Indigenous and Northern Affairs Canada | Affaires autochtones et du Nord Canada

ENNADAI LAKE
LONG TERM MONITORING PLAN

January 22, 2016

Table of Contents

Appendices

1.0 Introduction

Ennadai Lake was a former weather station. Remediation activities at the site were undertaken between 2014-2015, and involved the construction of a non-hazardous waste landfill (NHWL), demolition and disposal of buildings, structures and other debris, as well as the clean up of hazardous materials and contaminated soil.

1.1 Location

The Ennadai Lake site is located approximately 370 km west of Arviat (the nearest community) and 500 km southwest of Rankin Inlet, Nunavut, at approximately 61° 07' 51" N latitude and 100° 53' 14" W longitude (see Figure 1).

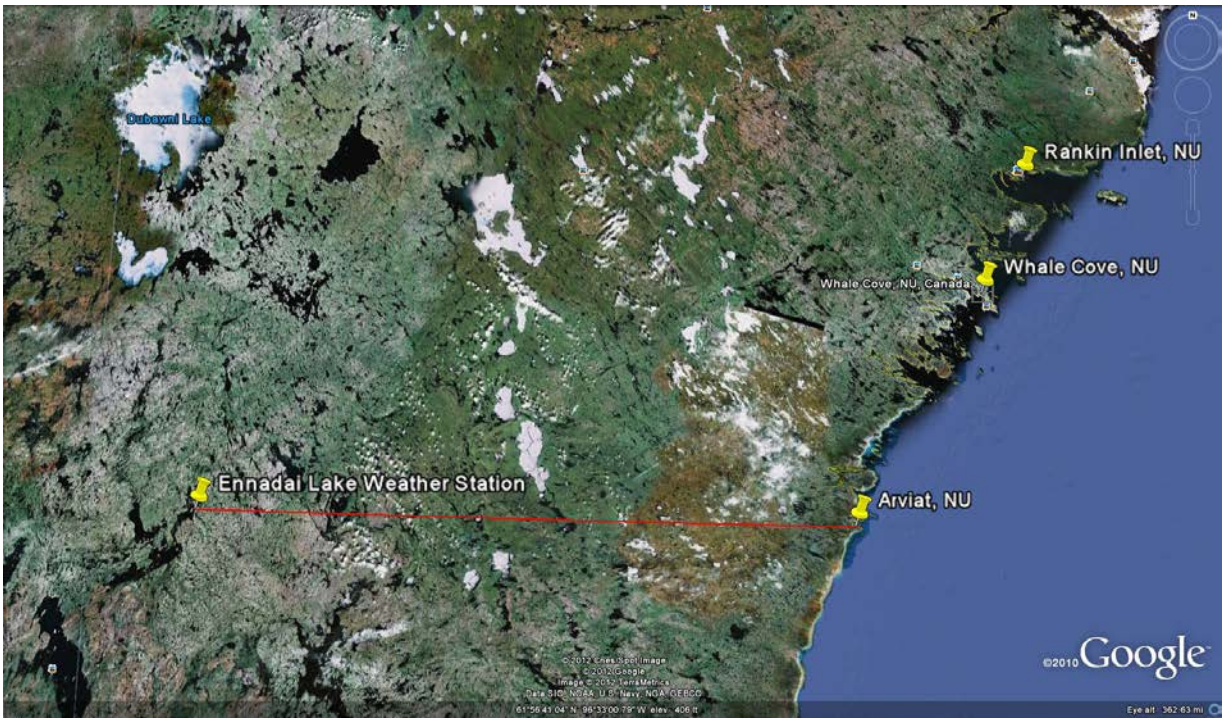


Figure 1: Ennadai Lake Site Location

1.2 Site Characteristics

The site was a weather station as of the 1950s. It was operated both as a manned and unmanned station, at different times since its construction and was abandoned in the late 1980s to early 1990s.

The site is a circle of land approximately a half (½) mile in radius. There are two small footprints of Inuit Owned Land (IOL) within the site. These were previously Crown Lands, leased by Indigenous and Northern Affairs Canada (INAC) [formerly Indian and Northern Affairs Canada – INAC] to a private company called Tundra Adventures (1983), and were later transferred to Nunavut

Tunngavik Inc. (NTI) through the Nunavut Land Claim Agreement (1993). The Crown portions of this land are administered by INAC with the IOL portions administered by Kivalliq Inuit Association (KivIA).

Since the 1950's, the site has housed a Department of National Defence (DND) signals station and a manned Transport Canada weather station which was later transferred to Environment and Climate Change Canada (ECCC). ECCC currently operates an unmanned weather station near the site, and an ECCC land reserve still exists on this portion of the site.

Ennadai Lake is 84 km long, between 5 and 23 km wide, and is drained to the north by the Kazan River. The region lies in the Kazan River Upland Ecoregion of the Taiga Shield Ecozone. Peatlands and lakes of various sizes are common in the region and are often interconnected. The predominant vegetation consists of black spruce and tamarack, with dwarf birch and willow shrubs, and a ground cover of cottongrass, sedge, moss and lichen. Ennadai Lake lies across the treeline – the gradual transition from boreal forest to tundra. The south end of Ennadai Lake is characterized by open canopy stands of black spruce, while the north end of Ennadai Lake is predominantly tundra vegetation and isolated black spruce colonies are only found in protected poorly drained terrain.

The NHWL is located approximately 240 m east of the site. The area identified is approximately 3,500 m^2 (70 m x 50 m). This landfill area is well-drained, and slopes gently to the east. The surface consists of exposed sand and gravel with patches of vegetation. The site consists of well-drained silty sand with a trace of gravel.

The wildlife typically found in this region includes barren-ground caribou, wolf, wolverine, weasel, arctic and red fox, arctic hare and brown lemming. Additional mammal species such as muskox, otter and mink, occur at the edge of these ranges and may be expected to occur irregularly. Bird species in the region include rock and willow ptarmigan, peregrine falcon, short-eared owl, sandhill crane and various waterfowl species.

2.0 Monitoring Areas

The monitoring program for Ennadai Lake includes the natural environment as well as the NHWL; the only structure remaining on-site after the completion of remediation.

2.1 Natural Environment Monitoring

Natural environment data has been collected during the environmental assessment and remediation of the site as well as during community meetings.

This data includes local and traditional knowledge of the site and will serve as a reference for post construction monitoring.

2.1.1 Monitoring Requirements

Natural environment data will be collected during site visits as well as during community meetings with people who use or visit the site/area frequently. The purpose of collecting this new data is not to find correlations with the landfill monitoring data but rather to provide anecdotal data related to the presence of wildlife and changes over time.

The site specific data to be collected during the site visit will include:

- Wildlife sightings (species, number, gender, juveniles)
- Other evidence of recent presence of wildlife (droppings, tracks, feathers/fur, carcass remains, etc.)
- Wildlife activity (summering/nesting/denning, migratory/passing through)
- Qualitative assessment of relative numbers versus previous years (more, same, less)
- Revegetation of disturbed areas versus previous years (more, same, less)

Information regarding visits made to the site by local people may also be collected through consultations with local community members and/or local Hunter and Trapper Associations (HTOs) and/or the Kivalliq Inuit Association (KIA). The type of information that may be collected includes:

- Wildlife sightings
- Use by people for traditional activities
- Season(s)
- Activities (hunting, fishing, trapping, camping, other harvesting)
- Relative frequency versus previous years (more, same, less)
- Wildlife species present (sightings or evidence)
- Wildlife presence versus previous years (more, same, less)
- Health of wildlife observed or harvested (good, average, poor)
- Relative health of wildlife versus previous years (better, same, worse)

2.2 Non-Hazardous Waste Landfill (NHWL)

Construction of the NHWL at Ennadai Lake started in 2014 and was completed in August 2015. A site map detailing the location of the NHWL can be found in Appendix A.

2.2.1 Design

The NHWL was constructed at a location approximately 200m west of the main Site and was designed to contain non-hazardous materials only. The cell was

approximately 15 m x 11.4 m (base interior) / 22m x 18.4 m (interior top-of-berm) in size and contained an estimated final volume of 506 cubic metres of waste.

It was constructed on native ground with the organic matter stripped and consists of four perimeter berms constructed of granular material. The non-hazardous waste was placed in the landfill in layers consisting of 0.5 metre lifts of waste covered by 0.15 metres of granular fill. Once all the layers were completed a final cover consisting of a minimum of 1.0 metres of granular fill was used to cap the landfill. See Appendix B for the As-Built Drawing.

2.2.2 Contents

The NHWL at Ennadai Lake contains the following materials:

- Non-hazardous site debris, such as scrap metal and wood
- Type A Petroleum Hydrocarbon (PHC) contaminated soil
- Tier I contaminated soil (see Table 1)
- Asbestos Containing Material (ACM)

Table #1: DEW Line Cleanup Criteria Tier I Contaminant Criteria

Parameter	Criteria
Lead	200 to <500 ppm
PCBs	1 to <5 ppm

2.2.3 Monitoring Requirements

The NHWL will be monitored by:

- Visual Monitoring
  - This will check the physical integrity of the NHWL and look for evidence of settlement, erosion, frost action, animal burrows, vegetation, staining, vegetation stress, seepage points, exposed debris, and condition of monitoring instruments (Appendix C contains a Visual Monitoring Checklist).
  - Photographs will be taken to document the condition of the NHWL and substantiate the recorded observations.
- Active Layer Water Monitoring
  - Samples will be taken from the 3 monitoring wells installed around the NHWL. These samples will be analysed and the results will be compared to those from background samples. Details on the monitoring wells can be found in Appendix D. The parameters that will be analysed include:
    - Petroleum Hydrocarbon Fractions, F1 and F2
    - Total and Dissolved Metals
    - Major Ions
    - Hardness
    - Total Dissolved Solids
    - Total Suspended Solids

        - pH
        - Conductivity
        - Polychlorinated biphenyls (PCBs)
- Soil Monitoring (as required)
    - Soil sampling will be limited to locations where seepage or staining has been identified as part of the visual inspection. When required soil samples will be collected over the interval of 0 to 0.15 metres and 0.35 to 0.50 metres depth. The parameters that will be analysed include:
        - Petroleum Hydrocarbon Fractions, F1 to F4
        - Arsenic, Cadmium, Cobalt, Chromium, Lead, Nickel, and Zinc
        - Polychlorinated biphenyls (PCBs)

2.3 Monitoring Schedule

The 25-year long term monitoring plan at Ennadai Lake will begin in 2016 and continue until 2040. Monitoring will occur on years 1, 3, 5, 7, 10, 15, 20 and 25. At the completion of the 25-year monitoring program, a review will take place and the need for continued monitoring will be assessed. The table below outlines the monitoring schedule:

Table #2: Monitoring Schedule

Year	Site Monitoring Scheduled (X)	Year	Site Monitoring Scheduled (X)
2016	X	**2029**	
2017		**2030**	X
2018	X	**2031**	
2019		**2032**	
2020	X	**2033**	
2021		**2034**	
2022	X	**2035**	X
2023		**2036**	
2024		**2037**	
2025	X	**2038**	
2026		**2039**	
2027		**2040**	X
2028			

2.4 Monitoring Plan Summary

The monitoring plan at Ennadai Lake will begin in 2016 and continue for 25 years. The monitoring will include the natural environment and the NHWL; the parameters that will be monitored include site specific data and regional information, visual characteristics, water, and soil (if required). The monitoring

requirements for the natural environment and the NHWL are summarized in the tables below:

Table #3: Natural Environment Monitoring Requirements

Area	Monitoring Parameter
Natural Environment	• Wildlife sightings (species, number, gender, juveniles) • Other evidence of recent presence of wildlife (droppings, tracks, feathers/fur, carcass remains, etc.) • Wildlife activity (summering/nesting/denning, migratory/passing through) • Qualitative assessment of relative numbers versus previous years (more, same, less) • Revegetation of disturbed areas versus previous years (more, same, less)

Table #4: NHWL General Monitoring Requirements

Area	Monitoring Parameter		
	Visual	Water	Soil
NHWL	X	X	as required

Table #5: NHWL Specific Monitoring Requirements

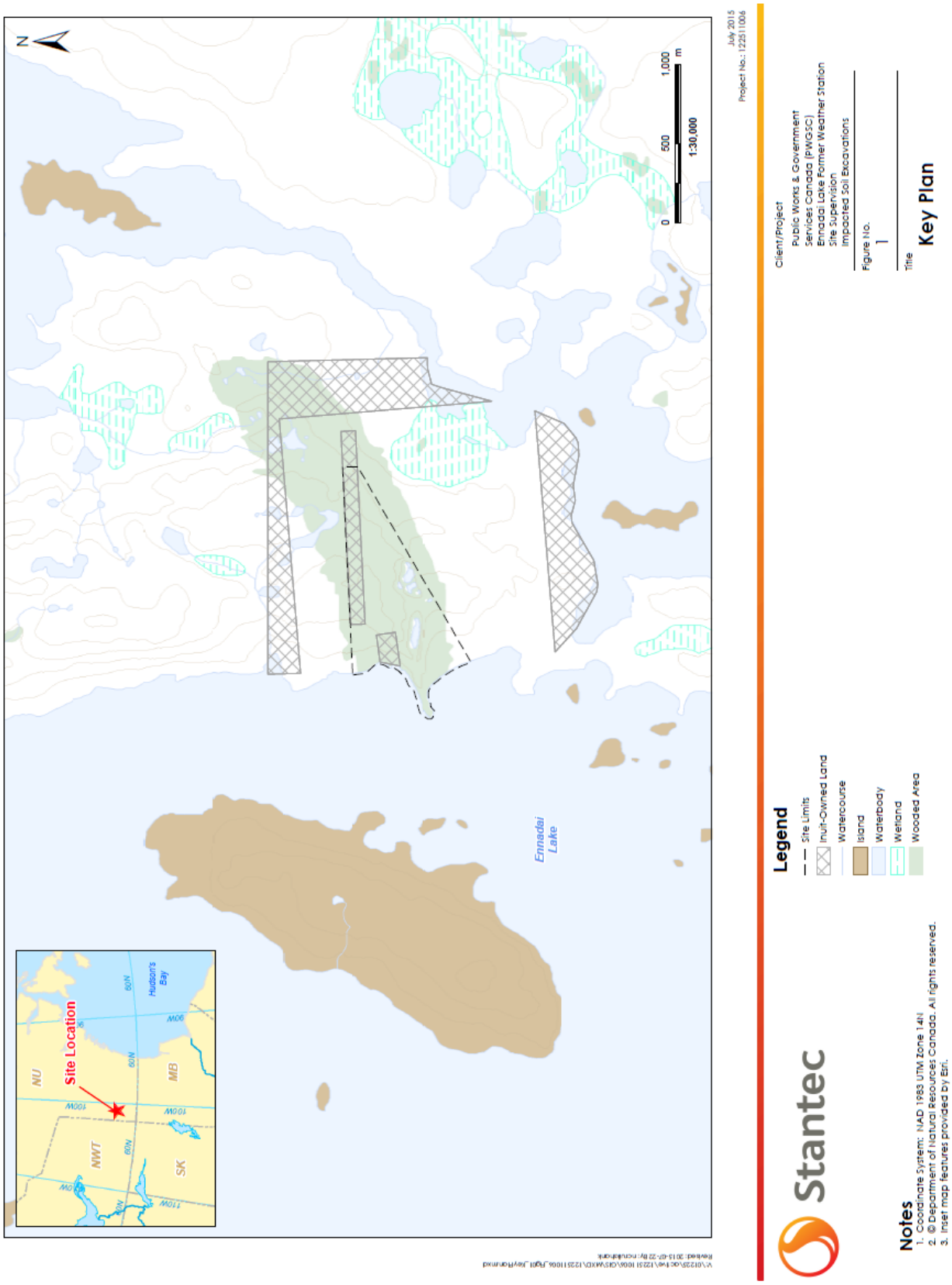
Area	Water
NHWL	**Monitoring Well ID #**
	MWLF-1 (SE of Landfill)
	MWLF-2 (SW of Landfill)
	MWLF-3 (NE of Landfill)

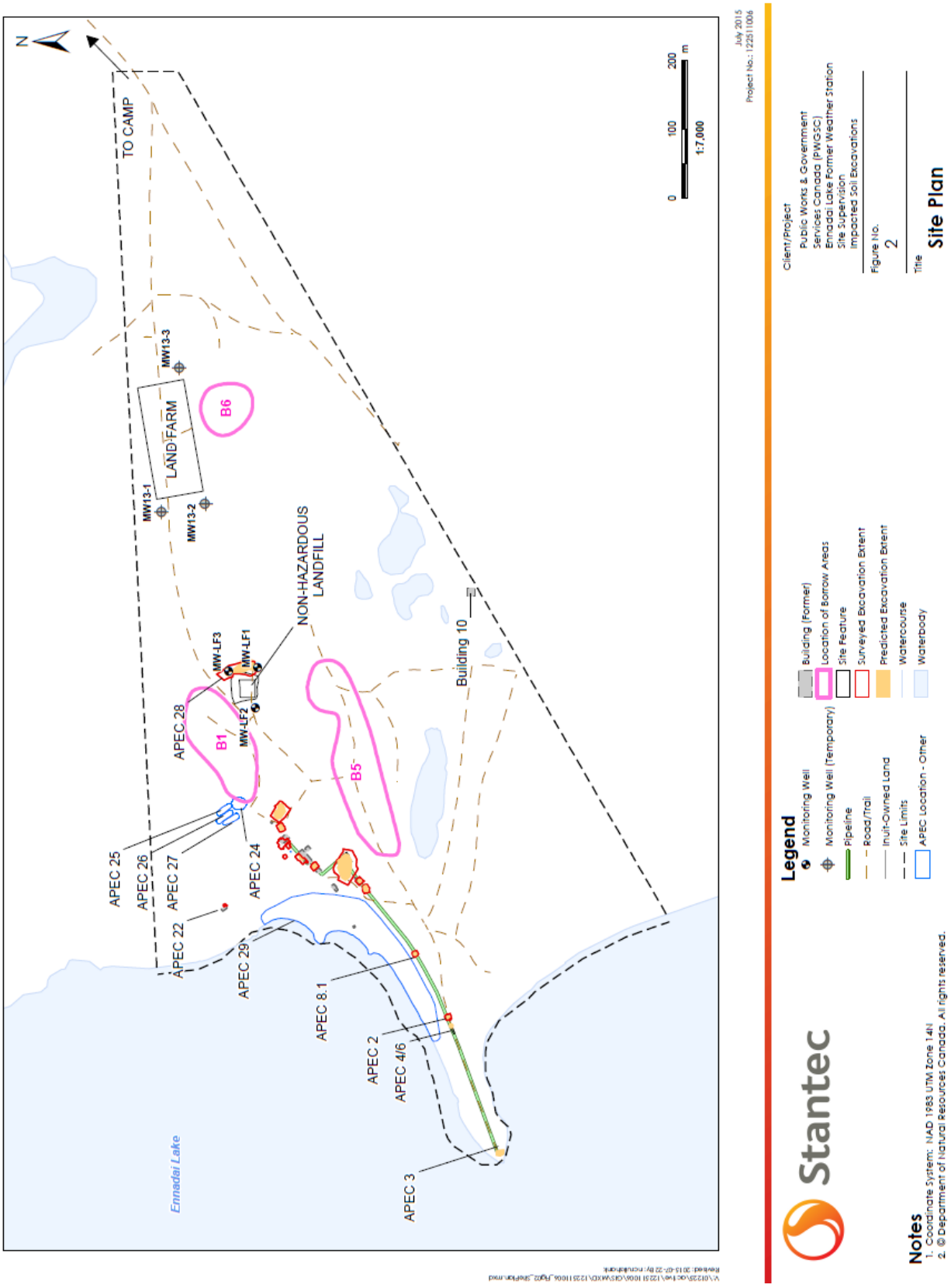
3.0 Quality Assurance/Quality Control

All sampling, sample preservation and analyses will be conducted in accordance with methods prescribed in the current edition of “Standard Methods for the Examination of Water and Wastewater”. All analysis will be performed in a Canadian Association of Environmental Analytical Laboratories (CAEAL) Accredited Laboratory.

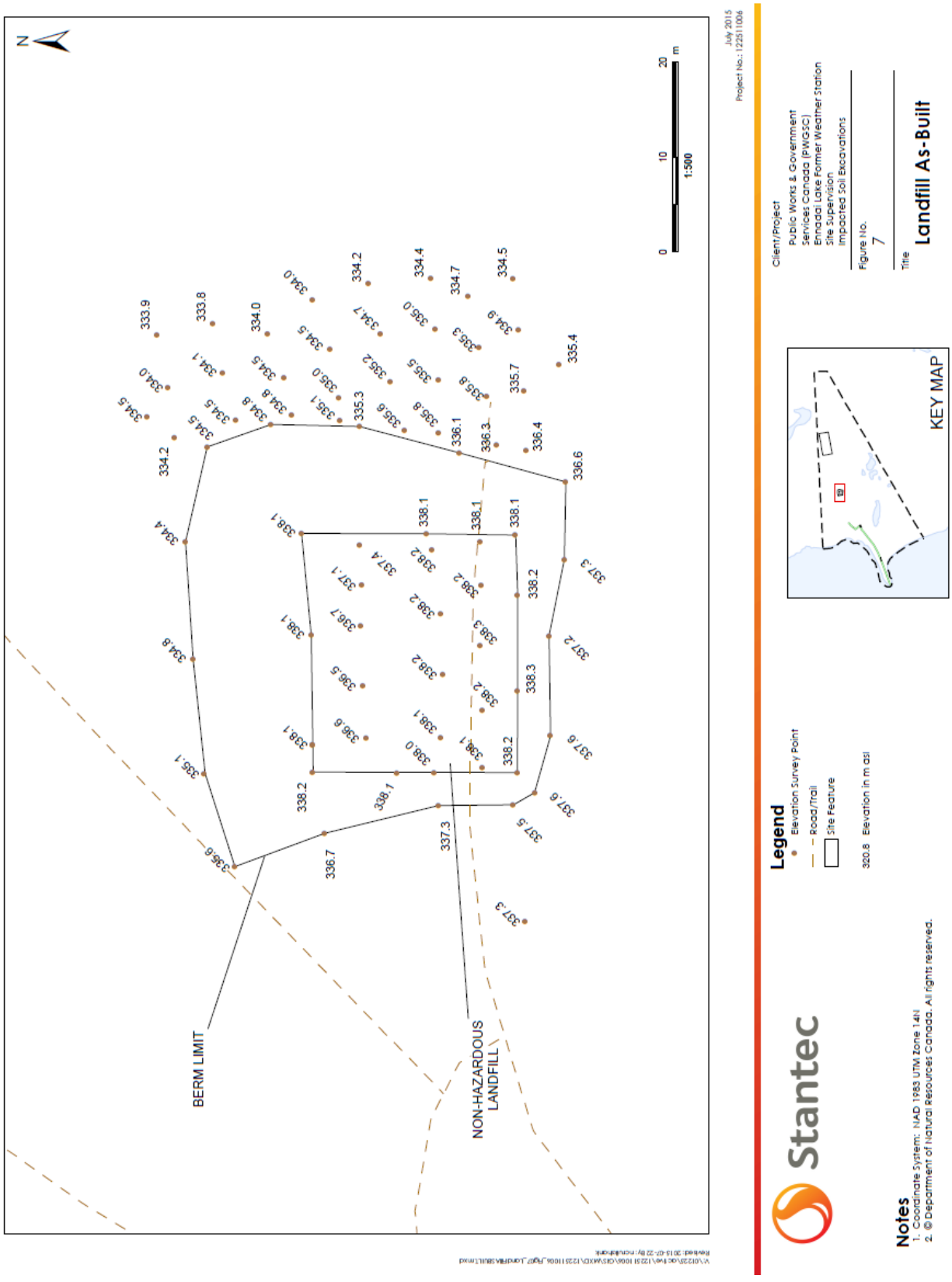
Quality Assurance/Quality Control (QA/QC) will be consistent with CAEAL regulations and guidelines. At least 20% of samples will be taken and analyzed in duplicate and all appropriate QA/QC data will be generated and reported.

Appendix A: Ennadai Lake Site Map


N
0
500
1,000
m
1:30,000
Ennadai Lake
Site Location
NU
MB
NWT
SK
Hudson's Bay
60N
90W
100W
110W
July 2015
Project No.: 122511006
Client/Project
Public Works & Government Services Canada (PWGSC)
Ennadai Lake Former Weather Station
Site Supervision
Impacted Soil Excavations
Figure No.
1
Title
Key Plan
Legend
Site Limits
Inuit-Owned Land
Watercourse
Island
Waterbody
Wetland
Wooded Area
Stantec
Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. © Department of Natural Resources Canada. All rights reserved.
3. Inset map features provided by Esri.


N
TO CAMP
LANDFARM
MW13-1
MW13-2
MW13-3
B6
B1
B5
MW-LF1
MW-LF2
MW-LF3
NON-HAZARDOUS LANDFILL
Building 10
APEC 22
APEC 24
APEC 25
APEC 26
APEC 27
APEC 28
APEC 29
APEC 8.1
APEC 2
APEC 4/6
APEC 3
Ennadai Lake
0
100
200 m
1:7,000
July 2015
Project No.: 122511006
Client/Project
Public Works & Government Services Canada (PWGSC)
Ennadai Lake Former Weather Station
Site Supervision
Impacted Soil Excavations
Figure No.
2
Title
Site Plan
Legend
Monitoring Well
Monitoring Well (Temporary)
Pipeline
Road/Trail
Inuit-Owned Land
Site Limits
Building (Former)
Location of Borrow Areas
Site Feature
Surveyed Excavation Extent
Predicted Excavation Extent
Watercourse
Waterbody
APEC Location - Other
Stantec
Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. © Department of Natural Resources Canada. All rights reserved.

Appendix B: Non-Hazardous Waste Landfill

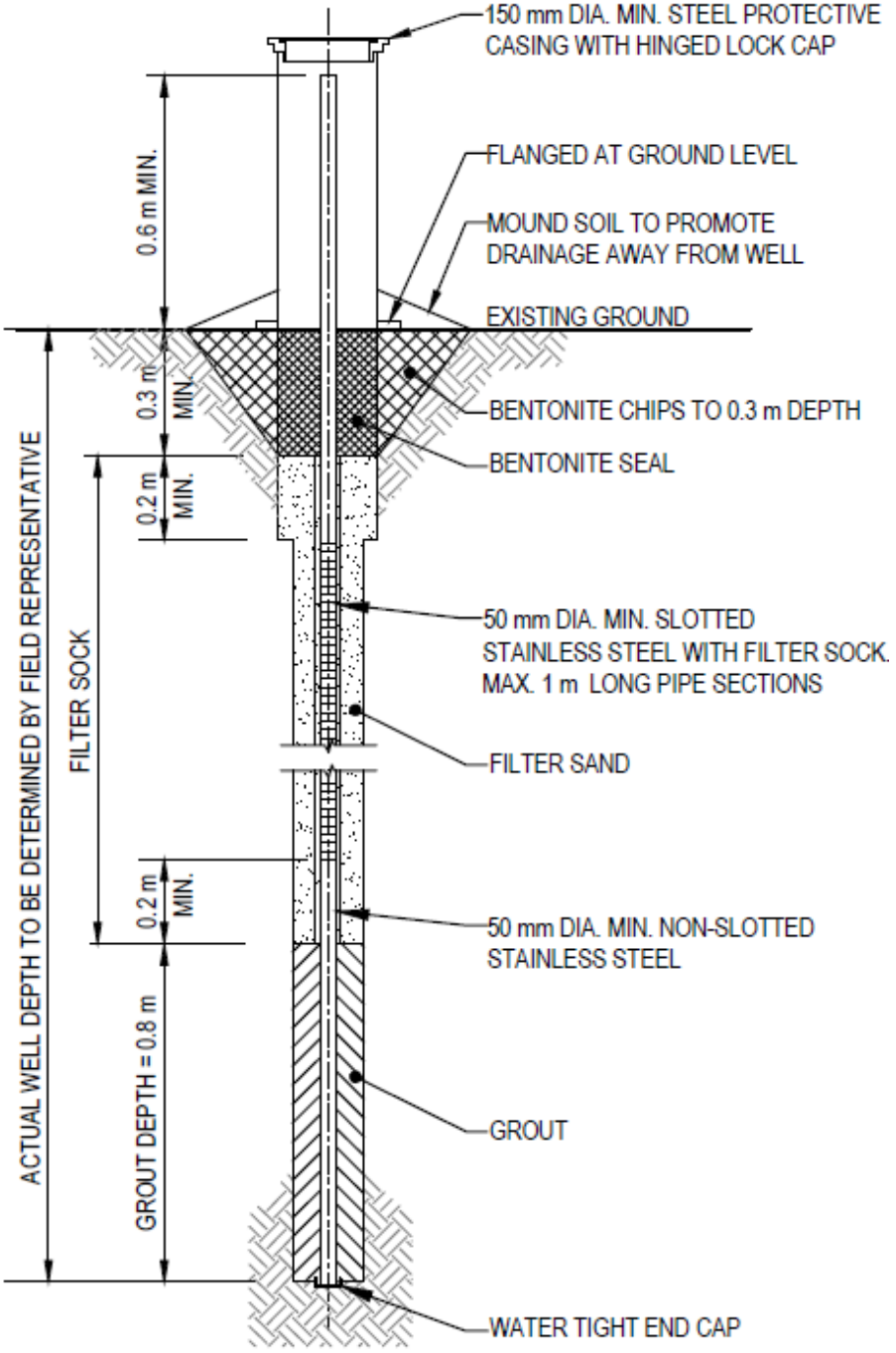

N
0
10
20 m
1:500
July 2015
Project No.: 122511006
Client/Project
Public Works & Government Services Canada (PWGSC)
Ennadai Lake Former Weather Station
Site Supervision
Impacted Soil Excavations
Figure No.
7
Title
Landfill As-Built
KEY MAP
Legend
Elevation Survey Point
Road/Trail
Site Feature
320.8 Elevation in m asl
Stantec
Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. © Department of Natural Resources Canada. All rights reserved.
BERM LIMIT
NON-HAZARDOUS LANDFILL

Appendix C: Visual Monitoring Checklist

Ennadai Lake
VISUAL MONITORING CHECKLIST

ITEM	PRESENCE/ ABSENCE	EXTENT	DESCRIPTION/ PHOTOGRAPHIC REFERENCE
Instructions	*Yes or No*	*Provide dimensions as applicable: Length, Width, Depth*	*Features of note, photographic reference with scale, point of view & direction*
Settlement			
Erosion			
Frost Action			
Animal Burrows			
Vegetation			
Staining			
Vegetation Stress			
Seepage Points			
Exposed Debris			
Condition of Monitoring Instruments			
Other Features of Note			

Appendix D: Detail of Monitoring Well



DETAIL OF MONITORING WELL

NTS