, surface water tends to be slightly acidic, coloured, highly corrosive, and of low mineral content (Doran et al. 2013).

Water Quality Monitoring Agreement Contours are provided by the NLDEC Water Resources Management Division for data collected between 1985 and 2000. Average surface water DOC concentrations in the general region of the site tend to range from 4.4 to 4.5 mg/L. Average surface water iron concentrations in the general region of the site tend to range from 1.12 mg/L to 1.33 mg/L. Regional exceedances of the iron guideline for the Protection of Aquatic Life are attributed primarily to natural geological influences (NL WQMA Contours, accessed 2015).

As previously noted, the water supplies for Mary's Harbour and Port Hope Simpson are both drawn from surface water sources. The former is drawn from the St. Mary's River and is an unprotected water supply that is treated by chlorination and using a potable water dispensing unit. A portion of the watershed that drains to this river lies to the south and may marginally intersect the 5 km radius of the proposed waste disposal facility, depending on the final boundaries of the facility. The Port Hope Simpson drinking water supply is drawn from Arnold's Brook and Pond (classified as a reservoir source). This water supply has protected status, and is treated by chlorination and by removal of iron and manganese (NL Water Resources Portal, accessed November 2015).

7. Summary of Findings

The hydrogeologic investigation determined that the water table is within the upper 0.3 to 0.6 m (1-2 feet) of the ground surface, and that the depth to bedrock ranges from 0.3 to 0.9 m (1-3 feet) in the areas where the monitoring wells were installed. Calculations of hydraulic conductivity from the development of these monitoring wells aligned well with information on similar wells completed in fractured granite and gneiss throughout Labrador, which are generally low-yield wells. The available geologic information and hydrogeologic literature support that the shallow soil depth and hydraulic conductivity may be characteristic of the region. Therefore, a site in the same vicinity (i.e., which is centralized to the waste disposal needs of the region), but which does not have these conditions, might not be easily identifiable.

The water quality parameters are within expected ranges, aside from the elevated iron results. As discussed in Section 6.1, resampling is recommended at a later date or after full purging of the wells has been completed to ensure that samples represent undisturbed groundwater from the formation, and to confirm the elevated iron results, which are uncharacteristic for the region.

This site was considered for a natural attenuation landfill under the NLDEC Environmental Standards for Labrador Landfills (Feb 2014). The standards require that natural attenuation landfills shall be sited in areas of low to medium hydraulic conductivity ($1x10^{-6}$ cm/s or less) and shall be at least 1.5 m above the seasonal high groundwater table. Areas where there is a reasonable soil depth and no useful groundwater resources are preferred locations. The standard does however allow for variances if the required hydraulic conductivity cannot be achieved under natural conditions. Due to the shallow depth of the groundwater, high hydraulic conductivity, and shallow soil depth, the site is not suitable for a natural attenuation landfill, unless variances are allowed by the NLDEC. The variances required for this site include importing locally-sourced fill material to raise the level of the site by between 1.2 and 1.3 m to attain the vertical separation above the groundwater table. Local fill material is expected to have hydraulic conductivity values typical of surficial deposits in Labrador, such as fine to coarse sand is typically in the range of 10^{1} to 10^{-4} cm/s (Doran et al. 2013). As a result, local fill material with hydraulic conductivity equal to or below the specified maximum value ($1x10^{-6}$ cm/s) is not expected to be available. The maximum hydraulic conductivity observed at the site was 2×10^{-2} cm/s, although this reflects the bedrock or a combination of bedrock and surficial materials. A variance allowing the imported fill material to have hydraulic conductivity up to this value is recommended.

8. References

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Appendix A

Boring Logs / Well Construction Records,

Core and Site Photos

Hatch Mott MacDonald

BORING LOG

BORING NO.: **B-1**

CLIENT:	Labrador Straits Waste Disposal, Inc.	**PROJECT NO.:**	357238
PROJECT:	Southern Labrador Waste Disposal Facility	**OBSERVER:**	Joelle Freeman
LOCATION:	(Between Port Hope Simpson and Mary's Harbour, Labrador)	**DRILLING CONTRACTOR:**	Cartwright Drilling
		WELL/BORING PERMIT NO.:	
		DATE (START / COMPLETE):	10/20/2015 / 10/20/2015

Total Depth (m):	0.91	**TOC Elev. (m):**	NA
Inside Diameter (in):	2.0	**G.S. Elev. (m):**	NA
Screen Interval (ft):	NA	**Northing (m):**	
Screen Type:	NA	**Easting (m):**	
Screen Slot Size (in):	NA		
Surface Completion:	NA		

Datums: Horizontal: **Vertical:**

Rig Make & Model: Geoprobe 8040DT

Rig			**Hammer**	**Drilling Fluid**
☐ Truck	☐ Tripod	☐ Cat-Head	☐ Safety	☐ Bentonite
☐ ATV	☑ Geoprobe	☐ Winch	☐ Doughnut	☐ Polymer
☑ Track	☐ Air Track	☐ Roller Bit	☑ Automatic	☐ Water
☐ Skid	☐	☐ Cutting Head	☑ Vibratory	☑ None

Depth (ft)	Samples	Recovery (m)	Sample No. & Depth (ft)	PID (ppm)	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	REMARKS
0					0.10 m (4") topsoil / moss	
	X	0.61	***SS-1***	NA	0.40 m (16") Black (5YR 2.5/1) well-graded medium to coarse **SAND** with silt and	
1	X		*0 - 0.61 m (0-2 ft)*		gravel (SW-SM), moist, loose to medium dense	
	X				0.10 m (4") light reddish brown (5YR6/4) to dark reddish gray (5YR 4/2) well-graded	
2	X				medium to coarse **SAND** with gravel (SW), most, loose to m. dense	
	X	0	***SS-2***	NA		Note: Assume that material from SS-1 may be representative of 0.61-0.91 m (2-3 ft depth)
3	X		*0.61-0.91 m (2-3 ft)*			
					Encounter refusal at 0.91m (3 feet) bgs, end of boring.	
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

Additional Comments

Location approximately 1.5 m (5 feet) to the north of B-1A / MW-1

NOT FOR GEOTECHNICAL OR STRUCTURAL DESIGN PURPOSES. Soil classifications and descriptions presented are based on visual-manual methods of the USCS system and were based solely on visual field observations. They were developed to generally characterize soils for environmental purposes only. They are not to be relied upon for any other purpose. Maximum Particle Size determined by direct observation within the limitations of sampler size.

Hatch Mott MacDonald	BORING LOG	BORING NO.: B-2
		Page 1 of 1

CLIENT:	Labrador Straits Waste Disposal, Inc.	**PROJECT NO.:**	357238
PROJECT:	Southern Labrador Waste Disposal Facility	**OBSERVER:**	Joelle Freeman
LOCATION:	(Between Port Hope Simpson and Mary's Harbour, Labrador)	**DRILLING CONTRACTOR:**	Cartwright Drilling
		WELL/BORING PERMIT NO.:	
		DATE (START / COMPLETE):	10/20/2015 / 10/20/2015

Total Depth (m):	0.91	**TOC Elev. (m):**	NA	**Datums: Horizontal:**			**Vertical:**	
Inside Diameter (in):	2.0	**G.S. Elev. (m):**	NA	**Rig Make & Model:**	Geoprobe 8040DT		**Hammer**	**Drilling Fluid**
Screen Interval (ft):	NA	**Northing (m):**		☐ Truck	☐ Tripod	☐ Cat-Head	☐ Safety	☐ Bentonite
Screen Type:	NA	**Easting (m):**		☐ ATV	☑ Geoprobe	☐ Winch	☐ Doughnut	☐ Polymer
Screen Slot Size (in):	NA			☑ Track	☐ Air Track	☐ Roller Bit	☑ Automatic	☐ Water
Surface Completion:	NA			☐ Skid	☐	☐ Cutting Head	☑ Vibratory	☑ None

Depth (ft)	Samples	Recovery (m)	Sample No. & Depth (ft)	PID (ppm)	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	REMARKS
0		0.61	***SS-1***	NA	0.025 m (1") topsoil / moss	
1			*0 - 0.61 m (0-2 ft)*		0.58 m (23") dark reddish brown (5YR 3/2) well-graded, medium to coarse **SAND** with silt and gravel (SW-SM) medium dense. Includes weathered granitic cobbles (quartz, feldspar, etc.), top 12" moist, bottom 12" dry	
2		0.3	***SS-2***	NA	0.30 m (12") brown (5YR 4/2) well-graded, medium to coarse **SAND**, loose to medium dense, slightly moist.	
3			*0.61 -0.91 m (2-3 ft)*		*Encountered refusal at 3 feet below ground surface, end of boring*	
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

Additional Comments

Location approximately 4.5 m (15 feet) to the north of B-2A / MW-2

NOT FOR GEOTECHNICAL OR STRUCTURAL DESIGN PURPOSES. Soil classifications and descriptions presented are based on visual-manual methods of the USCS system and were based solely on visual field observations. They were developed to generally characterize soils for environmental purposes only. They are not to be relied upon for any other purpose. Maximum Particle Size determined by direct observation within the limitations of sampler size.

Hatch Mott MacDonald

WELL BORING LOG

BORING NO.:	B-1A/MW-1
Page	1 of 1

CLIENT:	Labrador Straits Waste Disposal, Inc.	**PROJECT NO.:**	357238
PROJECT:	Southern Labrador Waste Disposal Facility	**OBSERVER:**	Joelle Freeman
LOCATION:	(Between Port Hope Simpson and Mary's Harbour, Labrador)	**DRILLING CONTRACTOR:**	Cartwright Drilling (Driller: Jelle Terpstra, Jr.)
		WELL/BORING PERMIT NO.:	
		DATE (START / COMPLETE):	10/22/2015 / 10/22/2015

Total Depth (m):	1.2	**TOC Elev. (m):**	125.00	**Datums: Horizontal:**	**Vertical:**
Inside Diameter (in):	2.0	**G.S. Elev. (m):**	123.92	**Rig Make & Model:**	Geoprobe 8040DT
Screen Interval (m):	0.30 - 1.2	**Northing (m):**	#########		
Screen Type:	Sch 40 PVC	**Easting (m):**	296951.88		
Screen Slot Size (in):	0.010	**Drill stem diam:**	3.790"		
Surface Completion:	108 cm Stickup	**Bit type:**	Diamond		

Rig			Hammer	Drilling Fluid
☐ Truck	☐ Tripod	☑ Cat-Head	☐ Safety	☐ Bentonite
☐ ATV	☑ Geoprobe	☐ Winch	☐ Doughnut	☐ Polymer
☑ Track	☐ Air Track	☐ Roller Bit	☑ Automatic	☑ Water
☐ Skid	☐	☑ Cutting Head	☐ Vibratory	☐ Other

Depth (ft)	Samples	Recovery & RQD (m / %)	Sample No. & Depth (m)	Instrum/ Well Diagram	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Joint Descriptions: Depth (m)	Type	Roughness	Aperture	Weathering	Infilling	Dip (°)
0		NA	NA		Drove 5.66" casing to bedrock at 0.3 m (1 foot) below ground surface							
1		**Recovery**	**R-1**		**QUARTZ DIORITE**, light gray (10 YR 7/1, quartz/plagioclase feldspar)	0.69	J	S	O	DS	FE	0°/60°
2		0.97 / 100%	*0.3 - 1.22 m*		and black (10 YR 2/1, olivine/ hornblende) medium-grained, slightly	1.08	J	P	O	FR	-	5°
					foliated, fresh, strong, v. close to moderate discontinuities	1.09	J	P	O	FR	-	0°
3		**RQD**			with large intervals of PEGMATITE, v. coarse-grained @ 0.3-0.61 m, 0.78-1.09 m							
		0.88 / 91%										
4					End of boring at 4 feet below ground surface.							
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												

Well Development Information

Date:	10/22/15
Purpose:	Well Installation
Method:	1/2" tubing/check valve
Yield:	.67 gal/min
Duration:	15 min

Instrum./Well Diagram

Riser Pipe	6" Steel Casing
Screen	Concrete
Filter Sand	Bentonite Seal
Cuttings	Permeability Test
Concrete Grout	_____Transducer

Water Level Data

Date	DTW (TOC)
10/22/15	128.5 cm

Additional Comments

NOTE: See Boring B-1 for description of soils. Boring B-1A / MW-1 is located approximately 5 feet to the south of B-1. Unable to cut screen to less than 5 feet. Screen was sealed with electrical tape and surrounded by Bentonite from 0-1 ft bgs, making the effective screen from 1-4 ft bgs

NOT FOR GEOTECHNICAL OR STRUCTURAL DESIGN PURPOSES. Soil classifications and descriptions presented are based on visual-manual methods of the USCS system and were based solely on visual field observations. They were developed to generally characterize soils for environmental purposes only. They are not to be relied upon for any other purpose. Maximum Particle Size determined by direct observation within the limitations of sampler size.

Hatch Mott MacDonald

WELL BORING LOG

BORING NO.: **B-2A/MW-2**

CLIENT:	Labrador Straits Waste Disposal, Inc.	**PROJECT NO.:**	357238
PROJECT:	Southern Labrador Waste Disposal Facility	**OBSERVER:**	Joelle Freeman
LOCATION:	(Between Port Hope Simpson and Mary's Harbour, Labrador)	**DRILLING CONTRACTOR:**	Cartwright Drilling (Driller: Jelle Terpstra, Jr.)
		WELL/BORING PERMIT NO.:	
		DATE (START / COMPLETE):	10/21/2015 / 10/22/2015

Total Depth (m):	3.7	**TOC Elev. (m):**	127.30	**Datums: Horizontal:**	**Vertical:**
Inside Diameter (in):	2.0	**G.S. Elev. (m):**	126.20	**Rig Make & Model:**	Geoprobe 8040DT
Screen Interval (m):	0.61 - 3.66	**Northing (m):**	#########		
Screen Type:	Sch 40 PVC	**Easting (m):**	296862.42		
Screen Slot Size (in):	0.010	**Drill stem diam:**	3.790"		
Surface Completion:	110 cm Stickup	**Bit type:**	Diamond		

Rig: ☐ Truck ☑ ATV...

Rig			**Hammer**	**Drilling Fluid**
☐ Truck	☐ Tripod	☑ Cat-Head	☐ Safety	☐ Bentonite
☐ ATV	☑ Geoprobe	☐ Winch	☐ Doughnut	☐ Polymer
☑ Track	☐ Air Track	☐ Roller Bit	☑ Automatic	☑ Water
☐ Skid	☐	☑ Cutting Head	☐ Vibratory	☐ Other

Depth (ft)	Samples	Recovery & RQD (m / %)	Sample No. & Depth (m)	Instrum/ Well Diagram	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)
0		NA	NA		Drove 5.66" casing to bedrock at 0.61 m (2 feet) below ground surface
1					
2	X	**Recovery**	**R-1**		**QUARTZ DIORITE**, light gray (10 YR 7/1, quartz/plagioclase feldspar)
		0.76 / 100%	*0.61-1.37 m*		and black (10 YR 2/1, olivine/ hornblende) medium-grained, slightly
3		**RQD**	*(2-4.5 ft)*		foliated, fresh, strong, close discontinuities
4		0.46 / 60%			
5	X	**Recovery**	**R-2**		**QUARTZ DIORITE**, light gray (10 YR 7/1, quartz/plagioclase feldspar)
		0.76 / 100%	*1.37-2.13 m*		and black (10 YR 2/1, olivine/ hornblende) medium-grained, slightly
6		**RQD**	*(4.5-7 ft)*		foliated, fresh, strong, v. close to close discontinuities
		0.46 / 60%			
7	X	**Recovery**	**R-3**		**QUARTZ DIORITE**, light gray (10 YR 7/1, quartz/plagioclase feldspar)
8		1.42 / 93%	*1.37-3.66 m*		and black (10 YR 2/1, olivine/ hornblende) medium-grained, slightly
		RQD	*(7-12 ft)*		foliated, fresh, strong, v. close to moderate discontinuities
9		0.99 / 65%			
10					
11					
12					End of boring at 3.66 m (12 feet) below ground surface.
13					
14					
15					

Joint Descriptions

Depth (m)	Type	Roughness	Aperture	Weathering	Infilling	Dip (°)
R-1 Joint Mapping						
0.05	J	U	O	DS	SD	0°
0.07	J	U	O	FR	-	3°
0.08	J	U	O	FR	-	5°
0.09	J	U	O	FR	-	5°
0.09	J	U	O	FR	-	10°
0.09	J	U	O	FR	-	5°
R-2 Joint Mapping						
0.12	V/J	U	O	FR	-	30°
0.12	J	U	O	FR	-	5°
0.13	V/J	U	O	DS	CL/FE	30°
0.15	J	U	I	DS	CL/FE	60°
0.16	J	P	O	DS	CL	5°
0.16	J	U	O	FR	SD	5°
0.17	J	P	O	DS	CL	10°
R-3 Joint Mapping						
0.2	J	U	O	FR	-	2°
0.22	J	U	I	DS	-	45°
0.23	J	P	O	DC	CL	2°
0.25	J	U	O	FR	-	0°
0.26	J	P	O	FR	-	2°
0.26	J	P	O	DS	-	0°
0.26	J	P	O	DS	-	0°
0.28	J	P	O	DS	-	0°
0.28	J	S	O	DS	-	8°

Well Development Information

Date:	10/22/15
Purpose:	Well Installation
Method:	1/2" tubing/check valve
Yield:	1.9 L/min
Duration:	40 min

Instrum./Well Diagram

Riser Pipe	6" Steel Casing
Screen	Concrete
Filter Sand	Bentonite Seal
Cuttings	Permeability Test
Concrete Grout	_____Transducer

Water Level Data

Date	DTW (TOC)
10/22/15	110 cm

Additional Comments

NOTE: See Boring B-2 for description of soils. Boring B-2A / MW-2 is located approximately 4.5 m (15 feet) to the south of B-2.

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Hatch Mott MacDonald

WELL BORING LOG

BORING NO.: **B-3/MW-3**

CLIENT:	Labrador Straits Waste Disposal, Inc.	**PROJECT NO.:**	357238
PROJECT:	Southern Labrador Waste Disposal Facility	**OBSERVER:**	Joelle Freeman
LOCATION:	(Between Port Hope Simpson and Mary's Harbour, Labrador)	**DRILLING CONTRACTOR:**	Cartwright Drilling (Driller: Jelle Terpstra, Jr.)
		WELL/BORING PERMIT NO.:	
		DATE (START / COMPLETE):	10/22/2015 / 10/22/2015

Total Depth (m):	1.7	**TOC Elev. (m):**	124.64	**Datums: Horizontal:**	**Vertical:**
Inside Diameter (in):	2.0	**G.S. Elev. (m):**	123.74	**Rig Make & Model:**	Geoprobe 8040DT
Screen Interval (m):	0.3 - 1.68	**Northing (m):**	#########		
Screen Type:	Sch 40 PVC	**Easting (m):**	296867.79		
Screen Slot Size (in):	0.010	**Drill stem diam:**	3.790"		
Surface Completion:	~90 cm Stickup	**Bit type:**	Diamond		

Rig: ☐ Truck ☐ Tripod ☑ Cat-Head; ☐ ATV ☑ Geoprobe ☐ Winch; ☑ Track ☐ Air Track ☐ Roller Bit; ☐ Skid ☐ ____ ☑ Cutting Head

Hammer: ☐ Safety ☐ Doughnut ☑ Automatic ☑ Vibratory

Drilling Fluid: ☐ Bentonite ☐ Polymer ☑ Water ☐ Other

Depth (ft)	Samples	Recovery & RQD (m / %)	Sample No. & Depth (m)	Instrum/ Well Diagram	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Joint Depth (m)	Type	Roughness	Aperture	Weathering	Infilling	Dip (°)
0	X	**Recovery**	**SS-1**		0.076 m (3") dark brown (7.5YR 3/2) organic material / moss / peat							
1		0.36 / 47%	*0 - 0.76*		0.279 m (11") dark brown (5YR 3/2) well-graded med-coarse **SAND** with gravel (S							
			(0-2.5 ft)		moist, loose to medium dense							
2					*Encountered refusal at 0.81 m (32"), switch from split-spoon to coring*							
3	X	**Recovery**	**R-1**		**QUARTZ DIORITE**, light gray (10 YR 7/1, quartz/plagioclase feldspar)	0.104	J	P	O	FR	-	0°
		0.81 / 100%	*0.76 - 1.68*		and black (10 YR 2/1, olivine/ hornblende) medium-grained, slightly	0.11	J	P	O	DS	FE	0°
4			*(2.5 - 5.5 ft)*		foliated, fresh, strong, v. close to close discontinuities	0.12	J	P	O	DS	-	0°
		RQD										
5		0.11 / 14%			0.76 - 1.25 m (2.5' - 4.1') rock fragments 0.025 - 0.05 m (1-2") diameter							
6					End of boring at 1.67 m (5.5 feet) below ground surface.							
7												
8												
9												
10												
11												
12												
13												
14												
15												

Well Development Information

Date:	10/23/15
Purpose:	Well Installation
Method:	1/2" tubing/check valve
Yield:	2.3 L/min
Duration:	15 min

Instrum./Well Diagram

Riser Pipe; Screen; Filter Sand; Cuttings; Concrete Grout; 6" Steel Casing; Concrete; Bentonite Seal; Permeability Test; _____Transducer

Water Level Data

Date	DTW (TOC)
10/23/15	115 cm

Additional Comments

Unable to cut screen to less than 1.5 m (5 feet). Screen was sealed with electrical tape and surrounded by Bentonite from 0.15-0.3 m (0.5-1.0 ft) bgs, making the effective screen from 0.3-1.67 m (1-5.5 feet) bgs.

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Core and Site Photos

Geoprobe navigating steep hill at site access point near Trans-Labrador Highway
October 20, 2015
Source: Joelle M. Freeman, Hatch Mott MacDonald

Setting up for coring at MW-2, using water from nearby water source.
October 21, 2015
Source: Joelle M. Freeman, Hatch Mott MacDonald

Setting up pump and hosing in stream which intersects the snowmobile trail southeast of the site, to provide water for coring at MW-1 and MW-3.
October 22, 2015
Source: Joelle M. Freeman, Hatch Mott MacDonald

Coring at MW-3.
October 22, 2015
Source: Joelle M. Freeman, Hatch Mott MacDonald

Rock core from B-1A / MW-1, representing 0.3 to 1.2 metres below ground surface (R-1)
October 22, 2015

Rock core from B-2A / MW-2, representing 0.6 to 1.35 metres below ground surface (R-1)
October 21, 2015

Rock core from B-2A / MW-2, representing 1.35 to 2.7 metres below ground surface (R-2)
October 21, 2015

Rock core from B-2A / MW-2, representing 2.7 to 3.6 metres below ground surface (R-3)
October 21, 2015

Rock core from B-3 / MW-3, representing 0.75 to 1.65 metres below ground surface (R-1)
October 22, 2015
Source: Joelle M. Freeman, Hatch Mott MacDonald

Completed MW-1, located towards the center of the eastern boundary of the site.
October 23, 2015
Source: Joelle M. Freeman, Hatch Mott MacDonald

Completed MW-2, located towards the northwest area of the site, as far as accessible.
October 23, 2015
Source: Joelle M. Freeman, Hatch Mott MacDonald

Completed MW-3, located near the southern boundary towards southwest area of the site.
October 23, 2015
Source: Joelle M. Freeman, Hatch Mott MacDonald

Appendix B

Hydraulic Conductivity Estimate from Drawdown Recovery

Estimate of Hydraulic Conductivity from MW-3 Well Recovery

DTW (cm from top of PVC)	DTW (cm from ground suface)	Displacement (cm)	Residual Drawdown (ft)	Recovery	t	t'	t/t'
207	98	92	3.02	0.00	15:10	00:10	91.00
203	94	88	2.89	0.13	15:20	00:20	46.00
200	91	85	2.79	0.23	15:30	00:30	31.00
195	86	80	2.62	0.39	15:40	00:40	23.50
190	81	75	2.46	0.56	15:50	00:50	19.00
185	76	70	2.30	0.72	16:00	01:00	16.00
180	71	65	2.13	0.89	16:10	01:10	13.86
175	66	60	1.97	1.05	16:20	01:20	12.25
170	61	55	1.80	1.21	16:30	01:30	11.00
155	46	40	1.31	1.71	17:00	02:00	8.50
148	39	33	1.08	1.94	17:30	02:30	7.00
145	36	30	0.98	2.03	18:00	03:00	6.00
143	34	28	0.92	2.10	19:00	04:00	4.75
141.5	32.5	26.5	0.87	2.15	20:00	05:00	4.00
140	31	25	0.82	2.20	21:00	06:00	3.50
137.5	28.5	22.5	0.74	2.28	23:30	08:30	2.76
135	26	20	0.66	2.36	25:45	10:45	2.40
130	21	15	0.49	2.53	29:05	14:05	2.07
125	16	10	0.33	2.69	33:00	18:00	1.83
121	12	6	0.20	2.82	39:15	24:15	1.62
118.5	9.5	3.5	0.11	2.90	45:00	30:00	1.50

Calculation of K using Theis's Recovery Method

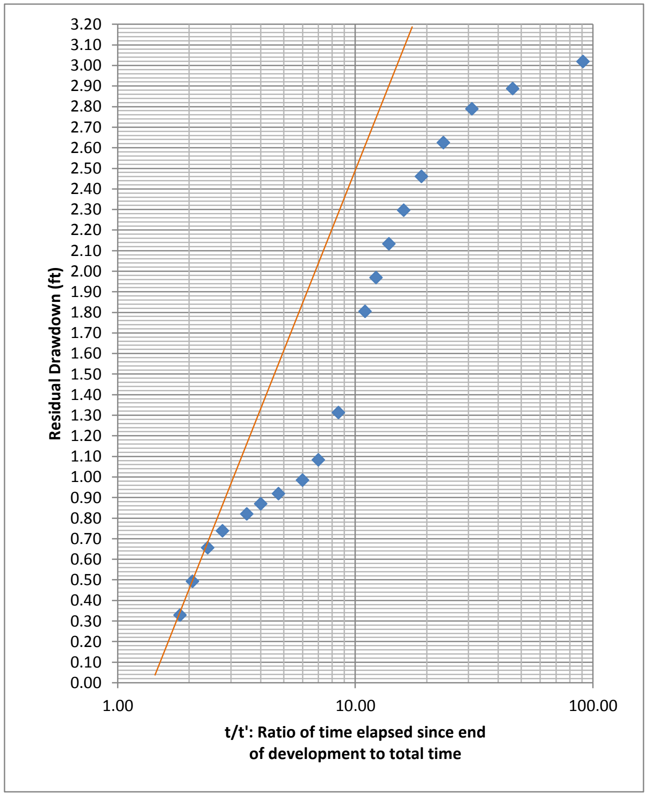
Q (rate of pumping is derived from time to remove 9 gallons)

0:15:00	9 gals	34.07	L	**Δs' (residual drawdown in 1 log cycle of time)**		**D (thickness of aquifer, taken to be screen length in this case)**	
0.6	gal/min	2.271	L/min				
0.080	ft^3/min	0.00227	m^3/min				
115.51	ft^3/day	3.271	m^3/day				
				3	ft	4.5	ft

K = 2.30 Q / 4πDΔs'

derived from Kruseman, G.P. and de Ridder, N.A., 1990. Analysis and Evaluation of Pumping Test Data, p. 194

K = 1.57 ft/day 0.48 m/day 0.00055 cm/s



ESTIMATED PVC stick up (cm)	Intial DTW (cm from top of PVC)	Intial DTW (cm from ground surface)	Intial DTW (ft from top of PVC)	Intial DTW (ft from ground surface)	ESTIMATED PVC stick up (ft)	Ground Elevation (m)	Initial GW elevation (m)
109	115	6	3.77	0.20	3.58	123.741	123.681

Estimate of K Using Empirical Equation (used as a general comparison)

T (in gpd/ft) = 1500 Cs (in gpm/ft)

Q	0.6	gpm		
s	3.1	ft		
Cs (= Q/s)	0.19	gpm/ft		
T	290.32	gpd/ft		
	38.81	ft^2/d		
K (=T/b)	**8.62**	**ft/d**	**2.63**	**m/d**
			0.003	**cm/s**

from Driscoll, F.G., 1986. Groundwater and Wells, 2nd Edition, p. 210

Appendix C

Groundwater Quality Analytical

Results Package

11 Morris Drive, Unit 122
Dartmouth, Nova Scotia
CANADA B3B 1M2
TEL (902)468-8718
FAX (902)468-8924
http://www.agatlabs.com

CLIENT NAME:	HATCH MOTT MACDONALD 1009, 1809 BARRINGTON STREET HALIFAX, NS B3J3K8 (902) 421-1065
ATTENTION TO:	Mark Armstrong
PROJECT:	357238
AGAT WORK ORDER:	15X034833
TRACE ORGANICS REVIEWED BY:	Jennifer Patterson, Organics Supervisor
WATER ANALYSIS REVIEWED BY:	Jason Coughtrey, Inorganics Supervisor
DATE REPORTED:	Nov 04, 2015
PAGES (INCLUDING COVER):	11
VERSION*:	1

Should you require any information regarding this analysis please contact your client services representative at (902) 468-8718

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 15X034833

PROJECT: 357238

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http://www.agatlabs.com

CLIENT NAME: HATCH MOTT MACDONALD

ATTENTION TO: Mark Armstrong

SAMPLING SITE:

SAMPLED BY:

Column 1 Organics - Comprehensive List for Groundwater and Leachate

DATE RECEIVED: 2015-10-26

DATE REPORTED: 2015-11-03

			SAMPLE DESCRIPTION:	MW-1	MW-2	MW-3	Trip Blank	Field Blank
			SAMPLE TYPE:	Water	Water	Water	Water	Water
			DATE SAMPLED:	10/23/2015	10/23/2015	10/23/2015	10/23/2015	10/23/2015
Parameter	Unit	G / S	RDL	7127594	7127649	7127672	7127703	7127706
Benzene	ug/L		1	<1	<1	<1	<1	<1
1,4-Dichlorobenzene	ug/L		1	<1	<1	<1	<1	<1
Methylene Chloride (Dichloromethane)	ug/L		2	<2	<2	<2	<2	<2
Toluene	ug/L		2	<2	<2	<2	<2	<2
Vinyl Chloride	ug/L		0.6	<0.5	<0.5	<0.5	<0.5	<0.5
Surrogate	Unit	Acceptable Limits						
Toluene-d8	%	60-140		122	117	121	120	116

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By: J. Patterson

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Certificate of Analysis

AGAT WORK ORDER: 15X034833

PROJECT: 357238

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CLIENT NAME: HATCH MOTT MACDONALD

ATTENTION TO: Mark Armstrong

SAMPLING SITE:

SAMPLED BY:

Glycols Analysis in Water

DATE RECEIVED: 2015-10-26

DATE REPORTED: 2015-10-29

Parameter	Unit	G / S	RDL	MW-1	MW-2	MW-3	Field Blank
			SAMPLE TYPE:	Water	Water	Water	Water
			DATE SAMPLED:	10/23/2015	10/23/2015	10/23/2015	10/23/2015
				7127594	7127649	7127672	7127706
Propylene Glycol	mg/L		10	<10	<10	<10	<10
Monoethylene Glycol	mg/L		10	<10	<10	<10	<10
Diethylene Glycol	mg/L		5	<5	<5	<5	<5
Triethylene Glycol	mg/L		10	<10	<10	<10	<10
Tetraethylene Glycol	mg/L		10	<10	<10	<10	<10
Surrogate	Unit	Acceptable Limits					
Heptanol	%	50-150		136	138	131	123

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7127594-7127706 Identification based on retention time relative to standards.

Certified By: J. Patterson

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AGAT WORK ORDER: 15X034833
PROJECT: 357238

CLIENT NAME: HATCH MOTT MACDONALD
ATTENTION TO: Mark Armstrong
SAMPLING SITE:
SAMPLED BY:

BOD

DATE RECEIVED: 2015-10-26
DATE REPORTED: 2015-11-02

			SAMPLE DESCRIPTION:	MW-1	MW-2	MW-3	Field Blank
			SAMPLE TYPE:	Water	Water	Water	Water
			DATE SAMPLED:	10/23/2015	10/23/2015	10/23/2015	10/23/2015
Parameter	Unit	G / S	RDL	7127594	7127649	7127672	7127706
Biochemical Oxygen Demand, Total	mg/L		2	213	9	<6	<2

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7127672 RDL for BOD is raised due to insufficient DO depletion at selected dilution levels.

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AGAT WORK ORDER: 15X034833

PROJECT: 357238

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CLIENT NAME: HATCH MOTT MACDONALD

ATTENTION TO: Mark Armstrong

SAMPLING SITE:

SAMPLED BY:

Column 1 Inorganics - Comprehensive List for Groundwater and Leachate

DATE RECEIVED: 2015-10-26

DATE REPORTED: 2015-11-02

			SAMPLE DESCRIPTION:	MW-1	MW-2	MW-3	Field Blank
			SAMPLE TYPE:	Water	Water	Water	Water
			DATE SAMPLED:	10/23/2015	10/23/2015	10/23/2015	10/23/2015
Parameter	Unit	G / S	RDL	7127594	7127649	7127672	7127706
Alkalinity as CaCO3	mg/L		5	8	10	11	55
Ammonia as N	mg/L		0.03	0.09	0.09	0.19	0.16
Dissolved Arsenic	mg/L		0.002	<0.002	<0.002	<0.002	0.006
Dissolved Barium	mg/L		0.005	0.053	0.033	0.011	0.006
Dissolved Boron	mg/L		0.005	<0.005	0.008	0.011	0.021
Dissolved Cadmium	mg/L		0.000017	<0.000017	<0.000017	0.000028	<0.000017
Dissolved Calcium	mg/L		0.1	1.0	1.9	0.4	16.0
Chloride	mg/L		1	2	2	2	3
Dissolved Chromium	mg/L		0.001	0.001	<0.001	<0.001	<0.001
Electrical Conductivity	umho/cm		1	37	40	45	134
Dissolved Copper	mg/L		0.002	0.018	0.012	0.028	<0.002
Dissolved Iron	mg/L		0.05	4.82	11.8	5.30	0.06
Dissolved Lead	mg/L		0.0005	0.0008	<0.0005	0.0007	<0.0005
Dissolved Magnesium	mg/L		0.1	0.9	0.7	0.1	5.3
Dissolved Manganese	mg/L		0.002	0.095	0.409	0.031	<0.002
Dissolved Mercury	mg/L		0.000026	<0.000026	<0.000026	<0.000026	<0.000026
Nitrate as N	mg/L		0.05	<0.05	0.06	<0.05	0.13
Nitrite as N	mg/L		0.05	<0.05	<0.05	<0.05	<0.05
Total Kjeldahl Nitrogen as N	mg/L		0.4	1.1	0.6	3.2	<0.4
pH				6.08	6.04	6.20	7.85
Dissolved Potassium	mg/L		0.1	3.1	1.2	0.8	0.6
Dissolved Sodium	mg/L		0.1	4.9	3.0	11.3	5.5
Total Suspended Solids	mg/L		5	102	947	29	<5
Total Dissolved Solids	mg/L		5	120	94	100	86
Sulphate	mg/L		2	<2	<2	<2	5
Dissolved Zinc	mg/L		0.005	0.016	0.152	0.014	<0.005
Chemical Oxygen Demand	mg/L		3	448	32	184	<3
Dissolved Organic Carbon	mg/L		0.5	126	33.5	34.4	2.4
Total Phenolics	mg/L		0.001	0.003	0.002	0.002	<0.001
Total Phosphorous as P	mg/L		0.03	0.87	0.21	0.61	0.03

Certified By:

Certificate of Analysis

AGAT WORK ORDER: 15X034833
PROJECT: 357238

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CLIENT NAME: HATCH MOTT MACDONALD
ATTENTION TO: Mark Armstrong
SAMPLING SITE:
SAMPLED BY:

Column 1 Inorganics - Comprehensive List for Groundwater and Leachate

DATE RECEIVED: 2015-10-26
DATE REPORTED: 2015-11-02

			SAMPLE DESCRIPTION:	MW-1	MW-2	MW-3	Field Blank
			SAMPLE TYPE:	Water	Water	Water	Water
			DATE SAMPLED:	10/23/2015	10/23/2015	10/23/2015	10/23/2015
Parameter	Unit	G / S	RDL	7127594	7127649	7127672	7127706
Lab Filtration Requested				Y	Y	Y	Y

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard
7127594-7127706 *Metal Scan performed on filtered sample.

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Quality Assurance

CLIENT NAME: HATCH MOTT MACDONALD
AGAT WORK ORDER: 15X034833
PROJECT: 357238
ATTENTION TO: Mark Armstrong
SAMPLING SITE:
SAMPLED BY:

Trace Organics Analysis

RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
Column 1 Organics - Comprehensive List for Groundwater and Leachate															
Benzene	1	7127594	<1	<1	0	< 1	103%	60%	140%	76%	60%	140%	69%	60%	140%
1,4-Dichlorobenzene	1	7127594	<1	<1	0	< 1	92%	60%	140%	77%	60%	140%	77%	60%	140%
Methylene Chloride (Dichloromethane)	1	7127594	<2	<2	0	< 2	114%	60%	140%	131%	60%	140%	72%	60%	140%
Toluene	1	7127594	<2	<2	0	< 2	105%	60%	140%	81%	60%	140%	85%	60%	140%
Vinyl Chloride	1	7127594	<0.5	<0.5	0	< 0.6	123%	60%	140%	86%	60%	140%	68%	60%	140%
Glycols Analysis in Water															
Propylene Glycol	177	7127649	<10	<10	0	< 10	123%	70%	130%	117%	70%	130%	126%	60%	140%
Monoethylene Glycol	177	7127649	<10	<10	0	< 10	106%	70%	130%	100%	70%	130%	110%	60%	140%
Diethylene Glycol	177	7127649	<5	<5	0	< 5	103%	70%	130%	102%	70%	130%	106%	60%	140%
Triethylene Glycol	177	7127649	<10	<10	0	< 10	114%	70%	130%	108%	70%	130%	118%	60%	140%
Tetraethylene Glycol	177	7127649	<10	<10	0	< 10	112%	70%	130%	100%	70%	130%	115%	60%	140%

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.

Certified By: J. Patterson

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Quality Assurance

CLIENT NAME: HATCH MOTT MACDONALD | AGAT WORK ORDER: 15X034833
PROJECT: 357238 | ATTENTION TO: Mark Armstrong
SAMPLING SITE: | SAMPLED BY:

Water Analysis

RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
Column 1 Inorganics - Comprehensive List for Groundwater and Leachate															
Alkalinity as CaCO3	7126306		95	96	1.0%	< 5	92%	80%	120%	NA	80%	120%	NA	80%	120%
Ammonia as N	1	7126091	<0.03	<0.03	NA	< 0.03	99%	80%	120%		80%	120%	97%	80%	120%
Dissolved Arsenic	1029201	7127703	0.006	0.005	NA	< 0.002	117%	80%	120%	95%	80%	120%	130%	70%	130%
Dissolved Barium	1029201	7127703	0.0056	0.0054	NA	< 0.005	90%	80%	120%	95%	80%	120%	106%	70%	130%
Dissolved Boron	1029201	7127703	0.021	0.020	NA	< 0.005	NA	80%	120%	NA	80%	120%	NA	70%	130%
Dissolved Cadmium	1029201	7127703	< 0.000017	< 0.000017	NA	< 0.000017	116%	80%	120%	95%	80%	120%	123%	70%	130%
Dissolved Calcium	1029201	7127703	18.0	18.4	2.2%	< 0.1	96%	80%	120%	93%	80%	120%	130%	70%	130%
Chloride	7127706	7127706	3	3	NA	< 1	89%	80%	120%	NA	80%	120%	83%	80%	120%
Dissolved Chromium	1029201	7127703	< 0.001	< 0.001	NA	< 0.001	120%	80%	120%	120%	80%	120%	130%	70%	130%
Electrical Conductivity	7126306		211	207	1.9%	< 1	98%	80%	120%	NA	80%	120%	NA	80%	120%
Dissolved Copper	1029201	7127703	< 0.002	< 0.002	NA	< 0.002	120%	80%	120%	102%	80%	120%	NA	70%	130%
Dissolved Iron	1029201	7127703	0.06	< 0.05	NA	< 0.05	120%	80%	120%	120%	80%	120%	NA	70%	130%
Dissolved Lead	1029201	7127703	< 0.0005	< 0.0005	NA	< 0.0005	120%	80%	120%	120%	80%	120%	130%	70%	130%
Dissolved Magnesium	1029201	7127703	5.3	5.4	1.9%	< 0.1	115%	80%	120%	109%	80%	120%	101%	70%	130%
Dissolved Manganese	1029201	7127703	< 0.002	< 0.002	NA	< 0.002	120%	80%	120%	120%	80%	120%	NA	70%	130%
Nitrate as N	7127706	7127706	0.13	0.13	NA	< 0.05	95%	80%	120%	NA	80%	120%	NA	80%	120%
Nitrite as N	7127706	7127706	<0.05	<0.05	NA	< 0.05	97%	80%	120%	NA	80%	120%	97%	80%	120%
Total Kjeldahl Nitrogen as N	1	7128151	0.5	0.6	NA	< 0.4	96%	80%	120%		80%	120%	107%	80%	120%
pH	7126306		8.02	8.02	0.0%	<	101%	80%	120%	NA	80%	120%	NA	80%	120%
Dissolved Potassium	1029201	7127703	0.6	0.6	0.0%	< 0.1	120%	80%	120%	120%	80%	120%	123%	70%	130%
Dissolved Sodium	1029201	7127703	5.5	5.5	0.0%	< 0.1	117%	80%	120%	111%	80%	120%	99%	70%	130%
Total Suspended Solids	1	7706	< 5	< 5	NA	< 5	101%	80%	120%		80%	120%	103%	80%	120%
Total Dissolved Solids	1	7706	86	80	7.2%	< 5	118%	80%	120%		80%	120%		80%	120%
Sulphate	7127706	7127706	5	5	NA	< 2	86%	80%	120%	NA	80%	120%	82%	80%	120%
Dissolved Zinc	1029201	7127703	< 0.005	< 0.005	NA	< 0.005	120%	80%	120%	120%	80%	120%	NA	70%	130%
Chemical Oxygen Demand	1	7132675	169	202	17.8%	< 3	96%	80%	120%		120%	120%		80%	120%
Dissolved Organic Carbon	1	7115862	23.8	20.7	13.9%	< 0.5	113%	80%	120%		80%	120%	92%	80%	120%
Total Phenolics	7127594	7127594	0.003	0.003	NA	< 0.001	98%	90%	110%	99%	90%	110%	99%	80%	120%
Column 1 Inorganics - Comprehensive List for Groundwater and Leachate															
Chemical Oxygen Demand	1	7132753	16	22	31.6%	< 3	100%	80%	120%		120%	120%		80%	120%
BOD															
Biochemical Oxygen Demand, Total	1		118	111	6.1%	< 2	75%	70%	130%		80%	120%		80%	120%

Certified By: [signature]

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Method Summary

CLIENT NAME: HATCH MOTT MACDONALD
AGAT WORK ORDER: 15X034833
PROJECT: 357238
ATTENTION TO: Mark Armstrong
SAMPLING SITE:
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Benzene	VOL-120-5001	EPA SW846 5230B/8260	GC/MS
1,4-Dichlorobenzene	VOL-120-5001	EPA SW846 5230B/8260	GC/MS
Methylene Chloride (Dichloromethane)	VOL-120-5001	EPA SW846 5230B/8260	GC/MS
Toluene	VOL-120-5001	EPA SW846 5230B/8260	GC/MS
Vinyl Chloride	VOL-120-5001	EPA SW846 5230B/8260	GC/MS
Toluene-d8	VOL-120-5001	EPA SW846 5230B/8260	GC/MS
Propylene Glycol	TO-1410	EPA SW-846 8015	GC/FID
Monoethylene Glycol	TO-1410	EPA SW-846 8015	GC/FID
Diethylene Glycol	TO-1410	EPA SW-846 8015	GC/FID
Triethylene Glycol	TO-1410	EPA SW-846 8015	GC/FID
Tetraethylene Glycol	TO-1410	EPA SW-846 8015	GC/FID
Heptanol	TO-1410	EPA SW-846 8015	GC/FID

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Method Summary

CLIENT NAME: HATCH MOTT MACDONALD
PROJECT: 357238
SAMPLING SITE:

AGAT WORK ORDER: 15X034833
ATTENTION TO: Mark Armstrong
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
Biochemical Oxygen Demand, Total	INORG-121-6023	SM 5210 B	INCUBATOR
Alkalinity as CaCO3	INORG-121-6001	SM 2320 B	
Ammonia as N	INORG-121-6003	SM 4500-NH3 G	COLORIMETER
Dissolved Arsenic	MET121-6104 & MET-121-6105	SM 3125	ICP-MS
Dissolved Barium	MET121-6104 & MET-121-6105	SM 3125	ICP/MS
Dissolved Boron	MET121-6104 & MET-121-6105	SM 3125	ICP/MS
Dissolved Cadmium	MET121-6104 & MET-121-6105	SM 3125	ICP/MS
Dissolved Calcium	MET121-6104 & MET-121-6105	SM 3125	ICP/MS
Chloride	INORG-121-6005	SM 4110 B	IC
Dissolved Chromium	MET121-6104 & MET-121-6105	SM 3125	ICP/MS
Electrical Conductivity	INOR-121-6001	SM 2510 B	
Dissolved Copper	MET121-6104 & MET-121-6105	SM 3125	ICP/MS
Dissolved Iron	MET121-6104 & MET-121-6105	SM 3125	ICP/MS
Dissolved Lead	MET121-6104 & MET-121-6105	SM 3125	ICP/MS
Dissolved Magnesium	MET121-6104 & MET-121-6105	SM 3125	ICP/MS
Dissolved Manganese	MET121-6104 & MET-121-6105	SM 3125	ICP/MS
Dissolved Mercury	MET-121-6100 & MET-121-6107	SM 3112 B	CV/AA
Nitrate as N	INOR-121-6005	SM 4110 B	IC
Nitrite as N	INOR-121-6005	SM 4110 B	IC
Total Kjeldahl Nitrogen as N	INOR-121-6020	SM 4500 NORG D	COLORIMETER
pH	INOR-121-6001	SM 4500 H+B	
Dissolved Potassium	MET121-6104 & MET-121-6105	SM 3125	ICP/MS
Dissolved Sodium	MET121-6104 & MET-121-6105	SM 3125	ICP/MS
Total Suspended Solids	INOR-121-6024, 6025	SM 2540C, D	GRAVIMETRIC
Total Dissolved Solids	INOR-121-6024, 6025	SM 2540C, D	GRAVIMETRIC
Sulphate	INORG-121-6005	SM 4110 B	IC
Dissolved Zinc	MET121-6104 & MET-121-6105	SM 3125	
Chemical Oxygen Demand	INORG-121-6013	SM 5220 B	SPECTROPHOTOMETER
Dissolved Organic Carbon	INORG-121-6026	SM 5310 B	TOC ANALYZER
Total Phenolics	INOR 1050	MOE ROPHEN-E 3179 & SM 5530 D	TECHNICON AUTO ANALYZER
Total Phosphorous as P	INORG-121-6009	SM 365.2	COLORIMETER
Lab Filtration Requested			

AGAT Laboratories

Unit 122 • 11 Morris Drive
Dartmouth, NS
B3B 1M2
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Chain of Custody Record

P: 902.468.8718 • F: 902.468.8924

Laboratory Use Only

Arrival Condition: ☐ Good ☐ Poor (see notes)
Arrival Temperature: 6°
Hold Time:
AGAT Job Number: 15X034833
Notes:

Report Information

Company: Hatch Mott MacDonald
Contact: Mark Armstrong
Address: 15 Allstate Parkway, Suite 300
Markham ON, L3R 5B4
Phone: 905.940.5487 Fax: 905.940.5848
Client Project #: 357238
AGAT Quotation:
Please Note: If quotation number is not provided client will be billed full price for analysis.

Report Information (Please print):

1. Name: Joelle Freeman
   Email: joelle.freeman@hatchmott.com
2. Name: Mark Armstrong
   Email: mark.armstrong@hatchmott.com

Report Format

☐ Single Sample per page
☑ Multiple Samples per page
☑ Excel Format Included

Turnaround Time Required (TAT)

Regular TAT ☑ 5 to 7 working days
Rush TAT ☐ Same day ☐ 1 day ☐ 2 days ☐ 3 days
Date Required:

Invoice To

Same Yes ☐ / No ☐

Company: Hatch Mott MacDonald
Contact: Mark Armstrong
Address: 15 Allstate Parkway, Suite 300
Markham ON, L3R 5B4
Phone: 905.940.5487 Fax: 905.940.5848
PO/Credit Card#:

Regulatory Requirements (Check):

☐ List Guidelines on Report ☐ Do not list Guidelines on Report
☐ PIRI
☐ Tier 1 ☐ Res ☐ Pot ☐ Coarse
☐ Tier 2 ☐ Com ☐ N/Pot ☐ Fine
☐ Gas ☐ Fuel ☐ Lube
☐ CCME ☐ CDWQ
☐ Industrial ☐ NSESQ-Cont. Sites
☐ Commercial
☐ Res/Park ☐ HRM 101
☐ Agricultural ☐ Storm Water
☐ FWAL ☐ Waste Water
☐ Sediment ☐ Other

Drinking Water Sample: ☑ Yes ☐ No
Reg. No.:

Sample Identification	Date/Time Sampled	Sample Matrix	# Containers	Comments – Site/Sample Info. Sample Containment	Field Filtered/Preserved	Standard Water Analysis	Metals: ☐ Total ☐ Diss ☐ Available	Mercury	☐ BOD ☐ CBOD	pH	☐ TSS ☐ TDS ☐ VSS	TKN	Total Phosphorus	Phenols	Tier 1: TPH/BTEX (PIRI) ☐ low level	Tier 2: TPH/BTEX Fractionation	CCME-CWS TPH/BTEX	VOC	THM	HAA	~~PAH~~ Glycols	PCB	TC + EC ☐ P/A ☐ MPN ☑ MF	☐ HPC ☐ Pseudomonas	Fecal Coliform ☐ MPN ☐ MF	Other: Landfill Column 1	Other:	Hazardous (Y/N)
MW-1	10/23/15 0920	Water	11																		X					X		
MW-2	10/23/15 0925	↓	11																		X					X		
MW-3	10/23/15 0905	↓	11																		X					X		
Trip Blank	NA	↓	4															X			~~X~~	[illegible]					X	
* Field Blank		↓	11																		X					X		

*Note: Inadequate bottle ware provided for field blank. please use enclosed 1 gallon water to complete full analysis.

*Also please add ethylene glycol to analysis for all samples if possible.

Samples Relinquished By (Print Name)	Date/Time	Samples Received By (Print Name)	Date/Time	
Joelle Freeman	10/24/15	Air Canada Cargo	10/24/15	Pink Copy - Client
Samples Relinquished By (Sign)	**Date/Time**	**Samples Received By (Sign)**	**Date/Time**	Yellow Copy - AGAT
[signature]	0730	[signature]	0730	White Copy- AGAT

Page 1 of 1
Nº:

Document ID: DIV-133-1501.003

Date revised: October 5, 2015

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Appendix C

Waste Generation Memo

Project Memo

HMM357238

January 29, 2016

To: Joseph Dunphy   From: Mark Armstrong

cc: Ian Duffett
Fay Pittman

Labrador Straits Waste Disposal
Southern Labrador Waste Disposal

Waste Generation Estimate

1. Introduction

The waste generation estimate for the Southern Labrador Waste Disposal Facility (SLDWF or Facility) site was prepared as part of the update to the Project Registration. This memo provides a summary of the waste generation estimate.

Estimates of general waste, compostable and recyclable materials are necessary to adequately size the collection, transportation, storage and disposal systems required for a non-containment landfill. The Hatch Mott MacDonald (HMM) study done in 2010 contained a review of the residential and commercial waste generation for the region. HMM will use data from previous reports and data from the Central Newfoundland waste management area, which has an operating program and encompasses areas which are similar to the Southern Labrador area. We will also utilize the population forecast data for Southern Labrador from the Department of Finance - Statistics Agency to project the waste generation.

1.1 Data Sources

The following data sources were used to prepare this updated waste generation estimate:

- Statistics Canada - 2006 and 2011 census data
- Department of Finance - Statistics Agency - population forecast data.
- Central Newfoundland Waste Management - waste generation data for 2014 and 2015.
- AMEC.2004. Regional Solid Waste Management Study Southeastern Labrador. Phase 2 Site Assessment. Final Report.
- Hatch Mott MacDonald Limited, 2010. Draft Report - Southern Labrador Waste Management Study.

2. Population Estimates

Population of the waste catchment area is an essential component of calculating the total waste generated which is used to size the landfill facility components. The population of an area rises and falls based upon births, deaths, and migration into and out of the area being assessed. For the Southern Labrador area, Statistics Canada census data was compiled for 2006 and 2011 for the communities within the Southern Labrador Waste Disposal Site area, as listed in Table 1.

Table 1: Summary of Census Population Data for Southern Labrador Waste Catchment Area

Community	Population (2006)	Population (2011)	% Change	Notes
Capstan Island	42	*42*		No Data 2011
Cartwright	552	516	-7%	
Charlottetown	366	308	-16%	
Forteau	448	429	-4%	
Lanse-au-Clair	226	192	-15%	
Lanse-au-Loup	593	550	-7%	
Lodge Bay	90	*90*		No Data 2011
Mary's Harbour	417	383	-8%	
Paradise River	14	*14*		No Data 2011
Pinsent's Arm	55	*55*		No Data 2011
Pinware	114	107	-6%	
Port Hope Simpson	529	441	-17%	
Red Bay	227	194	-15%	
St. Lewis	252	207	-18%	
West St. Modeste	140	120	-14%	
Totals	**4065**	**3648**	**-12%**	

Italicized figures are estimates

Population growth between 2006 and 2011 for the Southern Labrador Region ranged between -4 and -18% with a population weighted average of -12%. The Department of Finance - Statistics Agency prepares population forecasts for regions across Newfoundland and Labrador. For Labrador, the Statistic Agency predicts three scenarios for population growth between 2015 and 2035, the average annual growth rate of these scenarios are low 0.09%, medium 0.41% and high 0.70%. These scenarios have ranges due to year over year variances through identified major infrastructure projects in the area. For the purposes of sizing the SLWDF, the population will be assumed to remain steady at 3648. Any decreases in population could allow the facility to remain in operation longer than the planned 50 year lifespan if waste generation rates remain unchanged per person.

3. Waste Generation Estimate

3.1 Previous Studies

Waste generation estimates for this Facility were prepared in the 2003 AMEC report and the 2010 HMM report. The estimates for these two reports are summarized in Table 2 and Table 3.

Table 2: Waste Generation Summary 2003 AMEC Report

Community	Population (2003)	Households	Annual Residential (Tonnes)	Annual Commercial (Tonnes)	Total Annual (Tonnes)
Charlottetown	363	116	172.2	231	403.2
Lodge Bay	81	38	38.4		38.4
Mary's Harbour	427	157	202.6	113	315.6
Pinsent's Arm	47	18	22.3		22.3
Port Hope Simpson	449	179	213.1		213.1
St. Lewis	269	92	127.6	25	152.6
Totals	**1636**	**600**	**776.3**	**369**	**1145.3**

Table 3: Waste Generation Summary 2010 HMM Report

Communities	Population	No. of Households	Notes	Waste Generated per year*** (kg)	Waste Generated per year (tonne)
Capstan Island	42	21	*	19,929	20
Cartwright	575	258	*	272,838	273
Charlottetown	364	128	**	172,718	173
Forteau	448	160	*	212,576	213
Lanse-au-Clair	226	96	*	107,237	107
Lanse-au-Loup	595	220	*	282,328	282
Lodge Bay	90	35	*	42,705	43
Mary's Harbour	417	156	**	197,867	198
Paradise River	14	6	**	6,643	7
Pinsent's Arm	55	17	*	26,098	26
Pinware	114	50	**	54,093	54
Port Hope Simpson	500	182	*	237,250	237
Red Bay	210	76	*	99,645	100
St. Lewis	192	70	**	91,104	91
West St. Modeste	140	65	*	66,430	66
Totals	**3982**	**1540**		**1,889,459**	**1889**

* Population and number of households obtained from Town Clerk.

** Population and number of households obtained from 2006 Census Canada.

*** Assumes a per capita generation rate of 1.30 kg per day and 365 days per year.

The data in Table 2 were used to calculate the residential per person generation rates of 1.3 kg per person per day used in Table 3. However, the generation rate includes organics, recyclables, Household Hazardous Wastes (HHW), Construction and Demolition (C&D), and other waste types.

3.2 Updated Waste Generation Estimate

For this waste generation update, waste data from Central Newfoundland Waste Management (CNWM) were obtained for sub-catchment areas of similar population and community type. The sub-catchment areas of Indian Bay and Fogo Island have populations of approximately 4,800 and 2,400 respectively, which are comprised of smaller communities along their respective coastlines. In addition to similar population, the CNWM data provides the waste generation rates for Construction and Demolition (C&D), Household Hazardous waste (HHW), blue bin, metals, wood and cardboard, in addition to overall waste generation rates. These rates will be used to calculate both the mass of wastes to be landfilled and to be diverted from landfill.

The Table 4 and Table 5 provides a breakdown of the waste generated by waste type for Indian Bay and Fogo Island, respectively. The description of each waste type is summarized below:

- C & D Mixed - unsorted Construction and Demolition waste, including concrete, drywall.
- C & D Sorted - source sorted Construction and Demolition waste.
- Cardboard - source separated cardboard.
- E-Waste - electronic waste.
- Free - waste from households that is free for disposal.
- HHW - household hazardous waste.
- Metals - metals, including household appliances.
- Tires - source separated waste tires.
- Wet and Dry (W & D) Unsorted - wet and dry unsorted waste including recyclable and compostable waste, CNWM shifted in 2015 to the clear and blue bag system.
- Wood - source separated wood waste.
- Clear Bag - household general waste and compostable materials.
- Blue Bag - household recyclable wastes.

Table 4: CNWM Indian Bay Sub Catchment – Waste Stream Summary

Waste Category	Indian Bay 2014 Total Mass kg/year	Indian Bay 2014 kg/year/person	Indian Bay 2015 Total Mass (kg)/year*	Indian Bay 2015 kg/year/person
C & D Mixed	120,060	25.01	274,920	57.28
C & D Sorted	656,813	136.84	716,793	149.33
Cardboard	98,460	20.51	97,333	20.28
E-Waste	8,090	1.69	5,227	1.09
Free	38,600	8.04	200	0.04
HHW	3,930	0.82	1,493	0.31
Metals	79,030	16.46	93,973	19.58
Tires	5,600	1.17	11,927	2.48
W & D Unsorted	2,164,470	450.93	369,800	77.04
Wood	0	0	0	0
Clear Bag	0	0	1,067,459	222.39
Blue Bag	0	0	152,280	31.73

Total Waste, Indian Bay (2015):	2,791,405	kg
	582	kg/person/year
	1.6	kg/person/day

Table 5: CNWM Fogo Island Sub-Catchment - Waste Stream Summary

Waste Category	Fogo Island 2014 Total Mass kg/year	Fogo Island 2014 kg/year/person	Fogo Island 2015 Total Mass kg/year*	Fogo Island 2015 kg/year/person
C & D Mixed	59,276	24.70	103,367	43.07
C & D Sorted	472,035	196.68	490,519	204.38
Cardboard	49,750	20.73	46,413	19.34
E-Waste	2,870	1.20	11,600	4.83
Free	42,760	17.82	133	0.06
HHW	1,220	0.51	1,267	0.53
Metals	132,780	55.33	167,748	69.90
Tires	8,700	3.63	11,760	4.90
W & D Unsorted	785,535	327.31	135,493	56.46
Wood	19,120	7.97	40,733	16.97
Clear Bag	0	0	483,573	201.49
Blue Bag	0	0	74,667	31.11

Total Waste, Fogo Island (2015):	1,567,273	kg
	653	kg/person/year
	1.8	kg/person/day

This data provides an overall generation rates of 1.6 kg per person per day for Indian Bay and 1.8 kg per person per day for Fogo Island. For the waste generation estimate for Southern Labrador the average of the rates will be used, since neither sub-catchments had consistently higher generation rates for each waste type category.

The Clear/Blue Bag system in place for the CNWM operations comingles the organics that need to be diverted from the SLWDF landfill. A recently completed Study for Options for Organic Waste Processing in the Province of Newfoundland and Labrador (Dillon, 2014) found that organics, in the form of food, yard and other organics from rural municipalities accounts for up to 33.6% of the total waste stream, as shown in Figure 1 below.

Figure 3-12 Assumed Waste Stream Percentage Breakdown – Rural - Residential

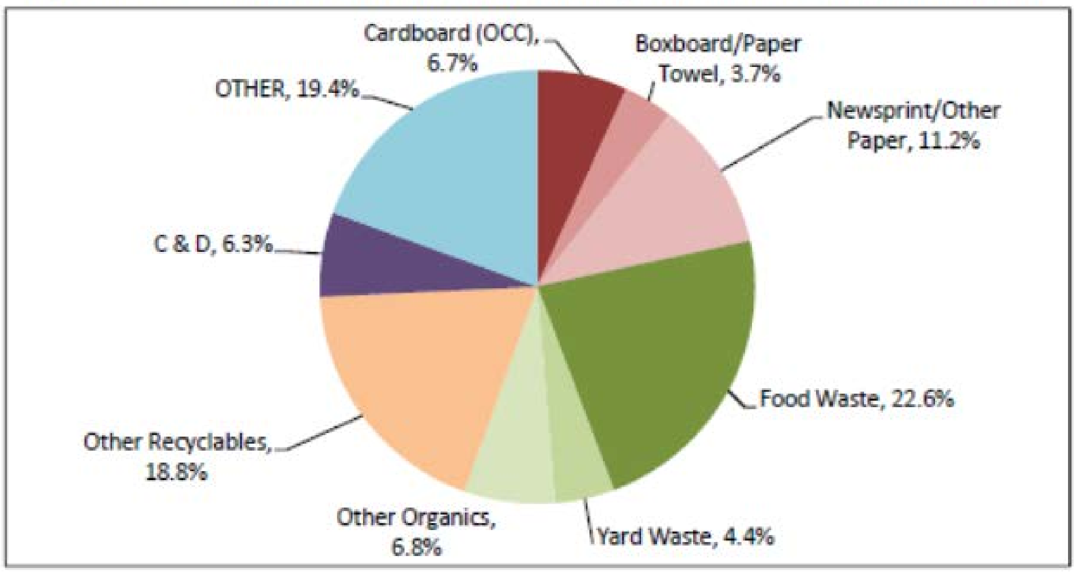


Figure 1: Assumed Waste Stream Percentage Breakdown (Dillion 2014)

Using the waste generation rates from the estimated annual waste generation rates for each waste type are summarized in Table 6 for the Facility, a breakdown of the estimated generation rates for the individual municipalities is provided in Appendix A. CNMW indicated that they switched in 2015 to a clear bag system for residual waste including organics. Since the SLWDF will operate with the clear bag / blue bag / organics sources separation from opening the generation rates for the Wet and Dry waste and clear bag waste, are combined in Table 6, with 33.6% of the waste mass diverted to organics.

The Southern Labrador Waste Disposal Facility is being designed for a 50 year operational lifespan. Based upon the population estimates in Section 2 and the annual generation rates provided in Table 6, the total waste generation over the operational lifespan of the facility are summarized in Table 6.

Table 6: SLWDF Projected Annual and Operational Lifespan Waste Generation Rates

Waste Stream	Per Capita Rate (kg/day)	Annual Mass (tonnes)	Operational Lifespan (tonnes)
To Landfill			
C & D Unsorted	0.51	183	9,151
Clear Bag	0.14	681	34,058
Diverted from Landfill			
C & D Sorted	0.48	645	32,259
Cardboard	0.05	72	3,613
E-Waste	0.01	11	540
HHW	0.00	2	77
Metals	0.12	163	8,160
Tires	0.01	13	673
Wood	0.02	31	1,548
Organics	0.25	225	11,239
Blue Bag	0.09	115	5,731
Total Waste	**1.69**	**2,141**	**107,049**
Total Waste to Landfill	**0.65**	**864**	**43,209**
Total Waste Diverted from Landfill	**1.04**	**1,277**	**63,839**

This data will be utilized to size the landfill cells and the ancillary facilities for composting and collection of recyclable and HHW materials for the conceptual design.

4. References

http://www12.statcan.gc.ca/census-recensement/2011/rt-td/Index-eng.cfm?TABID=1

http://www.economics.gov.nl.ca/POP-projections.asp

AMEC.2004. Regional Solid Waste Management Study Southeastern Labrador. Phase 2 Site Assessment. Final Report.

Hatch Mott MacDonald Limited, 2010. Draft Report – Southern Labrador Waste Management Study.

Study for Options for Organic Waste Processing in the Province of Newfoundland and Labrador, Dillon Consulting, 2014.

Mark Armstrong

MA:gd
Attachment(s)/Enclosure

Appendix A

Waste Calculation Worksheet

A.1 Southern Labrador - Total Estimated Waste Generated, 2015

TABLE A.1 Southern Labrador - Total Estimated Waste Generated, 2015	Paradise River	Capstan Island	Pinsent's Arm	Lodge Bay	Pinware	West St. Modeste	L'Anse-au-Clair	Red Bay	St. Lewis	Charlottetown	Mary's Harbour	Port Hope Simpson	Forteau	Cartwright	L'Anse-au-Loup	Total Waste (tonnes)
Population*	14	42	55	90	107	120	192	194	207	308	383	441	429	516	550	
To Landfill (kg)																
Clear Bag	2,614	7,842	10,270	16,805	19,979	22,406	35,850	36,224	38,651	57,510	71,514	82,344	80,103	96,348	102,696	**681.2**
C & D Mixed	702	2,107	2,759	4,516	5,368	6,021	9,633	9,733	10,386	15,453	19,216	22,126	21,524	25,889	27,595	**183.0**
Diverted from Landfill (kg)																
C & D Sorted	2,476	7,428	9,727	15,917	18,924	21,223	33,957	34,310	36,609	54,472	67,736	77,994	75,872	91,258	97,272	**645.2**
Cardboard	277	832	1,089	1,783	2,119	2,377	3,803	3,843	4,100	6,101	7,587	8,735	8,498	10,221	10,895	**72.3**
E-Waste	41	124	163	267	317	355	569	574	613	912	1,134	1,306	1,270	1,528	1,629	**10.8**
HHW	6	18	23	38	45	50	81	81	87	129	161	185	180	216	231	**1.5**
Metals	626	1,879	2,461	4,026	4,787	5,368	8,589	8,679	9,260	13,779	17,134	19,729	19,192	23,084	24,605	**163.2**
Tires	52	155	203	332	395	443	709	716	764	1,137	1,414	1,628	1,584	1,905	2,031	**13.5**
Wood	119	356	467	764	908	1,018	1,629	1,646	1,757	2,614	3,250	3,742	3,641	4,379	4,667	**31.0**
Organics	1,288	3,863	5,058	8,277	9,840	11,036	17,658	17,842	19,037	28,326	35,223	40,557	39,454	47,455	50,582	**335.5**
Blue Bag	440	1,320	1,728	2,828	3,362	3,770	6,032	6,095	6,504	9,677	12,033	13,855	13,478	16,212	17,280	**114.6**
Total Waste (tonn	**8.6**	**25.9**	**33.9**	**55.6**	**66.0**	**74.1**	**118.5**	**119.7**	**127.8**	**190.1**	**236.4**	**272.2**	**264.8**	**318.5**	**339.5**	**2,252**
Total Waste to landfill (tonnes)	**3.3**	**9.9**	**13.0**	**21.3**	**25.3**	**28.4**	**45.5**	**46.0**	**49.0**	**73.0**	**90.7**	**104.5**	**101.6**	**122.2**	**130.3**	**864**
Total Waste diverted from	**5.3**	**16.0**	**20.9**	**34.2**	**40.7**	**45.6**	**73.0**	**73.8**	**78.7**	**117.1**	**145.7**	**167.7**	**163.2**	**196.3**	**209.2**	**1,388**

*Assume population from 2010/2011 census.

A.2 Southern Labrador - Total Estimated Waste Generated in a 50 Year Period (2015 -2065)

TABLE A.2

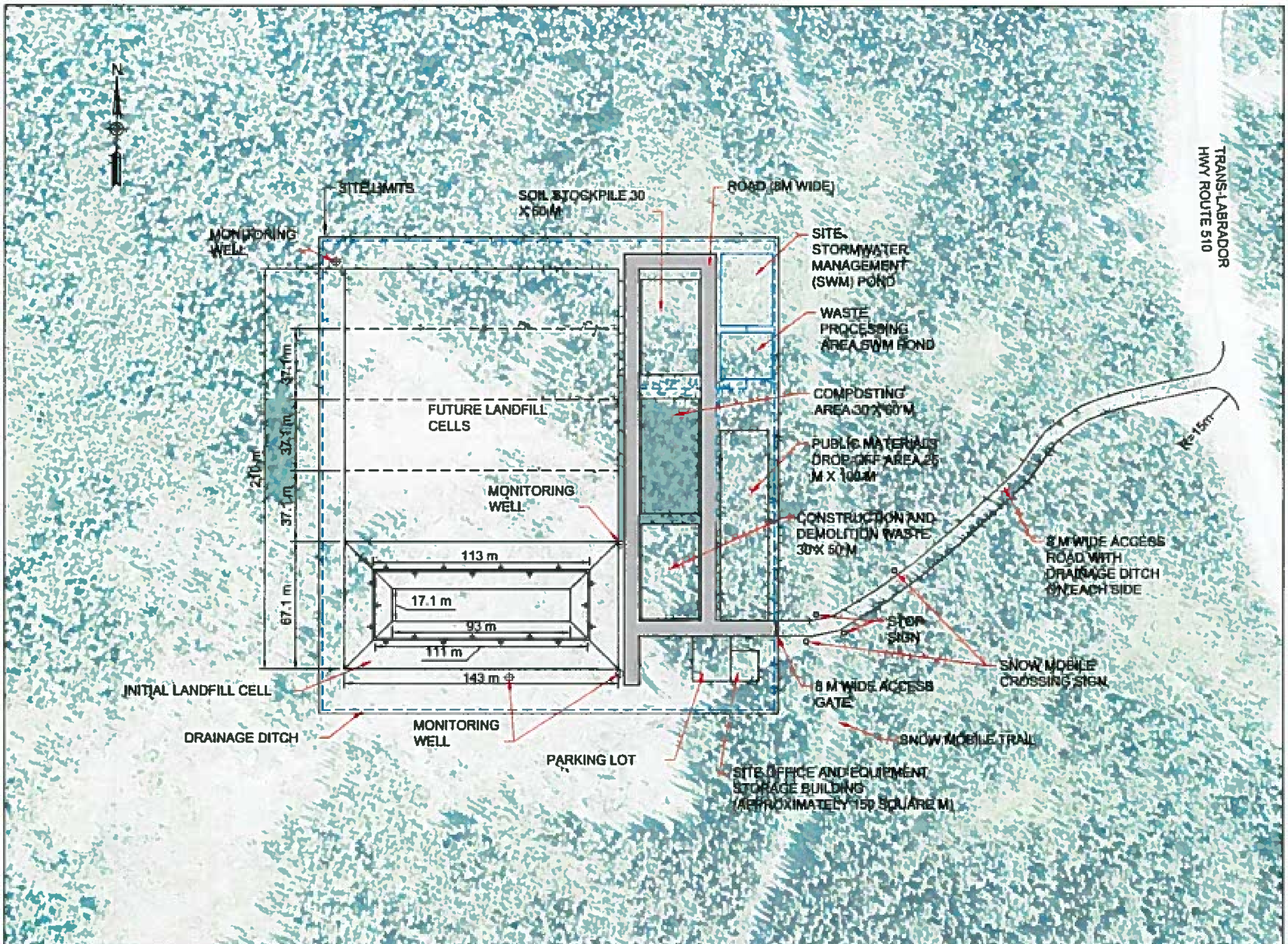
Southern Labrador -Total Estimated Waste Generated in 50 year period (2015-2065)

	Paradise River	Capstan Island	Pinsent's Arm	Lodge Bay	Pinware	West St. Modeste	L'Anse-au-Clair	Red Bay	St. Lewis	Charlottetown	Mary's Harbour	Port Hope	Forteau	Cartwright	L'Anse-au-Loup	Total Waste (tonnes)
Population**	14	42	55	90	107	120	192	194	207	308	383	441	429	516	550	
To Landfill (kg)																
Clear Bag	130,704	392,112	513,480	840,240	998,952	1,120,320	1,792,513	1,811,185	1,932,553	2,875,489	3,575,689	4,117,177	4,005,145	4,817,378	5,134,802	**34,058**
C & D Mixed	35,121	105,362	137,974	225,775	268,421	301,033	481,653	486,671	519,283	772,652	960,798	1,106,298	1,076,194	1,294,443	1,379,736	**9,151**
Diverted from Landfill (kg)																
C & D Sorted	123,800	371,400	486,358	795,858	946,187	1,061,144	1,697,831	1,715,516	1,830,474	2,723,603	3,386,818	3,899,705	3,793,590	4,562,920	4,863,577	**32,259**
Cardboard	13,866	41,598	54,473	89,138	105,975	118,850	190,160	192,141	205,016	305,048	379,330	436,774	424,889	511,055	544,729	**3,613**
E-Waste	2,073	6,218	8,143	13,325	15,842	17,767	28,427	28,723	30,648	45,601	56,705	65,293	63,516	76,397	81,431	**540**
HHW	294	881	1,153	1,888	2,244	2,517	4,027	4,069	4,341	6,459	8,032	9,249	8,997	10,822	11,535	**77**
Metals	31,315	93,946	123,025	201,314	239,340	268,418	429,469	433,943	463,022	688,940	856,702	986,437	959,596	1,154,199	1,230,251	**8,160**
Tires	2,585	7,754	10,154	16,616	19,754	22,154	35,447	35,816	38,216	56,862	70,709	81,417	79,201	95,263	101,540	**673**
Wood	5,940	17,821	23,337	38,188	45,401	50,917	81,467	82,315	87,831	130,686	162,509	187,119	182,027	218,942	233,368	**1,548**
Organics	64,377	193,130	252,908	413,850	492,021	551,800	882,879	892,076	951,854	1,416,286	1,761,160	2,027,864	1,972,684	2,372,738	2,529,082	**16,775**
Blue Bag	21,993	65,978	86,400	141,381	168,087	188,508	301,613	304,755	325,177	483,838	601,656	692,768	673,917	810,586	863,997	**5,731**
Total Cumulative Waste (tonnes)	**301**	**904**	**1,184**	**1,937**	**2,303**	**2,583**	**4,133**	**4,176**	**4,456**	**6,630**	**8,244**	**9,493**	**9,235**	**11,107**	**11,839**	**112,584**
Total Cumulative Waste to landfill (tonnes)	**354**	**1,062**	**1,391**	**2,276**	**2,706**	**3,034**	**4,855**	**4,905**	**5,234**	**7,788**	**9,684**	**11,151**	**10,848**	**13,047**	**13,907**	**43,209**
Total Waste diverted from	**266**	**799**	**1,046**	**1,712**	**2,035**	**2,282**	**3,651**	**3,689**	**3,937**	**5,857**	**7,284**	**8,387**	**8,158**	**9,813**	**10,460**	**69,375**

** Assume zero population growth

Appendix D

Conceptual Design Layout



Newfoundland Labrador

NOTES:
1. CONCEPTUAL SITE LAYOUT. NOT FOR CONSTRUCTION

NO.	DESCRIPTION	DATE	BY
1	FINAL DRAFT PROJECT REGISTRATION	MAY 2018	

REVISIONS

A – PLAN/SECTION/ELEVATION/DETAIL NO.
B – NO. OF DRAWING WHERE ABOVE IS DRAWN

CONSULTANT

HATCH

PROJECT

SOUTHERN LABRADOR
WASTE DISPOSAL FACILITY

DRAWING

CONCEPTUAL SITE LAYOUT

DRAWN BY	CHECKED BY	APPROVED BY	
JZ	MA	TP	
PROJECT NO. 357238	ORIG. FILE NO.	FILE NO.	
DATE MAY 18 2018	SCALE 1:2000	DRAWING NO. 001	REV. 1